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Ceramic Entanglements In The Urartian Periphery: Technology As The Nexus Of Politics And Practice

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Ceramic Entanglements In The Urartian Periphery: Technology As The Nexus Of Politics And Practice

Abstract

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CERAMIC ENTANGLEMENTS IN THE URARTIAN PERIPHERY:
TECHNOLOGY AS THE NEXUS OF POLITICS AND PRACTICE

Susannah G. Fishman

A DISSERTATION

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Degree of Doctor of Philosophy

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ABSTRACT

CERAMIC ENTANGLEMENTS IN THE URARTIAN PERIPHERY: TECHNOLOGY AS THE NEXUS OF POLITICS AND PRACTICE

Susannah G. Fishman

Lauren Ristvet

This project examines the dynamic relationship between political context and technological practice by investigating how ceramic production at local centers in Naxçıvan, Azerbaijan shifted with the changing political landscape. The regional center of Oğlanqala was one of many locally governed polities in the Early Iron Age (1200-800 BCE), became a vassal on the edge of the Urartian Empire in the Middle Iron Age (800-600 BCE), and finally had to survive on the battlefield between Parthia and Rome in the Classical Period (200 BCE-100 CE). Technological production is always embedded in a social context, and new political configurations create new desires, changing methods of identity construction, and shifting market access. In order to reconstruct the ceramic production sequence— including raw material acquisition, forming, decoration, and exchange— samples were analyzed using petrography, neutron activation analysis (NAA), scanning electron microscopy-electron dispersive spectroscopy (SEM-EDS), surface treatment analysis, and formal stylistic analysis. By layering this information, it was possible to document how inhabitants of Naxçıvan employed ceramic technology as a means of negotiating changing relationships. In the Early Iron Age, ceramics were locally produced within a regional stylistic tradition. Later, Urartian imperial expansion promoted a diversification of style and local material use alongside a significant expansion of multi-directional exchange. In contrast, Roman Period ceramics were produced within a uniform stylistic and technological tradition common throughout the Roman east, but half of the pottery was imported from Artashat, the capital of Roman Armenia. This imperial borderland was never completely incorporated into its powerful neighbors, and technological practices materialized changing relationships of engagement, ambivalence, and resistance.

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CHAPTER 1: Why the Politics of Things Matter: An Introduction

The political nature of technology is undeniable in the present. Outside of archaeological discourse, the word "technology" generally refers to machines that require some type of power source, often digital gadgets for a (post)modern age with roots stemming from the Industrial Revolution, as if technology began in that moment. Simply referring to the politics of technology may start a discussion on the dangers or benefits of algorithms manipulating big data, NSA eavesdropping, social network grandstanding, and privacy violations at the hands of private and public institutions.[1] These are clearly concerns tied up with the proliferation of digital technology, and the subject of much excellent research (Goni 2016; Gonzalez 2015; Lustig et al. 2016; Miller and Horst 2012; Schnitzler 2013). Modern technology is deeply implicated in political projects.

But what about the politics of technology in an archaeological sense? In archaeological discourse, technology typically refers to any type of tool, often with a particular emphasis on the making of things, or things in a process of becoming (Ingold 2013; Leroi-Gourhan 1945; Lemonnier 2013). Lithics, ceramics, glass, metal and more have been the subject of substantial archaeological and anthropological analyses, often with a focus on the social nature of objects (Appadurai 1986; Dobres 2000; Jones 2005; Loney 2000; Roux et al. 1995). The politics of the quotidian have been less thoroughly studied, but have certainly not been ignored (Erickson 2005; Hayashida 1999; Sinopoli 2003; Wright 2016).

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[1] This list will surely function as a time capsule.

Political organization and affiliation are necessarily intertwined with technological production. For example, a simple ceramic bowl in a middle class kitchen in Philadelphia in the 19th century was likely produced by a relatively small-scale local potter or imported from Europe (Finlay 1998; Myers 1980; Steen 1999). A similar bowl in the early 20th century would likely have been made in a factory in the U.S., and its late 20th-early 21st century counterpart would almost certainly have been imported from Asia (Ando and Kimura 2005; Meikle 2010). The changing context of production for these bowls meant that they participated in large-scale shifts in international and economic relations, even if the people using them never considered this larger context. However, the materiality of this larger context acted upon the people who just wanted to eat a bowl of soup. After all, a cheap 21st century bowl from Asia makes it possible to afford other luxuries, but the loss of manufacturing jobs in the late 20th century contributed to stagnant wages (DeSilver 2014; Elliott 2004). Where and how these bowls were made was not a product of abstract shifts in political and economic relations. Rather, shifts in physical production methods were part of what created these new relations.

Moving from contemporary digitization to industrialization and beyond, I argue that the political dimensions of technology must be explored in the more distant past. Specifically, this research examines the shifting political and technological landscape of the South Caucasus in the first millennium BCE. Beyond the specific context of elite sponsored production, the political dimension of ancient production is perhaps less overt, or more difficult to recover in the distant past. In fact, the very presence of a political dimension in technological production is one element of my research question. Did technological production shift with political change in this context? If so, what was the nature of this relationship? My work on ceramic production traces how these materials manifested relationships.

This project is specifically designed to examine the ways that coalescencing political power can lead to shifting behaviors in other aspects of life. These shifts are often not the product of a political directive or explicitly implicated in political projects. This research explores when and how people reoganize aspects of their daily lives in relation to large scale political shifts, consciously or otherwise. Material shifts constitute new cultural relationships. These relationships are formed from clay worked in new ways, trade routes over difficult terrain for objects that could be found locally, and changing aesthetics that entail adjustments in practice. In examining these connections, it is useful to keep in mind James C. Scott's differentiation between "hard" political power, i.e. direct political authority, which is often very geographically narrow, and "softer" forms of influence, such as economic and symbolic influence, which can be more generalized and polydirectional (2009:35). These ceramics are primarily evidence for soft influence, the precise nature of which requires detailed exploration.

Some Orientation

This project examines the relationship between political context and technological practice by investigating how ceramic production at local centers in Naxçıvan, Azerbaijan shifted with the changing political landscape. The main purpose of Chapter 1 is to frame the research question and to provide an outline for the research design so that the reader can orient themselves throughout the rest of the work. Chapters 2 and 3 provide the requisite theoretical and historical background, respectively, on which this new contribution is based. Chapter 4 describes the methods and materials that will be used to answer the research question, and Chaper 5 presents the results of these analyses. Finally, chapter 6 weaves all of these different threads together to present a new understanding of the political dimension of ceramic production and exchange in Iron Age Naxçıvan. Chapter 7 provides concluding remarks and tie these data into broader anthropological issues of empire, political peripheries, materiality, and technology. I provide a brief overview of the historical, theoretical, and methodological framing of this research below as a map for readers to chart their way through these topics when they are addressed in greater depth in later chapters.

Picking a place in time and space

The majority of the material for this research comes from the fortress site of Oğlanqala in the Şərur plain of western Naxçıvan, the largest area of arable land in the region. I also incorporate data from the valley surrounding the site of Oğlanqala, as well as material from a fortress and settlement site in the adjacent valley of Sədərək (Fig. 1.1) (Ristvet et al. 2012a). Naxçıvan is an exclave of the post-Soviet country of Azerbaijan, which, along with Georgia and Armenia, make up the region called the South Caucasus (Fig 1.1). The linguistic and political complexity of the South Caucasus, in both the distant past and current context, can make this region a difficult place to conduct research. The Cold War locked archaeological research behind the Iron Curtain for western researchers, leading to the development of a Soviet archaeology distinct from U.S./European archaeologies. After the fall of the Soviet Union, western scholars

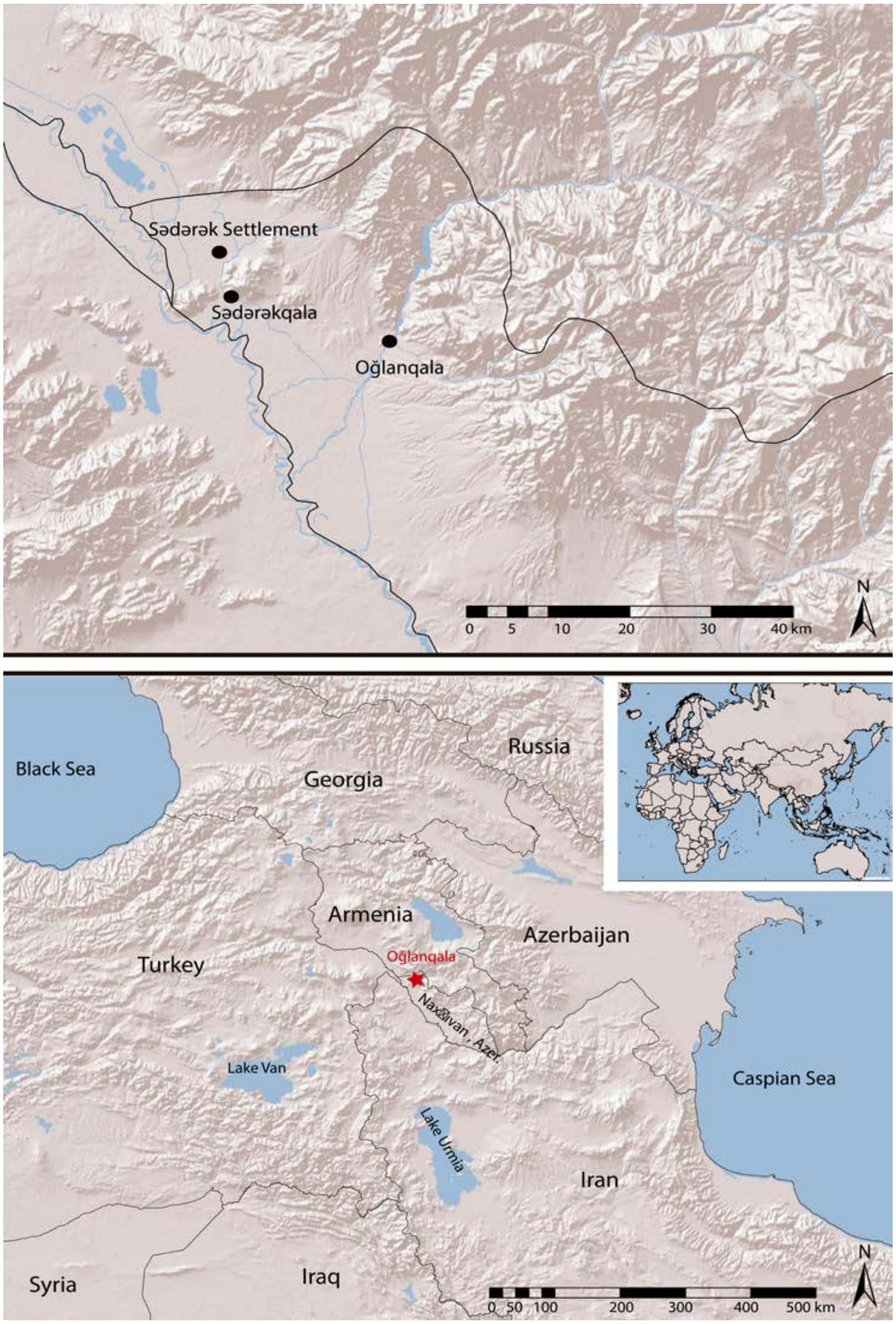

Fig. 1.1: *top:* Map of Şərur and Sədərək Plains, Naxçıvan, Azerbaijan; *bottom*: Map of South Caucasus

interested in working in this area needed to engage with scholarship published in myriad unfamiliar languages (Russian, Azerbaijani, Georgian, Turkish, Armenian, and Farsi being the main ones), unfamiliar and/or incommensurate systems of knowledge construction, and a highly politicized understanding of the past (Kohl and Tsetskhladze 1995; Schnirelman 2001; Smith and Lindsay 2006; Fabian, in press). Although these issues are not unique to the South Caucasus, their intensity is considerable. Today, Azerbaijan is perched in a geopolitically precarious position between Russia, Iran, and Turkey, with neighbors both friendly (Georgia) and hostile (Armenia). While this complicates modern research, it also provides a useful window into past engagements. The geographic area of modern Azerbaijan has always been a center of peripheries, a crossroads where different ways of being must be negotiated by local communities (Fishman et al., in press). This complexity is a strength, making it an ideal region to explore multi-polar political interactions from a long-term perspective.

Oğlanqala sits on top of a 130 m high black limestone/marble hill, guarding the Dələyrəs pass through the Lesser Caucasus between the Şərur Plain and the Sevan Basin (Fig. 1.1, 1.2). This strategic position resulted in several periods of occupation, from the Early Iron Age (1200-800 BCE) to the early 20th century, which in turn produced extremely complicated stratigraphy. Each period of occupation involved disturbing and often destroying contexts from previous occupations (Ristvet et al. 2012a: fig. 8, 16). Bedrock is often close to the surface, and erosion further displaces material. Pit digging obscures the remaining stratigraphy, and there are very few undisturbed contexts. As a result, ceramics used in this analysis were largely dated by stylistic parallels to contemporary sites, with the site chronology anchored by C^{14} dates. Therefore, this sample favors forms known from other sites, and under-represents the considerable proportion of local forms that cannot be dated through parallels.

Fig. 1.2: Photograph of Oğlanqala, facing southwest (photography by author)

For this project, I employ a simplified version of the Oğlanqala typology that only includes forms analyzed in this research. The full ceramic typology will be published by Hilary Gopnik in a forthcoming monograph. In addition to the Oğlanqala ceramics, I analyzed survey ceramics from the neighboring Sədərək plain (Fig. 1.1). However, these ceramics require further stylistic analysis and have not been fully integrated into the Oğlanqala typology. Therefore, I use a condensed, or "lumped" version of the full Oğlanqala typology to make it possible to compare forms from several sites (see chapter 4; appendix A).

This project addresses four periods of occupation at Oğlanqala: the Early Iron Age (1200-800 BCE)/period 5, the Middle Iron Age (800-600 BCE)/period 4, the

Seleucid Period (500-200 BCE)/period 3, and the Roman-Parthian Period (150 BCE-50 CE)/period 2 (Fig. 1.3; Table 1.1). There is no extant architecture on Oğlanqala from the Early Iron Age/period 5, but there are EIA grey wares present throughout the site, as well as a disturbed kurgan context. Oğlanqala was likely one of many locally governed polities in the South Caucasus and northwest Iran (Biscione et al. 2002; Ristvet et al. 2012a; Smith et al. 2009). In the Middle Iron Age/period 4, a fortress was constructed on top of Oğlanqala with a fortification wall that secured a 12 ha. citadel, accompanied by a signifincant increase in ceramics (Ristvet et al. 2012a). This construction coincided with the expansion of the Urartian Empire throughout the highlands of eastern Turkey, the South Caucasus, and northern Iran. Urartu challenged the might of Assyria to the south and just barely reached Oğlanqala's doorstep (Kroll et al. 2012). After a period of abandonment, Oğlanqala was repurposed as a partially contructed palace for a local strongman in the Seleucid Period, but the site was abandoned before the new construction was ever completed (Gopnik 2016; Ristvet et al. 2012a). Finally, in the Roman-Parthian Period/period 2, Oğlanqala became the site of a fortified settlement on the battlefield between Rome and Parthia, with the construction of houses, rebuilding of the outer walls, and the fortress ruins used as a site for refuse pits (Ristvet et al. 2012a,b). The specific relationship between Oğlanqala and its neighbors in every period is unknown, the subject of analysis rather than a premise.

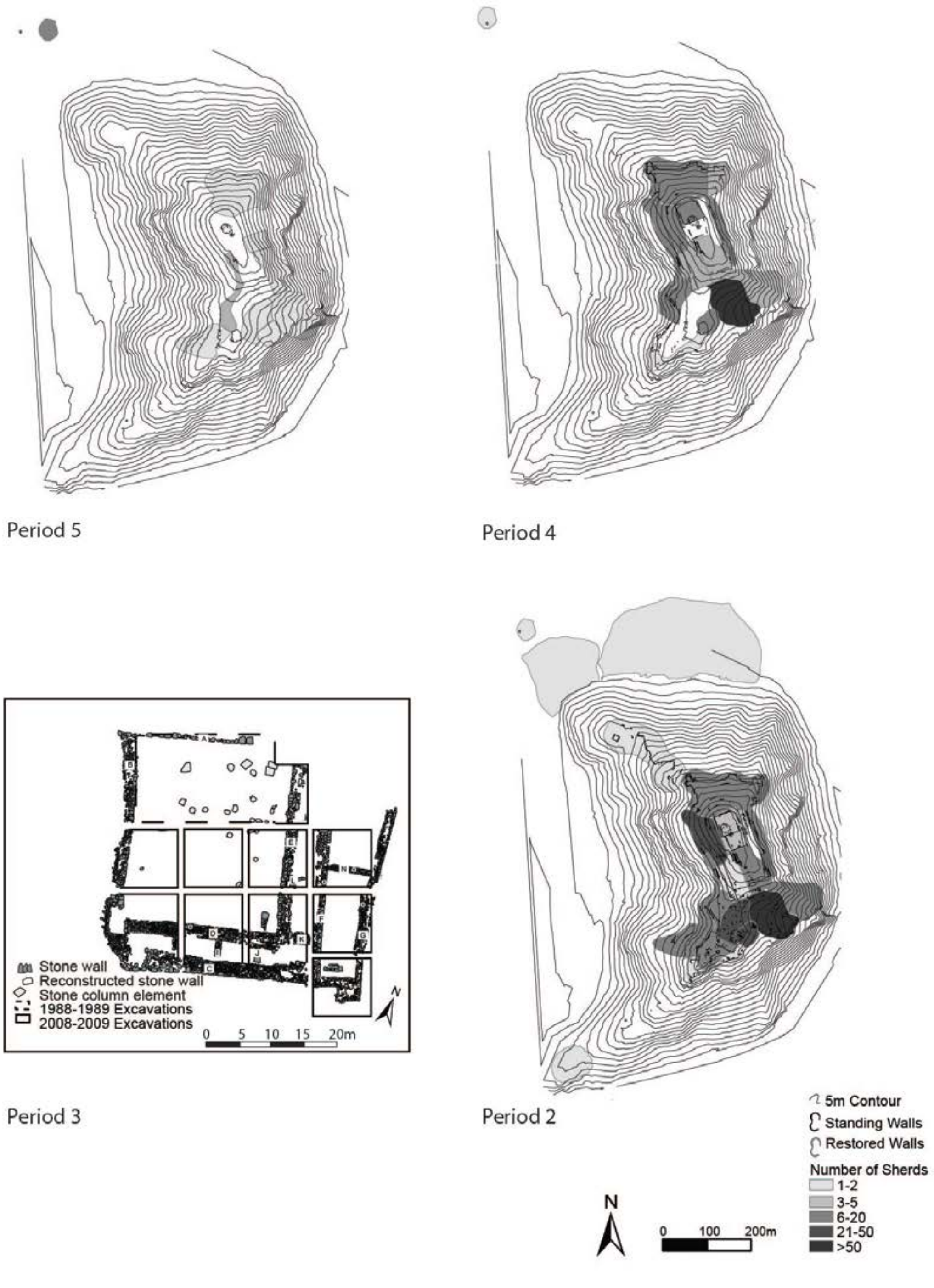

Fig. 1.3: Ceramic density and architecture present at Oğlanqala in each period. Only architecture is included for period 3 since it is the primary evidence for occupation in this period (based on Ristvet et al. 2012a)

Date	**Oğlanqala**	**Azerbaijan**	**Hasanlu (Urmia)**	**Iran**	**Armenia**	**General Periods**	**Historical Periods**
1200 - 800 BCE	period 5	Xocalı-Gədəbəy period	periods V and IV	Iron I and Iron II	Lchachen-Metsamor period	Early Iron Age	-
800 - 600 BCE	period 4	Mannaean period	period IIIb	Iron III	Urartu period	Middle Iron Age	Urartu period
500 - 200 BCE	period 3	Late Achaemenid/ Caucasian Albania/Media Atropatene period	period IIIa	Iron IV	Yervandid-Orontid period	Late Iron Age	Achaemenid and Hellenistic (Armenia/ Media Atropatene) periods
200 BCE - 100 CE	period 2	Late Media Atropatene/ Caucasian Albania/Arcacid period	period II	Parthian period	Late Hellenistic period	Classical period	Parthia/Armenia/ Media Atropatene

Table 1.1: Oğlanqala Periods (based on Ristvet et al. 2012a)

Thinking through things

Technological production is always embedded in a social context, and imperial expansion often results in changes in the organization of production, exchange networks, and style (Costin 1991; Hahn 2012; Stockhammer 2012a; Yao 2005, 2012; Rodriguez-Alegria, et al. 2013). Technology studies, as developed by Pierre Lemmonnier (1992), examine the sequence of production and technological choice, observing the social conditions that shape how people engage with the constraints and affordances of materials. Yet technology studies have traditionally focused on human agency, neglecting or even rejecting the ways that non-human agents act upon and structure society.

Drawing on the intersecting research conducted under the rubrics of Actor Network Theory (ANT), symmetrical archaeology, material engagement theory, and materiality studies, I examine the role materials play in creating a culturally and politically ambivalent space (Latour 2005; Law 1992; Olsen 2010; Hodder 2012; Malafouris 2013; Miller 2005). All of these approaches can be crudely summarized as: things matter. Things do not matter simply as a representation of human desires, identity, or power, but rather because things are an inalienable aspect of humanity. Employing Bruno Latour's (2005) concept of the non-substitutability of actors, I argue that the selective adoption of imperial styles, novel and traditional production methods, and changing exchange networks is part of what manifests the South Caucasus' ambivalent relationship with its imperial neighbors. The framing of the South Caucasus as politically ambivalent draws on the post-colonial theory of Homi Bhabha (1994), who discussed subversive ambivalence as part of a larger conceptual framing of hybridity. In this heuristic, violent colonial encounters create new practices and identities that can subvert the dominant power even while adapting aspects of it. Ceramic technological analysis provides a powerful means of observing hybridity in the archaeological record, since each step in the production sequence represents an opportunity to reimagine practices within the context of a particular political and economic framework. Ceramics are ubiquitous, employed by different classes and factions in many facets of life. This ubiquity allows them to provide a nuanced picture of local technological practices.

Methods of analysis

Building on this theoretical framework, I employ several methods to reconstruct the ceramic sequence of production, which in turn provide data to explore how people negotiated this complex political situation. Each step in the sequence of production provides different overlapping datasets that can be brought to bear on different aspects of ancient life. For example, clay sources can provide information on changing exchange networks (Arnold 1985; Herrera et al. 1991; Tomkins and Day 2001), vessel forming can speak to pedagogical communities of practice (Bowser and Patton 2008; Gosselain 2008; Herbich and Dietler 2008; Lave and Wengar 1991; Wallaert 2008), and decoration can inform us about shifting modes of cultural affiliation (Bowser 2000; Hodder 1982; Minc 2009a; Sackett 1990). By examining ceramics using methods that reconstruct the production sequence, I demonstrate how patterns of production shifted during different political contexts.

For this research, I employ ceramic petrography, neutron activation analysis (NAA), scanning electron microscopy-electron dispersing spectroscopy (SEM-EDS), and surface treatment analysis. Ceramic petrography is the primary method employed in each period, and provides information on raw material identification and proveniencing, clay paste recipe, forming, and firing conditions (Quinn 2013; Whitbread 1995). NAA was used to improve proveniencing data for a sub-sample of Middle Iron Age ceramics, and SEM-EDS was used to gather firing and slip compositional data for a sub-sample of ceramics in each period (Glascock and Neff 2003; Neff 2000; Maniatis and Tite 1981). Surface treatment analysis was employed to collect data on burnishing practices, which is the most common finishing treatment in the area (Ionescue et al. 2014; Lepère 2014; Timsit 1999). While my research program addresses most steps of the production sequence to varying degrees, the geological diversity of the South Caucasus made it possible to develop a particularly rich understanding of clay processing and proveniencing.Each of these methods adds to our knowledge of how people and things were making each other in each period.

Moving forward

With this research, I move between the micro-scale of geochemistry and local paste recipes to large-scale theoretical arguments about technology and empire. I ground these movements in the very specific historical context of Iron Age Naxçıvan, hopefully not simply linking these scales of analysis, but demonstrating that they are essential to developing a defensible understanding of the past. The social practices embodied in ceramic production enable this research to contribute to our understanding of the complex ways that local communities position themselves in relation to dominant powers. Smaller collectivities must respond to the economic, symbolic, and military might of larger polities, and the nature of these responses demands focused analysis. Post-colonial discourse on these questions has focused on the recent past, and primarily on literary sources (Ashcroft et al. 2002; Mbembe 2001; Said 1979). However, the analysis of ceramic technology provides a fresh perspective on these interactions by highlighting agentive practice rather than representations. Comprehensive ceramic technological analysis has never been conducted in the Southern Caucasus, although its application in other parts of the world has been productive (Blackman et al. 1993; Costin 1991, 2001; Costin and Hangstrum 1995; Dietler and Herbich 1989; Glatz 2009; Hayahisda 1999; Hirshman et al. 2010; Sinopoli 2003; Wattenmaker 1994). Ceramic production, style, and exchange provide sensitive measures of shifting political, economic and social relations that enable the nuanced exploration of dynamic frontier relationships.

CHAPTER 2: Thinking Through the Politics of Things

This project is designed to explore how large-scale political change, such as imperial expansion, was experienced and shaped by the local practices of smaller polities and communities in an empire's orbit. Technological production, particularly ceramic production, will serve as the lens through which changing practices are observed, and understood as one medium through which these changes were negotiated. Certain aspects of material culture, such as specific architecture, metalwork, and ceramic styles have long been interpreted as diagnostic of imperial presence, the corporeal residue of political change. But these materials must be understood as agents of change working in concert with the people whose lives shift with the new political reality.

To enable archaeological data to speak to these processes, it is necessary to dive into several rich, on-going theoretical discussions that grapple with the relationship between agent, structure and practice, what constitutes an agent, how humans and objects engage with each other, and how local populations engage with politically dominant forces. These terms denote complex conversations, rather than singular ideas, and engaging with these conversations enables my interpretations. The following chapter will outline some significant concepts that facilitate our understanding of these these issues, points of convergence and dissonance between these concepts, and the ways I am applying them. The the data we use to understand the past will always be more complex than any one theory can encompass, but the explicit development of a theoretical framework is critical for a strong interpretation of that data. I take a pragmatic approach theory to theory[2]; I use different theories as tools to eluecidate different aspects of my data, including theories that may appear to be unrelated or incommesurate. I often focus on specific aspects of theoretical frameworks that I find useful, and do not incorporate aspects of those frameworks that are not relevant to this research. This approach is a choice born of careful consideration, not a misunderstanding of the theories I draw upon. This chapter will trace the history and contemporary debates surrounding (object) agency, technology, entanglement, empire, and post-colonial theories to intellectually situate how I deploy these concepts in this research. This theoretical framework creates the conditions under which archaeological materials such as ceramics can intervene in narrative development— push back against, enhance and create alternate understandings of social, political and technological change.

Structure and Agency

In order to explore how large-scale political change is mutually constituted by local action, I begin by exploring the relationship between agent and social structure, providing a theoretical window into social continuity and change. In particular, I highlight differing conceptions of agents and agency, since a working definition of agency necessarily structures the interpretation of data. Who or what can act, and what is merely acted upon? I argue that non-human agents, such as ceramic vessels, are critical participants in social processes rather than mere reflections of human intentions. Since this proposition is a matter of debate, and foundational to my data interpretation, I trace the intellectual history of (object) agency to clarify the basis of my position.

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[2] Not to be confused with the New Pragmatism (Preucel and Mrozowski 2010)

Anthony Giddens (1979, 1984) and Pierre Bourdieu (1979) developed structuration theory and practice theory, respectively, to understand the relationship between agency and structure. These generally complimentary models of agency have been adopted, adapted, and only occasionally rejected by many scholars in the decades that followed. Giddens explicitly sought to reconcile hermeneutic sociologies that viewed human agency as primary with more structural approaches that placed great emphasis on constraint and left little room for social change. To resolve the gulf between those who studied society as subject or object, Giddens proposed a dialectic approach in which agent and structure mutually constitute each other. Calling this approach structuration theory, Giddens argued that, "system reproduction in human society can be regarded as involving the operation of causal loops, in which a range of unintended consequences of action feed back to reconstitute the initiation circumstances" (Giddens 1984:27). For Giddens, agents must be capable of "doing things" intentionally or otherwise, such that events would be altered if the agent had behaved differently (Giddens 1984:9-11). Therefore, the agent's choice to act in a certain way, or not to act at all, defines their agency.

Giddens denies situations in which a human might lack agency, since: "Even the threat of death carries no weight unless it is the case that the individual so threatened in some way values life" (Giddens 1984:175). Thus, "all human beings are knowledgeable agents," yet that knowledge is complex, incomplete, and often unarticulated (Giddens 1984: 281). Agents often act out the rules and tactics of social life with only a practical knowledge of their actions, meaning that they cannot discursively articulate the social rules they are reconstituting (Giddens 1984:90). Routinized behavior creates a sense of ontological security for agents, accounting for most action, and often continuing even when the structures that supported these behaviors are no longer present (Giddens 1984: 282). While an agent's choice of (in)action defines its agency, the choice may not be a conscious one. But "choice" is a problematic criteria for agency if choices are made without intentionality. As we will see below, I propose that this is not a useful way to understand agency in an archaeological context.

Bourdieu also developed an approach that attempted to reconcile more subject focused phenomenological perspectives with more object focused structural perspectives (Bourdieu 1979:5). Similar to Giddens, Bourdieu developed a model in which structuring forces (field) create a series of behavioral dispositions (habitus), which in turn reinforce the structural forces. According to Bourdieu, habitus functions:

> as principles of the generation and structuring of practices and representations which can be objectively "regulated" and "regular" without in any way being the product of obedience to rules, objectively adapted to their goals without presupposing a conscious aiming at ends or an express mastering of the operations necessary to attain them and, being all this, collectively orchestrated without being the product of the orchestrating action of a conductor (Bourdieu 1979:72).

Actions take the form of "regulated improvisation" with an agent's habitus providing both resources and constraints (Bourdieu 1979:79). This formulation is similar to Giddens' concept of routinization, wherein action does not require conscious knowledge to be effective. However, for Bourdieu, this lack of discursive knowledge is not merely common, but necessary for proper social functioning. Habitus requires misrecognition of the social imperatives being enacted. For example, the reciprocation of a gift must be appropriately timed for it to be taken as a gift rather than an insult, and the reciprocity must be viewed as generosity rather than the repayment of an outstanding debt of honor (Bourdieu 1979:6-9). According to Bourdieu, people's actions are nearly always unconsciously motivated by a few structuring forces, such as honor or economic gain. However, people necessarily misrecognize their actions as being motivated by these forces, and even if some awareness is achieved, it cannot be stated without facing serious social repercussions. Similar to Giddens, this formulation presents problems for the common association between agency and intentionality. After all, how can agency be defined by intentionality if people must misrecognize their intentions in order to be agents? Agents must mutually contitute their social structure, but it is not accurate to propose that they choose how they do so.

Bruno Latour (2005) criticized Bourdieu for reducing complex social networks to just a few forces that are only visible to anthropologists, which both condescends to populations being studied, and limits potential for more complex understanding. The basis of this critique can be observed in statements such as: "The relationship between informant and anthropologist is somewhat analogous to a pedagogical relationship, in which the master must bring to the state of explicitness…the unconscious schemes of his practice" (Bourdieu 1979:18). Latour argues that Bourdieu does not give agents enough credit for their knowledgeability and potential power. Latour, the most prominent proponent of the theoretical framework Actor Network Theory (ANT), argues that the subjects of scholarly analysis should be able to falsify the theories offered by social scientists, just as the material world can falsify the theories of natural scientists.

According to Latour (2005:115-120), laboratories are not designed to master objects, but to create the conditions under which objects can falsify statements about them. In this formulation, objectivity is the ability of an entity to object to what is said about it. Social scientists do not respect their subjects as much, since they present themselves as knowing more than their subjects, seeing the big picture while their subjects remain ignorant. Studied humans may even end up complying with the expectations of social scientists, whereas objects have the power, even agency to continue to intervene in the world regardless of human desires. ANT developed from Science and Technology Studies (STS), wherein social scientists attempted to subject natural science knowledge production to the same forms of analysis as other social groups (Callon et al. 1986; Hughs 1986; Latour 1992, 2005; Law 1992). However, natural scientists not only disagreed with many of the initial interpretations, but had the social capital to reject them, unlike many other subjects of social analysis. Following this approach, I try to enable my data to "push back" against assumptions about how and where ceramics were made, and how this relates to imperial power.

Object Agency (or agency for all)

For Giddens and Bourdieu, agency is implicitly a human characteristic. Giddens (1984:14) argues that, “To be able to ‘act otherwise’ means to be able to intervene in the world, or to refrain from such intervention…Action [re. agency] depends on the capability of the individual to ‘make a difference’ to a pre-existing state of affairs.” While agentive practices do not require intentional consequences or conscious understanding, the choice to act and thereby have an effect is a human privilege. This has been taken as the basis of most agency theory, in which, according to Sherry Ortner (2005:106), “There is a general agreement that agency is in some sense universal, and is part of a fundamental humanness” (see also Sewell 1992, Duranti 2004).

However, this formulation leads to several complicating features. Agency has sometimes been used almost interchangeably with power, as the ability to accomplish particular interventions (Ahearn 2001; Sewell 1992). If agency is a person’s capacity to have an effect, then while all humans have agency, some humans clearly have more agency than others. Ortner (2005) understands agency as the ability to have projects, or intentions that may or may not be conscious or achievable. However, this makes intentionality, rather than effectiveness the defining characteristic of agency. But it is difficult to track intentionality even for those studying contemporary populations, especially if it is unconscious or even necessarily misrecognized as Bourdieu suggests. In archaeological analysis this is further complicated by the difficulty of excavating the material signatures of intentionality, though technological choice will be discussed below as one possible avenue. Intentionality is a particularly tricky criterion, since having intentions does not necessitate achieving intended results, and archaeology primarily uncovers the results of what did happen, rather than what may have been intended (see Gopnik 2016 for an exception). In this sense, archaeology can largely observe what was efficacious in perpetuating, altering, or disrupting existing forms, with the assertion of particular intentionality the result of careful and tentative inference. Intentionallity is a very limited conceptial category for archaeology.

However, if agency is defined as anything that can intervene in a state-of-affairs, either through a particular action or inaction, then humans are not necessarily the only agents. Neither Giddens nor Bourdieu, nor many social theorists that followed, argued that agents needed to be human. It was simply assumed. However, arguments for non-human agency have been made more explicitly in recent decades under the related rubrics of material culture studies, materiality, ANT, and symmetrical archaeology (Callon and Latour 1981; Ingold 2000; Law 2009; Malafouris 2013; Meskell 2005; Miller 2005; Olsen 2003, 2010; Robb 2015; Shanks 2007). Alfred Gell (1998) argued that objects, particularly art, may be characterized by secondary agency. For example, an effigy may elicit particular behaviors from a worshipper, who treats the effigy as a living being. In order to interpret this interaction, the effigy must be considered agentive. However, this agency is considered a secondary agency that results from the primary, distributed agency of the effigy's creator. This formulation is similar to Marylyn Strathern's (1988) concept of the Melanesian 'dividual', in which identities are distributed through a web of relationships rather than residing in a single body or consciousness. Yet objects do not merely carry the intentions of their creators, whose identities are distributed through those objects (Malafouris 2008, 2013). Object biography approaches have demonstrated that objects may play many roles throughout their existences, from commodity to gift to heirloom and back again (Appadurai 1986; Kopytoff 1986). In doing so, objects move well beyond the agency of their creators and become enmeshed in new webs of intentionalities. For example, consumption studies have shown how people may employ mass produced objects in creative processes of identity formation that renders the previous commodity inalienable (Buchli 2002; Dant 2000; Miller 1987, 2002; Olsen 2003).

Simply put, humans cannot accomplish projects without objects, and objects can instigate new projects. Humans and non-humans participate equally in the co-production of agent and structure. This is not to say that humans are objects, or that objects have intentionality, but that in order to understand how human practices perpetuate and change existing structures, objects must be taken seriously as effective agents. The dualities of human and non-human, agent and structure, and subject and object, have been the focus of intense deconstruction by scholars who argue that such binaries obscure reality (Law 2002; Olsen 2010; Shanks 2007). Explaining ANT, Latour (2005:40) argues that actors (including non-human actors) must mediate a particular state of affairs, rather than function as intermediaries. For example, silk and nylon stockings are not intermediaries for a class divide that exists otherwise and could be represented in other forms, but rather this particular distinction manifests a particular class divide that would have different contours than if it were practiced through other forms. This illustrates Latour's assertion of the non-substitutability of particular actors, since if an actor can be replaced with another type of actor, then in fact, the subject in question must be an intermediary, a rare and not particularly useful category in ANT conceptions. An actor must modify a state-of-affairs in such a way that it cannot be substituted for another actor (Latour 2005:71-2). Yet for all of Latour's admonitions to treat non-humans as actors, his method for identifying non-human actors largely depends on the reports of humans. If an informant reports that a protein or the National Science Foundation made a difference, then these entities are equally actors in the network being studied. However, Latour has been criticized for ignoring the physical properties of things in favor of understanding their social effects (Lemmonier 1996, see also reply in Latour 1996).

Few scholars have appreciated the thingy-ness of things as much as archaeologists, whether or not archaeologists have always treated things as agents. Archaeologists have long studied, described, tested, and veritably obsessed over the physical properties of things. However, archaeologists have typically focused on understanding things as the residue of human activities, or more recently as signs that index human activities, rather than essential components of those activities (Feinman et al. 1984; Hodder 1982; Preucel 2006; Rice 1991; Wattenmaker 1998). However, collaboration between archaeologists and material culture specialists has led to the development of materiality studies, or the study of the relationship between people and things that privileges neither (Ingold 2000, 2007; Joyce 2015; Knappet 2005; Miller 2005; Meskell 2005). Daniel Miller (1987, 2005) has been a leading proponent of materiality studies, and points to two important theoretical underpinnings to human-object relations. The first is the Hegelian concept of objectification, in which humans and objects are in a dialectic relationship, since humans are born into a pre-existing material world, which shapes humans, who in turn both perpetuate and modify the material world (Miller 1987; Preucel 2006; Tilly 2006; Wallace 2011). This formulation is very close to Giddens' structuration theory and Bourdieu's practice theory, except that non-humans, as well as humans, are considered an essential part of understanding society. This approach differs from Latour's non-human agency because Latour denies the existence of structure altogether (Latour 2005). According to Latour, both the individual and structure are imaginary, and theoretical models that attempt to find a compromise between two imaginary entities are necessarily misleading.

The second underpinning of human-thing relations draws from Erving Goffman’s (1974) research on the contingency of meaning, particularly how the meaning of a social performance can vary considerably depending on the context, including the material conditions. Not only can objects create the conditions of a particular meaning, but the less the objects are noticed or consciously considered, the greater their impact can be since they are not open to challenge (Miller 1987, 2005). Miller (1987:85-108) calls the power of socially invisible objects, “the humility of things,” and this concept can clearly be related to the unconscious behavioral dispositions of Bourdieu’s habitus. In fact, these invisible objects can be viewed as constitutive of habitus, simply not considered by Bourdieu.

Proponents of materiality in archaeology have called for an approach called symmetrical archaeology. In general, this approach treats humans and non-humans as equally efficacious, if not qualitatively identical agents (Olsen 2003, 2010; Olsen and Witmore 2015; Shanks 2007; Witmore 2007). Michael Shanks (2007:590) employs a rather broad definition of symmetrical archaeology that attempts to overcome many dualisms, including past and present, human and object, nature and society, and agent and structure. Yet this very broadness can lead to imprecision, and this discussion will refer to the version of symmetrical archaeology that developed with materiality studies.

Ian Hodder (2012) has relatively recently offered a framework for understanding human-object relations drawing on many of the ideas outlined above. Though Hodder has reservations about symmetrical archaeology and ANT for treating non-humans as full agents, his method for understanding the social as relationships between humans and humans, humans and things, and things and things is largely analogous. Hodder calls these relationships "entanglements." This choice in terminology is rather confusing since this term already has a rich intellectual history in post-colonial studies, and before that physics, which will be discussed below. Beyond the clear similarities between Latour's networks and Hodder's entanglements, Hodder also calls attention to object decay as an important moment in processes of social change and continuity. After all, it is only when a wall collapses that people must decide to rebuild it. This focus on decay as a moment of truth finds inspiration in Latour's admonition to attend to controversies in scientific understanding as a window into relationships that might otherwise be hidden.

The argument that material decay rather than material permanence lies at the heart of social continuity seems to go against previous understandings of the role of materials in society. Michel Serres (1995) argues that social bonds are only made permanent through materials, and that without objects to anchor subject relationships all of society would perpetually be in flux. Hodder (2012) claims that it is precisely through responses to object decay, through the perpetual plastering of walls, for example, that societies continue. This is closely related to practice theory, but Hodder draws on evolutionary and cognitive archaeology to make his point. Humans heavily modify their environment as a means of adaptation, which they in turn must adapt to (a dialectic that mirrors objectification). These adaptations are path-dependent, in that later adaptations are constrained by earlier ones. Read and van der Leeuw (2004:46) explain that:

> The symbiosis that emerged between different landscapes and the life-ways invented and constructed by human groups to deal with them eventually narrowed the spectrum of adaptive options open to the individual societies concerned, and thereby drove them to devise new (and more complex) solutions with increasingly unexpected consequences… which was not always possible to keep under control.

Decay, change, and continuity are all ways that objects constitute social networks, limiting certain responses from humans and creating new opportunities. I opperationalize the premise that humans and non-humans are qualitatively different, but equally effective agents for perpetuating or changing the societies they constitute. If we do not attend to the conditions created by non-humans, we limit our ability to develop a holistic understanding of how politically ambivalent spaces were constituted in imperial peripheries.

Technology Studies

A different and eminently practical approach to understanding the constitution of society through human/non-human relations is technology studies, which can be traced to Marcel Mauss’ *Techniques du Corps* (1974). In this work, Mauss outlined how many common human actions, such as walking and swimming, are accomplished in culturally specific ways. A certain way of swimming is not only culturally specific, but also generationally specific. It is thus possible to connect swimming to a whole constellation of relationships that produced a certain type of swimming at a particular moment. Andre Leroi-Gourhan (1943, 1945), Mauss' student, adapted this insight and introduced the concept of *chaîne opératoire* for stone tool production. *Chaîne opératoire* refers to the entire sequence of production, and entails the examination of each step of production to discern how technological choices were made. Just as there are many culturally specific ways to walk, there are many culturally specific ways to knap a scraper, and these actions are physical manifestations of how people engage with the constraints and affordances of the material world. However, Pierre Lemonnier (1986, 1992, 1996, 2013) was an influential proponent for extending Gourhan’s insights with stone tools to technological production in general, from spear production to airplane design. According to Lemonnier, all techniques have five components: matter, energy, objects, gesture (organized in a sequence), and specific knowledge. All of these components must be understood as fully as possible in order to comprehend any aspect of technological production. The insight that there is more than one way to accomplish the same thing makes it possible to question why a particular technological choice is being made at any particular moment. For example, why are so many Middle Iron Age ceramics from Oğlanqala made with different paste recipes, but finished in the same manner (see chapters 6)?

Early analyses of technological change in archaeology typically employed the Spencerian concept of unidirectional evolution, in which objectively better technology, such as metal, would universally replace objectively less adaptive technologies such as stone tools (Braun 1983; Childe 1930; Cardwell 1972). Hodder (2012) also argues for directionality in technological change, but as a result of path dependency rather than teleology, as discussed above. Other more recent applications of evolutionary theory generally employ a Darwinian model of non-directional evolution, which emphasizes adaptations to a particular set of circumstances rather than cumulative progress (Dunnell

1980; Eerkens and Lipo 2008; Rindos 1989). However, even Darwinian evolutionary theory is problematic because it tends to explain technological change primarily in terms of efficiency and effectiveness, without taking into account the socially mediated way that humans use technology (Loney 2000; Lemmonier 1992). For example, Heather Lechtman (1977) proposed that Andean metal workers used a gold copper alloy for ritual objects, and then removed the copper from the surface in order to achieve the appearance of gold rather than simply gild the object because it was symbolically necessary for the gold to be suffused throughout. Marcia-Anne Dobres explained stylistic differences between contemporaneous and functionally identical European Upper Paleolithic needles and harpoons as expressions of individual or group identity (Dobres 2010). Clearly, all technological choices must be adaptive on some level, but it is impossible to explain technological change from a purely adaptive perspective. Ceramics in the Iron Age South Caucasus and elsewhere do not change because they become objectively better, or more functional according to a specific set of criteria. Ceramics change by participating in a network of social-material processes, wherein the material and the social cannot be separated.

As two of the leading figures in technological studies, Lemonnier (1996) and Latour (1996) both collaborated and publicly debated their divergent approaches to understanding the social and technological. Lemonnier critiqued Latour for paying insufficient attention to the material world and the necessity of technological adaptiveness. For example, an extremely efficient airplane design was rejected because it did not look like planes were ‘supposed’ to look, so people lacked confidence in it.

However, this design was ultimately adopted for some planes. While it was a very effective design, favorable circumstances needed to develop for it to be adopted. Lemmonier pointed to this plane as proof that technological adaptiveness was essential, even if adaptiveness was determined by circumstance. Latour argued that by focusing on adaptiveness first, and then only turning to social-symbolic explanations when practical explanations fail created a false dichotomy between the symbolic and the adaptive. Latour (1996) argued that it was the particular type of adaptiveness created with a certain technology that instantiated a particular set of symbolic consequences. The social-symbolic was not a separate substance, but an intrinsic part of any object. Lemonnier (1996) responded that he did not treat symbolism and adaptiveness as separate categories, but rather that Latour did not acknowledge adaptiveness at all.

In fact, not only did Lemonnier consider symbolism, he actually took a fairly structuralist approach to technological analysis. According to Lemonnier, technological traits are evidence for the "classifications of the technical universe" (Dobres and Hoffman 1994; Lemonnier 1986:173). Lechtman took an even more structural position. Lechtman's (1977) analysis of Andean statues was only possible because she had the technical knowledge to reconstruct their *chaîne opératoire*, thereby demonstrating specifically which technological choices were made among a range of known possibilities. This data was then interpreted with the assumption that style reflects essential and often unconscious cultural patterns that structure most behavior within a society. In contrast, Lemonnier (1992) tended to focus on conscious technological choice rather than unconscious structures. His fieldwork with the Anga of Papua New Guinea demonstrated that people knew that their neighbors made spears and fences differently, and that they chose to accomplish these tasks in a specific way because it fed a sense of group identity. However, archaeologists do not have the benefit of being able to ask their subjects what they meant to do, nor observe the ephemeral social interactions in which their actions take place.

Dobres (2000, 2010) placed *chaîne opératoire* in a practice theory framework, interrogating each step of technological production as a source of data for habitus. Since it is possible to reconstruct production sequences, technological analysis provides a unique opportunity to observe the individual, regulated improvisation that allows for social reproduction and change. Materials science methods allow for much more fine-grained reconstructions of the production of a ceramic vessel than almost any other part of its biography (Costin 1991). Each pot contains countless gestures, practices that are shaped by the context of production. The abundance of ceramic pots in the archaeological record makes it possible to examine how these practices relate to more structural forces. *Chaîne opératoire* in a practice framework enables the exploration of social processes through micro-scalar analysis. These practices may be the result of conscious decisions or practical knowledge. In fact, being able to discern when producers knew multiple methods of production, and yet chose to employ a specific range of knowledge is one context in which it is possible to observe intentionality in the archaeological record. For example, Gosselain (2008) showed that potters in Niger used different tempers for pots intended for sale, since customers preferred more complicated combinations of materials. These same potters use simpler and equally effective temper for their own pots.

Unconscious technological practices are perhaps even more powerful, since people do not consider how material production reproduces social relations. For example, the mass production of vessels in the Ur III period in late-3rd millennium BCE Mesopotamia supported the centralization of wealth (Wright 1998). To my knowledge, the possibility of discerning the intentionality of producers (rather than elites) in this context has yet to be explored. Regardless of intentionality, technological production is an important aspect of (re)producing social relations. Technological choice is significant even if choice is not the defining characteristic of agency, and non-human agents can shape human choices.

However, while Dobres brings material culture into a practice theory framework, agency still lies solely with humans in her analyses. She focuses on technological choice by producers, rather than on the material conditions that may have motivated such a choice. This research takes this a step further and treats the presence, absence, or changes in materials as potentially instigating shifts in habitus. As noted before, this does not mean that materials are the same as humans in possessing intentionality, but rather that that materials are potentially effective agents.

Ceramic Production

Up until this point, this discussion has focused on technology as a general category, drawing on specific examples only to illustrate broader points. However, ceramics are the main source of data for this research, and the evidence they offer must be explicitly outlined. In order to understand why people make pots in particular ways, this project will draw on analytical tools developed in a range of disciplines, including ethnoarchaeology, pedagogical studies, and experimental archaeology (Crown 2007;

Gallahue and Ozmun 2002; Harry 2010; Minar and Crown 2001; Sewell and Lewandowsky 2012; Stark 2003; Stark et al. 2008). What can ceramic production tell us about the generation of social, economic, and political relationships?

Three broad methodologies generate data on ceramic technology: physical analyses, experimental archaeology, and ethnoarchaeology. Physical analyses interpret data acquired from examining the material traits of specific archaeological materials, including macroscopic, microscopic, and chemical evidence, the full discussion of which lies in Chapter 4 (Glascock and Neff 2003; Quinn 2013; Rice 2005; Roux and Corbetta 1989; Rye 1981; Whitbread 1995). Experimental archaeology attempts to replicate certain aspects of ancient technologies to determine the limits and benefits of specific technological choices (Beck 2010; Harry 2010; Harry et al. 2009). Finally, ethnoarchaeologists observe modern people to understand the organization of production, technological choices, and how social meaning can be negotiated through ceramics. The general goal of ethnoarchaeology is to learn the material correlates of these practices in order to recognize them in the archaeological record. However, the result of ethnoarchaeological research has been to highlight the enormous variability in ceramic production, leading to increasingly nuanced interpretations at the expense of more generalized models (Costin 2000a,b; Gosselein 1992, 2000; Hegman 2000; Kramer 1985; Stark 2003).

Previous research indicates that certain steps in the ceramic production sequence are related to particular types of social and economic information. However, these common associations contain enormous variability, as well as exceptions, that are made meaningful by comparison. Analysis of raw materials provides information about the location of production and exchange, since ethnographic data indicates that the vast majority of potters collect clay from within 7-9 km of their workshop, and generally within 3-4 km. Added materials, called temper, may come from as far as 30 km away, but usually can be found in a similar range as the clay source (Arnold 1985, 2000:343; Druc 2013; Miska and Heidke 1995; Neupert 2000; Stark et al. 2000). Potters may go beyond this range to collect clays that they feel have superior qualities, or because political or economic factors have denied them access to the nearest clay source (Arnold 2000:341-350).

However, "local" production cannot be defined merely by measuring the distance from clay source to vessel. Large geographic areas might be geologically indistinguisheable, and conversely, small areas may contain extensive geological diversity (Hein et al. 2004; Steponaitis et al. 1996). Communities of practice can be as significant as geographic location when determining a useful analytical scale for "local." For example, in contemporary Mexico, seven pottery producing villages all acquire clay from a non-pottery producing village 10-12 km away (Druc 2000). Are these vessels "local" to the clay source or the village that produced them? Or should they be considered regional? At Chavin de Huntar, a first millennium BCE site in Peru, "local" pottery was made from two completely different geological sources that were both within 10 km of the site, with one local source replacing the other over time (Druc 2004). "Local" pottery production is a relative category that can inlude a range of raw materials, technological methods, and visual styles for a given site or region (Druc 2013). In Naxçıvan, I differentiate local and non-local production based on geological criteria, but I interpret these results in relation to technological and political shifts.

Though there are functional constraints in clay choice, people often do not make economically “optimizing” decisions. For example, in the Mississippi valley in the late first millennium CE, shell tempered pottery was adopted despite the fact that in some areas it produced weaker pottery than previous clay recipes (Alt 1999). Pauketat (2001) attempts to explain this apparent maladaptation by observing that shell tempered pottery was the technology employed by the powerful Cahokia polity, and that the adoption of this technology was one way of associating with Cahokia.

Standardization in clay paste recipe is often interpreted as evidence for specialization and centralization, since elites would have controlled resources for production, as well as the production process itself (Arnold 2000:334; Costin 1991, 2001a,b; Rice 1981). However, Arnold (2000) found that modern Latin American potters dealt with elite control of resources by finding other sources if a deal could not be reached. In Arnold's study area, elite control of resources did not result in elite control of production; the elites simply sold the clay to the potters who continued to work independently. Stark et al. (2000) show that two villages in the Philippines located just 2 km apart used distinct clay sources and recipes, despite access to similar resources. Thus, clay recipes can be affected by political, environmental, economic, and social factors, as well as be constrained by the basic function of the pot.

The next step in the *chaîne opératoire* is forming, or constructing the general shape the vessel. Forming techniques include molding, pinching, slab construction, coil building, slow wheel, and fast wheel (Rice 2005:124-152; Rye 1981:58-95). The same vessel may be the product of more than one forming technique (Glanzman and Fleming 1985; Roux 2008). The fast wheel stands apart functionally, since it requires a significant degree of specialization, and can produce high quantities of standardized vessels very quickly, relating it to mass production (Roux 2003a,b, 2008:103; Stark 2003:204). However, that does not mean that specialization or mass production cannot occur with other methods. For example, molds are another relatively common means of mass production (Peacock 1982). Moreover, shaping methods are constrained by the clay used. Excessively coarse clay, for example, cannot be used effectively with the fast wheel since the aplastic fragments hurt the potter's hand.

Forming appears to be the aspect of production that is most culturally resistant to change. Clay paste may remain constant over an extensive period of time because of geological conditions. However, forming practices remain relatively consistent due to the learned skills required to successfully produce a pot (Vandiver 1987). Potting skills may be transferred vertically from parent to child, horizontally within the same cohort, or diagonally from an older potter to a young apprentice (Bowser and Patton 2008; Gosselain 2008; Herbich and Dietler 2008; Wallaert 2008). Though both males and females may be potters in different cultural contexts, usually specific steps of production are restricted to one gender within a particular cultural context (Costin 2000:392; Stark 2003:204). Various combinations of these learning relationships may occur at different times in a potter's life. Ethnographic evidence suggests that potting is rarely formally taught. Rather, apprentice potters share in, "legitimate peripheral participation" in "communities of practice" (Crown 1999; Lave and Wenger 1991:29; Wenger 1998:45). This means that they learn by watching experienced craftspeople, and acquire practical knowledge by performing increasingly complex tasks. These skills become embodied knowledge that is often not amenable to extensive change later. When scholars asked expert potters from India and France to reproduce a range of vessel shapes, the participants were most consistent in their ability to make pots that were based on familiar forms, and less successful with new forms (Gandon et al. 2014). In an ethnoarchaeological study spanning Sub-Saharan Africa, Gosselain (2000) demonstrated that forming practices fall along ethnic and linguistic lines more than any other aspect of production. Potters' embodied knowledge was shaped by the community in which they learned, usually within their own social group. Loney (2007) applies this model to Bronze Age Italy to explain the persistence of handmade pottery after the introduction of the wheel, and suggests that the muscle memory of mature craftspeople made the adoption of another technique unattractive, despite its seeming benefits (see also Knappet 2004).

In ceramic production, embodied knowledge becomes a part of the potter's habitus, the constant reproduction and alteration of social practices (Bourdieu 1977; Clark 2007; Dobres 2000, 2010; Loney 2000). However, Bourdieu's theory of practice does not always leave much latitude for conscious manipulation of these norms, since people are unaware of the habitus that they inhabit. This formulation may suggest that people are confined by their embodied knowledge. However, forming practices clearly do change. Potters may continue to learn throughout their lives and make choices regarding which skills to employ (Chilton 1998; Crown 2007; Gosselain 2008; Herbich and Dietler 2008; van der Leeuw 1993; Wallaert 2008). Moreover, potters may choose to retain inherited practices as an aspect of social identity, despite being capable of learning alternatives, as would be expected in Lemonnier's approach (Gosselain 2008; Lemonnier 1986). Failing to retain such practices may have a social cost. Wallaert (2008:186-7) discusses two Dii potters in Cameroon who were ostracized for adopting foreign shaping practices, though they did so out of economic necessity. In Niger, changes in forming practices were only accepted when the foreign source of the technique was erased from the social narrative (Gosselain 2008:170).

If forming is the aspect of production most culturally resistant to change, then finishing or decoration is arguably the most fluid aspect (Dietler and Herbich 1989; Gosselain 2000). Finishing can encompass a broad range of techniques including painting, glaze, slip, incising, adding clay, burnishing, stamps, and rouletting (Rice 2005:144-52). These techniques have many different implications in terms of skill required, symbolism indicated, or possible functional benefits. For example, the textured paddle modern potters use to finish pots at Ban Chiang, Thailand may be an aesthetic preference, but it is also a necessary part of the technological process of making a pot (Cort and Lefferts 2000). Experimental archaeology suggests that the textured exterior of Mogollon pots in the American Southwest may have improved thermal shock resistance (Schiffer et al. 1994). Burnishing pots by rubbing them with a hard object in the leather hard phase, or smudging pots by smothering them in ash immediately after firing, both decrease porosity and create a striking visual effect (Rice 2005:231-2). The functional and the symbolic cannot be separated.

In the archaeological record, decorations have often been taken as ethnic or cultural markers, but these interpretations rarely account for the relative flexibility of decorations in the production sequence (Hodder 1982; Tehrani and Collard 2002; Wobst 1977). Clay recipe is limited by natural resource availability and forming practices require significant investment in muscle memory, and both steps of production have significant functional requirements. In contrast, decoration is primarily constrained by the imaginations and needs of the society in which vessels are used. This relative flexibility allows for the manipulation of social boundaries that ceramic decorations enact. These boundaries may exist on many different overlapping scales, including family, village, and regional levels (Bowser 2000; Bowser and Patton 2008; Minc 2009a; Sackett 1990; Stark et al. 2000). Significantly, ethnoarchaeology suggests the people may have an easier time recognizing out-group decorations than in-group decorations. For example, Bowser (2000) found that women in the same village in the Ecuadorian Amazon used the decoration of domestic serving vessels to indicate local political affiliations. These women could recognize the decoration of political rivals more consistently than members of their own group. Bowser suggests that the study population noticed more variation internally, while the out-group could be viewed as a monolithic block (see also Bowser and Patton 2008).

The choice to adopt certain decorative styles may be a matter of skill, as well as a means of social positioning. For example, in Niger, pottery produced by the Bella is generally considered to be the most beautiful, and some non-Bella potters copy this decorative style because of the economic incentive of customer preference. However, the low-class Songhay will not copy the Bella style, even though they prefer it. The Bella are believed to be ex-slaves, and as such are one of the few groups that the Songhay can position themselves as superior to, causing the Songhay to avoid conflation with the Bella (Gosselain 2008:171-3). Bowser (2000) notes that painting can be a highly skilled activity. The occurrence of poorly executed designs on skillfully executed pots has been used to interpret the presence of children in the archaeological record (Crown 1999). This places skilled decoration within an embodied knowledge framework similar to forming. In contrast, Gosselain (2000) notes that rouletting techniques are widespread and widely borrowed throughout Sub-Saharan African, since very little skill is required in their application.

Treating production steps as categories in the *chaîne opératoire* approach can be problematic, since shape and finish can be as much a part of the visual style as applied decoration. Changing the shape of a rim can be far simpler, and thus more susceptible to change, than adopting new painting styles. *Chaîne opératoire* was developed to understand lithic technology, which has a much more limited range of gestures and materials in its production sequence. The above discussion of possible constraints and affordances involved in certain steps of ceramic production is a starting point, not a static model. However, *chaîne opératoire* is a useful framework for conceptualizing how each step in the production sequence entails a socially embedded choice. All steps of the *chaîne opératoire* must be taken into account when making a sound interpretation of technological data. For example, the standardized production of a simple bowl type from Tell Leilan, Syria, in the third millennium BCE, may have been interpreted as evidence for centralized production. However, the use of compositional analyses demonstrated that these bowls were produce in dispersed workshops (Blackman et al. 1993, for critique see Roux 2003b, also see Longacre 1999). Moreover, technological analyses may reveal broad social implications obscured in other media. Leah Minc (2009a) demonstrated significant divisions in style and composition of ceramics under the Aztec Empire that fall along the borders of polities that the Aztecs had absorbed. This indicates economic and social divisions despite the political unification of the region. Considering the complex relations involved in each production step is critical to taking materials seriously as part of social production.

By reconstructing the technological production of archaeological ceramics, it is possible to make inferences about the context in which they were made (Arnold 2000; Arnold and Nieves 1992; Blackmen et al. 1993; Boileau 2005; Costin 1991, 2001; Costin and Hagstrum 1995; Courty and Roux 1995; Feinman et al. 1981; Feinman et al. 1984; Hayashida 1999; Longacre 1999; Peacock 1982; Rice 1981, 1991, 2005; Roux 2003a,b; Roux and Courty 1998; Sinopoli 1988, 1998, 2003; Tite 1999; van der Leeuw 1977; Wattenmaker 1998). While there are many different models for inferring the organization of production from ceramics, the model proposed by Cathy-Lynn Costin has been the most influential (Costin 1991, 2000; Rice 1991, van der Leeuw 1977). Costin (2000) describes how the physical attributes of objects such as formal/stylistic, technological, and material traits can be related to inferences about labor investment, skill, and standardization. In turn, these inferences can lead to interpretations regarding the specialization of labor, intensity of production, locus of control, and identity of artisans (Costin 2000:379). Costin (1991) proposed eight idealized types of specialization that develop under different social, economic, and environmental conditions and have specific technological correlates. These types include individual specialization, dispersed workshop, community specialization, nucleated workshops, dispersed corvée, nucleated corvée, individual retainers, and retainer workshops (Costin 1986, Costin and Hagstrum 1995). Though Costin's model cannot be viewed as definitive or comprehensive, it provides a good starting point for relating material traits to social organization. Costin and Hagstrum (1995) used these models to identify independent household production alongside locally recruited corvée labor for the Inka state. All of Costin's physical attributes are relative characteristics, which in turn are used to develop regionally specific reconstructions of the degree and type of specialization for different artifact classes. This project adapts her model to the data available in this study.

Models of craft production can be used to explore changes in political and economic complexity. Specialization can be defined simply as "the production of surplus for exchange" (Stein 1996:25), which means that any society with greater complexity than the self-sufficient Domestic Mode of Production contains some degree of specialization (Sahlins 1972). Specialized production can take the form of a full-time artisan crafting prestige goods for elites, or an independent potter making vessels for local exchange when there there are relatively few agricultural tasks (Clark and Parry 1990; Costin 1991; Peacock 1982; Rice 1991). The analysis of ceramic specialization cannot be framed as presence or absence, but degree and type in a comparative framework (Costin 2001; Clark 2007; Rice 1991). For example, Wattenmaker (1998) explains the increased specialization of domestic ceramics in 3rd millennium BCE Mesopotamia as the product of demand for a standardized semiotic vocabulary that could be understood in a larger social network. Costin (1986; 2001b) uses the analysis of ceramic production to understand how initially independent areas became incorporated into the economy of the Inka Empire. As a result, Costin found that utilitarian specialized production continued largely as it had before, and the same local potters made prestige wares for the state part time (cf Hayashida 1999). Finally, Sinopoli (2003) explores the specificity of how different crafts were organized under the Vijayanagara Empire in India, and finds that ceramics were produced by dispersed, independent workshops whereas the politically significant textiles were produced by centralized, attached artisans. These studies, along with many others, have established ceramic technological analysis as a powerful tool in understanding how economic, political, and symbolic changes intersect at multiple scales (Blackman et al. 1993; Costin 1991, 2001b; Hayashida 1999; Sinopoli 1988, 1998, 2003; Stein 1996). By observing the continuities and discontinuities of ceramic production from before and after imperial expansion, it is possible to map how economic production is re-ordered in an imperial context.

Empire and Political Economy

Next, we shift our scale of analysis from mundane cooking pots to mighty empires. The following discussion will not only demonstrate the links between these different scales, but also the necessity of reconstructing their relationships in order to effectively interpret changing patterns. Technology and politics intersect as agents reconstruct their social circumstances by engaging in a series of specific practices (Bourdieu 1977; Giddens 1984). Political context shapes economic opportunities, consumer preferences, and labor conditions that result in changing technological practices. In return, changes in technological practices can remake the political landscape, as the desire for certain luxury goods, new methods of food preparation, and previously unknown trade partners become essential in constructing local identities (Hahn 2012; Stockhammer 2012a; Yao 2005, 2012). The incorporation of peripheral communities into an empire occurs through enduring changes in technological practice as much as through military conquest. After briefly examining some of the more traditional, top-down models of empire, this discussion will turn to post-colonial research for a more bottom-up perspective on political power.

Many different definitions and models of empire have been offered over the years that variously emphasize geographic, economic, political, ideological, and/or military aspects of imperial control (Sinopoli 1994:160). Carla Sinopoli (1994:160) claims that these models generally:

> share in common a view of empire as a territorially expansive and incorporative kind of state, involving relationships in which one state exercises control over other sociopolitical entities.... The diverse polities and communities that constitute an empire typically retain some degree of autonomy-in self- and centrally-defined cultural identity, and in some dimensions of political and economic decision making.

The internal heterogeneity of empires is what makes them so difficult to understand as a whole, since a single empire superimposes itself onto a diversity of pre-existing cultures and political institutions. Lori Khatchadourian (2016: 23) notes that "cross-cultural histories of imperialism have established the recurrence of layered, nested, or 'partial' sovereignty" (see also Stoler and McGranahan 2007). While imperial rule requires domination, it also requires negotiation with diverse communities, with the conditions of imperial rule contingent upon those negotiations. This can result in different degrees of rights and sovereignty for communities under the same imperial rule. Some local freedoms are necessary for the continuation of imperial power, and others create dangerous independence (Stoler 2006). Although empires are the most geographically expansive political system, they will always be a local process. All empires must solve the problem of incorporating heterogeneity, and the means by which they do so will define the empire. An empire, by definition, is not its core, though that is usually what is most visible, but rather its constituent localities in relation to the core.

Imperial power must be enacted through widely recognized forms that cause the majority of the inhabitants to acquiesce to their own domination. This power has different dimensions of distribution depending on the media through which it is deployed. Bradley Parker (1989) developed a model of the spatial distribution of imperial control for the Neo-Assyrian Empire by combining two frameworks. First, Mario Liverani’s concept of a “network-empire,” in which imperial control is exerted by dominating particular nodes of power such as roads, canals, and economic resources with the surrounding areas relatively unaffected by the centralized polity (Liverani 1988, Parker 1989:9-13). Second, Terrence D’Altroy’s “territorial-hegemonic” continuum model, which suggests degrees of dominance ranging from complete incorporation to less direct control (D’Altroy 1992, Parker 1989:9-13). This results in a model wherein the degree of incorporation, in some cases, decreases from the core to the periphery, while greater incorporation can be maintained in areas of imperial interest. In discussing Liverani's network model, Nicholas Postgate notes that "all territorial control must take [a network] configuration since people cannot be evenly distributed across a landscape and communications must be maintained between the groups" (Postgate 1992:255).

Since empires are a conglomeration of different societies and social structures, they are difficult to delineate as an analytical category. Unlike the other social evolutionary categories-- band, tribe, chiefdom, and state-- which have been endlessly critiqued but still deployed, empires cannot be defined by settlement type, population density, or any other typical criteria (Khatchadourian 2016:26-30; see also D'Altroy 1992; Service 1975). Rather, empires are defined by their ability to dominate less powerful societies. There is enormous variation in the types of societies incoporated into an empire, and the methods employed to dominate. For example, the Urartian Empire only incorporated mountainous territories, and fortress architecture defined their imperial assemblage. These fortresses were characterized by the presence of Urartian style elite materials that are typically not present in other contexts (Kroll et al. 2012; Zimansky 1985, 1995). In contrast, the Achaemenid, Seleucid, and Parthian Empires all controlled a much broader range of territories, and typically adopted local symbols and political structures into their own system of domination (Dusinberre 2003; Hannestad 2012; Hauser 2012; Khatchadorian 2016). Finally, Rome had a remarkably coherent material assemblage that extended far beyond its administrative borders, and entailed clear shifts in elite and non-elite contexts (Sartre 2005; Woolf 1992). These empires are discussed in greater detail in chapters 3, 6, and 7, but it is important to note their distinctive ways of enacting empire. These empires were vastly different imperial projects, and understanding the diversity in how these projects were enacted is central to this study. The materials associated with these empires participated in the production of diverse imperial systems.

Ancient imperial borderlands are especially difficult to qualify, since they rarely have a line demarcating imperial versus non-imperial space (rare exceptions include Hadrian's Wall and the Great Wall of China, but even these are not simple). Parker (2006) developed a system to describe borderlands that accounts for the diversity present in these complicated regions. In this system, Parker proposes a matrix of different types of boundaries, including cultural, political, economic, geographic, and demographic, which exist on a continuum from border (static, restrictive) to frontier (porous, fluid). These different types of boundaries interact with each other to create different types of borderlands. A political boundary might involve the integration of another polity into an empire as a vassal, with military and administrative ties for elite centers but a limited impact on the majority of the population. For example, the Inka Empire asserted indirect administrative control over a diverse population, but this border did not coincide with cultural and demographic frontiers. The new Inka administrative border did not prevent the existence of alternate borderlands, and these different types of borders and frontiers interacted to create new borderlands (D’Altroy 1992; Hyslop 1984; Morris and Thomson 1970). Untangling the different types of borderlands is an important step towards understanding how peripheral regions are engaging with their powerful neighbors.

Frontiers may also extend well beyond political borders. For example, while Roman political-military borders were generally quite rigid, defined by walls, forts, and garrisons, their cultural and economic frontiers could be quite porous. In Germany, well beyond the reach of Rome's administrative boundary, potters produced Roman style ceramics and Roman metal vessels and jewelry were common in burials (Wells 1992; 1999). Similarly, in late first millennium CE Peru, Wari style pottery was produced in areas beyond any evidence for Wari administrative control (Jennings 2006). Pre-Roman style local ceramics continued to dominate Roman Southern France, even after conquest, with just a few select Roman style drinking vessels that resonated with local feasting practices (Dietler 2010; see also Skoglund et al. 2006). Influence in imperial borderlands is multi-directional, both radiating from imperial centers, and generated through interactions with neighboring peoples.

Lori Khatchadourian (2016) developed a model for Achaemenid imperialism that defines imperial objects as delegates, proxies, captives, and affiliates, categories that depend on the social roles of objects in recreating and resisting imperial systems. However, with the last category of affiliates, Khatchadourian consigns all material things not stylistically associated with empires as neutral, rather than exploring the range of possible meaning inherent in continuity, including resistance or conscious insularity.

The movement of objects, as part of gift exchange, trade for profit, or carried by people for personal use, is central to the creation and perpetuation of imperial networks. Really, this movement of objects is central to the existence of human networks, going back to the evolution of *Homo sapiens* (Adams 1992; Carson 2017; Gamble 1998; Issac

1993). Mapping these networks is crucial to understanding who was interacting, and the nature of these interactions. For example, to what degree were various empires economically integrated, for which materials, and under what degree of centralized control? Were imperial communities trading beyond their administrative borders? Research on ancient trade often focuses on the applicability of modern economic models to pre-modern contexts, with formalists arguing that human economic behavior is universally value optimizing (LeClair and Schneider 1968; Pospisil 1973; Schneider 1974), and substantivists insisting that exchange is socially embedded and culturally relative (Dalton 1975; Finlay 1985; Polanyi 1966). In fact, these two positions represent poles on a continuum, with archaeological and ethnographic examples typically falling somewhere in between (Oka and Kusimba 2008). Hutterer notes that economic "exchanges [lent] concrete manifestations to social relations which themselves may transcend the economic realm" (Oka and Kusimba 2008:341).

Substantivists, most prominently Karl Polanyi, drew support from anthropologists Bronislaw Malinowski (1922) and Marcel Mauss (1925) and argued that pre-modern exchange primarily served to reinforce relationships rather than optimize personal wealth. Giving an appropriate gift, such as a kula shell, tied the recipient to the giver and created a social debt, but would not increase the wealth of either participant. Polanyi (1966, 1975, 2001) argued that pre-modern economies were almost entirely administered by elites, who guided production and exchange to support their own political systems; to display, redistribute, and exchange wealth, cementing ties between allied elites and the common people. Any resemblance these economies might bear to modern economies must be superficial, since they were driven by the maintenance of social ties rather than supply and demand (Carrasco 1978; Dalton 1969; Ratnagar 1981). Andean scholarship reinterpreted this model in a Marxist framework and presented Inka elites as using their monopoly on economic activity for personal aggrandizement, circling back onto a formalist value maximizing approach for those in power (Brumfiel and Earle 1987; Earle 2002; Gilman 1991; Mann 1986). D'Altroy and Earle (1985) explicitly developed a model that differentiated between luxury and staple economic spheres, with the former serving to justify power among elites and the latter among the masses. The Amarna tablets show that Near Eastern kings in the Late Bronze Age (1400-1300 BCE) used gifts as a crucial mechanism for international relations, with ambassadors, women, and luxuries all serving to maintain the ties of a metaphorical brotherhood (Liverani 2001; Podany 2010). The luxuries exchanged had a distinctly 'international' style, drawing on a broad range of regional motifs to create meaning that could crosscut geographies (Feldman 2002). The production and exchange of regional style pottery in Middle Iron Age Oğlanqala similarly enacted connections between disparate polities (see chapter 6).

While trade is necessarily embedded in a social context, independent merchants and craftspeople did exist in the ancient world, and they were certainly not adverse to the accumulation of wealth. Rahul Oka and Chap Kusimba (2008:351) note that archaeologists working in areas without a textual record, primarily the Americas, have tended to favor models that emphasize political control of economic activities. In contrast, archaeologists with access to detailed textual records, such as the Middle East and Asia, have tended to acknowledge a more complex relationship between political elites, merchants, and crafts people, with the degree of independence and balance of power often shifting (Stein 1999; Lamberg-Karlovsky 1975; Larsen 1977; Woolf 1992). While this impression could be the result of very broad economic patterns in different parts of the world, Oka and Kusimba argue that texts make it possible to observe more fine-grained political-economic relationships. For example, documents from the Kültepe merchant quarter in ca. 1800 BCE Anatolia reveal a complex series of trading activities that involved, but was not controlled by the political elite. The extent and nature of economic activity at Kültepe would likely not have been discernable from the archaeological record alone (Casson 1994; Gledhill and Larsen 1982; Larsen 1977). This was trade to maximize profit, not to enact relationships.

Following and in some ways parallel to the substantivist-formalist debate, World Systems Theory (WST) proponents argued that unequal trading conditions resulted in entrenched political inequalities (Algaze 2001; Ratnagar 2001; Wallerstein 1979). WST is based on modern colonial world systems, with an exploitative core and exploited peripheries. Even Wallerstein, the author of WST, questioned its applicability to pre-modern contexts. However, archaeologists found it useful for explaining long distance trade systems, and a plethora of "world-systems" were delineated throughout the world (Abu-Lughod 1989; Frankenstein and Rowlands 1978; Glover 1989; Kohl 1987). For example, Algaze (1992) argued that southern Mesopotamia's agricultural productivity incentivized and enabled their colonization of northern Mesopotamia and Syria. Even before archaeological evidence demonstrated that the north developed agricultural productivity and urbanism independently, Stein (1999) objected that ancient societies did not have the technology to enforce economic dominance.

Finally, objects move when people do, and not necessarily as part of an exchange process. This can typically be observed through the small-scale movement of objects, and can occur over short and long distances. Since inhabitants of the Iron Age South Caucasus practiced transhumant pastoralism, some portions of the population were moving seasonally between summer and winter pastures. Neighboring communities were likely interrelated, containing family and prospective spouses, necessitating local travel. The geological variation of the region means that pottery does not need to be carried very far to reach an area with a different mineralogical profile, and thus appear non-local in this analysis. The movement of objects across greater distances is often part of imperial processes, which connect disparate communities who might not otherwise interact. For example, Roman coins are common in burials in the South Caucasus. They were not used as currency on a large-scale, nor do they appear to have been part of a gift exchange system to solidify social ties. Rather, they were re-imagined for a ritual context that bears no relation to the intended use of the coin, yet nonetheless connects this area to Roman networks (Fabian, in press; Khatchadourian 2008; Nugent 2013). As discussed above, the nature of objects is socially contingent, and can shift from commodity, to gift, to grave offering (Appadurai 1986). The way in which an object moves is part of what creates this context, participating in the negotiation of relationships.

Post-Colonial Theory

Post-colonial theory initially developed as a form of literary criticism that attempted to discern and deconstruct the ways that colonial privilege was instantiated through the ability to control discourse and define the subaltern. Post-colonial theorizing has produced powerful ways of understanding the complexity of domination in past societies, leading to new insights in the archaeological record. However, the general concepts of post-colonial theory have been employed in several different, sometimes contradictory ways. This discussion will explore some of the major streams of post-colonial theory as they developed in a modern, particularly literary context, and then examine which aspects of this body of work may be effectively translated for archaeological purposes in general, and ceramic production in imperial peripheries in particular.

Transferring post-colonial theory to periods before modern colonialism is especially daunting because even contexts that have traditionally been included in post-colonial studies are incredibly diverse. The disparate peoples and places incorporated into post-colonial studies has led some to argue that post-colonialism could become a universalizing narrative in its own right (Coronil 1992; Lalu 2008; Parry 1997; San Juan 1999; Sethi 2011; Slemon 1994). The problem of balancing analysis of the structural problem of colonialism with the diversity of local instances has been compared to feminist debates over the universal application of patriarchy (hooks 1981; Mohanty 1984; Slemon 1994, Suleri 1999). However, post-colonial theorists generally agree that the term post-colonial refers to the period after the beginning of modern colonialism, rather than after formal colonization ended (Ashcroft et al. 1989, 1995; Sethi 2011; Sökefeld 2005).

This attention to the continuities among the various forms of domination, as well as the range of forms that domination can take, is what has made post-colonial theory so productive. This perspective is especially useful in Şərur, Naxçıvan, where the form and degree of Urartian, Roman, and Parthian dominance is a subject of inquiry rather than a known entity. Political, economic, psychological, material, aesthetic, and textual forms of hegemony as well as resistance are all intertwined in the colonialist package.

The concept of hegemony, developed by Antonio Gramsci writing from a Marxist perspective, permeates post-colonial studies (Ahmad 1993; Davidson 1984; Gorlier 2002; Gramsci 2011; Morton 2003; Said 1993). Hegemony is when the worldview of the dominant minority is imposed upon the subjugated majority and becomes common sense, which results in the subjugated acquiescing to their own oppression. The Subaltern Studies Group, most famously represented by Ranajit Guha’s (1999) *Elementary Aspects of Peasant Insurgency in Colonial India*, seeks not only to reveal the dominating discourse, but also to recover the voices of those who had been silenced under colonial oppression (Bayly 1988; Chaturvedi 2012; Guha 1982, 1997; Guha and Spivak 1988; Maseslos 1992; Prakash 1994). The Subaltern Studies Group was informed by Marx in general and Gramsci in particular, and encouraged the recognition and development of proletarian intellectuals (Alam 2002; Arnold 1984; Chakrabarty 1993, 1995; Guha 1982). As a historian, Guha depended on elite textual sources to develop a counter-narrative of peasant resistance in colonial India with the goal of further revolutionizing subaltern communities. However, like most post-colonial research, the Subaltern Studies Group did not consider archaeological evidence, which can be an invaluable source of data for non-literate populations.

Gayatri Spivak (1988), however, questions whether it is possible to recover the subaltern voice in “Can the Subaltern Speak?” In this piece, Spivak (1988:72) argues that in “the banality of leftist intellectuals’ lists of self-knowing, politically canny subalterns stands revealed; [by] representing them, the intellectuals represent themselves as transparent.” Preferring Derridean deconstruction to the more structured projects of Foucault and Deleuze, Spivak concludes that all representation of the other is ultimately appropriation, and that the subaltern, by definition, cannot speak (Spivak 1988:104, see also Parry 1987). Spivak is not alone, and several scholars have critiqued the use of subaltern as a category for being reductive (Bahl 1997; Chakrabarty 2000; Sarkar 2002). However, Spivak does argue for the utility of “strategic essentialism,” in which a diverse group of people craft a unified identity in order to effectively participate in a discourse from which they would otherwise be excluded (Spivak 1990; later rejected by Spivak in Darius et al. 1993; see also Parry 1997).

Bhabha (1994) takes a very different approach by focusing on colonization as a process of cultural production rather than solely one of destruction or effacement. While cognizant of the brutality of colonization, Bhabha argues that this cultural production, which he calls hybridity, is actually a form of resistance. Hybridity exists at the point of engagement, not as the mixing of two otherwise pure cultures, but as a creative process that occurs in unequal interactions (Canclini 2005; Kapchan and Strong 1999; Young 1995; see also Bahktin 1981 for a linguistic approach). According to Bhabha (1994), colonization is characterized by ambivalence, in which the colonizers desire to assimilate the colonized, to render them transparent, while simultaneously wanting to maintain their alerity (also Fanon 2008). In turn, Bhabha (1985, 1986, 1994) draws on the Lacanian concept of mimicry as camouflage, in which the colonized employ elements of the occupiers' practice, but always depart from the dominant model, creating slippage that disrupts the dominant discourse. Hybridity provides a heuristic that blurs the categories of subject and object to focus on how colonization creates new engagements, practices, and identities without ignoring the unequal power relations that engender these interactions.

Finally, Achille Mbembe (2001) makes a powerful critique of the post-colonial canon that his work would ultimately join, claiming that:

> recent historiography, anthropology, and feminist criticism inspired by Foucauldian, neo-Gramscian paradigms…have reduced the complex phenomena of the state and power to 'discourses' and representations,' forgetting that discourses and representations have materiality (Mbembe 2001:5, see also Parry 2004; Weate 2003; Yang et al. 2006).

Mbembe (2001) points out that reality cannot be reduced to language, but rather must be understood through the entire complex range of sensory experiences and processes that occur at multiple temporal scales (see also Merleau-Ponty 2002). These appeals for greater attention to materiality and a long-term perspective clearly point to the significant contribution that archaeology can make to post-colonial studies.

Recently, post-colonial theory has increasingly been utilized in archaeological interpretations as a means of understanding earlier instances of asymmetrical cultural interactions, ranging from Hellenistic Iberia (Dietler and Lopez-Ruiz 2009; Dietler 2010;

Domínguez 2002; Van Dommelen 2005) to Han China (Yao 2012) to Native Americans in New England during America's colonial period (Silliman 2009). The adoption of hybridity in archeological analysis is related to the rejection of the acculturation model, in which the dominant culture essentially replaces the subordinate culture, with any vestiges of the latter simply being retrograde (Ackermann 2012; Hahn 2012; Thomas 1994). The post-colonial concept of hybridity (distinct from the biological concept) describes processes of negotiation and interaction between various actors and in doing so introduces practice into the material engagements of cultural interaction (Bourdieu 1979; Stockhammer 2012a; Van Dommelen 2005). For example, Peter Van Dommelen (2002, 2005) uses the concept of hybridity to explore how different Punic colonies in the Western Mediterranean resulted in very different hybrid cultures, since the settlements were the product of regional as well as Punic influences, resulting in material forms that were both and neither.

However, there have been several objections to the use of hybridity in archaeological analysis, especially by those who are engaging with post-colonial theory. Philipp Stockhammer (2012b) objects to the use of hybridity in archaeological analysis for two reasons. First, he argues that while hybridity is supposed to deconstruct the idea of bounded cultures, it actually reintroduces the concept of purity since at least two identifiable cultures need to interact in order to be considered hybrid. In fact, Bhabha (1994:5-7) states that he is not referring to bounded categories of culture, ethnicity, race, or gender. However, Stockhammer resolves his concerns over purity by pointing out that archaeological cultures are material assemblages that represent etic categories available to the researcher, rather than emic categories necessarily employed by people in the past. Treating heterogeneous archaeological cultures as a unified entity for the purpose of greater understanding is in some ways the mirror image of Spivak's (1990) strategic essentialism, wherein a heterogeneous group constructs their own etic identities.

Stockhammer's (2012b: 45-6) second issue with the concept of hybridity is that Bhabha develops this term within a political framework that implies resistance to the colonial system. Stockhammer argues that it is premature, if not impossible, to ascribe the politically laden concept of hybridity to prehistoric material interactions when we cannot understand the intention of those who produced these objects. Instead, Stockhammer prefers the term "entanglement" to describe the complexity of cultural interactions without beginning with a particular political stance. According to Stockhammer, entanglement implies creation rather than mixing, and was employed productively by Thomas (1991) in his analysis of exchange on the Pacific. Michael Dietler (1998, 2010) also prefers the term entangled for similar reasons. Dietler claims that hybridity implies imperial rule, wherein a metropole maintains territorial control over an area. In contrast, entanglement can be employed in colonial situations that are less clear-cut, such as when settlers have influence in a previously foreign region but do not rule it. While I appreciate the desire to avoid assumptions about power relations, the dismissal of power in the primary analysis of imperial expansion misses an important axis of engagement. Since this research specifically deals with the expansion of Urartu and Rome into previously non-imperial space, asymetric power relations are taken as a starting point for examining how these regions became entangled.

Both Dietler and Stockhammer define the term entanglement quite differently than Mbembe (2001), who made this concept prominent in *On the Postcolony*. There, Mbembe (2001:66) explains entanglement as:

> the coercion to which people are subjected, and the sufferings inflicted on the human body by war, scarcity, and destitution, but also embrace a whole cluster of re-orderings of society, culture, and identity, and a series of recent changes in the way power is exercised and rationalized.

This definition actually lends itself to archaeological analysis quite well, since it emphasizes the material reordering of human life that accompanies colonization. However, it assumes unequal power relations, and does not imply the heterarchical conditions that Dietler and Stockhammer want to take as a starting point. However, all of these uses of entanglement are related to the material consequences of intercultural interactions, which is why Hodder's adoption of the term for human-thing interactions is confusing, and will not employed as such in this project. Before entanglement became a disputed term in social theory, it was employed by physicists to refer to quantum entanglement, wherein a pair or group of particles cannot be described independently of each other regardless of distance (Barad 2007; Vedral 2003).

Chris Gosden (2004) also objects to the use of hybridity because he argues that it invokes the existence of pure cultures that are then hybridized. Gosden argues that an alternate model is Richard White's (1991) Middle Ground Theory (MGT), which was developed to understand the interactions between the British, French, and Algonquians. MGT posits that intercultural interactions produce new systems of cultural logic that contain elements of its components but are identical to none. Although this sounds quite similar to hybridity, perhaps the distinguishing aspect is the emphasis on functional, patterned misunderstandings. For example, Thomas (2002) shows how English missionaries in the nineteenth century wanted Tahitians to adopt European dress for the sake of modesty, which they viewed as moral/religious value. The Tahitians, who had a long tradition of bark cloth production and prestige associated with clothing, seem to have been receptive to European dress not for moral reasons, but because it was associated with the English who were perceived as powerful. Cloth was not a symbol of modesty, but power. This "misunderstanding" was understood to different degrees by different parties, but provided discursive cover and the desired result, at least in the short term. While semantic discussions of hybridity, entanglement, and MGT are useful to the extent that they encourage terminological precision, ultimately these terms describe the creative potential of cultural engagements to enable the assimilation, rejection, and invention of new practices.

As archaeologists have productively engaged with post-colonial theory, it has become apparent that archaeology has the ability to contribute powerful perspectives to interdisciplinary discussions of post-colonialism. While political science, history, cultural anthropology, art history, and economics have all been incorporated into the post-colonial conversation, this motley field remains primarily focused on discourse analysis of the very recent past (Brah and Coombes 2000; Das and Poole 2004; Guenther 2003; Kohn and McBride 2011; Pollard and Samers 2007; Van Dommelen and Rowlands 2012). However, archaeology is often the only means of accessing the non-literate subaltern. For example, the recovery of a cemetery of enslaved Africans in New York demonstrated the extent to which the northern states participated in slavery, as well as the hybrid burial practices that enslaved Africans employed (Blakey 2008). Excavations of a female convict settlement in Tasmania, Australia demonstrated that the inmates engaged in a number of creative and forbidden practices that textual sources do not record (Casella 2011). In order to understand what occurred during modern colonization, it is necessary to understand the complex histories of places before this period. Until recently, texts have always been elite documents, and while scholars such as Guha can read against the texts to develop a counter-narrative, this narrative is impoverished by its lack of attention to materiality and practice. Mbembe (2001), Bhabha (2005), and Bakhtin (1981) all point to the double speak and dissimulation of colonial discourse (see also Mohanty 1984). While archaeology has limitations, it can provide a different range of counter-narratives. Although they may not fully enable the subaltern to speak, such archaeological work can at least establish the presence and agency of different actors. One goal of this research is to reconstruct the story of those living beyond the imperial centers and textual records. Ceramic production, decoration, and exchange provide a window into the activities of those who constituted the social world at the imperial borderlands of Urartu, Parthia, and Rome.

Terms of Engagement

The purpose of this discussion was to develop a conceptual tool-kit with which to approach the data under analysis. Each concept has a rich, complex intellectual history, and the multiplicity offered by many terms can be both enabling and obfuscating. While I attempted to clarify my position on these terms throughout, I would like to offer a succinct summary of how I will employ these heavily laden terms in this research.

Despite the objections to hybridity enumerated above, this term will be used specifically to refer to the creative products of interactions between two or more unequal polities. This does not assume that these polities are somehow pure and bounded, but rather that the points of interaction both define and obliterate the boundaries between such entities. Entanglement refers to the specifically material mediums and consequences of cultural interactions, a meaning that derives from both Mbembe and Thomas' use of this term. Bourdieu's practice theory and Gidden's structuration theory provide the broadest models for how local actions constitute broader political and economic structures, which in turn produce a range of possible actions. However, this analysis will allow for considerably greater heterogeneity in possible agents, both in the sense of rejecting Bourdieu's argument that human motivations can be reduced to a few prime movers, and in accepting the possibility of non-human agents. Drawing on materiality studies and selective aspects of ANT, this project equates agency with efficacy rather than intentionality, and focuses on how agents perpetuate and/or change a state of affairs. Technological analysis in general and ceramics in particular provide an excellent source of data for these questions since it enables the examination of relationships, human and non-human, that produce social change and continuity. In order to understand how life in Ṣərur changed with the expansion of the imperial systems, it is necessary to consider the diversity and complexity of the players involved. In turn, elaborating on this particular instance of how political and technological factors mutually constitute each other gives us insight into the nature of relationships that continue to shape the modern world.

CHAPTER 3: Contextualizing Things: Overview of the South Caucasus from the Early Iron Age to the Roman-Parthian Period

The South Caucasus is located on the isthmus between the Black and Caspian Seas, encompassing the modern countries of Georgia, Armenia, and Azerbaijan, as well as parts of eastern Turkey and northwest Iran. Historically understudied, this region is a cultural crossroads positioned at the geographic nexus between Europe and the Middle East. Moreover, Naxçıvan, Azerbaijan, lies at the crossroads of this already intersectional area, positioned on the frontier of regions with diverse cultures that have often been studied as distinct areas of academic focus. Eastern Anatolia, northwest Iran, and the South Caucasus crash, merge, and recreate each other culturally just as plate tectonics produce the Taurus, Zagros, and Lesser Caucasus mountain chains that define the landscape. While this area has often been treated as a periphery of more well known ancient centers, increased archaeological research has demonstrated the internal complexity and regional significance of the political, social, and technological trajectory of this area. The material below is a select overview of research on this region from the Early Iron Age (EIA, 1200-800 BCE) to the Roman-Parthian period (150 BCE-50 CE). The main selection criteria was how a particular period and corpus relates to Oğlanqala. Some areas that were highly influential in one period may be less so in another and each period is organized in the manner judged to be most sensible for that context.

Early Iron Age (ca. 1200-800 BCE)

The Early Iron Age (EIA) was a politically fragmentary period in Naxçıvan and the areas surrounding it. However, different areas experienced this fragmentary period in different ways, responding to different political histories and producing different material cultures (Fig. 3.1).

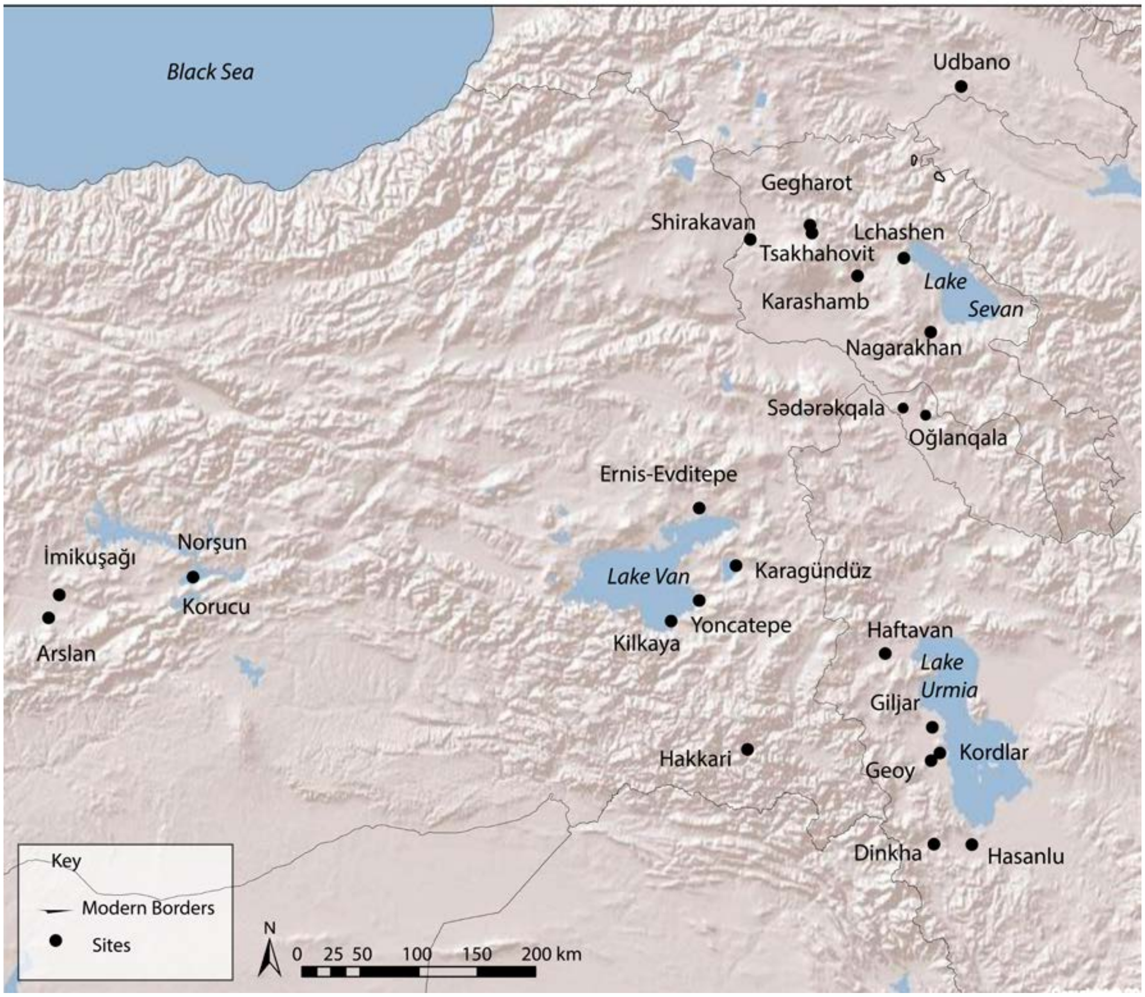

Fig. 3.1: Map of Early Iron Age sites mentioned in text

Eastern Anatolia

The EIA in Eastern Anatolia was defined by its position between imperial periods. The Late Bronze Age (LBA, 1650-1200 BCE) was characterized by the Hittite Empire, and to a lesser degree the Middle Assyrians, while the MIA was defined by Urartian rule. The EIA started with the dissolution of centralized political rule, resulting in significant changes in material culture (Hawkins 1994; Sevin 1991). At sites where the

Hittite Empire was prominent, such as Norşun Tepe, Korucu Tepe, and Arslan Tepe, EIA material lies on top of a destruction layer with almost no architectural or ceramic continuity. Architecture became simple, with no evidence of central planning. The EIA site of Imikuşağı is one of the few examples of fortress architecture. While LBA pottery was wheel made and relatively standardized, EIA pottery was handmade and irregular, though sometimes made with the slow wheel at the end of this period (Koroğlu 2003). The regional EIA pottery has characteristic horizontal incised decoration, or grooves, and is referred to as grooved or groovy pottery. Groovy pottery can be found in a broad range of wares, suggesting many different local centers of production for this regional style (Erdem 2012). While Veli Sevin (1991) has argued that groovy pottery was a significant break from the earlier Hittite forms because the *Mushki* brought it with them from the northeast, most scholars prefer an Upper Euphrates origin for this style (Bartl 2001, Güneri 2002; Müller 2003, Summers 1994). Moreover, many, if not most, scholars dispute the association of groovy pottery with an ethnicity (Müller 2003, Roaf and Schachter 2005).

Müller (2003) argues that groovy pottery displays more continuity with earlier ceramic styles than discontinuity, and that major ceramic changes only occurred in Hittite controlled areas. In fact, he argues, groovy ware harkened back to pre-Hittite local forms. Müller emphasizes that groovy pottery found around Van is quite different from groovy pottery farther southeast in Lidar, and that not all pottery with grooves is groovy pottery. The variety of styles subsumed under this type name has caused enormous confusion, including chronological confusion that will be addressed below. Roaf and Schachter

(2005) show that groovy pottery maps onto the area that will eventually be ruled by the Nairi as Urartu, and suggests that the variety evident in this pottery is the product of the many tribes and ethnicities that would later characterize Urartu.

Though political rule was decentralized in the EIA, textual sources attest to the continuation of hierarchy in the form of more local rulers. Assyrian inscriptions from Shalmaneser I (1274-1245 BCE) say Urartu consisted of eight kingdoms and texts from Tukulti-Ninurta I (1244-1208) claim that Nairi had sixty kings (Belli 2005; Grayson 1976: nos. 527, 715, 721, 760, 773, 803). Textual references to fragmentary principalities are supported by the presence of fortresses and necropoleis that have been dated to the EIA, including Ernis-Evditepe, Dilkaya, Karagündüz, Yoncatepe and Hakkari (Belli 2005; Belli and Konyar 2001, 2003; Çilingiroğlu 1991; Sevin 1999; Sevin and Kavaklı 1996). These sites have primarily been dated by ceramics and architecture. The presence of groovy pottery and more iron than bronze have caused the excavators to assert an EIA date. Veli Sevin (1999, 2003) argued that fortresses with cyclopean block masonry and repeatedly reused stone chamber tombs with multiple burials were pre-cursers to similar, but larger and more elaborated Urartian forms in the MIA. Moreover, the presence of typically Urartian red polished ware in this area may represent the earliest examples of this type, showing that this style developed in the Van region.

However, Koroğlu and Konyar (2008) argue that the Van burials in Dilkaya, Karagündüz, and Yoncatepe are actually MIA. The groovy pottery found in these graves is wheel made, not handmade as usual in the EIA, and they argue that their presence in these burials demonstrates a continuous rural tradition from the EIA to MIA rather than hints of the Urartians in the EIA. The less elaborated burials and pottery in these sites is the result of differences between larger and smaller sites, instead of a chronological difference between EIA and MIA. Sagona (2012) agrees, and points out that groovy pottery has even been found at the Urartian center of Ayanis, and in the Keban and Karakaya region groovy ware shows continuity from the LBA to the MIA, making it an unreliable marker of the EIA.

This chronological confusion results in shaky grounds for reconstructing the EIA in Eastern Anatolia. There was clearly a material shift following the decentralization of power caused by the dissolution of the Hittite Empire, which led to more localized political control in the EIA. However, it is unclear to what extent the fortress, mortuary, and ceramic styles that would later characterize the MIA began in the EIA, and to what extent these EIA forms extend into the MIA.

South Caucasus

In contrast to Eastern Anatolia following the fall of the Hittites, the South Caucasus experienced almost no material shifts from the LBA to the EIA. Rather, there was considerable continuity, with the introduction of iron producing little effect on the sociotechnical life of the region (Avetisyan et al. 2000; Smith et al. 2009:83). The lack of well-stratified sites also means that archaeologists do not have a good grasp of ceramic or site chronology in these periods (Badalyan et al 2003:154). Therefore, the LBA and EIA will be discussed together. Instead of developing in a context of imperial disintegration, the LBA/EIA in the South Caucasus grew from the inequality of nomadic kurgan culture in the MBA. Rich, massive mound burials demarcated control of the landscape, and attested to the power of those who could command the large-scale deposition of pottery, jewelry, bronze weapons, chariots, animals, and humans (Dergachev 1989; Kuftin and Field 1946; Kushnareva 1997:89-114; Rubinson 1977; Schaeffer 1944). If kurgans point to the development of extensive inequality in the MBA, then fortress architecture represents its canonization in the Late Bronze Age (LBA, 1500-1200 BCE). The transition from MBA to LBA in the South Caucasus can be seen most clearly in the settlement of Shirakavan, though it has also been documented at many other sites including Gegharot, Lchashen, and Karashamb (Avetisyan and Bobokhyan 2008:128; Smith et al. 2009:68).

Many have argued that the LBA/EIA transition can be characterized by shifts in social structure more than a technological change resulting from the introduction of iron. However, perhaps it is more accurate to note that the technological basis of the new social structure was architectural rather than metallurgical, as the new complex political culture developed around fortress centers (Lindsay et al. 2008; Lindsay and Greene 2013; Smith et al. 2009:29, 83). These stone fortresses, including Tsaghahovit, Udbano, and Nagarakhan, were constructed on high ground with architecture that followed the natural topography of the mountainous terrain (Biscione 2003; Biscione et al. 2002; Smith 2012:683; Smith et al. 2009). Although there is no evidence for permanent villages around these fortresses, their authority was projected in the surrounding environment through irrigation works, deforestation, and new mortuary and ritual architecture (Badalyan et al. 2003:152).

The LBA/EIA ceramics are referred to as the Lchashen-Mestaor Horizon 4-5, and they are roughly contemporaneous with northwestern Iran's Iron 1-2 (Avetisyan et al. 1996; Smith et al. 2009). This horizon has considerable heterogeneity, with black, grey, brown and yellowish surfaces that were typically slipped and burnished. Polishing was common for fine wares, while kitchenwares were unburnished and often smudged. Vessel shapes became flatter, wider, and more symmetrical than in previous periods. The most common decorations were incised waves, oblique lines, and hanging triangles, and zoomorphic relief decoration became more widespread (Smith et al. 2009:83).

Burials in the LBA/EIA tended to be less elaborate than the MBA kurgans, indicating that political legitimacy was no longer dependent on extravagant demonstrations of wealth, but on the new fortress institution (Badalyan et al. 2003:163; Smith 2012b). Since burials often border the valley controlled by fortresses, Adam T. Smith (2006:267) suggests that cemeteries served to demarcate political territory, making them analogous in purpose, if not form, to the MBA kurgans that also served to inscribe the landscape with political power (Smith 2006, Smith et al. 2009). Although the largest EIA necropolis in Eastern Anatolia, Ernis-Evditepe, is located on high ground, many cemeteries moved down to the lower alluvial plains in this period (Belli and Konyar 2003; Sevin 2003:187).

In the South Caucasus, this was the period in which political complexity resembling states first developed. But the uneven transition from the MBA to LBA suggests that the South Caucasus was connected by loose political networks rather than formalized power relations (Smith 2012:685). Boris Piotrovskii (in Badalyan et al.

2003:152) described this as "a period of cultural blossoming and independent development," while Philip Kohl (1993: 128) goes so far as to call this "a Late Bronze/Early Iron state formation." Based on a settlement hierarchy analysis of the fortresses in the Lake Sevan Basin, Raffaele Biscione (2003: 180) argues that this area was at most a "protostate," but clearly demonstrated a high degree of political complexity. The contemporaneous construction of twelve fortresses along the margins of Tshaghkahovit plain, with cromlech burials surrounding the larger fortress conglomeration rather than between fortresses indicates that this region was politically coordinated to maintain territorial control of the plain within the ring (Smith 2009:396, 2012). Moreover, the contemporaneous rise and fall of population densities in fortresses throughout the plain from the LBA to the MIA suggests that these sites were working and trading together as a larger political entity (Badalyan et al 2003:162). Lindsay et al. (2008) use neutron activation analysis to show that ceramics were moving between these fortresses within the Tsakhahovit plain, but not beyond, suggesting a bounded, integrated economic system. While this area lacked many of the signatures of political complexity from Mesopotamia, specifically writing and large settlements, these fortresses represent administrative and military coordination on a regional scale. Middle Assyrian texts note that while their neighbors to the north were politically fragmentary, with Shalmaneser I referring to Urartu as eight countries, and Tukulti-Ninurta I and Tiglath-pileser I referring to forty kings, those kings were able to join together in military alliances to push back the Assyrians (Grayson 1976: nos. 527, 715, 721, 760, 773, 803). The development of fortress-based polities in this period was the foundation for political complexity in the region for centuries, and a particularly significant influence on Urartian political organization (Smith 1999, 2003, 2015)

Northwestern Iran

The archaeology of northwestern Iran in the EIA is largely based upon sites in the Lake Urmia Basin, particularly Hasanlu and its neighbors. While previous analyses of this material proposed a sharp break in material culture from the LBA to the EIA, more recent reconsiderations of this material indicate that there was an extended period of local development of political complexity from ca. 1600 to 800 BCE, when Hasanlu was destroyed. Over this period, evidence for increasing political complexity includes the emergence of citadel centers, more monumental architecture, greater status differentiation in material culture attested in architecture and burials, more luxury items, and greater militarization as seen from fortifications and a proliferation of weaponry (Danti 2013:23-24).

Arguably the defining material trait of the EIA in northwestern Iran is Early Western Grey Ware (EWGW), associated with period Iron I (1250-1050 BCE) and Late Western Grey Ware (LWGW), associated with Iron II (1050-800 BCE) (Danti 2013; Young 1965).[3] While previously WGW was viewed as a strictly EIA phenomenon, Danti (2013) has shown that it began to appear in LBA levels with painted polychome "Urmia

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[3] The dates and definition of Grey Ware and interpretations of Hasanlu material more generally have changed considerably over time and have been the subject of much healthy debate. I follow the dates and periodization outlined in Michael Danti's *Hasanlu V* volume, as it offers the most recent and comprehensive synthesis of the sprawling Hasanlu corpus. However, I retain the use of the ceramic category Grey Ware, which Danti replaces with the term Burnished Monochrome Ware (BMW), in order to remain in conversation with earlier scholarship. Danti prefers BMW because much of what is called Grey Ware is actually a variety of shades, and Grey Ware is firmly associated with the IA in scholarly literature when in fact it begins in the LBA. Despite these problems, I use the established terminology so that it is clear that all of these terms are referring to the same body of archaeological material.

Ware." These LBA polychrome ceramics are found in stratified contexts in Haftavan VIB, Geoy D, and Dinka Tepe IVD, all of which overlie Middle Bronze Age Khabur ware found throughout Northern Mesopotamia, and under EWGW that stretches into the South Caucasus (Burton-Brown 1951; Edwards 1981, 1983, 1986, Rubinson 1994, 2004). Karen Rubinson (1994, 2004) argued that Urmia Ware that has generally been found out of context in the South Caucasus should be dated by the stratified Iranian material, which in turn shows closer cultural ties in the LBA than to proceeding periods. However, polychrome ceramics had predecessors in both the South Caucasus as at Kizilvank, and in Northern Mesopotamia as Khabur ware (Belli and Bahkshaliyev 2001; Danti 2013; Kushnareva 1997). The key point here is local continuity within regional stylistic traditions, which occurs with "Urmia ware" and continues with WGW. These two styles often co-occur in the same contexts (Danti 2013)

WGW is known from Hasanlu V-IV and the surrounding sites of Dinkha Tepe III-II, Haftavan Tepe III, Geoy Tepe A, Kordlar Tepe IV-II, and Giljar Tepe (Burney 1970, 1972, 1973, 1975; Burton-Brown 1951; Dorner and Lippert 1974; Dyson 1965; Lippert 1977; Muscarella 1974; Pecorella and Salvini 1984). This ware was characteristically grey, though it could range from black to greyish-buff, and was generally slipped and burnished, or at least smoothed. The fabric was generally medium grit tempered, and the surface was occasionally decorated with incising, appliqué, or patterned burnishing. The diagnostic forms for this horizon were the bridgeless spouted pouring vessel, the pedestal-base goblet, a flared rim "worm" bowl, carinated bowl with pierced lugs, incurved rim bowl, and holemouth jars with crosshatch decoration (Danti 2013: 145, 219-

224; Muscarella 1974; Young 1965). However, these type fossils were often in use for centuries (Danti 2013).

For decades, scholars viewed EWGW as a total break from the painted wares that preceded them. This break was interpreted as the product of a nearly complete population replacement, with a new people/culture bringing their pottery, architecture, and burial practices (Burton-Brown 1951, Dyson 1963; Ghirshman 1938, 1939, 1954; Young 1963). Until recently, Medvedskaya (1988) most prominently opposed this reconstruction, and claimed that there was considerable continuity between BA and IA northwestern Iran. While Medvedskaya was correct in general, her evidence was not well marshaled, and Muscarella (1994) refuted her point-by-point. While he stopped short of associating these material shifts with a particular ethnicity, he maintained that monochrome Grey Ware began abruptly in the EIA. However, the perception of rapid replacement of an earlier culture was largely the product of the timing and manner in which the material from this region was excavated and published. Recent reexaminations of E/LWGW show that it was not a homogenous block, but rather contained considerable regional and chronological variation (Danti 2013, Piller 2004). Danti (2013) argues that the Iron I/II culture requires no demic shift to explain its appearance, but rather its roots lie in local traditions that changed in different areas at different rates in different ways.

Danti (2013: 23-24) attributes the rapid increase in political complexity that occured in the LBA/EIA as secondary state formation in response to Assyria and the South Caucasus (proto-Urartu). Hasanlu was most prominent when Assyria was in a state of relative decline between the Middle and Neo-Assyrian Empires, while the increasing complexity found in the South Caucasus follows a similar time-line, but a different format than the Urmia basin. For example, while people were building fortresses in the South Caucasus, sites on the Urmia plain were located at lower elevations with fewer fortifications and clear permanent domestic settlement (Biscione et al. 2002; Dyson and Muscarella 1989; Muscarella 2006; Pecorella and Salvini 1982). By the EIA, the entire region was controlled by small, rival polities that seem to have coalesced into “proto-states” (Biscione 2003:177). At Hasanlu, the columned hall suggests gatherings of elites from diverse backgrounds more than defense (Danti 2013; see also Gopnik 2010). These regions were developing different models of political complexity in parallel, almost certainly in response to the varied environmental and cultural conditions in different areas. While these neighboring regions were influencing each other, they followed their own trajectories to political complexity.

Mortuary practices were relatively diverse in EIA northwestern Iran (Danti 2013), but individual, extramural inhumations became common (Sagona 2012). This stands in contrast to the group inhumations in stone chambers in eastern Anatolia, though there are stone chamber tombs at Dinkha Tepe (Muscarella 1974, Pizzorno 2011). The individual, extra-mural burials in Iran were similar to contemporaneous practices in the South Caucasus, where Smith et al. (2009) suggest that burials were used to mark political boundaries. Moreover, personal ornaments from Hasanlu IVB were found to have closer parallels with Artik, Armenia, and the Caucasus in general, than the rest of Iran (Rubinson and Marcus 2005).

Middle Iron Age (ca. 800-600 BCE)

During the ninth century BCE (the Middle Iron Age, MIA) many disparate polities in southeast Turkey, northwest Iran and western Armenia were united to form the Urartian Empire (Fig. 3.2). Although Oğlanqala was located at the very edge of Urartu, this powerful neighbor exerted significant political and cultural influence in the Şərur plain. The other two entrances to the Şərur plain were guarded by more characteristically Urartian fortresses at Sədərəkqala and Verachram. The fact that Oğlanqala was not characteristically Urartian was odd, and suggests complex cultural and political negotiation. Therefore, the majority of the MIA overview will be devoted to understanding the Urartian Empire in order to better assess the ways that the people at Oğlanqala were engaging with it. While there is robust scholarship on Urartu, its periphery and beyond are far less studied. I will present as much as possible on Oğlanqala's peripheral or non-Urartian neighbors, but this evidence will necessarily be more limited.

Urartian Political Structure

The term Urartu was an Assyrian name for the latter’s rivals to the north, and originally referred to a geographic region rather than a unified polity (Kroll et al. 2012:1). The Urartian term for their polity was Biainili.[4] The earliest Urartian fortresses and inscriptions are from around Lake Van, and Sevin (1999) claims that EIA burials from Karagündüz and Ernis contain polished red pottery that is characteristic of the later Urartian Empire, though Koroğlu and Konyar (2008) dispute their chronology (see

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[4] I use Assyrian names for ancient places as most of the textual evidence is Assyrian, and most of the scholarship addressing it is Assyrian focused. In order to avoid confusion, I choose consistency with broader scholarship over local toponyms.

above). Paul Zimansky (2012) argues that the founders of Urartu actually invaded the Van region from the east. Regardless of where his ancestors came from, Sarduri I is considered to be the founder of the Urartian dynasty because he was the first to build an Urartian style fortress, Tušpa, and leave his own written records (Sagona and Zimansky 2009:320). By 832 BCE, Shalmaneser III encountered king Sarduri of Urartu in his third campaign north (Kroll et al. 2012).

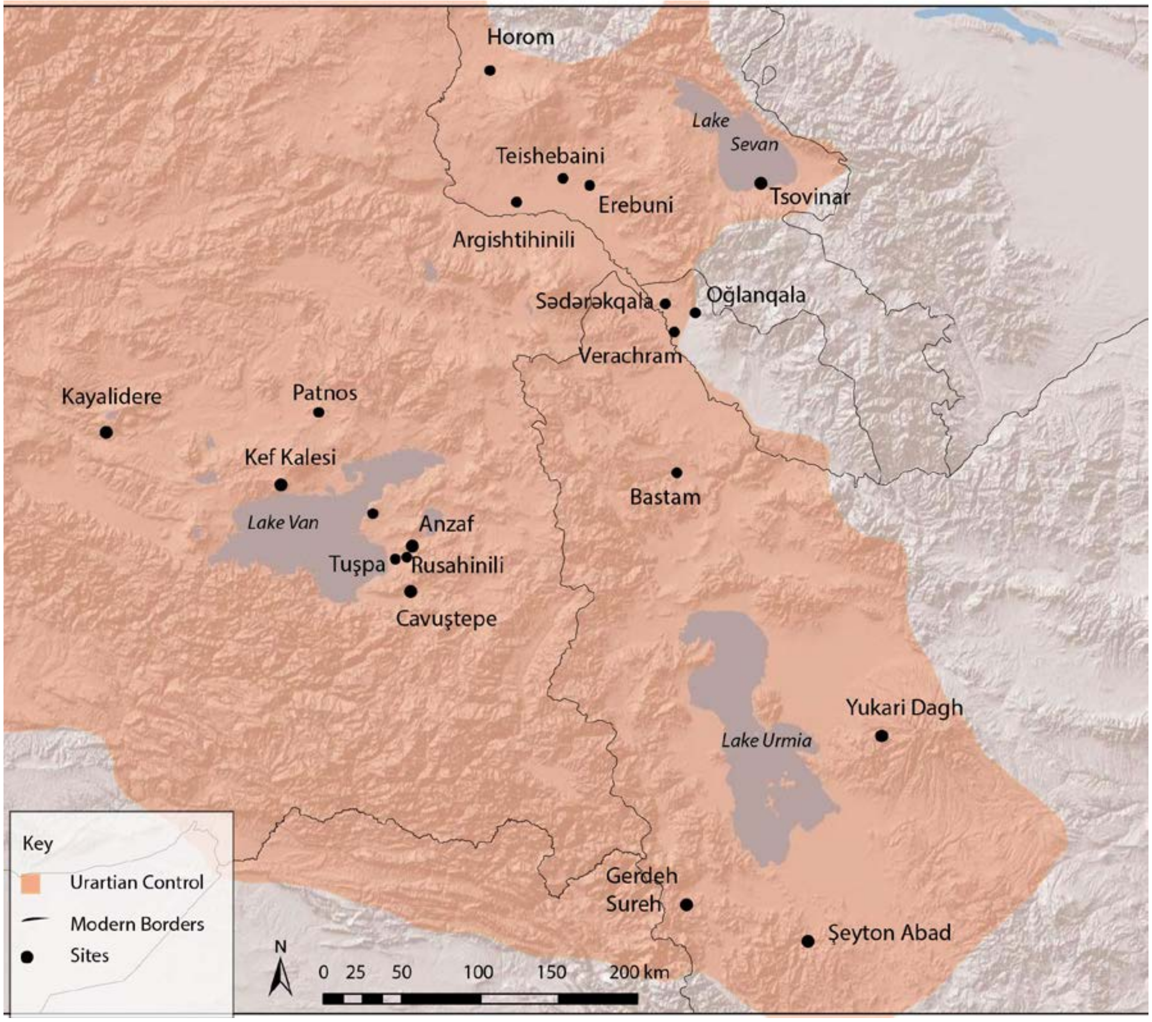

Fig. 3.2: Map of Middle Iron Age sites mentioned in text

Many scholars have suggested that the people around Lake Van created a pan-regional polity in response to Neo-Assyrian aggression as secondary state formation. However, the mechanics of this process remain obscure (Burney and Lang 1971; Diakanoff 1984; Levine 1976; Saggs 1962:114; Zimansky 1985:48-50). While Charles Burney's work provided the foundation, Paul Zimansky's work defined the contours of Urartian research in the U.S., starting with his proposal that:

> the Urartian kingship was certainly inspired by Assyrian traditions: the style and iconography of art associated with the Urartian court are clearly derivative; and in form, language, and content early royal inscriptions are close enough to Assyrian examples to insure that they are the product of deliberate imitation. The Urartian state itself seems ultimately, if unwittingly, to have been a creation of the Assyrians (Zimansky 1985:48).

While Zimansky (1985:49) acknowledged that it was possible that the Assyrian influence was overstated in the development of the Urartian state, the limited accessible research for preceding periods in the South Caucasus made this difficult to refute. While Zimansky argued that Urartu developed a distinct political system suited to the mountainous terrain (discussed below), this was viewed as a local adaptation of southern-inspired political complexity. Unique fortress architecture born of mountainous terrain was the main distinguishing trait of the Urartian imperialism, with writing, art, and the very development of an imperial state the product of Assyrian influence.

The derivative nature of Urartian imperialism became the starting point for research that followed, and exploring this premise led to a significantly improved understanding of local forms of political complexity. More recent scholarship has focused on how the Urartians drew on local forms of political complexity that developed in LBA/EIA South Caucasus and northwestern Iran, in particular the fortress as institution

(Biscione 2003; Smith 2012, 2015; Smith and Thompson 2004). As noted above, LBA fortresses in the South Caucasus were loosely organized into territorial systems of control and mutual protection, and EIA fortresses in northwestern Iran controlled settlements. While the rise of the Neo-Assyrian Empire may have encouraged the coalescence of political power, the foundations of political complexity were already present in the region.

Yet the Urartians did not acknowledge the influence of either their local predecessors or the Assyrians, and instead claimed to have brought order to the wilderness (Smith 2003; 2012). Moreover, the Urartians were doing something quite different from their local predecessors in bringing fragmentary polities under one rule, and accomplishing this required many mechanisms of control. The reconstruction of the Urartian political structure is hampered by the fact that the vast majority of our evidence comes from the sites constructed by a single king, Rusa son of Argishti (ca. 680-640 BCE), who ruled at the very end of the Urartian Empire, and it is unclear the degree to which this sample is representative of earlier periods. Moreover, previous work on Urartu has almost solely focused on large centers, meaning that we simply do not have a very clear idea of what Urartu 'looks like' archaeologically outside of these centers. The Urartian periphery will be discussed further below, and the initial presentation of Urartu will focus on those more explored centers.

Urartu appears to have been ruled by a single dynastic line with power passing from father to son (Table 3.1). However, establishing the chronology of the Urartian kings is fraught with ambiguity, since there is no Urartian kinglist to consult. The territorial expansion of the Urartian Empire can be dated through the spread of cuneiform building inscriptions.

Name of King	Name of king's father	Assyrian synchronisms
Sarduri	Lutipri	830
Išpuini	Sarduri	ca. 820
Minua	Išpuini	
Argišti	Minua	774
Sarduri	Argišti	(755/753), 743, 735
Rusa	Sarduri	719-714/3
Argišti	Rusa	709
Rusa	Argišti	673/2, 652
Sarduri		646/642
Rusa	Erimena	
Sarduri	Sarduri	

Table 3.1: Urartian dynastic chronology (based on Kroll et al. 2012)

From about 800-750 BCE, Ishpuini and Minua conquered Urmia and much of eastern Anatolia, during the period of greatest expansion (Benedict 1965; Diakonoff 1984; Kroll et al. 2012:12-15). In the following decades, Argisti I and Sarduri II expanded north, founding major centers at Erebuni and Argishtihinili in the Ararat plain (Sagona and Zimansky 2009:321-5, Smith 1999; Stronach et al. 2011). Rusa son of Argishti (ca. 680-640 BCE) was Urartu’s most energetic builder. The vast majority of archaeological material from controlled excavations comes from centers founded by him, which contributes to the coarse resolution of the Urartian archeological record. Rusa built at least five major centers, including Teishebaini, Toprakalle/Rusahinili, Ayanis, Kefkalesi, and Bastam, the last of which is the largest known Urartian site (Çilingiroğlu and Salvini 2001; Kleiss 1980; Piotrovsky 1969; Zimansky 1995). The end of the

Urartian Empire is obscure, though the empire clearly fell as a result of violence around 640 BCE, rather than by slow decline, during the early 6th century BCE (Grekyan 2009; Hellwag 2012; Kroll et al. 2012; Zimansky 1995). All the citadels Rusa built appear to have been destroyed, which contributed to their excellent preservation (Kohl and Kroll 1999).

Cuneiform script was imported from Mesopotamia, adapted to the Urartian language, and employed for propaganda and administrative purposes (Campbell 2012; Sagona and Zimansky 2009; Zimansky 1985). Although the vast majority of Urartian texts come from royal inscriptions on rock faces, bronze weapons, and bowls, there are several dozen administrative clay tablets that provide insight into the bureaucracy of the empire. These tablets have only been found at large centers, including Rusahinilli, Teishebaini, Upper Anzaf, Çavuştepe, Ayanis, and Bastam. While the corpus is too small to develop a complete picture, it is possible to show that there was an active group of scribes producing this material (Kroll 2011:8). Intriguingly, these texts suggest a system in which the king, or his proxies, was unusually involved in matters than might otherwise be considered beneath royal notice (Zimansky 1985:83). For example, one text from Teishebaini records that, “the king writes to an official entitled $^{\text{lú}}$KÙ$^{\text{meš}}$ that he has given the daughter of one cook to another cook as a wife. The king has returned her from the palace” (Zimansky 1985:81). In another text, the king “orders the return of a girl who has been abducted by a slave (or subject)” (Zimansky 1985:81). These texts show the king “adjudicating land disputes, confirming marriage contracts, confirming the return of fugitives, distributing certain commodities, and allocating small numbers of livestock" (Zimansky 1985:83).

However, it appears that the king's royal authority was often employed without the king himself being personally involved. His title, rather than his name was usually used, and often the tablet was sealed by $^{\text{lú}}$A.NIN rather than the king. Thousands of bullae excavated in a single context at Bastam demonstrate that many copies of the king's seal were in use at the same time, which indicates that the authority of the king was deployed by lower levels of the bureaucracy. However, these types of administrative documents are limited to very large sites. There is no evidence of such texts at other significant sites such as Argishtihinili, Erebuni, Kayalidere, and Patnos. This could indicate that royal administration was not enacted in the same way in all of these areas (Zimansky 1985:84).

The actual administrative structure of the Urartian Empire is obscure. Though the extant clay tablets refer to several official titles, the duties and powers associated with these titles are often unclear, especially since everything is done on the authority of the king. There is a group of actors with the title $^{\text{lú}}$A. ZUM.LI, who often bear names associated with the royal family. These people occasionally issued decrees in the name of the king, and were the only people besides the king with cuneiform on their seals (Kroll et al. 2012:21). The $^{\text{lú}}$EN. NAM, or provincial governor, was a somewhat more accessible title, since both Assyrian and Urartian sources refer to their functions. Most references to these governors in both Assyrian and Urartian texts relate to their military function, though they were also responsible for the local administration of their provinces. The

Urartian military was based on contingents provided by these governors, which the governors also led into battle (Zimansky 1985:90). These governors also occasionally led troops into battle independently of the king (Kroll et al. 2012:21). Zimansky suggests that the power of these governors was checked by their large numbers, which made it difficult for them to band together, and by the close involvement of royal bureaucracy in major centers that may have challenged royal rule (Zimansky 1985:94). While these provinces are generally believed to consist of a single plain or valley surrounded by mountains, the number of provinces and the nature of their development within the empire is unclear (Kroll et al. 2012:21). However, it is likely that the fragmented topography of the region and the existence of provincial militias allowed the governors to retain considerable autonomy in their own realm. The Urartian empire was not hegemonic according to D'Altroy's (1992) system, but rather more like a network controlling particular nodes (Liverani 1988).

Urartian Material Culture

The mechanisms of Urartian control have been described as a “state assemblage,” wherein distinctive fortress architecture, ceramics, and metal work were used to signal centralized authority in a mountainous landscape (Ayvazian 2012; Biscione 2003; Çilingiroğlu 2004; Koroğlu and Konyar 2011; Kroll et al. 2012; Salvini 2004, 2011; Smith 2003; Smith and Thompson 2004; Zimansky 1985, 1995, 2011, 2012). The Urartian Empire also deployed political-religious spectacle, landscape manipulation, deportation, forced labor, public works, and military might to maintain control over their subjects (Belli 1999; Biscione 2003; Çifci and Greaves 2013; Magee 2008; Smith 2003; Zimansky 2012).

Polished red ware, also known as palace ware or Topprakale ware, is the defining ceramic type for the Urartian state. Brown slipped wares were, in fact, more common, and massive pithoi were also characteristic. The Urartian capital Ayanis provides a model ceramic assemblage from Urartu (Çilingiroğlu and Salvini 2001). The main ceramic classes at the site are brown slipped wares (dominant), red polished wares (17%), and massive pithoi with cuneiform volume measurements (Kobze et al. 2001). A similar ceramic assemblage was found at Bastam, which was incorporated into Urartu in the 7th century BCE (Kleiss 1980, Kroll 1976; Kroll et al. 2012). These polished red and brown wares were typically found at Urartian centers, and in different areas either partially replaced or co-existed with the pre-existing grey wares in northwest Iran, Lchashen-Metsamor wares in Armenia, and groovy pottery in Eastern Anatolia (Avetisyan and Bobokhyan 2008, 2012; Erdem 2012; Müller 2003; Roaf and Schachter 2005; Smith et al. 2009; Zimansky 1995). In addition, local pottery traditions were combined with Urartian technologies and/or styles to create entirely novel vessels at centers such as Teishebaini and Erebuni (Avetisyan and Bobokhyan 2012:378; Ter-Martirosov 2012). In more peripheral sites such as Horom, ceramics changed less following conquest, with excavators classifying only 1% of the ceramics as red slipped Urartian wares (Badaljan et al. 1994; Kohl and Kroll 1999:253-4).

In many ways, the Urartians continued applying the same settlement patterns used in previous periods, in which a fortress on high ground overlooked people living below.

Only a few Urartian centers, including Tesheibaini, Bastam, Argishtihinili, and Ayanis had permanent settlements outside their walls. Yet, the settlement around Ayanis was not walled, unlike other less planned settlements at sites such as Argishtihinili, Upper Anzaf, and Kef Kalesi. The highly variant nature of Urartian settlement layouts suggests a considerable degree of local autonomy in this genre, unlike the rigidly standardized fortress forms (Stone and Zimansky 2004:242; Stone 2012). Moreover, the fact that permanent settlements tend to be associated with later sites could indicate that royal involvement in this sphere was mainly pursued by Rusa son of Argishti (Zimansky 2012).

As the majority of the Urartian population was likely transhumant pastoralists, their settlements left a minimal archaeological trace. This issue was exacerbated by centuries of farming and Soviet land amelioration polices in recent decades. Moreover, since Urartian sites have been generally dated by elite goods, identifying non-elite sites is difficult. The continuation of EIA ceramic and architectural forms into the MIA makes these periods difficult to differentiate in the absence of characteristic Urartian luxury materials. Zimansky (1985: 46) argued that the Urartian defensive network was organized to, “protect the populations of arable lands, rather than to prevent invaders from securing valuable resources." However, there was considerable variability in the way that each agricultural center was defended, since in some areas the population was defended in a major fortress center, and in others the population would disperse to smaller centers (Luckenbill 1926:163, 166; Zimansky 1985:46).

The Urartians, however, did not simply continue employing the same old settlement patterns, but rather manipulated that model to create a unified polity. As mentioned above, the South Caucasus in the EIA was characterized by fortresses that ruled over relatively dispersed populations. However, while EIA fortresses tended to be located at high altitudes and follow the local topography, Urartian fortresses tended to be located at lower altitudes, and were built with geometric precision on bedrock (Burney and Lawson 1960; Çilingiroğlu 2004; Jakubiak 2005). These massive structures, with cyclopean block walls several meters thick, were defensively formidable. Moreover, their location at lower altitudes overlooking roads and rivers would have enabled the administrative elite to more closely monitor the population and communicate with each other. Additionally, the Urartians razed previous EIA fortresses, built on top of them, and then claimed to have brought civilization to the wilderness (Badalyan et al. 1992, 1993; Smith 2003:168). When building a new fortress at places such as Metsamor and Horom, Urartians expended considerable effort scraping previous constructions down to bedrock, which created a firm physical and symbolic foundation for Urartian dominance (Smith 2003).

The Urartian Frontier and Beyond

Reconstructions of Urartian imperialism have focused on large centers and have neglected how smaller and peripheral sites participated in this system (Burney and Lang 1971; Çilingiroğlu and Salvini 2001; Kleiss 1980; Piotrovski 1969; Smith 1999; Stronach et al. 2010; Zimansky 1995). Building on the research of Urartu’s internal operations, this project investigates the frontier dynamics of this expanding empire.

Texts and inscriptions refer to buffer states that were situated between Assyria and Urartu, and who maintained relations with both (Kessler 1995; Lanfranchi 1995;

Radner 2012; Salvini 1995). These states include Šubria, Kumme, Ukku, and Musasir. However, these kingdoms have not been definitively located, and few sites along the southern periphery have been excavated (though perhaps the ongoing Rowanduz Archaeological Project in Iraqi Kurdistan will change this). These border polities had long served as pawns in proxy wars between Assyria and Urartu, with both sides demanding loyalty from the same kings, and punishing them harshly when their loyalty wavered. In response to what appears to have been an admonishment by Sargon II for allowing Rusa to enter Haldi's Shrine, the king of the soon to be destroyed city of Musasir asks, "when the king of Assyria came here,/ could I hold him back? He did what he did./ So how could I hold back this one!" (Lafranchi and Parpola 1990: no. 147). Musasir was the location of the temple of Haldi, the head of the Urartian pantheon, and where the king of Urartu was crowned (Radner 2012). When Sargon II sacked Musasir, he presented it as the end of the Urartian Empire, though Urartu saw its greatest period of construction in the years following this loss (Kroll 2012; Luckenbill 1927: no. 175; Zimansky 1995). Kumme also had an important temple to the storm god Teššub, and Ṣubria is where both Urartian and Assryian refugees fled from their states, probably because of a religious sanctuary tradition (Deszö 2006; Radner 2012). While being a religious center was certainly not a guarantee of continued autonomy, it seems to have helped these buffer states.

The Urmia Basin has been surveyed extensively, but the focus on Urartu has resulted in a poor understanding of contemporary non-Urartian material (Biscione 2012; Kleiss and Hauptmann 1976; Kleiss and Kroll 1992; Kleiss 1972; Kroll 1972, 1976, 1977). Yukari Dagh, Şeyton Abad, and Gerdeh Sureh were identified as non-Urartian MIA sites because they did not contain characteristically Urartian architecture and ceramics. These sites had grey and buff wares with some finer brown and red slipped wares, and none of the characteristic Urartian polished wares (Kleiss et al. 1976; Kleiss and Kroll 1979; Kleiss and Kroll 1992; Kroll 1976, 1977). However, defining non-Urartian sites by the absence of definitively Urartian material runs the risk of missing the full range of material possibly present in Urartian sites that are simply not centers of imperial rule. Moreover, defining sites as Urartian or non-Urartian ignores the range of possible political and cultural engagements these sites may have had with the state. Finally, the focus on defining Urartian material culture has resulted in vague glosses of non-Urartian material. All of this is completely understandable for surveys, but it is unfortunate that none of these "non-Urartian" sites have since been excavated or published.

The northern periphery has several inscriptions boasting of Urartian conquest, but not as much clearly Urartian material as might be expected (Kleiss 1992; Köroğlu 2005). Besides the inscriptions, the most obvious Urartian material imprint was the construction of a characteristically Urartian fortress at Horom with rubble filled walls and regularly placed buttresses. But it was built among the ruins of previous structures, when at other centers these were razed to the ground. Indeed, Horom lacks many features of the typical "state assemblage." There are no cuneiform texts, though cuneiform numerical characters are found on pithoi. After Horom’s conquest, EIA grey wares decreased and MIA buff/brown wares increased, but just 1% of the ceramics are Urartian red slipped ware

(Kohl and Kroll 1999). Though the common wares show continuity with previous traditions, there are more wheel-made materials, possibly indicating an increase in specialization on the local scale and the transfer of skill from luxury production to more common production (Badaljan et al. 1993, 1994). Urartian vessel forms were used, but local metallurgical traditions continued in the form of Caucasian fibulae (Kohl and Kroll 1999). There are textual references to a tribal confederation called the Etiuni that resisted Urartu in the northeast, in the general vicinity of Horom, but no identifed archaeological correlates (Biscione et al. 2002). Horom demonstrates that there was a range in the type and degree of control that Urartu have exerted over its vassals.

There are two Urartian rock cut inscriptions in Naxçıvan, at Ilandağ and Fərhat Evi, of which only the former is legible (Bahkshaliyev and Marro 2009:58; Ristvet et al. 2012a:356; Salvini 1998). This inscription records the victory of Ishpuini and Menua in ca. 820-810 BCE over the lands of Arsinie and Ania, in honor of which the victors offered sacrifices to Haldi (Hmayakan et al. 1996; Ristvet 2012a; Salvini 1998). While these rock cut inscriptions are evidence of military campaigns in Naxçıvan, they are not evidence of occupation in the absense of significant Urartian material culture.

In some ways, the Urartian Empire appears to have functioned as a confederacy, with fortress polities coordinating for administration and mutual defense. The fact that different parts of the empire were cut off from each other for large portions of the year would make a certain degree of autonomy necessary, and the segemented organization resisted Assyrian conquest. However, Urartu developed and spread through conquest. Razed EIA fortress confirm the many inscriptions claiming domination of different regions. The fortresses, storage jars, polished red wares, and metal work did comprise a remarkably consistent "state" assemblage (Zimansky 1995). But even the relatively rare settlements outside of the larger fortress walls vary considerably, though they represent a narrow time frame. More peripheral sites such as Horom and Tsovinar are even less uniform, and identifying a site as Urartian or non-Urartian becomes more complex. Different types of frontier dynamics were likely at work in different parts of the Urartian frontier, and only closer examination of the different borderland processes at a range of periperal sites will clarify the the situation.

Late Iron Age-Early Hellenistic (ca. 600-200 BCE)

Late Iron Age/Achaemenid

After the fall of Urartu and Assyria, the next empire to incorporate territory in the South Caucasus was the Achaemenid Empire (Fig. 3.3). However, the archaeological presence of the Achaemenid Empire is notoriously difficult to observe as a result of several factors, including the prominence of perishable materials, such as vellum and textiles, and a willingness to adopt local symbols of power in conquered regions (Briant 2002; Dandamayev 1999; Dusinberre 2003; Khatchdourian 2016). But there were material markers from the Persian heartland that appear throughout the empire, including an extensive network of royal roads, distinctive metal and ceramic carinated bowls, cylinder seals, and characteristic architecture with bell-shaped column bases and stepped platforms (Dusinberre 1999, 2003; Knauss 2006; Lordkipanidze 2000; Potts et al. 2009; Stern 1982; Summers 1993; Sumner 1986). The South Caucasus lay mostly within the satrapy of Armenia, with the east possibly falling under the purview of Media. Eastern

Georgia existed as a separate region the Greeks called Colchis (Braud 1994; Khatchadourian 2008, 2012, 2016).

Survey evidence suggests a settlement policy that was focused on the northern periphery of the Achaemenid Empire, beyond the settlements of the old Urartian heartland. In a survey north of Mt. Aragats, no evidence for occupation in the EIA or MIA was found, but six LBA fortresses were reoccupied in the Achaemenid Period (Avetisyan et al. 2000; Smith et al. 2009; Khatchadourian 2008).

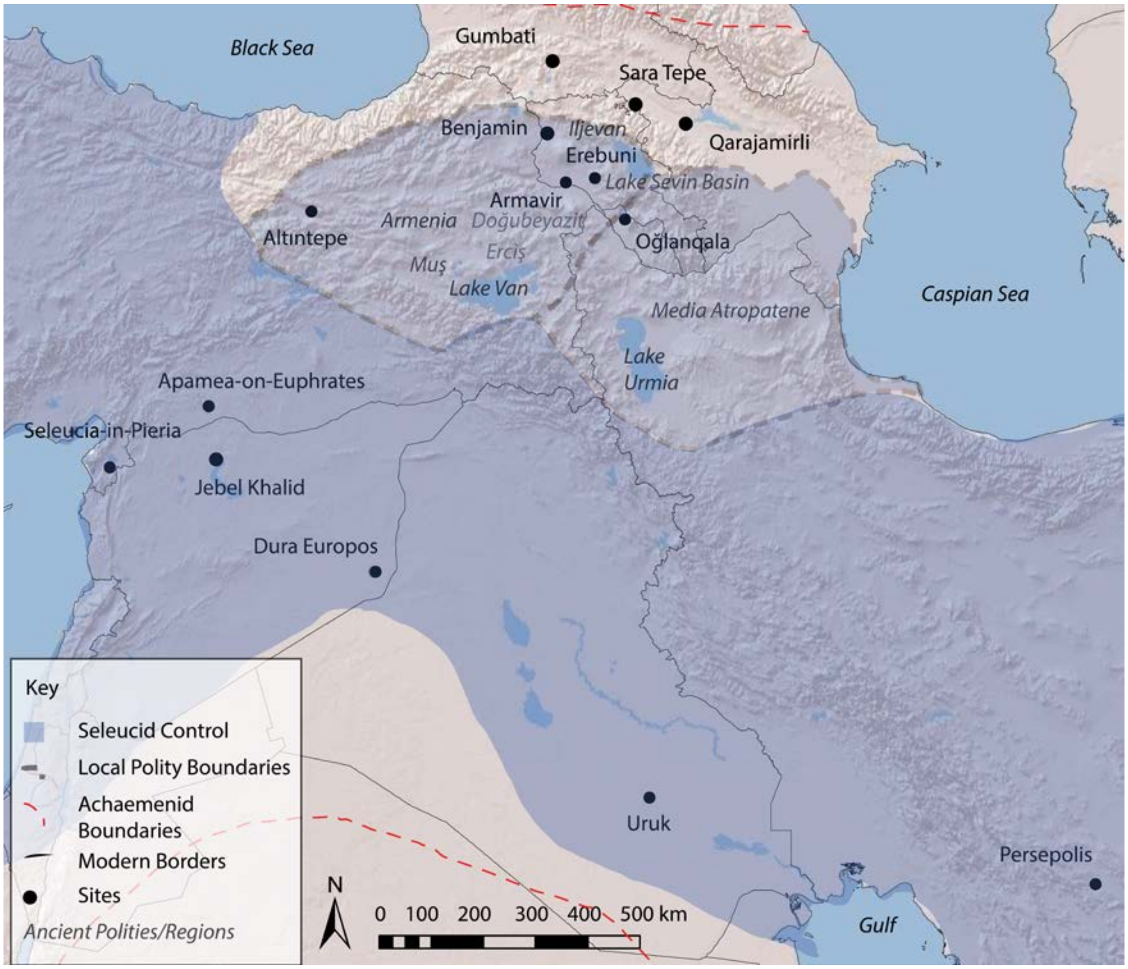

Fig. 3.3: Map of Late Iron Age and Seleucid Period sites mentioned in text

A survey of the Ijevan region also reveals a sharp spike in settlement during the LIA, with nineteen active fortresses, ten of which were new settlements (Khatchadourian 2008:365-368). The northern periphery also contains new sites that are more characteristically Achaemenid. Gumbati, Sara Tepe, Qarajamirli, and Benjamin all include palatial structures built on previously unoccupied low ground (Babaev et al. 2007; Kohl and Kroll 1999; Knauss 2001, 2005, 2006; Zardarian and Akopian 1994). These structures have Achaemenid style bell-shaped fluted column bases, locally made ceramics in Persian shapes, and some imported material from the imperial core. Although there are regional influences on this architecture, the style is recognizably Achaemenid. These structures likely housed local Persian officials, and there are no clearer examples of Achaemenid architecture known outside of the Persian heartland.

Kohl and Kroll (1999) suggest that Benjamin was built on a plain because defense was essentially unnecessary under *Pax Persica*. However, this ignores the presence of the Scythians, who Darius campaigned against in 513 BCE. Knauss (2006) suggests that these sites were constructed in the years following this campaign. This indicates that Achaemenid style influenced structures were built along the frontier, possibly to project Achaemenid dominance into contentious space. Moreover, this region is north of the Urartian fortress range, meaning that the landscape was less encumbered by previous architectural demonstrations of power. This condition allowed the Achaemenids to symbolically inscribe the area with Persian expressions of dominance.

In contrast, areas that were surveyed further south show either continuous settlement or outmigration. The Lake Urmia region, the Erciş region, and the

Doğubeyazit region all appear to have seen a drop in their populations during the Achaemenid Period (Biscione et al. 2002; Khatchadourian 2008, 2016; Marro and Özfirat 2003, 2004, 2005). All of these regions were most densely populated during the previous Urartian Period, and the few sites that continued were mostly older settlements that had been present since the Bronze Age. Surveys of the southern Lake Sevin basin show a relatively constant number of sites during the MIA/LIA, but a lack of settlement continuity suggests a high degree of mobility (Biscione et al. 2002). The Muş region also had a fairly constant population during the MIA/LIA, during which the abandonment of Urartian constructions and the creation of new settlements characterized changes in settlement patterns (Rothman 2004; Rothman and Kobze 1997). These areas are located in the old Urartian heartland and were already extensively inscribed with fortresses. The majority of these fortresses were not reoccupied during the Achaemenid Period.

However, the satrapal capitals of Altıntepe and Erebuni were prominent exceptions. Both of these were Urartian centers that the Achaemenids appropriated for their own purposes. Altıntepe and Erebuni were both rebuilt with a Persian style columned hall. The hall at Erebuni was built on a pre-existing Urartian hall and contains more elements from its predecessor (Khatchadourian 2007, 2008; Stronach 2012). Rather than attempting to establish the direction of influence, it is more useful to view the columned hall as a shared architectural symbol of power (Gopnik 2010; Khatchadorian 2008; Summers 1993; Ter-Matirossov 2001). These sites suggest that the Achaemenids selectively repurposed Urartian forms in satrapal centers where they were able to control the deployment of symbolic expressions of dominance.

Early Hellenistic/Seleucid Period (330-200 BCE)

Following the conquest and then early death of Alexander III of Macedon (ca. 334-323 BCE), the Achaemenid Empire was divided among Alexander's generals (Sherman-White and Khurt 1993). Large portions of the South Caucasus fell under the sway of the Seleucids, though their control of the region was always tenuous, even nominal (Fig. 3.8). The early Seleucid Empire commanded the construction of new settlements throughout their realm, including Seleucia-in-Pieria, Apamean-on-the-Euphrates, Jebel Khalid, Dura Europos, and Ai Khanoum, as well as the reconstruction and re-branding of pre-existing cities such as Uruk (Hannestad 2012). Many scholars have attempted to delineate and measure the "Greek" or "Oriental" characteristics of Seleucid settlements, but this obscures the way that syncretism was creating novel, hybrid ideas and forms (Langin-Hooper 2007, 2013; Mairs 2013; Stavrianopoulou 2013).

In the South Caucasus, Alexander permitted Media Atropatene to remain under the rule of the Persian satrap Atropates (Strabo 11.13), a policy that continued under the diadochi. The Orontids, who had also served as satraps of Armenia under the Achaemenids, retained control of their realm but fell under the authority of the Seleucids (Khatchdourian 2007). However, the borders of these realms were likely more flexible and permeable than Roman authors would prefer. Reoccupation of Urartian sites was common in the South Caucasus, especially for capital cities. Armavir, the first Orontid capital in the 4th century BCE, was founded on the remains of the Urartian city of Argishtihinili. In the initial reoccupation, the fortification walls, citadel, and living quarters were all repaired and reused (Zardarian and Akopian 1994). However, there is also a major Urartian complex on the site that was not reoccupied, but rather used as a cemetery in what became a common practice during this period (Khatchadourian 2007).

According to Strabo (11.14), when the Orontid king Xerxes refused to pay tribute, the Seleucid king Antiochus III besieged Artashat and forced Xerxes to marry his sister, who promptly murdered her husband. When replacing Xerxes with a more compliant Orontid did not result in stability, Antiochus III supported the uprising of Artaxias I. While the coup was successful in placing the Artaxiads in power for centuries, it did not serve the Seleucids well since Artaxias used the growing power of Rome as leverage to secede (Lang 1983:508-512). Regardless of the details of internecine strife, the Artaxiads replaced the Orontids in the late-third to early-second century BCE (Khachadorian 2007). This was a period of "strong men," military conflict, nebulous borders and contingent alliances.

Roman-Parthian Period (ca. 200 BCE-100 CE)

Following the fall of the Achaemenids and the Seleucids, two mighty empires established themselves in the Near East and South Caucasus: Parthia and Rome (Fig. 3.4). As these great powers fought each other for dominance, vassal kingdoms became the proxies, pawns, and key players. The kingdoms of the South Caucasus became one of the most important battlegrounds for imperial supremacy.

However, before proceeding, a note of caution is particularly warranted for this period. Reconstructions of the past are necessarily intertwined with conditions in the present, and the political conditions of the South Caucasus make the period in question particularly fraught (Dudwick 1990; Khatchadourian 2008; Kohl and Tsetskhladze 1995;

Shnirelman 1995; 2001). Furthermore, the abundant historiographical evidence for the ancient Armenian kingdom in Roman sources can create an artificial sense of certainty. In fact, these sources can be remarkably contradictory, with accounts firmly embedded in the authors' needs and often separated from their subjects by time and distance (cf accounts of Pompey in the Caucasus: Florus 1.40.21; Velleius Paterculus 2.40.1; Fabian 2014). Roman textual sources must be approached critically, and the historiography of the South Caucasus has not received the same attention as other parts of the Classical world, making it more difficult to parse events (Badalyan et al. 2009:33, 40-41; Braund 1986:32; Dabrowa 1989:67; Dignas and Winter 2007; Patterson 2013).

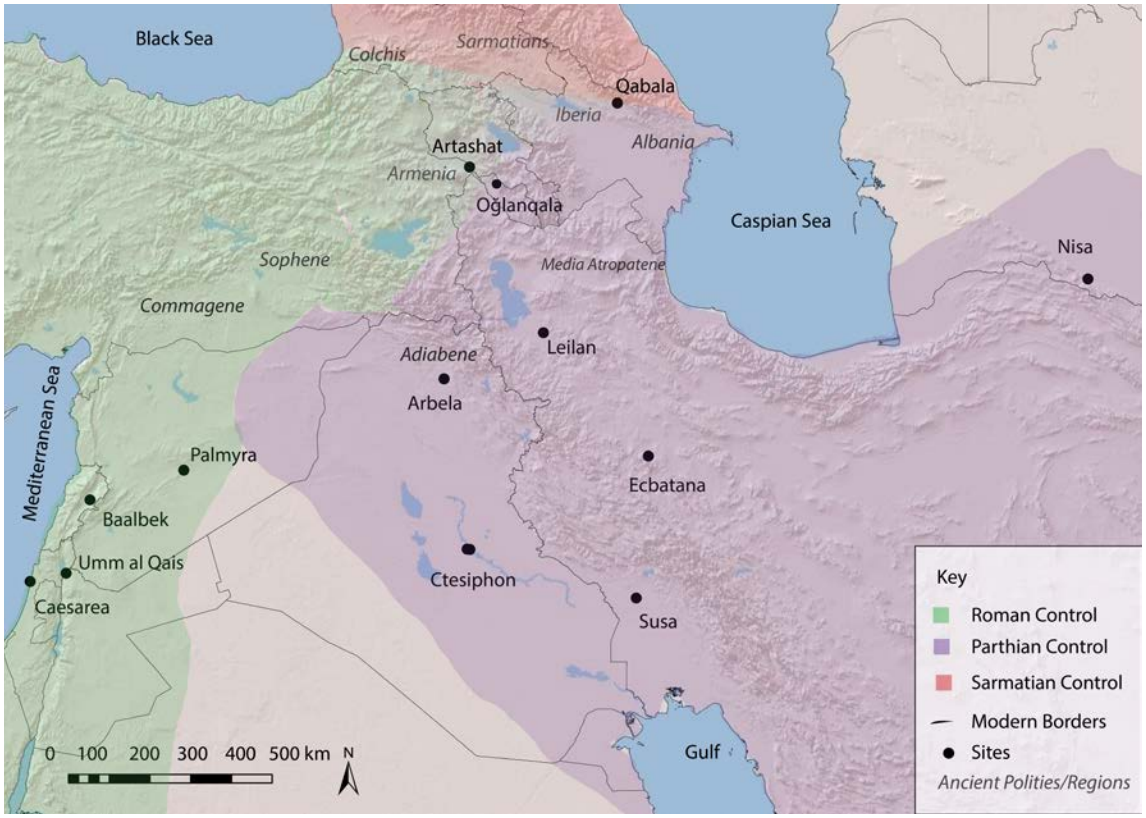

Fig. 3.4: Map of Roman-Parthian Period sites mentioned in text

The contemporary polities of Media Atropatene, Albania, Iberia, and Colchis are even less well documented than Artaxiad Armenia, though they were critical players in regional politics, and non-Roman textual sources are rare (Babayev 2001; Bäbler 2005; Licheli 2001; Patterson 2002; Schottky 1998). The brief historical outline offered is necessarily simplified and incomplete, but provides some requisite orientation.

Parthia (Arsacids)[5] *in the West*

The Arsacids rose to power along the southeastern coast of the Caspian in the mid-third century BCE when they led the Parni in overthrowing descendants of the Achaemenid satraps. Over the next century they defended their territory from Seleucid incursions, and became a truly expansionist imperial power with the rise of Mithiridates I (Bivar 2008; Mayor 2011). By the end of Mithridates I's rule in 138/7 BCE, the Parthians controlled the territory from the Persian Gulf to the Indus, including Media in central and western Iran (Bivar 2008; Hauser 2012). Over the next few decades, the Seleucids fell and Parthia gained control of Babylon, Assyria (Adiabene) and the Syrian Euphrates. The capital shifted west along with territorial expansion, from Nisa, Turkmenistan to Ecbatana, western Iran and finally to Ctesiphon along the Tigris in Iraq, the latter of which was across the river from the Seleucid capital of Seleucia-on-the-Tigris (Hauser 2012).

Following these conquests, the Parthian king took the title "king of kings." Similar to the Achaemenids and the Seleucids, the cohesion of the Partian Empire is a subject of debate among scholars (Hauser 2012). Like their imperial predecessors, the

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[5] Parthia was the Roman term for their eastern rival. Arsacid was the dynastic name that rulers of this Iranian empire used for themselves. These will be used interchangeably in this overview.

Parthians tended to leave existing political systems and symbols of power largely in place, co-opting them to claim authority. While local rulers were often replaced with members of the Arsacid family, the governing structures would otherwise remain more or less unchanged. These local rulers held the title of "king" along with certain rights and responsibilities in the service of the "king of kings" (Hauser 2005, 2012; Keall 1994). Among their rights, some local rulers were permitted to mint currency. The stylistic typology and economic systems involved with Arsacid coinage is a vast and contentious topic (Alram 1987; de Callatay 1994; Sellwood 1980). While the local minting of coins has traditionally been viewed as evidence for decentralizion of Parthian power, an alternate interpretation views currency production as another responsibility that does not imply local independence (Hauser 2012).

By this time, Rome had replaced the Seleucids as Parthia's western rival, and in 96 BCE Arsacid and Roman representatives met on the Euphrates and agreed that it would serve as the border between their domains. This arrangement was successful until Crassus led an invasion that resulted in a humiliating defeat of Roman troops at Carrhae in 53 BCE (Frendo 2003). This defeat was followed by approximately one hundred years of conflict, including involvement in civil wars, disputed successions, and military incursions (Hauser 2012). These conflicts were so regular that the eastern Roman army reorganized in response, including the addition of heavy cavalry. The Parthians were renowned for their mounted archers clad in heavy iron armor (Hauser 2012; Mielczarek 1993). Although earlier scholarship (Koshelenko and Pilipko 1994; Wolski 1965) claimed that the Parthia had no standing army, Stefan Hauser (2006) has more recently argued that they had standing army units strategically located in garrisons along the border. When necessary, the Parthian king could call upon territorial armies of reservists, but this was only used in times of crisis.

Nisa was the first capital of the Arsacids and has been subject to large-scale excavation since the 1930s. As a result, it provides some of the best evidence of the early to middle Arsacid period. The monumental "Square House" contains large amounts of Hellenistic material with some Central Asian elements, including ivory rhyta with Greek mythological scenes and deities, gilded figurines of Athena and Eros, as well as marble statues of Aphrodite, Artemis, and Dionysis (Invernizzi 1999; Hauser 2012; Masson and Pugachenkova 1982; Pilipko 2008). The "Round Hall" was decorated with painted larger than life size clay sculptures and has parallels with palatial structures in Uzbekistan (Invernizzi 2007; Pugachenkova 1971). Nisa demonstrates the combination of Hellenistic and Central Asian elements that characterizes much of the earlier Parthian material.

However, Parthian material culture was defined by heterogeneity, with major differences in the architecture, mortuary practices, reliefs, and pottery in each region, and between large Hellenized cities and more rural areas in the same regions (Hauser 2012). Pottery in particular shows high degrees of regionalism, with Haerinck dividing Parthian pottery into nine different areas, each of which has several phases (Adachi 2005; Haerinck 1983). In highly Hellenized cities such as Susa and Seleucia, Hellenistic forms such as fish plates and the two handled amphora were made with typically Arsacid blue-green glaze. Eggshell ware was common for small jars in Babylonia, but was absent in Adiabene. Roman forms are extremely rare (Hauser 2012). Since the Parthians tended to co-opt local cultural norms to assert their authority, their imperial influence is simply less archaeology visible than the contemporary Roman Empire. According to Parker's (2006) borderland scheme, the Parthians created new political borders while existing cultural and demographic frontiers remained in place or only shifted slowly.

In Iranian Azerbaijan, Haerinck (1983:120-40; 1979) identifies a painted pottery style that is distantly related to the late Achaemenid/Early Seleucid "Triangle Ware" that he calls "Ardabil Ware" (Dyson 1999; Haerinck 1978; Stronach et al. 1979). This style is characterized by monochrome red or brown painted geometric and occasionally faunal designs on a cream background. There is buff, brown, and orange burnished pottery as well, but this is less well understood. Theriomorphic vessels are also relatively common, particularly in mortuary contexts. Finally, burying individuals in massive pithoi became a widespread practice starting in the first century BCE and continued through the second century CE, though it was not necessarily associated with Parthian imperialism (Haerinck 1983:125-126, 132 fig. 21).

Rome in the East

After the Romans defeated the Seleucids at the Battle of Magnesia in 190 BCE, both parties signed the Treaty of Apamea 188 BCE. This treaty formally established the ostensible independence of kingdoms that had previously been vassals of the Seleucid Empire, although this independence was granted to these kingdoms by Rome as part of their protectorate (Bivar 1983; McDonald 1967; Sartre 2005). States that fell under this treaty included Armenia, Sophene, Commagene, Judea, the Nabatean Kingdom, and generally most of the Near East that was not under Parthian rule. Following this, Rome had an extensive diplomatic relationship with nearly every kingdom in the Hellenistic East. Roman officials traveled east on diplomatic missions, and most eastern kingdoms had embassies in Rome. Dynasts would seek the support of the Roman senate in disputes over inheriting the right to rule, and Rome developed opportunities to intervene militarily to support their allies (Sartre 2005). However, for the next century, Rome's involvement in the Near East was primarily diplomatic rather than military.

Rome's next great military entanglement in the east was with Mithridates VI of Pontus (Mithradates the Great) over control of Anatolia (De Souza 2002; Sarte 2005; Troster 2009). The Mithridatic Wars (88-63 BCE) concluded with a Roman victory and the incorporation of Pontus and Syria into Rome, as well as the acquisition of Armenia as a client kingdom (Bellemore 1999; Sartre 2005). However, this conquest was followed by decades of Roman civil war that did not end until Octavian claimed power in 31 BCE. Caesar, Antony, Cleopatra, and Octavian all marched armies through the region, and demanded resources to fund their military needs (Butcher 2003; Fischer-Genz 2012). Client kingdoms were mostly left to their own devices, and local monarchs were understood as useful in negotiating with large, often nomadic populations in Syria and the Caucasus (Gregoratti 2013; Taxidor 1984). Once Octavian established his dominance as Augustus, he initially left the majority of local governments in place, but over time absorbed them into Roman provinces.

The *polis* was the basic unit of Roman government in the Near East. Cities could mint silver coins, and taxes that had previously been paid to Hellenistic dynasts went to Rome. Only ruling families received the honor of Roman citizenship, with the vast majority of cities, practically all rural populations, and all slaves disenfranchised. The first two centuries of Roman rule saw a burst of monumental construction in the form of baths, theaters, hippodromes, temples, and long colonnaded streets (Fischer-Genz 2012). In contrast to Parthian material culture, Roman architecture and associated material is clearly recognizable in the archaeological record at sites such as Palmyra, Umm al-Qais, Baalbek, Caesarea, even if they display regional variation (Beebe 1983; Kropp 2013; Millar 1993; A.M. Smith 2013). Rome exerted a far greater hegemonic influence over their territories than any other empire in this study.

The most common ceramic style associated with Roman influence in the Near East was eastern red slipped ware. Antecedents of this glossy red slipped table ware had been produced in the Near East at least since the fourth century BCE, and the forms produced in eastern centers often parallel Italian terra sigillata around the first century BCE and remained popular for the next several centuries (Hayes 1997; Mlynarczyk 2002; Regev 2007; Roberts 1997). The expansion of red slipped wares has been called the "Augustan tableware boom," representing "a fairly unique phase of empire-wide cultural integration" (Poblome et al. 2007: 222 quoted in Bes 2015: 147-148). Terra sigillata was mass-produced on an industrial scale in many regional centers, including Ephesos, Pegamon, Cyprus, and Northern Syria, and Italy (Bes 2015; Gunnewag et al. 1983; Poblome et al. 2002). Mold thrown decorations and potters stamps were common motifs, and the name loosely translates to "clay with little figures," but a range of glossy red slipped pottery is considered terra sigillata (Boardman 1993). These include five eastern wares with the actual name sigillata: Eastern Sigillata A (ESA), Eastern Sigillata B

(ESB), Eastern Sigillata C (ESC), Eastern Sigillata D (ESD), and Italian Sigillata (ITS), as well as three later varieties called African Red Slip Ware (ARSW), Cypriot Red Slip Ware/Late Roman D (LRD), and Phocaean Red Slip Ware/Late Roman C (LRC) (Bes 2015). Of these, ESA was the widespread in the Near East during the late second century BCE to the first century CE (Bes 2015:61-64). ESA was produced in a variety of bowl, cup, and jug forms, including the "fish-plate" with a turned down rim and a small impression in the center, as well as the "echinus" bowl, which has a simple in-turned rim (though these forms were not limited to ESA). Both of these forms typically have ring bases (Connelly 2009; Hayes 1997; Mlynarczyk 2009; Sagona et al. 1993).

While the various terra sigillata and red slip wares were are defined by macroscopic criteria, extensive archaeometric work indicates that each of these wares were mass-produced in just a few workshops. For example, ESA was likely produced along the coast of northern Syria/southern Turkey (Regev 2007; Schneider 1996; Slane et al. 1994), while ESC was produced in the area around Pergamum, western Turkey (Japp 2009; Schneider and Japp 2009). Phillip Bes (2015:142) notes that pottery production can be organized into three categories based on scale: household/estate, regional workshop, and supraregional manufactories. The major terra sigillata and red slip wares discussed above were all mass-produced in the third context, and are the most well studied of the red slip wares. While a few regional workshop wares have been tentatively identified, they are far less well understood, while household production is effectively unknown (Hayes 1972, 2008; Japp 2005; Magness 2005). Local or regional production of "Roman" style pottery has been studied more extensively in areas beyond Roman borders than within it, particularly in Britain (Freestone and Rigby 1988; Rigby and Freestone 1986; Willis 1996). Since the red slip wares found at Oğlanqala were almost certainly made in regional workshops, they contribute to our understanding of locally produced varieties.

The industrial scale of production and widespread movement of terra sigillata, red slipped wares, as well as amphora, have been used to argue that Rome was largely economically integrated (Greene 1986; Bowman and Wilson 2009; Woolf 1992). While early Roman scholars, most notably Mikail Rostovzeff (1998), argued that the Roman economy could be understood through modern economic models, Moses Finley (1985) championed the "primitivist" or substantivist perspective. Finlay argued the Roman economy was largely agricultural and politically directed, rather than comprised of independent markets explicable through modern economic theories. Peacock and Williams (1986) proposed a mixed Roman economy that combined political redistribution of wealth, reciprocity/gift exchange, and independent merchants, which is more in agreement with later analyses that support a mixed economic model (Aarts 2005; Oka and Kusimba 2008; A.M. Smith 2004). The difficulty lies in untangling these different modes of exchange (Bes 2015:77).

Roman control of the Near East was a process of increasing political control accompanied by growing cultural and economic integration. While Rome eventually claimed a more complete form of imperial authority than almost any empire in ancient history, making them extraordinarily archaeologically visible, this happened over centuries. Even political incorporation was uneven over time, with different regions shifting from rivals, to conquests, to allied polities, and eventually, to provinces at different rates. Moreover, Roman political, economic, and cultural frontiers could be quite disparately located, as noted in relation to Rome's western border in chapter 2. Yet, unlike Rome's western borderlands, the Near East was already an integral part of the Hellenistic realm. Attempting to untangle the strands of Hellenistic, Roman, and "indigenous" or local practices is a questionable pursuit, and the ways that people enacted or re-imagined different practices understandably varied by region (Butcher 2003; Fischer-Genz 2012). The theoretical frame of entanglement has been most extensively developed and applied in the Hellenistic and Roman Mediterranean specifically to conceptualize of the dynamic complexity of these cultural engagements (Dietler 2010; Stockhammer 2012a,b; Van Dommelen 2005).

Negotiating the Periphery

Between Rome and Parthia lay the Hellenistic states of the Southern Caucasus, including Iberia in eastern Georgia, Albania in Azerbaijan, and Armenia in parts of modern Turkey, Armenia, Syria, and Azerbaijan, though neither their boundaries nor their histories can be mapped onto modern nation-states. These states arose from the chaotic rubble of the late Achaemenid-Seleucid Period to become the key players in the Roman-Parthian fight for dominance. This overview will focus on the ancient state of Armenia, since it is both the most well attested historically and the most relevant to Oğlanqala.

In 189 BCE Artaxias, a figure with unclear origins, took power over Armenia from the Orontids (see above). While much of the Orontid territory was lost, Artaxias' expansionist policy led to the region's first encounters with Rome, as well as further entanglements with the Seleucids and the Parthians. By 148 BCE Parthia had taken Media Atropatene from the Seleucids. In 110 BCE the area north of the Araxes River also fell to Parthia, which gained the submission of the current king, and the future king Tigranes II was taken as a hostage (Redgate 1998). Tigranes II ascended the throne in 95 BCE after relinquishing a considerable amount of land to the Parthians as the price for his freedom. At this point, Parthia controlled all of the territories south and east of Tigranes' realm, as well as retaining considerable influence within it. To the west were areas under the influence of Rome (Manandyan 2007).

However, Tigranes II would eventually expand Armenia's territory considerably, absorbing Armenia Minor through alliance and conquest. Following a marriage alliance with Mithridates VI of Pontus, Tigranes supported his father-in-law's unsuccessful attempt to annex Roman Cappadocia. Pompey's troops not only compelled Armenia to become a client kingdom of Rome, but also marched on Iberia and Albania, an area that had previously been outside of their sphere of influence (Dabrouwa 1989; Sherwin-White 1984). However, Rome was occupied with its own affairs for the next several decades, and Armenia essentially continued as an independent buffer state. After his adventures with Mithridates, Tigranes largely avoided confrontations with Rome and instead turned to conquer what had been previously been ceded to Parthia, and then some (Redgate 1998).

The nomadic people of the northern steppe, the Alan-Sarmatians, were also important players in the political machinations of this time. Classical historians claimed that nomadic hordes from the northern steppe were barely contained by the Caucasus

Mountains from the civilized world of sedentary states (Herodotus IV.5-7; Strabo II.1.1., 5.13). In fact, the nomadic Sarmatians had long been well integrated into the more sedentary south, and presenting this as a dichotomy is misleading (Gregoratti 2013; Olbrycht 1998). The Roman-Parthian conflict drew in even greater numbers of Sarmatians as mercenaries. Iberia and Albania consolidated as states around this time in part based on their ability to control goods and mercenaries coming through the Caucasus along the Darial and Derbend passes (Bosworth 1977; Gregoratti 2013; Lordkipanidze 1991).

In 35 BCE Armenia lost its position as a relatively independent buffer state between Rome and Parthia and became a vassal of Rome following Marc Antony's conquest of Artashat, the Artaxiad capital. From this point until the early first century CE, the Armenian throne went back and forth between Roman and Parthian supported kings (Garsoin 1997; Lang 1983). When Parthia placed one of their princes, Tiridates I on the throne, Corbullo invaded. This resulted in a stalemate, and after years of fighting a compromise was finally reached in 66 CE. The Parthian prince remained on the throne, but he was crowned king by Nero, making the state a vassal of Rome (Dignas and Winter 2007; Redgate 1998; Schottky 1989).

Artashat was founded in the second century BCE on the site of an Urartian fortress, drawing on a communal memory of past greatness inscribed in the mountainous landscape (Khachadourian 2007). However, instead of adopting the extant Urartian remains wholesale, the fortress was incorporated into a much larger, highly fortified settlement that extended over twelve hills. Large portions of Artashat were built as a single project that enabled both communication and defense between the hills over which it sprawled (Invernizzi 1998; Khatchadourian 2007; Tonikyan 1997a,b). The domestic structures were all variations on the theme of a large central room or covered courtyard surrounded by smaller rooms, and were quite densely settled (Tonikyan 1997a). Along with serving as political capital until 120 CE, Artashat was a major center of Hellenism, trade, and production, including ceramic production (Invernizzi 1998; Tiratsyan 2003; Tonikyan 1997a, b). The pottery production is significant because Artashat's red slipped wares provide the closest parallels with Oğlanqala's period II material, including ledge rimmed plates that do not have any other known parallels (Khachatrian 1998: Fig. 49; Gopnik, personal communication).

Considering that the South Caucasus was the battleground between Rome and Parthia, it has received surprisingly little attention in Classical scholarship. This is partially the product of modern geopolitical circumstances, which divide scholarship on this subject into a multitude of linguistic and national interests (Khatchadourian 2008; Kohl and Tsetskhladze 1995; Shnirelman 1995; 2001). Western scholarship has largely ignored this complex region and simply focused on other research questions (notable exceptions include: Khatchadorian 2007; Fabian 2017; Fagan 2015). Yet the contemporary multi-polar political context of the South Caucasus can also be a resource for understanding ancient political complexity. Models of ancient imperial structures generally depict power radiating from a single source, instantiated through networks or hegemony (D'Altroy 1992; Liverani 1988; Parker 2003). Even frontier studies, such as Parker's borderlands model, generally assumes that the various borders and frontiers exist at the meeting of a single imperial power and some local community. However, Oğlanqala was positioned at the crossroad of both Rome and Parthia, as well as the Sarmatians to the north. The local powers of Armenia, Atropatene, Colchis, Iberia, and Albania all needed to figure out ways to rule in this context. These polities were characterized by porous, nebulous frontiers rather than clear political borders. The multi-polar experience of the space between empires is currently under-theorized, and this research represents an initial step to address this gap. The degree and direction of political, economic, and cultural influences must be taken as a question, rather than a premise.

Conclusion

Covering thirteen hundred years in a short overview means that coverage is necessarily selective. However, this summary provides the necessary political and archaeological background to contextualize the new data emerging from Oğlanqala. Moreover, we can interpret changes in Oğlanqala's ceramic use and production within this context to understand more about how the inhabitants were using technology to engage with broader political circumstances.

CHAPTER 4: How To Go About Questioning Things: Materials and Methods

Ceramic production can be a complicated, messy process, involving myriad variables such as available raw materials, weather, geography, function, and aesthetics negotiated by networks of producers and consumers. These variables result in physical, social, and political constraints, affordances, and compromises. No single analytical method can capture this complexity, and even the use of several different methods result in a necessarily partial picture. However, many studies have shown how the use of multiple methods of analysis can significantly refine our understanding of ceramic production, with different methods correcting for the weakness of any single method, as well as provide data on different steps in the production sequence (Belfiore et al. 2007; Day et al. 1999; Jones 2004; Porat et al. 1991; Tite 2008).

This project seeks to reconstruct the sequence of ceramic production for Oğlanqala and neighboring assemblages. Petrographic analysis is the primary method of analysis for this project, since the coarse, low fired ceramics and geological diversity of the South Caucasus makes this method particularly productive for this assemblage. Moreover, it can potentially provide information on several steps in the production sequence, including raw material acquisition, clay preparation, forming, and firing practices. However, since the Middle Iron Age is the focus of this project, neutron activation analysis (NAA) was employed for a substantial subsample of the ceramics from this period, and proved extremely useful for interpreting clays that were difficult to differentiate petrographically. Scanning electron microscopy-electron dispersive spectroscopy (SEM-EDS) was conducted on a small sub-sample in each period to better understand firing practices and slip composition. Finally, surface finishing analysis was conducted on a larger sample of the Naxçıvan assemblage in order to observe the range of gestures used for burnishing, the most common method used for finishing these ceramics. More methods and samples can almost always be employed to provide more information, and radiographic analysis would have been particularly desirable to understand forming (Berg 20008; Glanzman and Fleming 1985; Pierret et al. 1996; Roux 2003; Roux and Courty 1998). The almost universal practice of slipping and burnishing obscures surface features that could indicate forming methods. However, the vast majority of these sherds are too small for radiographic analysis, and facilities for radiography are difficult to access in Azerbaijan. While it was not possible to thoroughly explore this step, these methods and samples were chosen as the most productive for this assemblage, and the results are powerful.

This chapter describes the archaeological material present at Oğlanqala in each period, the ceramics and contexts sampled for this research, and the geology of the region. Finally, I describe each method in terms of samples analyzed, methods employed, and goals targeted.

Oğlanqala Ceramics in Regional Context

In this section, I describe the material found at Oğlanqala for each period with a particular focus on the ceramics. Oğlanqala is a very stratigraphically complex site that sits on top of a 130 m high black limestone/marble hill (Qaratepe), with bedrock often close to the surface and considerable erosion. Each period of occupation involved rebuilding, cutting into, and sometimes completely obliterating contexts from previous occupations (Ristvet et al. 2012a: fig. 8, 16). Extensive pit digging further obscures the remaining stratigraphy, and there are very few undisturbed contexts. Therefore, ceramic dates are largely based on stylistic parallels to other excavated sites, with the chronology at Oğlanqala anchored by C^{14} dates. Ceramics were selected for this analysis because they could be the most firmly dated based on style, including form, ware, and finish. As a result, this sample favors regionally recognizable types, and under represents local forms that we cannot date through parallels. Since I only analyzed a limited proportion of the ceramic assemblage, I present a simplified version of the typology that does not encompass the full diversity of what is present at Oğlanqala. The full ceramic typology will be published by Hilary Gopnik in a forthcoming monograph.

In addition to the Oğlanqala ceramics, I also analyzed material collected in survey from the neighboring Sədərək plain (full description of contexts below). However, these ceramics have not been studied as completely as the Oğlanqala material, and have not been fully integrated into the Oğlanqala typology. Therefore, the typology I present below is a condensed, or "lumped" version of the full Oğlanqala typology to make it possible to compare forms regionally. For example, the full Oğlanqala typology includes several different varieties of simple rim bowl forms, but I lump these together as a single 'simple rim bowl' to facilitate analysis. The image plates for the simplified typology include examples of the form varieties that I analyzed for each period. Since many of these forms extend across several periods, and many of the ceramics from the site cannot yet be firmly dated, I cannot report what percentage of each period was analyzed. However, there are 1858 diagnostic sherds from the 2008 to 2011 Oğlanqala excavations, and I conducted petrographic analysis on 221 sherds, or 12% of the entire assemblage. I analyzed an additional 53 sheds from surveys of the Şərur plain (n=6), Sədərəkqala (n=8), and Sədərək settlement (n=39) (contexts described below).

Period 5-Early Iron Age (1200-800 BCE.)

Naxçıvan was closely tied to northwestern Iran in the EIA. Similar to its southern neighbors, the people of Naxçıvan continued to produce polychrome pottery at sites such as KülTepe I, KülTepe II, and Kizil Vank through the late 2nd millennium, centuries after it disappeared in Armenia (Burney 1973; Abedi et al. 2009; Edwards 1986; Smith 2012:684). The MBA pottery was replaced by burnished black, grey, and buff wares with incised decoration throughout much of the South Caucasus (French and Summers 1994; Sagona 1999; Sevin 1999; Smith et al. 2009; Young 1965).

EIA ceramics were found in survey collections and excavations at Oğlanqala (Ristvet et al. 2012a, b). The EIA ceramics are almost uniformly burnished grey ware vessels, often bowls, plates and jars with some incised decoration, and can clearly be located within the WGW horizon characteristic of the EIA throughout the broader region of the South Caucasus and northwest Iran (Danti 2013; French and Summers 1994; Gopnik and Rothman 2011; Sagona 1999; Sevin 1999, Young 1965). The bridgeless spouted pouring vessels found in the EIA kurgan context at Oğlanqala are particularly characteristic of this horizon, and all the ceramics from this context were finished with identical, unmistakable grey burnish.

The EIA ceramics analyzed for this project include three types of jars: simple everted rim (appendix A: plate 1:a-d), rolled rim (appendix A: plate 1:e-l), and storage;

five types of bowls: carinated (appendix A: plate 2:a-b), indented rim (appendix A: plate 2:c, e), simple rim (appendix A: plate 2:f-g), clubbed rim (appendix A: plate 2:h); simple vertical rim (can have lugs) (appendix A: plate 2:i-j), and two types of plates: simple rim (appendix A: plate 2:d) and rolled rim (appendix A: plate 2:k).

However, the MIA fortress obliterated any pre-existing architecture, making ceramic technological analysis a critical means of understanding this area before the Urartian expansion (Fig. 4.1) (Ristvet et al. 2012a, b). Based on the fragmentary political organization of the region during the EIA, it is likely that the Şərur Plain was locally ruled in this period (Biscione 2003; Biscione et al. 2002; Sevin 1999; Smith et al. 2009).

In addition to the EIA pottery from survey and excavation on the citadel, the majority of pottery from this period was collected from the excavation of the remains of a disturbed kurgan at the base of the citadel. Similar pottery was found in survey throughout the valley surrounding Oğlanqala. While the kurgan pottery is well preserved and has very clear parallels with WGW, the citadel pottery is more complicated. The pottery from the citadel is poorly preserved, and largely comes from tertiary contexts, including eroding out of mud brick. The citadel EIA pottery does not parallel the WGW pottery as closely as the rest of the EIA material. This could indicate divergent styles based on different social contexts (burial and settlement), or it could indicate a chronological difference.

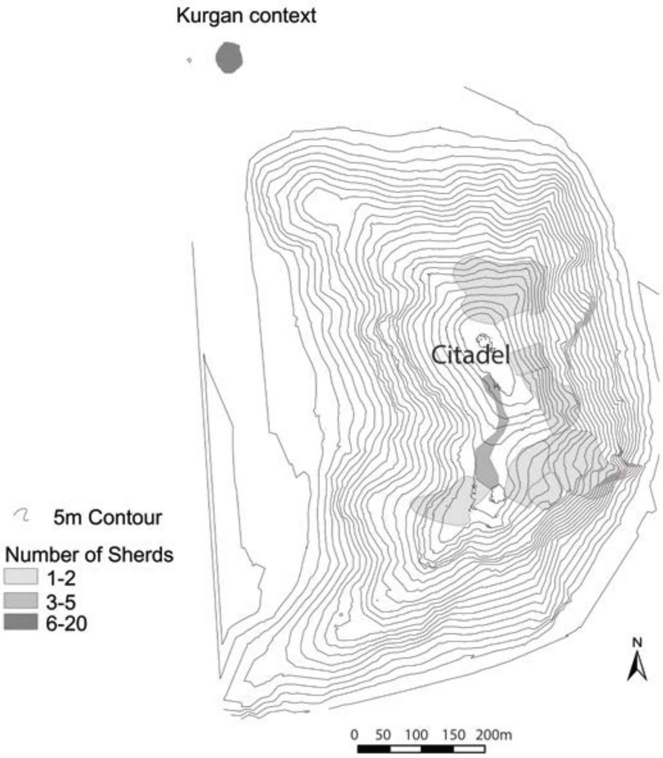

Fig. 4.1: Map of Period 5 Oğlanqala (based on Ristvet et al. 2012a)

Period 4-Middle Iron Age (ca. 800-600 BCE)

Oğlanqala changed significantly during the MIA, with the construction of a large fortress on top of the citadel, and a clear shift in ceramic style with new fabrics and vessel classes. The fortification walls enclose 12 ha, surrounding a palace dominated by a large (33x34 m^2) courtyard (Fig. 4.2). The fortification walls and palace foundations were constructed from roughly hewn, cyclopean limestone blocks and topped with mud brick. These structures feature irregular walls that follow the natural topography of the hillside, and are built with masonry techniques that resemble EIA rather than Urartian architecture. However, ceramics and C^{14} samples from the foundations of walls date to the eighth or seventh century BCE. (Ristvet et al. 2012a).

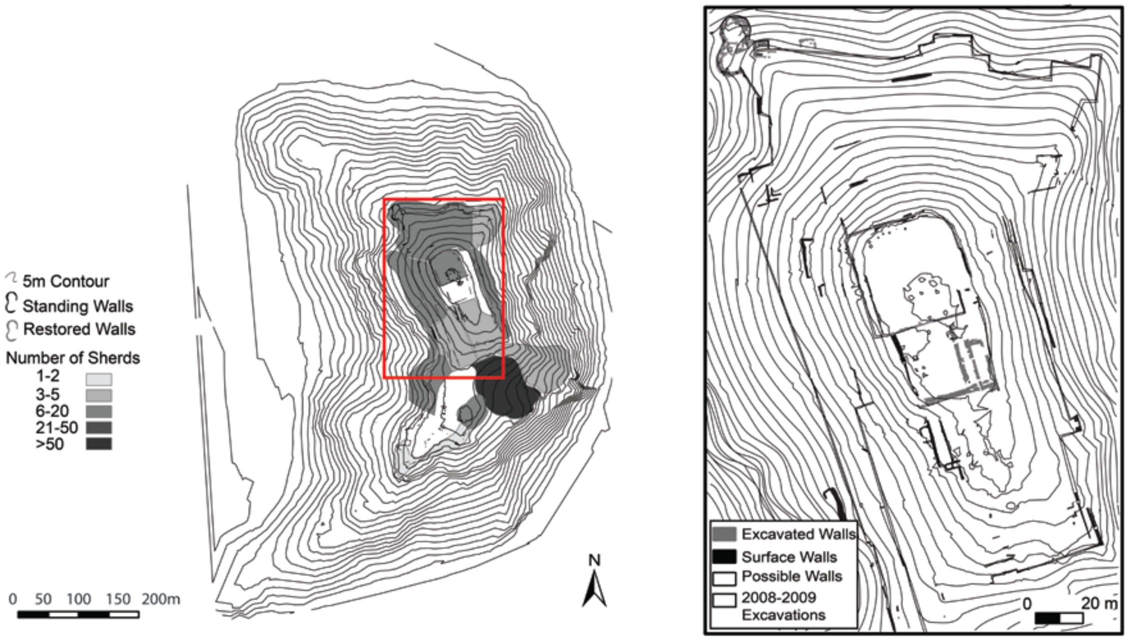

Fig. 4.2: Map of Period 4 Oğlanqala (based on Ristvet et al. 2012a)

Oğlanqala lacks many of the elite materials characteristic of Urartian centers. The only cuneiform text found at the site are some jar volume measurements, and the only luxury goods are a few sherds of Urartian palace ware. The MIA ceramics at Oğlanqala show engagement with Urartian material, but there are few diagnostically Urartian ceramics (Avetisyan and Bobokhyan 2012; Khatchadourian 2008; Kobze et al. 2001; Kroll 1976, 1979, 1984; Ristvet et al. 2012a). For example, this period sees the introduction of massive storage jars, an Urartian type, but the examples at Oğlanqala have distinct arrow shaped molding decoration that is not found elsewhere. Red and brown slipped, burnished bowls and jars largely replace the grey wares, a transition that occured throughout the region as the Urartian Empire expanded. However, the ceramic shapes made from these materials remain essentially local, and grey wares persist throughout the MIA.

The ceramic forms analyzed for this project include four types of jars: simple everted rim (appendix A: plate 3:a-e), rolled rim (appendix A: plate 3:g-h), storage (appendix A: plate 3:k), and hole mouth; two types of cooking pots: simple everted rim (appendix A: plate 3:f), and rolled rim (appendix A: plate 3:i-j); seven bowl types: clubbed rim (can be incised) (appendix A: plate 4:a-f), carinated (can be incised) (appendix A: plate 1:b, plate 4:g-k), simple rim (appendix A: plate 2:f-g), thick rim (appendix A: plate 4:l), pointed rim (appendix A: plate 4:m), indented rim (appendix A: plate 1:c, plate 4:n). Of these, thick rim bowls, carinated bowls, pointed rim bowls and club rim bowls are often finished with a carefully burnished dark brown mottled slip, which is the most common ware from Urartian imperial sites, but this particular finish only accounts for 7% of the sherds found at Oğlanqala (Kobze et al. 2001:95; Ristvet et al. 2012a:345).

Despite the relatively low proportions of more typically Urartian material, Oğlanqala is just 15 km from the Urartian sites of Sədərəkqala and Verahram (Fig. 3.6, 4.5). The former is located at the far western edge of the Şərur plain and the latter lies just across the Araxes River, so these different material engagements were not the result of mountainous barriers. However, the construction of a fortress and shift in ceramic styles coincident with Urartian expansion shows that Oğlanqala and surrounding sites were clearly materially reordering their way of life in response to a changing political landscape.

Period 3- Late Iron Age (ca. 400-200 BCE)

Radiocarbon dates indicate that Oğlanqala was occupied at some point during the period from approximately 400-200 BCE, or precisely during the transition from Achaemenid to Seleucid rule. The evidence for this period is rather strange, in that it is solely a construction level (Fig 4.3). Thirty-one unfinished column elements lie scattered throughout the courtyard, including twenty drums with Hellenistic proportions, two attic bases and plinths, and two smaller bases with an Achaemenid bell shape and attic fillet. Although unfinished, Hilary Gopnik (2016) reconstructed what the builders intended to make, including two sets of columns that creatively combine Achaemenid and Hellenistic elements. The layout of the period III palace has parallels in the Achaemenid palace at Lachish and the Seleucid palaces at Jebel Khalid and Ai Khanoum (Bernard 1973; Clarke 2001; Fantalkin and Tal 2006; Gopnik 2016; Tufnell 1953).

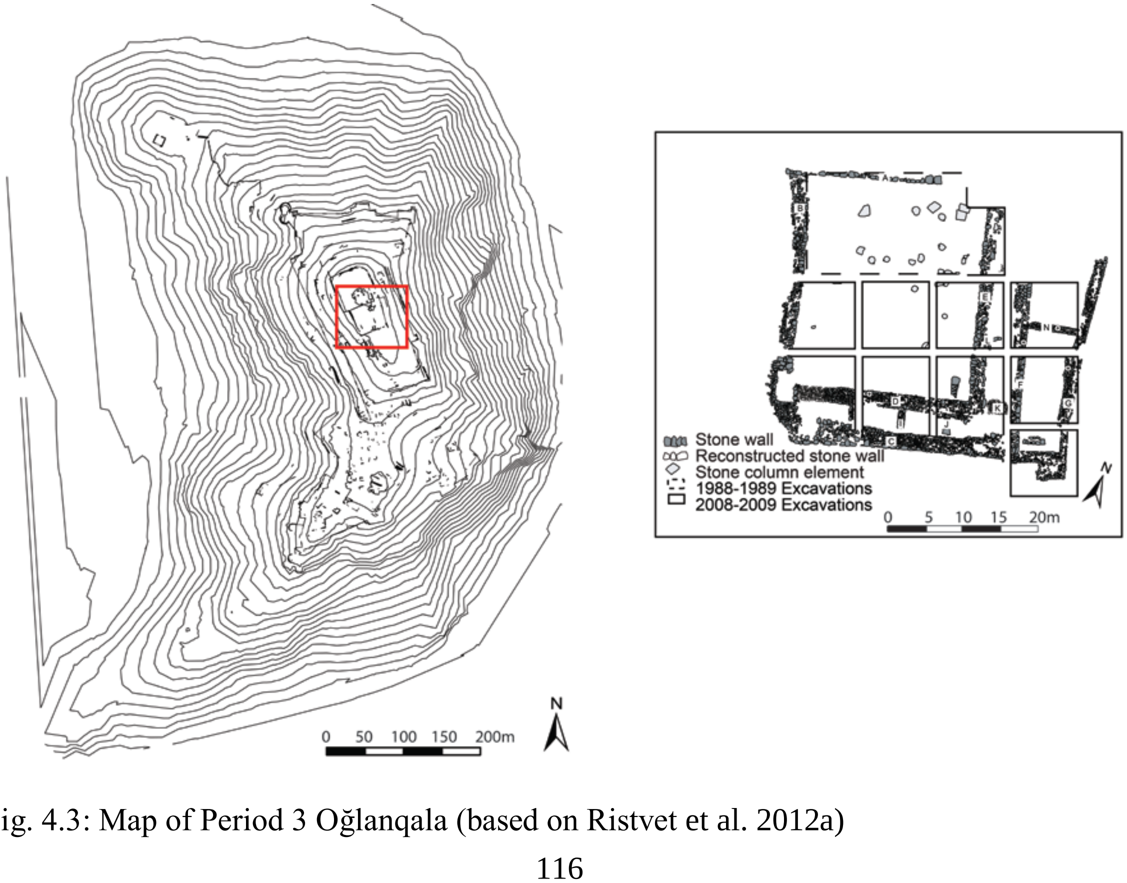

Fig. 4.3: Map of Period 3 Oğlanqala (based on Ristvet et al. 2012a)

There is very little pottery that can confidently be associated with this period, since there was no true occupation as a settlement or completed palace. Burnished red ware traditions that begin in the MIA continued in different forms through the following Roman-Parthian period, a situation that is further complicated by an archaeological context that has been heavily disturbed by both human activity and erosion. Certain carinated forms can be associated with this period, as well as sixteen painted "Triangle Ware" sherds that were found mostly out of context. Triangle Ware is a highly variable genre of painted pottery that can be found from Georgia to Pasargardae, Iran from the late Achaemenid to Hellenistic Period (Dyson 1999; Gopnik 2015; Kroll 2000). In addition to carinated bowl forms (appendix a: plate 4:h, j), clubbed rim (appendix a: plate 4:b, d, e) and simple rim bowls (appendix a: plate 2:f, g) were analyzed for this assemblage, as well as rolled rim jars (appendix a: plate 3:g-h, plate 5:j). The relative dearth of identifiable pottery in this period is the reason why it is not the focus of analysis.

Period 2-Roman-Parthian Period (150 BCE-50 CE)

As Rome and Parthia battled for dominance in the South Caucasus, occupation at Oğlanqala took a different shape from previous periods. While the outer defensive wall was refurbished, the monumental fortress/palace structure at the top of the citadel was largely abandoned as an architectural feature (Fig. 4.4). However, the citadel remained very much in use. Thirty-one pits, some plaster-lined, and hearths were cut into the floor of the Seleucid period palace, which contained ash, animal bones, and ceramic bowls and trays. Additionally, two small domestic structures were excavated at the lower elevation southern end of the hill outside of the citadel area. Data from a magnetometry survey suggest that additional small structures, as well as one larger one, likely exist. Additionally, two carbon dates taken from the houses, as well as four carbon dates taken from the pits all date to between the first century BCE to the early first century CE, and are therefore assumed to be contemporaneous. These contexts also all have similar ceramics that can be stylistically dated to the same period (Ristvet et al. 2012a).

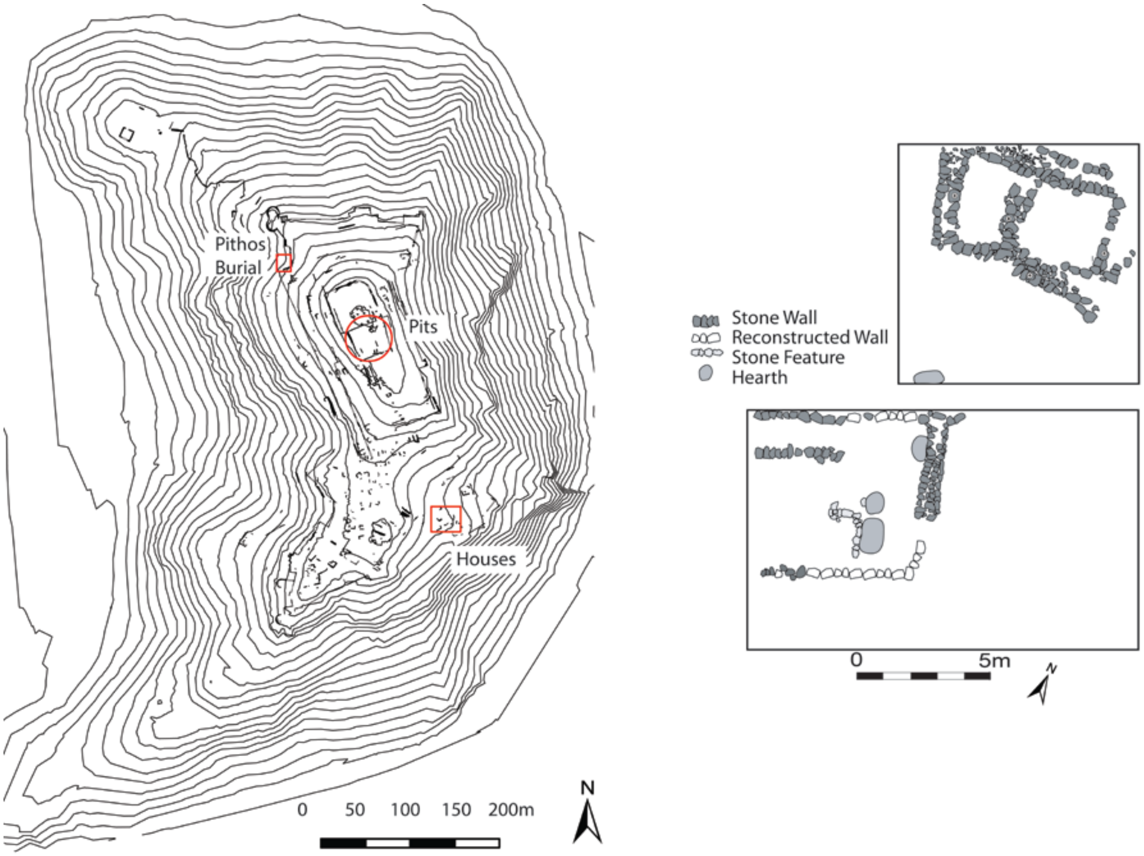

Fig. 4.4: Map of Period 2 Oğlanqala (based on Ristvet et al. 2012a)

Another notable context from this period is a pithos burial found just outside the western fortification wall. The human interred in this large pithos was accompanied by four Augustan denarii minted between 2 BCE-14 CE (Cooley 2009; Ganzert 1984;

Mousheghian and Depeyrot 1999; Swerida, ND), three Roman style glass bottles (Grossmann 2002; Luckner 1994; Walker 2008), six intaglio rings (Önal 2010; Spier 1992; Tomorad 2005), a bead with Phoenician parallels (Moscati and Grassi 1988), and an accessory jar beside the pithos that has parallels throughout Armenia and Northwest Iran (Abdi 2000; Fard 1995; Zardarian and Akopian 1995).[6] In addition, isotopic analysis of the interred individual shows that they did not grow up locally, and likely hailed from the Eastern Mediterranean region (Nugent 2013). In fact, the only locally produced aspect of this burial was the pithos (Fishman 2016).

The majority of Oğlanqala ceramics that can be securely identified from this period are burnished red slipped bowls and plates, including simple rim bowls (appendix a: plate 6:a-b), thickened rim plates (appendix a: plates 6:c), and ledge rim plates (appendix a: plate 6:d-f), the latter of which can have a lid (appendix a: plate 6:g). The few bowls that do not fall into the above vessel class are generally thicker and have a pink-buff slip, including clubbed rim bowls (appendix a: plate 3:g) and a pointed rim bowl (appendix a: plate 4:m). In addition to bowls, there are large, crudely shaped buff trays (appendix a: plate 5:d-e), scalloped rim buff and grey pithoi (appendix a: plate 5:f-g), rolled rim jars (appendix a: plate 5:a-b) and rolled rim cooking pots (appendix a: plate 3:j, plate 5:c).

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[6] Jennifer Swerida and Selin Nugent generously shared their research for this discussion. See their chapters in the forthcoming Oğlanqala monograph for more information.

Archaeological Contexts

The ceramics for this analysis were collected from two general areas: 1) Oğlanqala and the surrounding Şərur plain, and 2) the Sədərək region, including a fortress and a settlement (Fig 4.5).

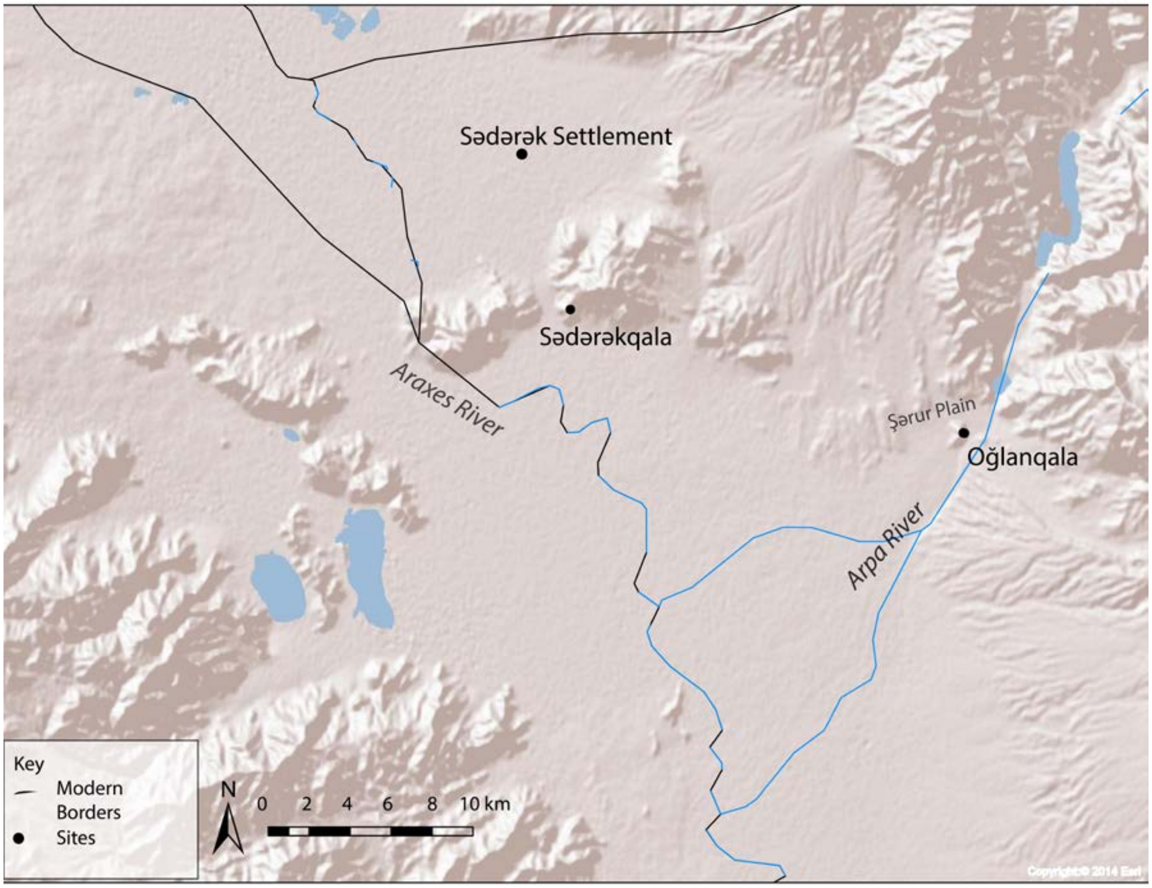

Fig. 4.5: Map of sites where samples collected

Building on the overview of Oğlanqala in each period, I define these areas as sampling contexts. See Tables 4.1 and 4.2 for distribution of samples collected from these contexts. I subdivide Oğlanqala and the Şərur plain into five areas:

1) Oğlanqala citadel: excavation of this area included 1,300 m^2 (13 trenches measuring 10x10 m) within the southern half of the Middle Iron Age to Seleucid

Period architecture at the highest point on the site (Figs. 4.1-4.4) (Ristvet et al. 2012a). Very rarely (n=9 for petrographic samples), surface survey sherds were included in this sample when they were clearly diagnostic. Since this context is the highest point, these sherds were unlikely to have traveled from another area.

2) Oğlanqala domestic structures or 'houses': excavation of this area included 250 m^2 (2 trenches measuring 10x10 m, 1 trench measuring 10x5 m), and uncovered two simple stone structures built into the southeast hillside below the citadel (Fig. 4.4). These structures contained three hearths and evidence for multiple activity use, including indoor and outdoor food and materials processing (Ristvet et al. 2012a: 341-342). Although two C^{14} dates and the majority of the ceramics found in these structures show that they were in use during the Roman-Parthian period, some Middle Iron Age ceramics were also found in this context.
3) Oğlanqala kurgan: excavation of this area included 150 m^2 (6 trenches measuring 5x5 m) in the valley approximately 150 m north of northwest edge of Qaratepe (the hill on which Oğlanqala is situated) (Fig. 4.1). Although disturbed, this context includes a stone circle with a diameter of 3 m, covered by mounded stones that rise about 2 m above the surrounding plain. This context contained a ceramic assemblage with clear parallels to Iron I and Iron II material from northwest Iran, as well as Xocalı-Gədəbəy ceramics known from Azerbaijan, all dating to the Early Iron Age (Aslanov and Kashkai 1991; Bakhshaliyev 2002; Bakhshaliyev and Schachner 2001; Ristvet et al. 2012a,b; Young 1965).

4) Oğlanqala fortification walls: these included excavations undertaken along the northern and western fortification walls, uncovering 215 m of the former and 70 m of the latter (Figs. 4.2-4.4). These walls were carbon dated to the eight century BCE, but were rebuilt several times, at least into the 1st century BCE. The western wall excavations uncovered the Roman period pithos burial that was described previously (Fig. 4.4) (Ristvet et al. 2012a,b).
5) Şərur plain survey: included a 34 ha intensive survey of the area to the north and east of Oğlanqala, into the foothills approximately 2 km across the valley (Fig. 4.5) (Hammer 2014).

Sədərək is the region immediately to the west of Oğlanqala, and only contains material from the Early Iron Age and Middle Iron Age. Further data on this survey will be published by Emily Hammer. This area can be subdivided into two contexts (Fig. 4.5):

1) Sədərəkqala: a Middle Iron Age fortress site 13 km from Oğlanqala that has Urartian architectural and ceramic parallels. All ceramics from this site were collected by surface survey. Any settlement that may have once existed around Sədərəkqala was demolished by cement production at the base of the fortress.
2) Sədərək settlement: an Early Iron Age to Middle Iron Age settlement located in survey, 5 km north of Sədərəkqala. Any secure context for this site was destroyed by farming, but augur drill exploration found ceramics with clear parallels to Oğlanqala's Early Iron Age and Middle Iron Age assemblages.

These subdivisions are often reconstituted to treat Oğlanqala/Şərur as a unit of analysis and Sədərək as a unit of analysis, but can be disentangled when doing so provides insight, such as the comparison of the petrofabrics from the Oğlanqala citadel and houses in period 2.

Geological Context

Understanding the raw materials available in the surrounding environment makes it possible to observe how potters at Oğlanqala chose to use those materials at different times, as well as to identify non-local material. The geological diversity of the Southern Caucasus makes it an excellent region in which to undertake petrographic analysis, as various areas have distinct geological signatures. Since the local geology can vary from one valley to the next, it is possible to be relatively precise when making inferences about what raw materials can be considered "local" or "non-local." However, the geological complexity can also make it difficult to relate raw materials to a specific region, since distant regions may have the same geological make-up, while being separated by areas that are geologically different.

The geology of the region is defined by the continued collision of the Eurasian and Africa-Arabian tectonic plates where the Tethys Ocean lay until the Early Cenozoic (~64 mya) (Fig. 4.6a,b). Geological, palaeobiogeographical and palaeomagnetic data indicate that many separate geological terrains underwent substantial horizontal displacements within the oceanic area of the Tethys "before being accreted together in a single complicated fold-thrust belt" (Adamia et al 2011: 534; Dercourt et al. 1986, 1990; Barrier and Vrielynk 2008; Stampfli 2000).

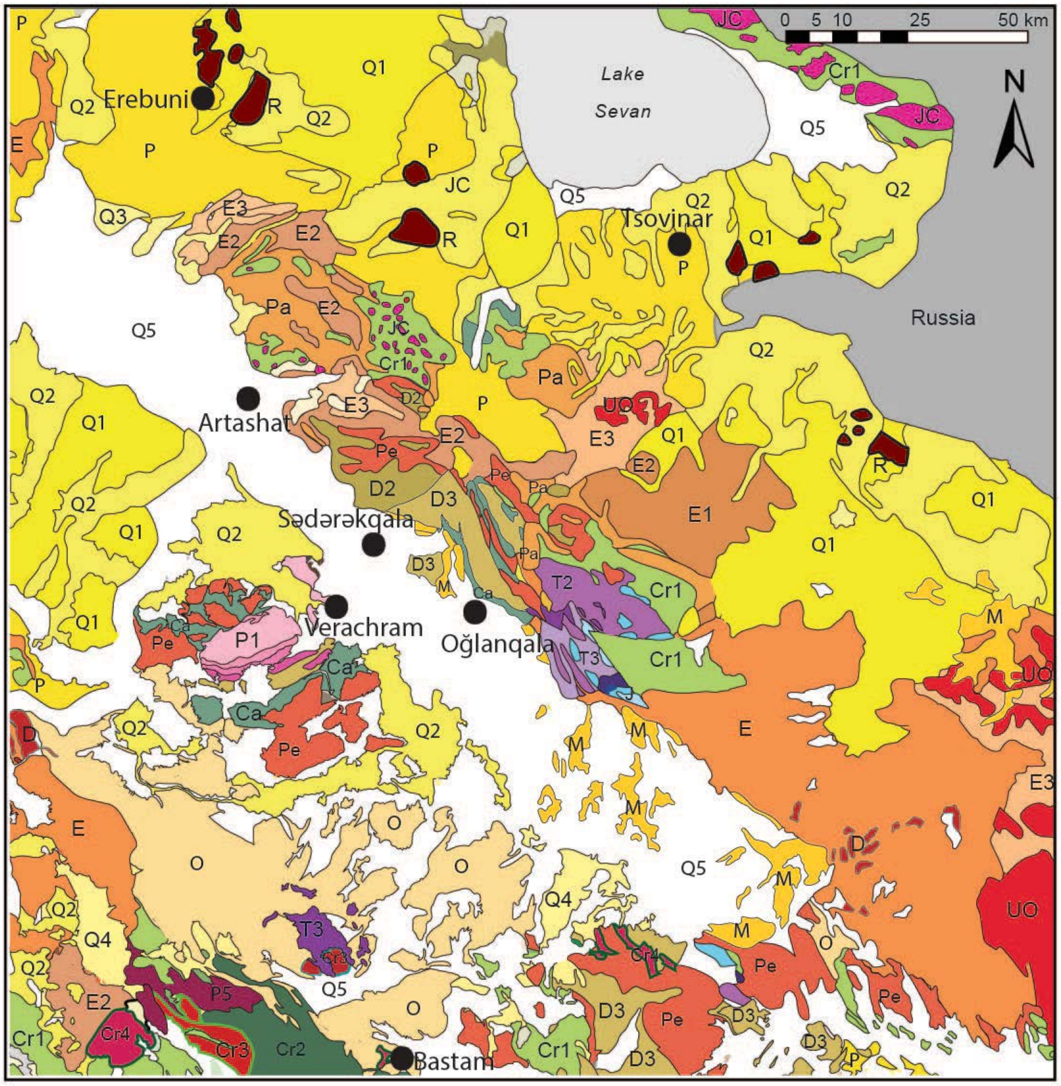

Fig. 4.6a: Geological Map of Naxçıvan and Surrounding Area- key on following page (after 1:500,000 Geology and Mineral Resources of Azerbaijan; 1:600,000 Dallegge et al., 2010; 1:250,000 Geological Survey of Iran; 1:500,000 Geological Map of Turkey)

KEY

⬜ Quaternary (Q5)
alluvium: clay, sand, gravel

⬜ Quaternary (Q4)
terrace, sandstone, marl

🟨 Quaternary (Q3)
travertine, travertine conglomerate

🟨 Lower Quaternary (Q2)
basalt, andesite, dacite

🟨 Lower Quaternary (Q1)
andesite, dacite

🟨 Pliocene (P)
andesite, dacite, dolerite-basalt, tuff, tuffaceous conglomerate, sandstone

🟧 Miocene (M)
clay, sand, sandstone, tuff, conglomerate, shingles, volcanogenic formations

🟨 Oligocene
Iran (O): limestone, marl, sandstone, conglomerate, gypsum bearing clay

🟧 Upper Eocene (E3)
tuff, sandstone, clay, marl

🟫 Middle Eocene (E2)
limestone, marl, sandstone

🟧 Lower Eocene (E1)
sedimentary and volcanic rocks

🟧 Eocene (E)
terrigenous-carbonaceous, tuff-sedimentary, volcanic formations

🟧 Paleocene (Pa)
sandstone, slate, marl, siltstone, limestone, conglomerate

🟩 Upper Cretaceous (Cr1)
limestone, marl, sandstone, siltstone, tuff, tuff conglomerate; south of Araxes can include andesite, basalt

🟩 Upper Cretaceous (Cr2)
Metamorphosed basic rocks

🟦 Upper Jurrasic (J3)
tuff, tuffaceous sandstone/breccia/conglomerate, limestone, dolomite, argillite, sandstone

🟦 Middle Jurrasic (J2)
shale, sandstone,

🟦 Lower Jurassic (J1)
quartzose conglomerates/sandstone, schists, shale, tuff, tuffaceous sandstone, basalt, diabase

🟪 Upper Triassic (T3)
micaceous argillite, quartzose sandstone, sandy argillite, carbonaceous shale

🟪 Middle Triassic (T2)
dolomite, diabase

🟪 Lower Triassic (T1)
limestone

🟥 Permian (Pe)
limestone, schist, dolomite, sandstone, quartzite, shale

🟩 Lower Carboniferous (Ca)
shale, quartzite, limestone, sandstone

🟨 Upper Devonian (D3)
dolomite, gypsum, limestone

🟫 Middle Devonian (D2)
limestone, sandstone, shale, schist, quartzite

🟪 Precambrian (P1)
metamorphic rocks

🟪 Precambrian (P2)
crystallized limestone and dolomite

🟪 Precambrian (P3)
schist, phyllite, slate

🟪 Precambrian (P4)
metamorphosed acid volcanic rocks

🟥 Precambrian (P5)
Metamorphosed gabbro, basalt, andesit

INTRUSIONS

🟥 Upper Oligocene (UO)
porphyritic granite, granodiorite, monozonite

🟥 Upper Cretaceous (Cr3):
Ultrabasic rocks

🟪 Jurassic-Cretaceous (JC)
ophiolite complex: grabboric pyroxenite, periodotite, dunite, serpentinite

🟥 Upper Cretaceous (Cr4):
Diabase pillow lavas

🟫 Rhyolite, dacite, pumice, obsicdian, perlite (R)

🟥 Diorite, diabase, rhyolite, rhyodacite, andesite (D)

4.6b: Key to Geological Map

During the Early Paleozoic, backarc rifting above a south-dipping subduction zone caused this area to separate from western Gondwana. Continued rifting produced the Paleotethys Ocean, and the displacement of the Caucasus to the southern margin of Eurasia was completed by the Lower Carboniferous (~323 mya). A north-dipping Paleotethyan subduction zone occurred below emplacement of granite plutons along the active continental margin of southern Eurasia in the Upper Carboniferous. The Mesozoic age Tethys Ocean was inherited from the Paleotethys Ocean, and the Caucasus were the southern active margin of the Eurasian plate (Adamia et al. 2011:489; Zonenshain et al. 1990).

During the Early Cenozoic, the region was characterized by island arcs, intra-arc rifts, and backarc basins. The division of the Caucasus into northern and southern regions occurred during the Early Cenozoic. Lithologically, the southern region (Naxçıvan) is characterized by sedimentary, mostly carbonate shelf sediments, while the Lesser Caucasus ophiolite belt contains rocks from the Tethyan ocean floor and the northern Greater Caucasus is represented by rocks characteristic of an active continental margin, similar to present-day Pacific rim margin contexts (Adamia et al. 2011:489-512; Nalivkin 1973).

In the Early Eocene (~56 mya), this southern area shifted from being characterized by carbonate sedimentation to submarine volcanic eruptions, including intermediate lavas and pyroclastic debris, which alternated with carbonate deposits to form comglomerates. These deposits contain nummulites, large molluscs, echinoids, brachiopods, corals, and some other fossils indicating shallow sea environment (Adamia et al 2011: 513, Aslanian 1970; Azizbekov 1972). Eocene volcanism was part of the massive andesite belt that spanned from the Aegean Sea, through Turkey, the Lesser Caucasus, Iran, to Afghanistan. Petrochemical data suggest that these are mainly calc-alkaline series island arc volcanics (Adamia et al 2011:513; Lordkipanidze et al. 1989; Vincent et al. 2005). By the Late Eocene this volcanism subsided and sandy argillaceous and carbonate sediments returned.

The Oligocene (~34 mya) represents the beginning of the syn-collisional, or orogenic, phase. During this period, mountain ranges formed where deepwater basins had been, and shallow marine basins sank and formed intermontane depressions that accumulated molasse deposits, as observed in Naxçıvan. In the western side of the Aras basin, this period is represented by sandy-argillaceous and course grained terrigenous clastics, while the eastern side is represented by basaltic-andesitic and dacite-rhyolitic lava flows. Miocene (~28 mya) deposits are represented by lagoonal gypsiferous-salt bearing terrigenous clastics and shallow-marine terrigenous and carbonate rocks characterized by molluscs, foraminera, ostracods, and corals (Adamia et al 2011: 521-525; Aslanian 1970; Azizbekov 1972).

It was only in the Upper Miocene (~11 mya) that the Caucasus became largely dry land, with the uplift of clastic areas, further distinguishing the northern Cretaceous-Paleogene flysch of the Great Caucasus and the southern Mesozoic-Cenozoic volcanics of the Lesser Caucasus (Adamia et al. 2011: 528). Late Miocene to Quaternary (~2.6 mya) volcanic activity took place within a broad belt extending from Central Anatolia to the Great Caucasus, related to the Van-Caucasian uplift (Adamia et al 2011: 532;

Lorkipanidze et al. 1989). These volcanic deposits can be over a kilometer thick, and range in composition from basalt to rhyolite, with pyroclastic materials less common. This widespread volcanism, present as a compositional continuum, is part of what makes provenicing raw materials so difficult.

This geological history results in a very complicated geological context. The following sketch will describe the range of materials available within 10 km of Oğlanqala (local), 10-20 km from Oğlanqala, and then, briefly, 20-60 km from Oğlanqala. This overview will give a sense of the range of raw materials available to Oğlanqala potters.

<10 km from Oğlanqala

Oğlanqala is located in a karstic region of Lower Carboniferous/Devonian age (~360 mya) characterized by a broad range of interbedded limestone and sedimentary material, primarily coral-brachiopod limestones (often bituminous), quartzite sandstones, and argillites (Fig. 4.7) (Adamia et al. 2011:15, *Geological and Mineral Resources of Azerbaijan* 2000: 21-26, 31-37). Additional microfossils that characterize this geological zone are foraminiferans, bryozoans, tabulates, rugoses, ostracodes, crinoids, conodonts, and algae (Grechishnikova and Levitskii 2011). To the north, east, and northwest of Oğlanqala are Permian age bituminous algal foraminifera limestones containing corals, brachiopods, ammonoids, and conodonts that overlay the Devonian and Carboniferous deposits. Quaternary and Neogene clay and sandstone sediments are located to the south and southwest. Upper Cretaceous (Senonian) sedimentary, carbonate, and volcanic material can be found 10 km to the northeast, while Eocene terrigenous, carbonaceous, and volcanic facies are west of the site.

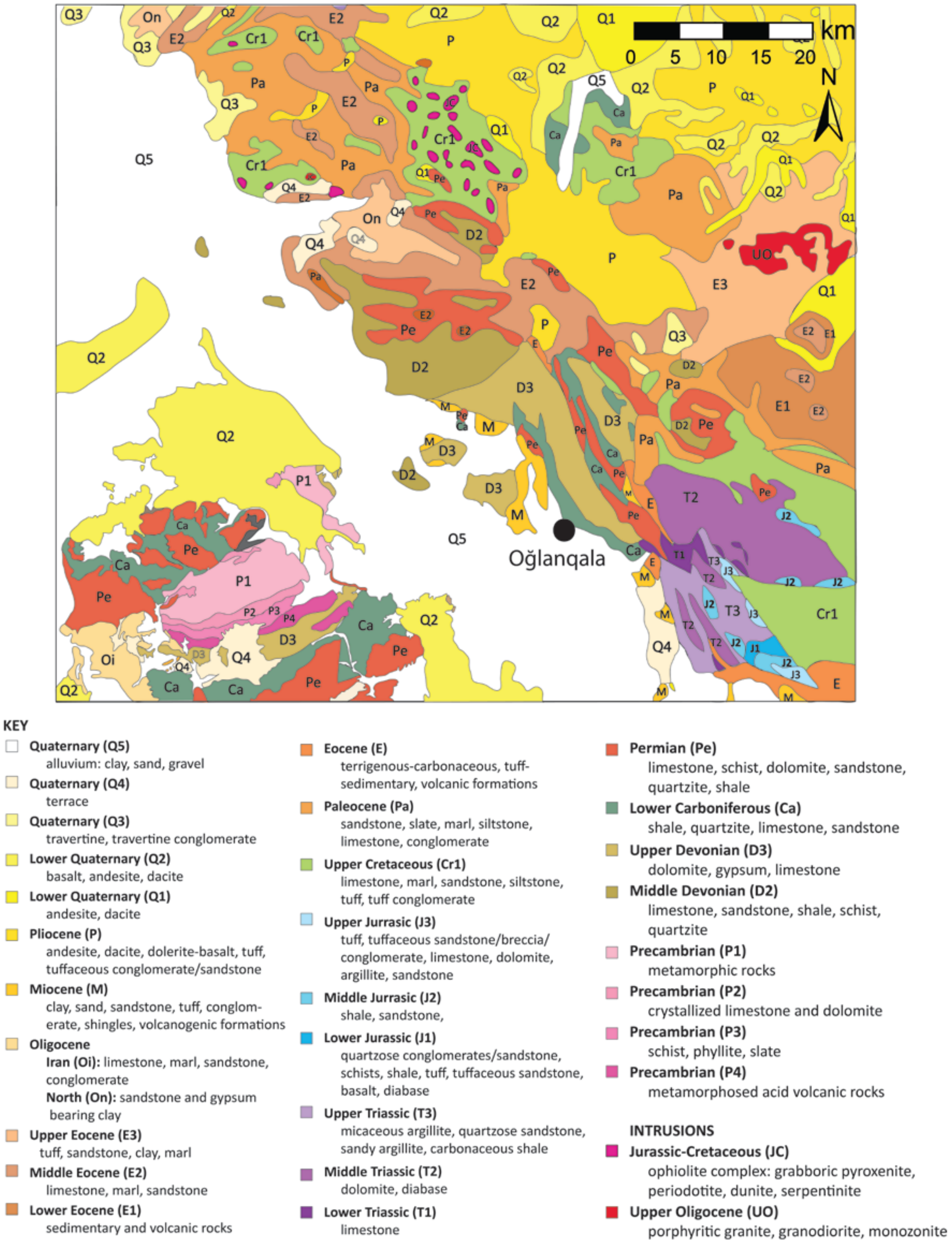

Fig. 4.7: Geological Map of Şərur and Surrounding Area (after 1:500,000 Geology and Mineral Resources of Azerbaijan; 1:600,000 Dallegge et al., 2010; 1:250,000 Geological Survey of Iran; 1:500,000 Geological Map of Turkey

There may be gabbro-diabase, diorite, and subvolcanic (hypabyssal) intrusions in the area immediately surrounding Oğlanqala, though none were located in survey, and they are certainly present in the broader region (Dallegge, et al, 2010: Plate 1, *Geological and Mineral Resources of Azerbaijan* 2000: 21-26, 31-37).

10-20 km from Oğlanqala

Upper Cretaceous, Triassic, and Jurassic age sedimentary, carbonate, and volcanic material can be found 12-15 km to the northeast (Fig. 4.7). The Triassic age deposits are characterized by limestones, marls, and dolomites. The Jurassic age deposits overlay the Triassic material, and can include diabase porphyrites, argillaceous deposits with tuffaceous sandstone, sandy-argillaceous-carbonates, and gabbro-diabasic intrusions (Abdullaev and Bagirbekova 2007; Adamia et al. 2011; Azizbekov 1972). Quaternary age travertine, conglomerate, and basaltic-rhyolitic lava flows are present 15-20 km southeast of Oğlanqala, across from the Araxes River. Between these largely volcanic zones, Permian and Precambrian age schistose-phyllite metavolcanic and metacarbonate facies, slate, shale, limestone and dolomite are present.

20-60 km from Oğlanqala

Within 60 km of Oğlanqala there is a complex mosaic of sandstone, carbonates, slate, schists, ophiolites, volcanics, and plutonic rocks (Fig. 4.6a,b). Two additional geological suites that cannot be found closer to Oğlanqala are the Vedi Ophiolitic (55 km northwest) and the Oligocene plutonic intrusions (~40-50 km to the northeast and southeast). The Vedi ophiolitic complex is part of the same Jurassic backarc basin as the

Sevan, Stepanavan, and Zangezur ophiolitic complexes (Galoyan and Sosson 2007; Galoyan et al. 2009; Rolland et al. 2010).

Geological Survey

Understanding the range of raw materials available in the environment makes it possible to observe how potters at Oğlanqala chose to use those materials at different times (Arnold 1984, 2000). Different local materials may have been preferred for different vessels in different periods, and shifting exchange networks can be observed through the presence of different non-local ceramics (Costin 2001b). Therefore, geological samples must be collected from as many areas as possible to build a reference collection of local and regional clays that may have been used in the past (Rice 2005; Rye 1981).

I conducted a geological survey for the Şərur plain in 2011 and the entire region of Naxçıvan in 2014. I collected eleven geological samples from Oğlanqala and the surrounding area for petrographic analysis (Fig. 4.8; see appendix C for all geological sample descriptions). Eight of these samples were sediments and clays from the valley and steppe surrounding Oğlanqala. Samples were obtained by first removing the top 10 cm of soil from the surface to allow the collection of the underlying sediment. Grain size and plasticity of sediments was determined in the field. The remaining samples were taken from Middle Iron Age unfired mud brick, and from the banks of the Arpa River.

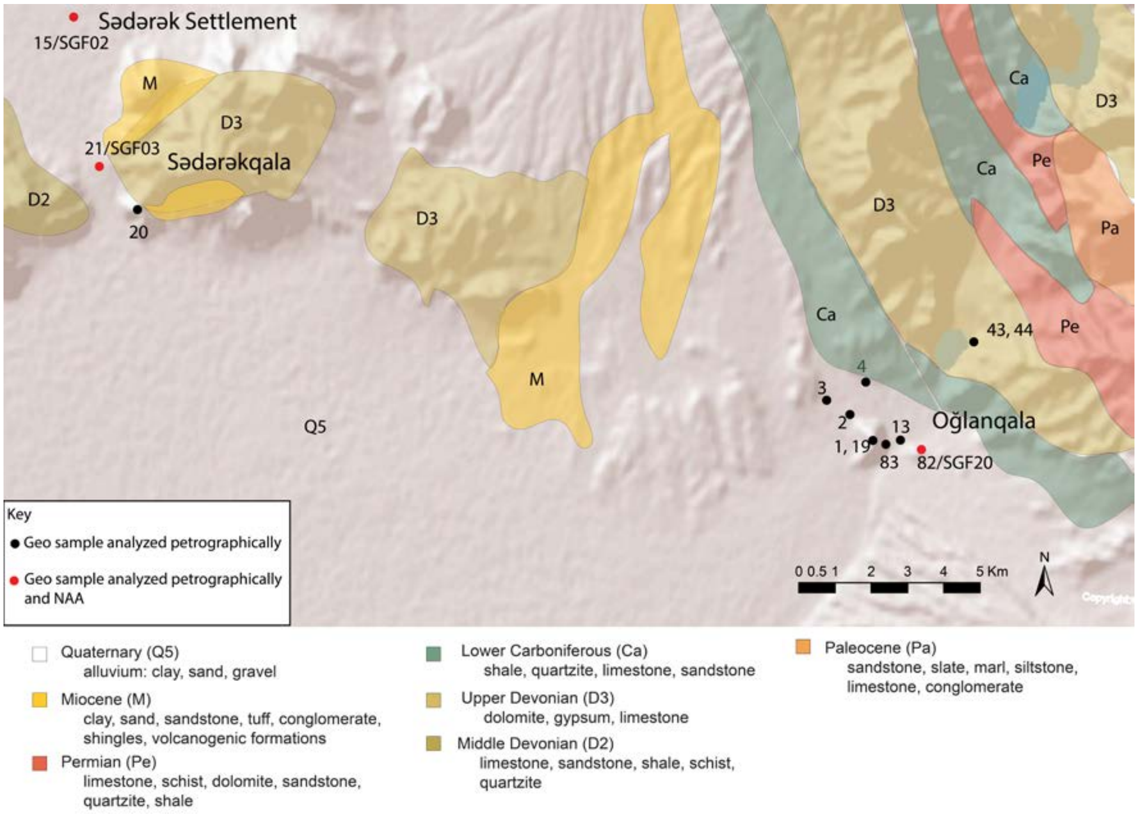

Fig. 4.8: Map of Local Geological Samples

Clays were prepared as briquettes, fired at 500°C, 700°C, and 900°C for one hour in an oxidizing atmosphere and petrographic thin sections were made. I also collected forty-four additional samples from throughout Naxçıvan, resulting in a total of fifty-five geological samples (Fig. 4.9). The clay samples from the regional survey were prepared in the same manner as the local survey, but were only fired at 700°C. In this study, my working hypothesis is that if the fabric of a ceramic samples was made from materials that could be local to Oğlanqala, I treat it as representing a local source. This hypothesis implies that the closest possible source for a given ceramic is the probable source, unless there is reason to invalidate this.

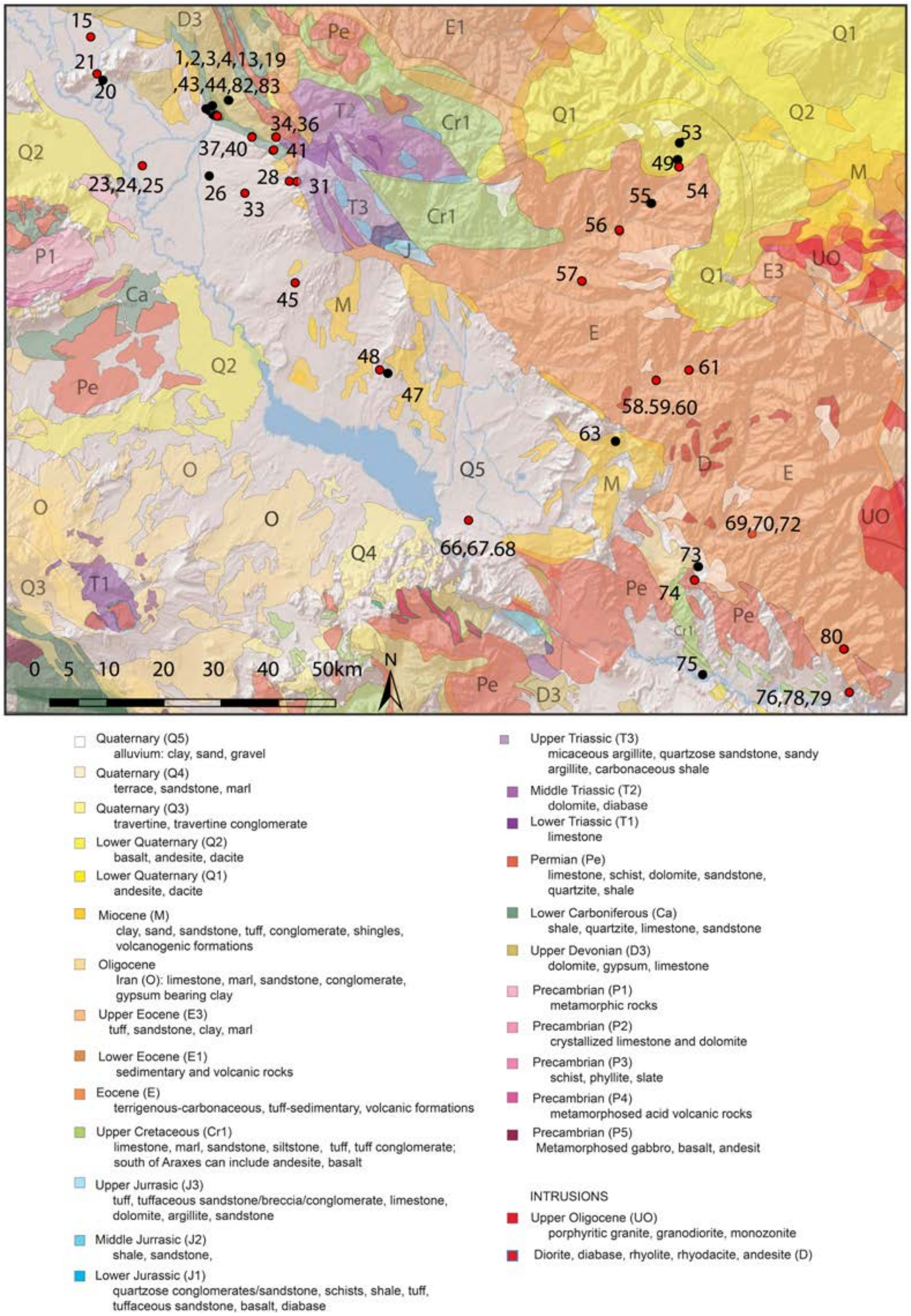

Fig. 4.9: Map of Regional Geological Samples. Red dots indicate sample was analyzed with NAA as well as petrography. See appendix C for concordance of thin section and NAA IDs

In addition to petrographic analysis, 20 clay samples were analyzed with neutron activation analysis (NAA). These 20 samples were selected to capture the broadest possible range of clay sources available in Naxçıvan, including three samples from the area surrounding Oğlanqala, one sample from Sədərəkqala, and the remaining 16 samples from different drainage systems and geological contexts throughout Naxçıvan.

Petrographic Analysis

Analyses of raw materials provide information about the location of production since clay is usually collected close to production (Arnold 1985, 2000). Petrography is the primary means of analyzing clay sources and processing for this project. The coarseness of the ceramics as well as the geological diversity of the region is ideal for petrographic analysis. The diverse geology makes it possible to link ceramic inclusions with particular regions, identify local and non-local ceramics, and potentially locate the areas where the non-local materials originated. This allows for an assessment of the economic integration of the Şərur plain into the broader region (Costin 2001b). Following Druc (2013), "local" ceramics are defined as a social category based on communities of practice as well as a geological/geographic category, and the contours of "local" shift in each period. For example, in the EIA and MIA, local encompasses Oğlanqala and Sədərək, since the geology and production methods are largely indistinguishable (see chapers 5 and 6). Additionally, the type, angularity, size, and proportions of non-plastic inclusions provide data on clay preparation methods such as the addition of temper, microstructure provides information on forming practices, while the color and optical activity of the groundmass provides data on type of firing conditions (Whitbread 1989, 1995; see also Quinn 2013). All of these data contribute to the reconstruction of the organization of production in different periods, by making it possible to infer whether production is primarily dispersed or centralized, local or non-local, and attached or domestic (Costin 1991). All of these production contexts exist on a continuum, rather than as binary opposites, and are part of immensely complicated systems.

I made 274 ceramic samples into petrographic thin sections for analysis (Table 4.1; appendix B). Of these, 227 of the samples were obtained from the Şərur plain, primarily Oğlanqala. While the majority of these samples come from the citadel, many of the EIA samples come from the kurgan context, as well as survey material from the Şərur plain (Hammer 2014). In contrast, many of the Roman-Parthian period samples come from domestic structures that were occupied in this period (Ristvet et al. 2012a,b). Since the stratigraphy at Oğlanqala is extremely complicated, samples were selected primarily for their ability to be dated to a period based on stylistic parallels, while also attempting a complete, if not perfectly balanced representation of the Oğlanqala assemblage. Local forms that could not be dated by parallels are significantly underrepresented. Stylistic and period designations were based upon the typology developed by Hilary Gopnik for the site. In addition to the Şərur plain samples, 47 samples were collected from the Sədərək plain. Overall, this suite includes 86 sherds dated to the Early Iron Age, 100 sherds dated to the Middle Iron Age, 9 sherds dated to the Late Iron Age/Seleucid period, and 79 sherds dated to the Roman-Parthian period. Further discussion of the ceramic forms and contexts by period are presented in Chapters 5 and 6.

	Oğlanqala citadel	Oğlanqala domestic structures (period 2)	Oğlanqala kurgan	Oğlan-qala walls	Şərur valley survey	Sədərək-qala	Sədərək Settlement	**Total**
Early Iron Age/ Period 5	30	n/a	25	0	6	4	21	86
Middle Iron Age/ Period 4	72	2	0	4	0	4	18	100
Seleucid Period/ Period 3	8	1	0	0	0	0	0	9
Roman-Parthian Period/ Period 2	55	18	0	6	0	0	0	79
Total	165	21	25	10	6	8	39	274

Table 4.1 Petrographic samples by period and context

Petrographic samples were primarily taken from diagnostic rim sherds, and the thin section billets were cut in an orientation perpendicular to the rim (Quinn 2013; Whitbread 1995). The samples were made into standard thin sections, and analyzed at the Center for the Analysis of Archaeological Materials at the University of Pennsylvania Museum of Archaeology and Anthropology following the methodology proposed by Whitbread (1989; 1995; 2005; see also Quinn 2013). Samples were grouped into fabrics based on the mineralogy of the non-plastic inclusions, grain-size distribution, color and optical activity of the groundmass.

Neutron Activation Analysis (NAA)[7]

The chemical composition of 60 ceramic samples and 20 clay samples was analyzed by neutron activation analysis (NAA) at the University of Missouri Research

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[7] The following description of NAA methodology was adapted from the standard language MURR uses on all of their reports for ceramic and soil samples.

Reactor (MURR) Archaeometry Laboratory. The majority of the ceramics came from excavations at the Oğlanqala citadel (n=50), and the remainder were selected from the Sədərək settlement (n=10) (Table 4.2; appendix B). The ceramic samples were compared to twenty clay samples collected throughout Naxçıvan. Pre-existing NAA data sets for the region were used for comparison, including Speakman et al.'s (2004) analysis of material from Urartian centers, and Lindsay et al.'s (2008) analysis of material from Tsaghkahovit Plain, Armenia. The Speakman et al. (2004) data were all analyzed at MURR, while the Lindsay et al. (2008) data were analyzed at both MURR and Ford Nuclear Reactor at the University of Michigan, Ann Arbor.

	Oğlanqala citadel	Oğlanqala domestic structures	Oğlanqala fortification walls	Sədərək settlement	Total
NAA samples (n)	46	1	3	10	60

Table 4.2: NAA samples by context

NAA was conducted for two reasons 1) to check and refine the petrographic data and 2) because several of the period 4 polished red ware sherds were too fine for petrographic analysis, and previous research by Speakman et al. (2004) suggested that these sherds were likely to be non-local in origin.

NAA specimen preparation and procedure for irradiation and gamma-ray spectroscopy used procedures established at MURR (Glascock 1992; Glascock and Neff 2003; Neff 2000). NAA of ceramics at MURR consists of two irradiations and a total of three gamma counts to produce elemental concentration values for 33-34 major and trace elements, including aluminum (Al), barium (Ba), calcium (Ca), dysprosium (Dy), potassium (K), manganese (Mn), sodium (Na), titanium (Ti), vanadium (V), arsenic (As), lanthanum (La), lutetium (Lu), neodymium (Nd), samarium (Sm), uranium (U), and ytterbium (Yb), cerium (Ce), cobalt (Co), chromium (Cr), cesium (Cs), europium (Eu), iron (Fe), hafnium (Hf), nickel (Ni), rubidium (Rb), antimony (Sb), scandium (Sc), strontium (Sr), tantalum (Ta), terbium (Tb), thorium (Th), zinc (Zn), and zirconium (Zr). Statistical analyses are carried out on base-10 logarithms of elemental concentrations. Log concentrations, as opposed to raw data, are used to adjust for differences in magnitude between major elements such as Ca and trace elements such as the rare earth or lanthanide elements (REEs). Transformation to base-10 logarithms also produces a more normal distribution for many trace elements.

The primary goal of elemental data analysis is to discern relatively homogenous groups that are distinct from other samples within the analytical database (Baxter and Buck 2000; Bieber et al. 1976; Bishop and Neff 1989; Glasscock 1992; Harbottle 1976; Neff 2000). The success of this goal depends on the applicability of the provenance postulate of Weigand et al. (1977), which states that sourcing is possible as long as inter-source differences exceed intra-source differences. If true, different chemical groups can be understood as representing geographically restricted areas. This postulate is relatively straightforward for more homogenous materials such as obsidian and chert, which can often be compared to a limited number of possible sources. This process is complicated by more widely available, and heterogenous resources such as clay. The boundaries of clay sources can be inferred by comparing unknown ceramic specimens to known clay samples, or by indirect methods such as arguments based on geological characteristics (Steponaitis et al. 1996) or the "criterion of abundance" (Bishop et al 1982; Renfrew

1977). The latter argument is the premise that objects will be most abundant closer to their source, though this is not always the case (Day and Wilson 1998).

The provenance postulate becomes problematic if a large geographic area has little compositional diversity, such as the Lower Mississippi Valley or Mesopotamia (Steponaitis et al. 1996), or great intra-deposit diversity, such as weathering of Neogene clays in Crete (Hein et al. 2004). Moreover, it is not possible to completely sample all possible clay sources since they are so widely available. This is especially true in geologically complex regions such as Naxçıvan. Additionally, differences in chemical groups may represent different clay recipes used in the same area, rather than different geographic domains, highlighting the necessity to consider chemical data alongside mineralogical and stylistic data (Day et al. 1999).

Compositional groups can be understood as "centers of mass" in the compositional hyperspace described by the measured elemental data. Groups are characterized by the locations of their centroids and the correlations between elements. A specimen's membership in a compositional group is evaluated by the probability that the measured concentrations for the specimen could be obtained from that group. Hypotheses about sub-groups can be based on non-compositional information such as archaeological context or decoration, or from the application of pattern-recognition techniques to chemical data. Cluster analysis (CA), discriminant analysis (DA), and principal components analysis (PCA) have all been applied to archaeology data, and each has its advantages and disadvantages. However, PCA is most readily applied to archaeological data since it is able to convert many correlated variable into few variables for analysis.

PCA creates a new set of reference axes, or principal components (PC) that can account for the total variance of the original data set. Each individual PC is a linear combination of the original variables. These axes are arranged in decreasing order of the variance that they represent. The data can be displayed in combinations of the new axes as biplots just as they can be displayed on the original elemental concentration axes as bivariate plots. PCA can be used as a method of pattern-recognition to distinguish sub-groups in a dataset, or as an evaluative method to assess the coherence of groups suggested by other criteria.

PCA of chemical data is scale dependent, which means that analyses can be dominated by elements with large concentrations such as Si. Therefore, data are transformed into log concentrations as a first step in the PCA in order to equalize the differences in variance between the major elements such as Al, Ca, and Fe in relation to trace elements such as the lanthanides.

One of the strengths of PCA is that it can be applied as a simultaneous R (variable, i.e. elements) and Q (object/sample) mode technique, with both variables and samples displayed on the same set of principal component reference axes (Baxter 1992; Baxter and Buck 2000; Neff 1994, 2002). A plot using the first two principal components as axes is usually the best possible two-dimensional representation of the correlation or variance-covariance structure in the dataset. Examining the first three principal components is useful for developing initial hypotheses of structure in the dataset. Displaying both objects and variables on the same plot makes it possible to observe the contribution of specific elements to group separation and to the specific shape of each group. This is called a biplot because it simultaneously plots objects and variables. The inter-relationships inferred from a biplot can be verified by examining bivariate elemental concentration plots.

It is possible to evaluate whether a group can be discriminated from other groups in multiple dimensions statistically. The Mahalanobis distance (or generalized distance) is a metric that makes it possible to describe the separation between groups or individual specimens and groups on multiple dimensions. The Mahalanobis distance of a specimen from a group centroid (Bieber et al. 1976; Bishop and Neff 1989) is defined by:

$$D^2_{x,y} = [y - \bar{X}]^t \, I_x \, [y - \bar{X}]$$

where *y* is the $1 \times m$ array of logged elemental concentrations for the specimen of interest, *x* is the $\mathrm{n} \times \mathrm{m}$ data matrix of logged concentrations for the group to which the point is being compared with $\bar{X}$ being it $1 \times m$ centroid, and I_x is the inverse of the $m \times m$ variance-covariance matrix of group *x*. Because Mahalanobis distance takes into account variances and covariances in the multivariate group, it is analogous to expressing distance from a univariate mean in standard deviation units. As with standard deviation units, Mahalanobis distances can be converted into probabilities of group membership for individual specimens.

Small sample and group sizes constrain the use of Mahalanobis distance, since if there are more elements than samples the group variance-covariance matrix is singular, making the calculation of I_x (and D^2) impossible. Therefore, the dimensionality of the groups must be reduced. One approach involves removing elements from consideration that are considered irrelevant or redundant, but this approach is vulnerable to the investigator's bias. Moreover, it limits the main advantage of multi-element analysis, which is to measure a large number of elements. An alternative solution is to calculate Mahalanobis distances with the scores on principal components extracted from the variance-covariance matrix from the complete dataset. This approach requires the assumption that the most group-separating differences should be visible on the first several principal components. This assumption generally works because a relatively small number of principal components can account for the vast majority of the variance in the dataset. Unless a dataset is unusually complex, it should be possible to yield Mahalanobis distances that come close to Mahalanobis distances in full elemental space by using enough components to account for at least 90% of the total variance in the data.

Scanning Electron Microscopy-Electron Dispersing Spectroscopy (SEM-EDS)

SEM-EDS was conducted on 12 sherds (Table 4.3). When directed at fresh fractured ceramic cross section, SEM was used to identify and characterize possible vitrification of the microstructure, which provides information on the temperature and atmosphere while firing (Maniatis and Tite 1978, 1981). An EDS attachment makes it possible to collect semi-quantitative elemental data, which was used to observe differences in slip composition. SEM creates an electron micrograph of the sherd surface by scanning it line by line with a focused beam of electrons. The interaction between the sample and these primary electrons results in the emission of electrons and photons, including secondary electrons, backscattered electrons, and X-rays. EDS measures the X-ray spectrum while the SEM is scanning, and is able to develop a profile of the elemental composition of the target (Day and Kilikglou 2001; Froh 2004; Kilikglou 1994).

Samples were selected in order to collect data on firing practices and slip composition for each major period (i.e. periods 5, 4, and 2). For each period, samples were selected that are part of the most common local petrogroup (e.g. Andesite Calcerous Group), as well as a range of other petrogroups that vary by period. The Andesite Calcareous samples make it possible to compare data on local production across periods, and the other samples make it possible to explore variation within periods. All samples were collected from the citadel excavations.

Period	Roman Parthian/ Period 2	Middle Iron Age/ Period 4	Early Iron Age/ Period 5
Number of samples (n)	4	5	3

Table 4.3: SEM-EDS samples by period

Samples were analyzed at the Penn Laboratory for Research on the Structure of Matter (LRSM). Images of ceramic fresh fractures were acquired at 15 kV with 1 torr of water vapor pressure in an FEI Quanta 600 environmental scanning microscope (ESEM). EDS spectra were collected with an EDAX Octane Super detector for 90 seconds at 15 kV and analyzed with the TEAM software package from EDAX. EDS data was collected from a single spot on the fresh fracture of the clay body, and a single spot on the slip in order to be able to compare their compositions.

Surface Treatment Analysis

The orientation of burnish stroke striations was analyzed to distinguish between different technological gestures, or different methods of accomplishing the same task. Since specific methods of technological production, including burnishing, are learned as part of a community of practice, each gesture can become ingrained as both muscle memory and social identity (Lave and Wengar 1991; Loney 2007; Wallaert 2008). As with other steps in ceramic production, diversity in methods of accomplishing the same task can indicate different nodes of production. While surface treatment application has not received the same attention as other steps of ceramic production such as clay preparation or forming, recent work has established surface treatment as a viable means of differentiating production (Ionescue et al. 2014; Lepère 2014; Timsit 1999).

In total, 597 sherds from 1200 BCE to 100 CE from Oğlanqala were examined for surface treatment, including 62 from the EIA, 332 from the MIA, and 203 from the Roman-Parthian period (Table. 4.4).

	Oğlanqala citadel	Oğlanqala domestic structures	Oğlanqala fortification walls	Sədərəkqala	Sədərək Settlement	**Total**
Early Iron Age/ Period 5	34	0	4	4	20	62
Middle Iron Age/ Period 4	263	12	37	16	4	332
Roman-Parthian Period/ Period 2	150	28	25	0	0	203
Total	447	40	66	20	24	597

Table 4.4: Surface finishing analysis samples by period and context

Each sherd was examined using a 10x magnification hand lens in shaded natural light to determine its membership in one of seven, mutually exclusive categorizations (Fig. 4.10). horizontal irregular (HI: strokes follow intersecting diagonals that are only loosely horizontal), horizontal regular (HR: strokes horizontal to the vessel rim that are parallel), vertical (V: strokes perpendicular to the vessel rim), horizontal-vertical (HI/V: strokes are perpendicular on different areas of the vessel, usually irregular horizontal on the body and vertical on the neck), polished (P: no visible strokes, very shiny), eroded (E: slip was once present but stroke no longer visible), and N/A (no slip ever present). Samples were also analyzed for evidence of manufacturing visible on the surface, but the prevalence of slipping makes this evidence rare (Lepère 2014; Rye 1981:90).

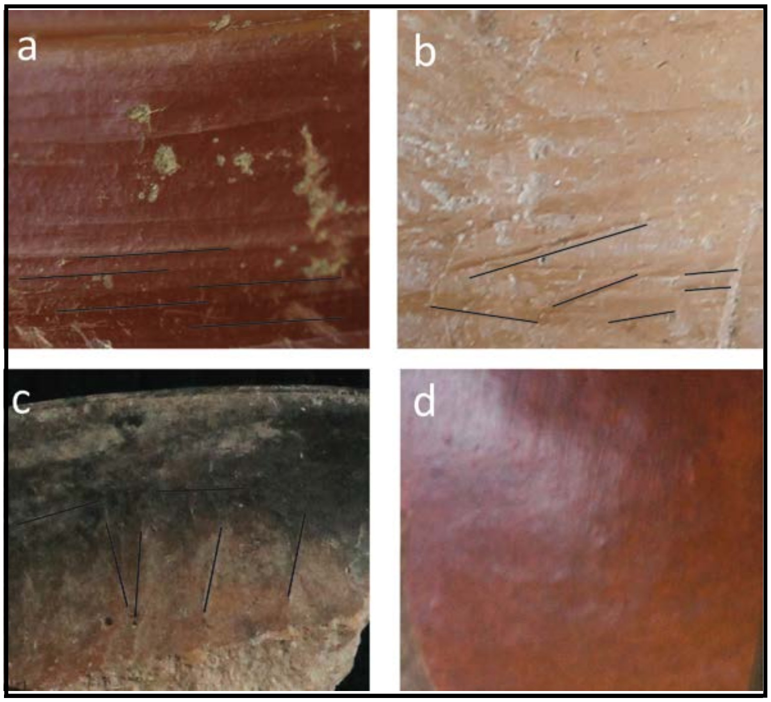


Fig. 4.10: Burnish Strokes Categories: (a) HR burnish strokes, image width 2 cm; (b) HI burnish strokes, image width 2 cm; (c) HI/V burnish strokes, image width 4 cm; (d) P burnish, image width 3 cm. Stroke direction enhanced by lines in portion of images a-c.

Conclusion

These methods and materials were deemed the most likely to produce the necessary data to reconstruct ceramic production and exchange at Oğlanqala and environs. Bruno Latour (2005) noted the remarkable capacity of materials to refute researchers' hypotheses and to even resist answering their questions at all, often proving far less amenable to scientists' wishes than human subjects. This program was designed to ask the ceramics my research questions in such a manner that they would deign to reply.

CHAPTER 5: What The Things Said: Results

In this section, I describe the results of geological survey, petrographic analysis, neutron activation analysis, scanning electron microscopy-electron dispersive spectroscopy, and surface treatment analysis. Each of these datasets will be discussed separately, though I cross-reference the results when doing so provides useful information. In the following chapter, all of these datasets will be woven together in a comprehensive analysis of this assemblage.

Geological Survey Results

Fifty-four geological samples were analyzed as petrographic thin sections (Fig. 4.8, 4.9). Twenty of these samples were also studied using NAA, which is discussed in greater depth in the following NAA results section below. This section provides a summary of the geological samples from within 10 km of Oğlanqala, Sədərəkqala, and Sədərək settlement. The remaining samples will be discussed in terms of possible matches with the ceramic samples. Refer to appendix C for descriptions of all geological samples. It is not the goal of this project to match ceramics to specific geological deposits, but rather to assess the range of geological raw materials available for production in each area.

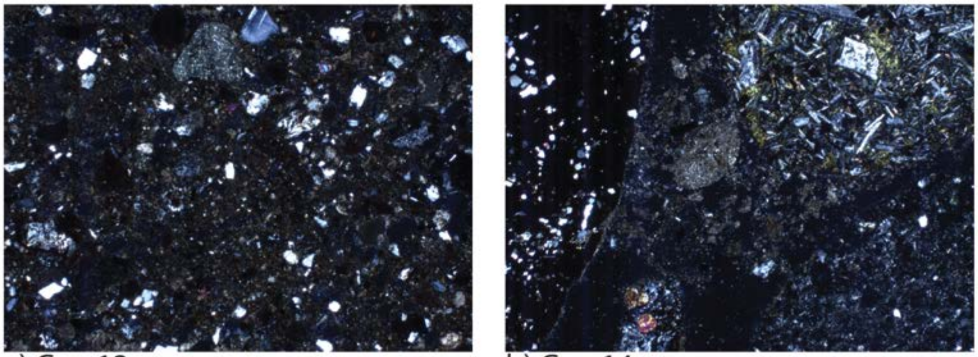
Oğlanqala Samples

Eleven geological samples were collected in the vicinity of Oğlanqala, including four silty clay/silty loam samples, five silty sand/sand samples, two rock samples, and a sample from unfired MIA mud brick from the citadel (Fig. 5.1; appendix C).

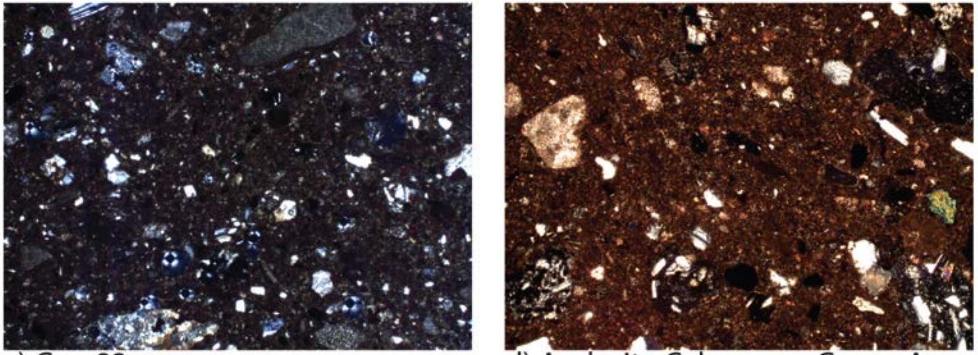
Three samples (Geo2, Geo3, and Geo4) are fine clays with silt to fine sand sized inclusions of micritic carbonate, sandstone, and acidic to intermediate volcanic rock fragments with quartz mineral fragments. These samples all come from the valley floor to the north of Oğlanqala, and are much finer than the majority of the ceramic samples in this assemblage. It is possible that sand temper was added to this clay. However, the period 2 trays (Carbonate Group A petrogroup) are quite similar to these geological samples, supporting the conclusion of local production.

The MIA mud brick sample (Geo1) has more large, gravel sized carbonate inclusions than the other local samples. Since the unfired mud brick was certainly manufactured locally, perhaps the soil on the outcrop of Qaratepe, upon which Oğlanqala sits, has more coarse, carbonate inclusions than what washes down into the valley floor. In addition, sand collected from a bulldozer cut at the base of Qaratepe (Geo83), also has coarse sedimentary inclusions. Siltstone and slate are more common than carbonates in this sample, and there is an additional presence of chert and acidic volcanics, but carbonate inclusions are common, and much of the siltstone has high proportions of carbonate material.

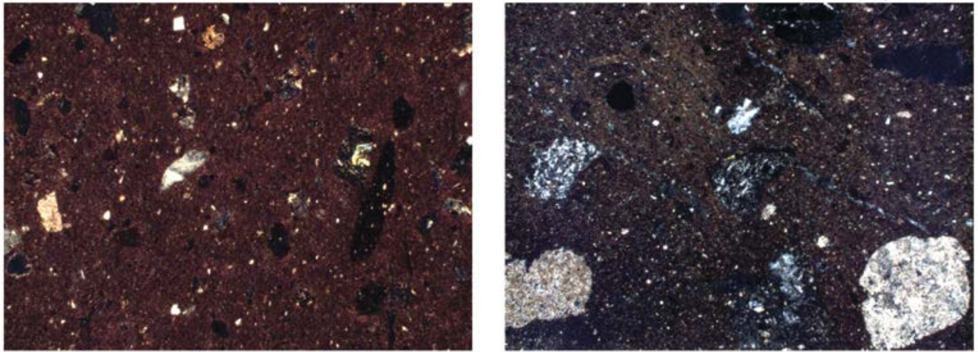
Three samples (Geo13, Geo14, and Geo82) represent the closest mineralogical match to the dominant Andesite Calcareous Group. These samples are a mix of primarily andesite and rhyodacite rock fragments, micritic carbonate inclusions, and rare sandstone as well as detrital volcanic minerals such as pyroxene, plagioclase, quartz, and amphibole (Fig. 5.2). The sand sample (Geo83) is different from these samples because it is coarse sand rather than loam, but the overall mineralogy is the same.



a) Geo 13 b) Geo 14



c) Geo 82 d) Andesite Calcareous Group A



e) Andesite Calcareous Group B f) Andesite Calcareous Group C

Fig. 5.2: Comparison of Local Geological Samples and Andesite Calcareous Group. All images XPL, width a, b, c, e, f = 4.45 mm, d = 2.25 mm

This volcanic mix, not found in local outcrops, is the product of the Arpa River passing through varied volcanic contexts and bringing andesitic sand into the river valley. Two samples (Geo13 and Geo14) were taken from the modern Arpa riverbed, which was constructed along with the two dams to the north of Oğlanqala in the 1970s, and therefore may not be a good representation of past raw material contexts. To evaluate this observation, a sample (Geo82) was collected from a road cut by Ovuçulartepesi, where the Arpa flood plain once extended. This sample was collected primarily because a local informant told me that this was where villagers collect clay to make tandirs (bread ovens). It is also the closest geochemical match (SGF020) to the HCa1, or majority of Andesite Calcareous samples (see NAA section below), indicating a strong link between sandy clay from the Arpa River and the dominant petrographic group identified at Oğlanqala.

Two samples (Geo43 and Geo44) were taken from the same outcrop in the foothills north of Oğlanqala, with Geo43 from the rock outcrop, and Geo44 fron the sediment immediately below. Both samples are primarily sandstone and sandy tuff rock fragments, with quartz grains supported by glass and clay.

A basaltic andesite (Geo19), acquired from a pile of similar rocks on top of the citadel, was brought there some time in the past. This rock was analyzed to determine if it matched the inclusions in the Trachyandesite petrofabric (see Petrographic Analysis Results below). However, Geo19 is much coarser than the trachytic textured inclusions in the Trachyandesite group, being compositionally a diabase.

Sədərək Samples

Three samples were analyzed from the Sədərək region, including two from Sədərəkqala and one from the Sədərək settlement. While neither of the Sədərəkqala samples (Geo20 and Geo21) match the mineralogy of the petrofabrics in isolation, mixed together they would match the Andesite Calcareous fabric. Geo20 is sand collected from a bulldozer cut, and consists of andesite, plagioclase, k-feldspar, pyroxene, and few carbonate grains. Geo21 is a calcareous clayey loam with a range of carbonate inclusions (sparitic, micritic, siliceous, fossiliferous). Lastly, Geo21 (SGF003) also has a strong geochemical association with HCa1, the majority of Andesite Calcareous samples (see NAA section below).

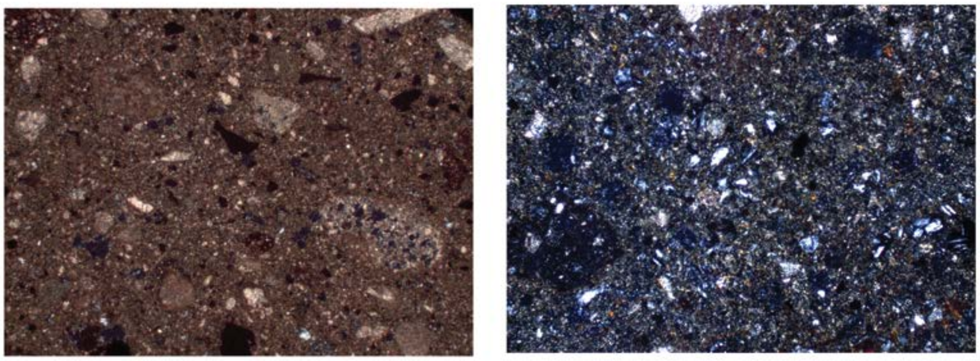

a) Geo 15
b) Geo 21

Fig. 5.3: Geological Samples from Sədərək. Both images XPL, image width = 4.45 mm

Another calcareous clayey loam (Geo 15) from the Sədərək settlement has more micritic carbonate than other varieties of carbonates, though a range is present. There are also argillaceous rock fragments (with high optical densities), suggesting that some of these fragments possibly represent extensively devitrified volcanics.

Non-Local Naxçıvan Samples

There are no conclusive matches between the non-local Naxçıvan geological samples and the ceramic assemblages. However, I will summarize some of the possible matches, as well as samples that may appear to match superficially, but in fact do not.

The largest group for possible matches are six samples that contain weathered, mixed, intermediate volcanics and micritic carbonates. These samples come from an irrigation canal in alluvial deposits in Xalac (Geo25), an Upper Triassic age hillside in

Axura (Geo37), an Eocene aged road cut in Kolani (Geo56/SGF013), an Eocene age riverbed in Milakh (Geo60/SGF015), an Eocene age road cut in Parağa (Geo72), and a Cretaceous age streambed in Kotom (Geo76/SGF019). While it is possible that the Andesite Calcareous Group includes some samples from one or several of these sources, there is no way to be certain. Moreover, the NAA data provides no evidence for these samples matching the ceramic assemblage tested.

Three samples have andesite inclusions that mineralogically match the Coarse Andesite Group, including a Jurassic age outcrop from Axura (Geo41), and a Neogene age road cut (Geo49) and hillside from Batabat (Geo53). No geochemical analysis was conducted on these samples, I simply mention them as possible sources. Three samples (Geo55, Geo69, and Geo70) are also primarily andesitic and may seem like they match based on a short description. However, all of these samples have more marked hydrothermal alterations than are present in the ceramic assemblage.

Similarly, samples from Milakh (Geo58) and Parağa (Geo73) are dominated by rhyolite, but with a trachytic texture rather than the equigranular texture found in the Rhyolite Group petrofabric.

Samples from Duz Dağ (Geo 48) and the Naxçıvan River (Geo57) are both very fine clays that visually match the Carbonate Group: Subgroup B, but that is largely because there are no inclusions to identify. Both of these samples were analyzed with NAA, and neither of them showed any probability of matching the MIA polished red wares.

Finally, sample Geo54 is visually and mineralogically very similar to the Feldspar Andesite Loner. Unfortunately, the Feldspar Andesite Loner (133) is from period 2, and was thus not part of the NAA study.

This geological survey was successful in establishing the range of local sources available around Oğlanqala and Sədərək, as well as linking some of these sources petrographically and geochemically to major petrofabric groups. However, the regional study was largely inconclusive, since the geological diversity of the region means that several potential sources were often available for the same geological signature. Also, while this survey was expansive, there are almost certainly aspects of the geological landscape that were not covered. However, no matches were found for some of the more mineralogically narrow petrogroups (e.g. Rhyolite, Dacite, Serpentinite), suggesting that they derived from regions beyond the modern borders of Naxçıvan.

Petrographic Analysis Results

The 274 petrographic thin sections have been grouped into eight petrofabric groups, two petrofabric pairs, and eleven single sample fabrics (i.e. loners) (appendix B). This section contains narrative summary descriptions of the petrofabrics (refer to appendix D for long form descriptions). Since this is a diachronic study, petrofabric descriptions are ordered first by the period in which they most commonly appear, second by abundance, and third alphabetically.

Early Iron Age/Period 5

The 86 petrographic samples dated to the EIA include one petrofabric group (Andesite Calcareous) that can be found in all periods, four loners, and one single sample from a petrogroup (Coarse Andesite) that is primarily associated with the MIA, and will thus be described in that section. In the EIA, all of the Sədərək settlement (n=21) and Sədərəkqala (n=4) samples, and 92% of the Oğlanqala samples (n=56/61) belong to the Andesite Calcareous Group, which is considered broadly local. A full discussion of what "local" means in the context of this project is in the following chapter. The five other samples are all characterized by different petrofabrics, and were only found at Oğlanqala (Fig. 5.3).

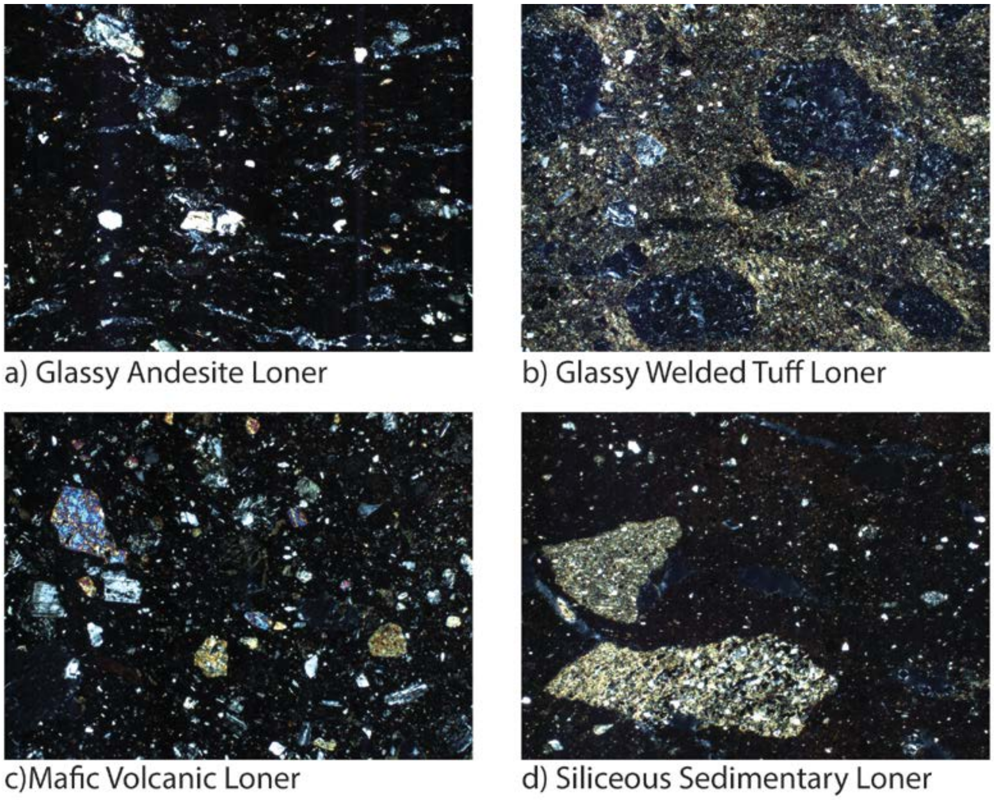


Fig 5.4: Period 5 Petrofabrics. All images XPL, image width a = 2.25 mm, b, c = 4.45 mm. For Andesite Calcareous Group, see Fig. 5.2 d-f

Andesite Calcareous Group

Fig. 5.2 d-f

n=169 for all contexts, periods; samples:

Subgroup A (n=80): 2, 4, 10, 15, 17, 21, 29, 31, 37, 38, 42, 48, 49, 54, 60, 63, 69, 74, 75, 80, 86, 98, 101, 102, 109, 112, 116, 121, 122, 126, 132, 138, 153, 155, 160-162, 164, 165, 168, 173, 185, 192, 194, 208, 209, 213, 217, 223, 224, 225, 230, 234, 237, 251, 252, 254, 258, 259, 262-264, 270-272, 274, 278, 282, 289-291, 294, 296, 300, 303, 306, 309, 310

Subgroup B (n=56): 3, 39, 53, 70, 79, 82, 88, 89, 91, 99, 103, 114, 118, 145-149, 159, 163, 171, 172, 180, 183, 193, 203, 205, 207, 210, 214, 239, 240, 243, 244, 248-250, 253, 255, 256, 260, 261, 266, 267, 273, 277, 279-281, 283, 285, 301, 302, 304, 308, 311

Subgroup C (n=33): 18, 72, 73, 76, 81, 83-85, 87, 90, 92-94, 105, 125, 139, 151, 166, 167, 169, 202, 204, 211, 241, 242, 245, 246, 257, 265, 269, 275, 286, 287

This group is extremely heterogenous, and encompasses the majority of the samples from this assemblage (169 out of 274, 62%). However, the heterogeneity is continuous, representing a diverse but limited range of methods for using the same basic materials: fine calcareous clay available throughout the plain and foothills in Şərur and Sədərək, well sorted and poorly sorted river sand dominated by intermediate volcanics, and sandy clay from the riverbeds. Vessels were fired in relatively low temperatures (500-800°C) in both oxidizing and reducing atmospheres, with the former mostly replacing the latter from period 5 to period 2.

While the mineralogy of these samples is similarly heterogeneous, they are all present in the Arpa River or Sədərək drainage system. The dominant constituents are intermediate volcanics (e.g. andesite and rhyodacite) in a range of textures and compositions and a wide variety of carbonate rock fragments. Felsic, intermediate, and mafic volcanics are all present. Many of the volcanics are partially devitrified and/or altered by carbonates. The main inclusions are sub-angular to sub-rounded trachyandesite, porphyritic andesite, and carbonate rock fragments, with k-feldspar, plagioclase, pyroxene and amphibole mineral fragments. In addition (in order from most to least prevelant), felsic-intermediate subvolcanics, sandstone, microfossils (primarily planktic foraminifera), quartz, and chert are also present, though less common. The majority of the limestone is micritic, though there is a considerable range present, including siliceous, fossiliferous, and sparitic. The fine fraction does not differ from the coarse fraction mineralogically

Differences in mineralogy are the result of the various ways these materials were deposited over time in different micro-contexts. The presence or absence of particular minerals is continuously overlapping, though the main constituents remain constant. The only possible indicator of provenience is biotite, which is present in the majority of the Sədərək samples (n=39 out of 46, 85%), and approximately half of the Oğlanqala samples (n=61 out of 117, 52%). Moreover, this disparity becomes greater when I compare the Sədərək samples, which are only dated to periods 4 and 5, to Oğlanqala samples only from periods 4 and 5, in which 38 out of 84 (45%) samples have biotite. Since biotite is present in such a high proportion of the Sədərək material, it is possible that at least some percentage of Oğlanqala material with biotite came from Sədərək. The higher proportion of biotite (20 out of 30, 67%) in period 2 Oğlanqala material probably represents the use of a slightly different local clay source, which would be expected from a five hundred year time difference between periods 2 and 4. However, the amounts of biotite are so small in any sample (<3%) and naturally present in the geology of either plain (though seemingly in different amounts), making this an unreliable marker of provenience or production.

The range of methods applied to these same raw materials is observed through their differences in inclusion size, porphyric relative distribution (PRD)[8], and groundmass. Therefore, subgroups were distinguished based on these criteria. PRD and inclusions modality was prioritized since this proved to be the most consistent means of differentiation. However, inclusion size and groundmass differences loosely map onto PRD, which in turn can be related to chronological change. Subgroup A is the largest group (n=80), and is characterized by close to double (mostly single) space PRD and seriated modality. This group has smaller, more poorly sorted inclusions on average, and is more likely to be fired in an oxidizing firing atmosphere at moderately higher temperatures than the rest of the assemblage. Subgroup B is an intermediate group with double to open PRD and poor to moderately sorted inclusions, a seriated modality with a relatively coarse/abundant fine fraction. Subgroup C (n=33) is characterized by double to open space PRD and bimodal inclusions. The inclusions in this subgroup are generally larger, more well sorted, and are more often fired in an reducing atmosphere at lower temperatures.

These are subgroups rather than separate petrofabrics because the differences between them are nebulous. Subgroups A and C were delineated because clearly

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[8] Porphyric relative distribution (PRD) refers to the spacing of aplastic inclusions relative to each other. For example, double space PRD means that aplastic inclusions are separated from each other by twice the mean diameter of the aplastic inclusions for that sample (Whitbread 1995; Quinn 2013).

distinguishable clay processing methods were visible for these samples. The characteristics of subgroup A indicate that this clay was primarily naturally coarse river clay, though it is certainly possible, even likely, that in some samples more sand was added without concern for grain size while some of the coarser inclusions were removed, and/or sandy clay was mixed with finer clay. The bimodality of the inclusions in subgroup C indicates that particularly coarse, perhaps sieved sand, was added to fine calcareous clay as temper. The subgroup B (n=56) largely represents the samples that could have been end-members in either subgroup, and demonstrates the continuousness of this heterogeneity. Subgroup B may represent finer clay with a relatively small amount of sand temper added, or a preference for a clay source that has fewer natural inclusions than what is used for subgroup A. Clearly ceramic producers were making choices about the coarseness of their clay, and used their knowledge of local resources to develop clay recipes to suit their needs.

The distribution of these subgroups is chronological, indicating changes in local production methods over time (Table 5.1; Fig. 5.2 d-f). There is a general trend from a relatively even distribution of varied clay preparation methods in period 5 to a more narrow focus on clays with smaller but more abundant inclusions (Andesite Calcareous A) in period 2. The change in proportion of subgroups from the EIA to the MIA (χ^2=9.0069, $p < 0.05$), and the MIA to the Roman-Parthian period (χ^2=18.9376, $p < 0.05$) is significant. However, the nebulousness of these subgroups as well as the small counts for the Roman period limit the reliability of this test. While the sample for period 3 supports the idea of a slow shift, it is too small of a sample size to be considered representative. The larger shift in local clay preparation practices, including the preference for subgroup A and the increase in biotite indicating different local clay sources, is expected after a 500 year chronological gap, and could represent more rapid or more gradual change.

As expected for the largest petrogroup, the Andesite Calcareous group has enormous variation in ceramic forms. It represents 94% (n=81/86) of the total period 5 assemblage sampled, 50% (n=50/100) of period 4, 70% (7/10) of period 3, and 38% (n=30/78) of period 2. The formal variation means that nearly every vessel type is represented in this group, including several types of bowls, plates, pithoi, jars, and trays (appendix B).

	EIA/Period 5	MIA/Period 4	LIA/Period 3	Roman/Period 2
Andesite Calcareous A	32% (n=26/81)	42% (n=21/50)	71% (n=5/7)	83% (n=25/30)
Andesite Calcareous B	37% (n=30/81)	46% (n=32/50)	29% (n=2/7)	10% (n=3/30)
Andesite Calcareous C	31% (n=25/81)	12% (n=6/50)	0% (n=0/7)	7% (n=2/30)

Table 5.1: Distribution of Andesite Calcareous subgroups as a percentage of Andesite Calcareous samples present in each period.

This group is interpreted as broadly local, both based on the criterion of abundance (Bishop et al 1982; Renfrew 1977) and matches with geological samples (Geo13, Geo14, Geo82) from the Arpa River. However, 'local' in this context means both the Şərur and Sədərək valleys, since it was not possible to clearly differentiate between these samples petrographically. In addition, other geological samples (Geo25, Geo37, Geo56, Geo60, Geo72, Geo76) cannot be excluded as potential matches. It is possible, even likely that this group contains some non-local samples. The NAA results were helpful in clarifying this issue, and will be discussed below. However, the Andesite Calcareous group is understood as broadly local.

Coarse Andesite Group

See summary description in MIA/Period 4 section on pg. 164. One sample (104) from this group, a grey carinated bowl from the citadel, was dated to period 5.

Glassy Andesite Loner

Fig. 5.4:a

n=1, sample 142

This fabric is characterized by sub-rounded, poorly sorted fine to coarse sand sized glassy andesite with pyroxene and feldspar phenocrysts. Secondary inclusions include (from most to least prevalant) unidentifiable acidic volcanics, orthoclase, quartz, pyroxene, sandstone, and muscovite. The inclusions are single to double spaced and poorly sorted, which along with the consistent mineralogy suggests that this fabric is naturally coarse. The groundmass is dark red brown with low optical activity, suggesting an oxidizing firing atmosphere. This sample comes from a brown everted rim jar. It is not possible to narrow down the source of these materials, since andesite flows are so common. The lack of carbonates suggets it is likely non-local.

Glassy Welded Tuff Loner

Fig. 5.4:b

n=1, sample 77

This fabric is characterized by sub-rounded, coarse sand sized glassy welded tuff fragments. The inclusions are double spaced, bimodal with a well-sorted fine fraction, suggesting the use of temper. While the glassy welded tuff predominates, there are rare examples of glassy andesite and micritic carbonate rock fragments as well as orthoclase, and pyroxene mineral fragments. The groundmass is light brown with a brown core and optically active, suggesting that it was low fired in a reducing atmosphere. This sample was taken from a base, so its form is unknown. Since tuff is very common throughout the region, it is difficult to define a source but it is likely non-local.

Mafic Volcanic Loner

Fig. 5.4:c

n=1, sample 247

This fabric is characterized by a very high aplastic density in both the coarse and fine fraction, mostly consisting of basalt rock fragments and detrital minerals including plagioclase, pyroxene, and olivine. Diabase and rhyodacite rock fragments are also present, as well as their detrital minerals including amphibole, biotite, and quartz. The groundmass is mostly dark brown with low optical activity and low porosity.

The inclusions appear to be naturally occurring (rather than additive, i.e. temper), likely the result of a riverbed with a drainage system that passes through a few different volcanic/subvolcanic rich contexts. It is certainly non-local, but its provenience cannot be determined with greater precision. This sample comes from an EIA brown jar from the Oğlanqala citadel.

Siliceous Sedimentary Loner

Fig. 5.4:d

n=1, sample 78

This fabric is characterized by fine gravel sized fragments of siliceous calcareous siltstone with silt to medium sand sized quartz/feldspar inclusions. Some fragments have a laminate structure (e.g., similar to shale). Additionally, there are coarse sand sized micritic carbonate and coarse sand sized and smaller intermediate volcanic inclusions. Minor inclusions appear to be detrital from these rock fragments and include quartz, orthoclase, plagioclase, and pyroxene. The fine fraction has more volcanic inclusions than the coarse fraction. In addition, the sedimentary fragments are much larger than the volcanic fragments, suggesting that the sedimentary material may have been added as temper to a more volcanic rich clay. The large, elongated rock fragments and macro-planar voids are parallel to the vessel walls. The groundmass is moderately optically active with an orange brown color that indicates it was fired in an oxidizing atmosphere.

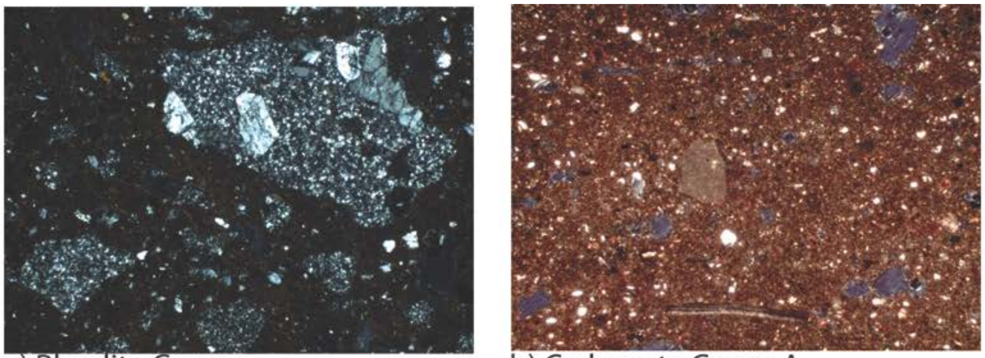
This sample is a buff jar found in the EIA kurgan at the base of Oğlanqala. It is stylistically and petrographically related to similar jars found in the MBA-EIA canal cut context by Qiz Qala (Fishman et al. 2015). The coarse fraction and microstructure of this sample is similar to the Sedimentary Group for the MBA samples, and could be placed with this group except for the volcanic fine fraction, which places it closer to Andesite Calcareous subgroup C for the MBA samples.

Middle Iron Age/Period 4

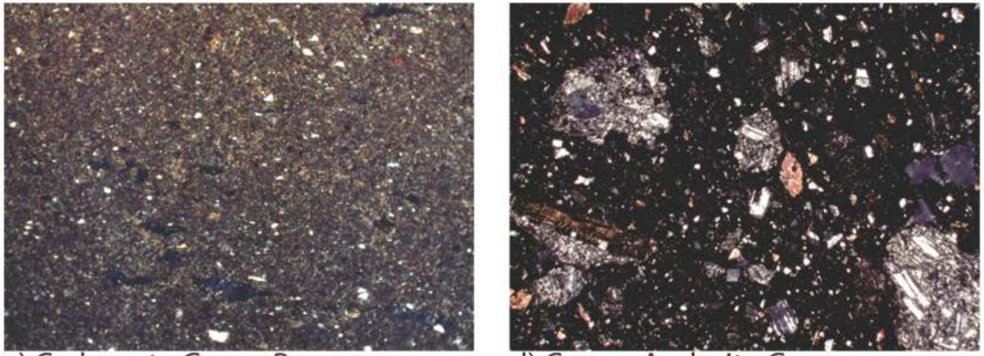
The 100 petrographic samples dated to the MIA include seven petrofabric groups (including the Andesite Calcareous group), two pairs (one of which spans two periods), and five loners (Figs 5.5, 5.6). In the MIA, 100% of the Sədərək settlement samples (n=18), most of the Sədərəkqala samples (n=3/4), and 38% of the Oğlanqala samples (n=30/78) belong to the broadly local Andesite Calcareous Group. The remaining Sədərəkqala sample (305) is a non-local, Sandstone Rhyolite Loner. The considerable petrographic diversity found in the MIA assemblage is mostly encompassed by the remaining 50 samples from Oğlanqala, including the likely local Andesite Calcareous Group, Carbonate Volcanic Loner, and Volcanic Carbonate Loner; the ambiguous Trachyandesite Group, Micritic Carbonate Loner, and Glassy Welded Tuff Feldspar Loner; and the non-local Rhyolite Group, Coarse Andesite Group, Fine Glassy Andesite Group, Dacite Group, Andesitic Sand Pair, Metamorphic Pair, Micritic Carbonate Loner, Sandstone Rhyolite Loner, and Volcanic Conglomerate Loner.

Andesite Calcareous

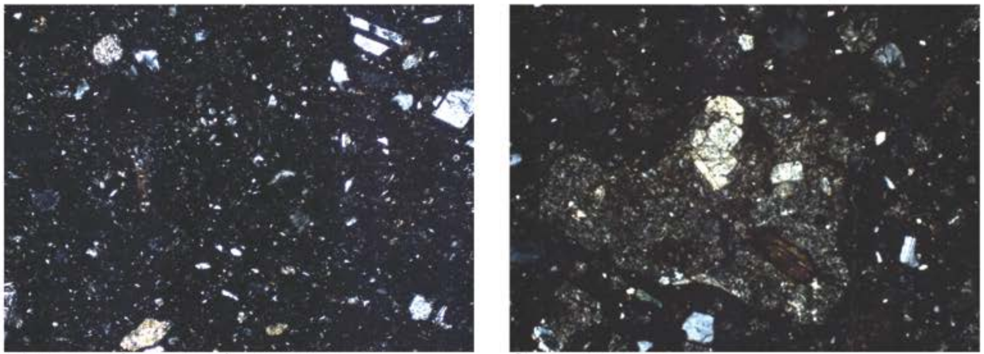
See summary description in EIA/Period 5 section on pg. 150. 50 MIA samples belong to this petrogroup.



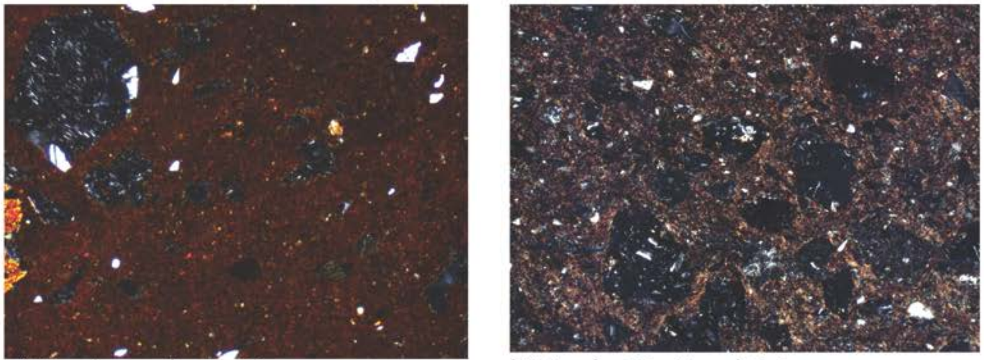
a) Rhyolite Group b) Carbonate Group A



c) Carbonate Group B d) Coarse Andesite Group

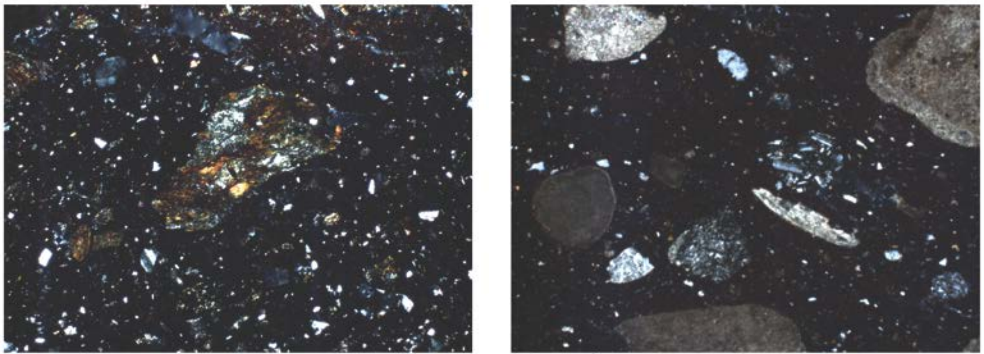


e) Fine Glass Andesite Group f) Dacite Group



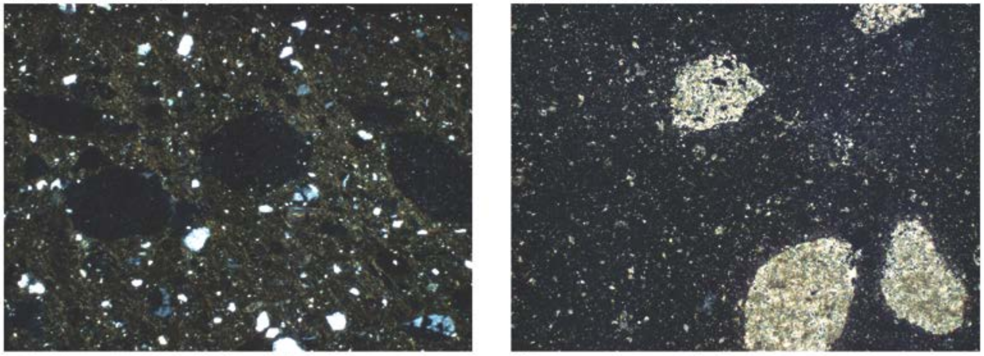
g) Trachyandesite Group h) Andesitic Sand Pair

Fig, 5.5: Period 4 Petrofabrics. All images XPL, image width a, b, c, d, f, g = 4.45 mm, e, h = 2.25 mm



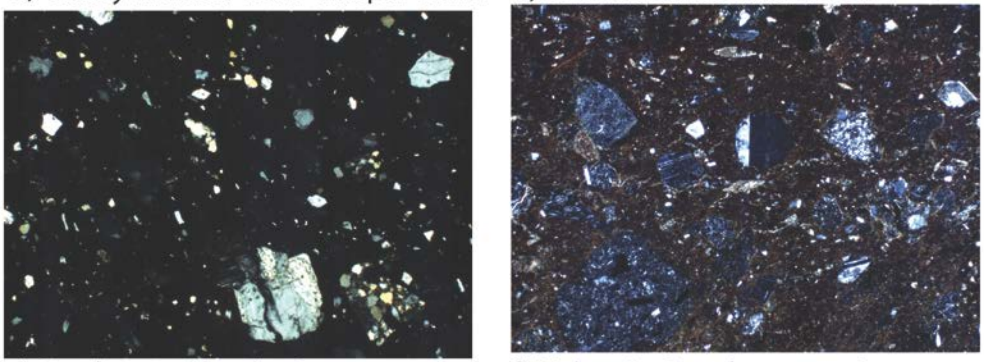
a) Metamorphic Pair

b) Carbonate Andesite Loner



c) Glassy Welded Tuff Feldspar Loner

d) Micritic Carbonate Loner



e) Sandstone Rhyolite Loner

f) Volcanic Conglomerate Loner

Fig. 5.6: Period 4 Petrofabrics: All images XPL, image width = 4.45 mm

Rhyolite Group

Fig. 5.5:a

n=10, samples 24, 120, 175, 176, 191, 196, 197, 199, 200, 206

This group is characterized by sub-rounded to sub-angular rhyolite inclusions with a continuous grain size range from silt to fine gravel sized, mostly in the medium to coarse sand size fraction. Rhyolite can be weathered, and contain porphyritic quartz and/or feldspar crystals, with rare biotite. Most of the other mineral inclusions appear to be detritally derived from the rhyolite, including biotite, quartz, orthoclase, and plagioclase, along with very rare carbonates and muscovite. The inclusions are single to double spaced. The groundmass is heterogenous, including red brown, light brown, dark brown, and black, suggesting uneven firing in a mostly reducing atmosphere. This fabric is mostly optically active except for the black areas. The black is the result of carbon present in both the core and the surface, indicating that it remains from firing and was deposited during use. The continuous grain size, uneven distribution, and the identical mineralogy in the coarse and fine fraction indicates that this fabric is naturally coarse, with no evidence for temper additives. The coarseness of the fabric suggests that it must have been hand built, and a relic coil is visible in sample 130.

This fabric was used to make a limited range of shapes that were all slipped, burnished, and fired to an uneven grey-brown color. This fabric includes three thick rimmed bowls, three cooking pots, three carinated bowls, and one everted rim jar. The consistency of the mineralogy indicates that these vessels were made within a very small geological area. The closest sources for the material in this group are Tertiary age deposits in a line about 70 km northeast of Oğlanqala, near the Urartian center of Erebuni, and the Urartian border fortress of Tsovinar (Fig. 4.6).

Carbonate Group

Fig. 5.5:a,b

n=11 for all contexts, periods; samples:

Subgroup A (n=7): 11, 13, 36, 52, 100, 129, 177

Subgroup B (n=4): 30, 115, 135, 154

This group consists of a fine carbonate groundmass with (from most to least prevalant) micritic and fossiliferous carbonate, quartz, feldspar, and sandstone inclusions, with rare felsic to intermediate volcanic inclusions. While all of the samples in this petrofabric have an open spaced PRD, they are divided into subgroups based on the size and percent density of their inclusions.

Subgroup A (n=7) is coarser, with a lower percentage of clay matrix and medium to coarse sand sized inclusions. Subgroup A appears to be naturally coarse with no evidence of temper. Subgroup B (n=4) is extremely fine, with the vast majority of inclusions fine sand sized or smaller. Subgroup B may have been levigated, although it also may be naturally fine, since clays of this quality were found in geological survey. The differences between these subgroups could be the result of different clay preparation methods and/or clay sources. Subgroup A includes four samples from period 4, including three (52, 100, 129) fine, red slipped bowls that are similar to Urartian palace ware, as well as a simple orange jar. Subgroup A also includes three (11, 13, 36) samples from period 2, all of which are the same simple tray form, seemingly hastily thrown together with readily available calcareous mud. Subgroup B, which is finer than subgroup A, is used to make fine red palace wares from bowls or unidentifiable body sherds. Both coarse and fine carbonate clay is readily available in the Şərur plain, but some of these samples were imported (see NAA section for these results).

Coarse Andesite Group

Fig. 5.5:d

n=11, samples: 104, 108, 110, 117, 127, 131, 136, 143, 144, 186, 221

This coarse fabric is characterized by sub-rounded porphyritic andesite rock fragments that are generally quite weathered. Also present are detrital pyroxene, amphibole, biotite, k-feldspar and plagioclase mineral fragments, as well as rare carbonates and quartz. However, the mineralogy of each sample is a little different, with andesite that can range from glassy to cystallitic, and a range of plagioclase, orthoclase, pyroxene, amphibole, and biotite inclusions. Usually a single sample contains a relatively narrow range of andesitic variation, though all of these samples exist on the andesitic continuum and there is overlap from between specimens. This suggests that these group members do not come from the same immediate production context, but rather from different contexts that use similar materials and methods of production.

The fine fraction of each sample consists of minerals also found in the coarse fraction, and the largest fragments are fine gravel sized, with a continuous range of smaller sizes, indicating that this is a naturally coarse fabric. However, the optically inactive groundmass makes it difficult to be certain. The groundmass of these samples appears almost black, with low optical activity as a result of incompletely burned carbon. These were fired at relatively low temperatures in a highly reducing atmosphere, and in many cases additional carbon was deposited during use as a cooking pot. Whether naturally coarse or the product of additive temper (or both), this fabric is extremely coarse, with a coarse fraction of 30-35%.

There is one EIA sample in this fabric, a carinated grey bowl. The Coarse Andesite petrofabric is most common in the MIA, when it was used to produce mainly brown, grey, and black cooking pots (n=6), as well as one grey thick rimmed bowl. Volcanic inclusions, seriated inclusion sizes, and course fractions (>20%) all improve thermal shock resistance, which indicates that the technological similarities between these samples were the result of functional considerations for the cooking pots (West 1992). In the Roman-Parthian period this group is used to make a red slipped everted rim jar, a red slipped simple rim bowl, and a lamp. It is possible that this fabric was favored for the lamp for the same reasons (thermal shock resistance) it was favored for MIA cooking pots, thermal shock resistance. However, for the jar and the bowl it simply seems to indicate production of these materials in different contexts.

It is unlikely that any of these samples were produced in the Şərur plain, since volcanic materials enter the area mainly as a mix from the Arpa River, and the range of andesite in each of these samples is too narrow to have come from that source. The closest large andesitic context is located in Axura, the valley just 12 km east of Oğlanqala with several Classical period (i.e. Roman-Parthian period) sites (Ristvet et al. 2011). There are also smaller outcrops from dikes throughout the area around Oğlanqala and Axura, and andesitic formations are common ~20 km to the south and north of Oğlanqala. In fact, andesitic formations are common throughout the South Caucasus, and sampling on geological survey has only helped to demonstrate the ubiquity and variety of this rock type (*Geological and Mineral Resources of Azerbaijan* 2000: 21-26, 31-37). There is currently no way to establish the source(s) for this group, but it is possible to determine that they are not from the Şərur plain and likely come from a range of production contexts using similar materials and technologies.

Fine Glassy Andesite Group

Fig. 5.5:e

n=7, samples: 178, 179, 184, 187, 188, 198, 212

This group is characterized by sub-rounded to angular, moderately well sorted fine sand sized glassy andesite inclusions, though medium and coarse sand sized inclusions are present as well. The andesite is typically "fresh," meaning there is little evidence of weathering. Phenocrysts can include plagioclase, orthoclase, and clinopyroxene, sometimes with boundaries merging into the groundmass. Most of the other mineral inclusions appear to be detrital from the andesite, including pyroxene, plagioclase, quartz, orthoclase, biotite, and amphibole. The only non-detrital material is rare rhyolite and volcanic conglomerate rock fragments. The inclusions are single to close spaced. The groundmass can be brown, dark brown, red brown, and black with varied optical activity, suggesting uneven firing. The black is the result of carbon present in both the core and the surface, indicating that the carbon may remain from firing and/or was deposited during use. The evidence is inconclusive regarding whether this fabric is naturally coarse or tempered.

This fabric was used to make a limited range of shapes that were all slipped, burnished, and fired to a mottled grey-brown color. This fabric includes two thick rimmed bowls, and five carinated bowls (in two different varieties). The similar minerology and fabric matrix indicate that this group was produced within a small geographic area. However, it is difficult to narrow down the area since andesite flows are so prevalent throughout the region. Currently, it is only possible to say that this group was not produced in the Şərur, nor using the same andesite found in the Coarse Andesite Group.

Dacite Group

Fig. 5.5:f

n=6; samples: 16, 134, 182, 189, 195, 232

This group is characterized by sub-rounded to sub-angular dacite inclusions with a continuous grain size range from silt sized to fine gravel sized, mostly in coarse sand size fraction. Dacite is often highly weathered, sometimes visibly disintegrating into the groundmass. Grain boundaries within the dacite are unclear, and pheocrysts include amphibole, quartz, and orthoclase. Most of the other mineral inclusions appear to be detritally derived from the dacite, including orthoclase, amphibole, pyroxene, plagioclase and quartz. The only non-detrital material are rare argillaceous rock fragments. The inclusions are single to double spaced. The groundmass can be red brown, light brown, dark brown, and black with varied optical activity, suggesting uneven firing. The black is the result of carbon present in both the core and the surface, indicating that it both remains from firing and was deposited during use. The continuous grain size, visible disintegration of inclusions, and the identical mineralogy in the coarse and fine fraction suggests that this fabric is naturally coarse, with no evidence for temper additives. The coarseness of the fabric means that it must have been hand built.

Five (134, 182, 189, 195, 232) of the six samples made in this fabric are dated to period 4, and made in a limited range of shapes that were all slipped, burnished, and fired to a mottled grey-brown color. This includes three carinated bowls, one thick rim bowl, and one lamp. The chronological outlier (16) is a cooking pot that was dated to period 2, although it was found on the surface of the citadel and cooking pots are very difficult to date. The consistency of the mineralogy indicates that these vessels were made within a very small geological area. The closest sources for the material in this group are Tertiary deposits in a line about 70 km northeast of Oğlanqala, near the Urartian center of Erebuni, and the Urartian border fortress of Tsovinar (Fig. 4.6).

Trachyandesite Group

Fig. 5.5:g

n=4; samples 50, 58, 157, 158

This group has a red brown groundmass with medium to coarse sand sized trachyandesite inclusions. The andesite is occasionally carbonate altered and contains porphyritic plagioclase and pyroxene. The inclusions are angular to sub-angular. Though there is a range of inclusion sizes present, the fine groundmass, inclusion angularity and presence of a single rock type indicates that this was likely tempered. These vessels were fired in an oxidizing atmosphere at relatively high temperatures for Oğlanqala materials. Samples 50 and 158 each have evidence for a relic coil, which is not surprising for such a large, coarse vessel. All of these samples come from period 4 storage jars that are too large to have been easily moved. However, andesite is not found in isolation in the valley, but rather arrives as a mix of weathered sand. Since this is freshly crushed andesite, either the temper or the vessels must have been imported, though the abundance of andesite regionally means that it need not have been imported from very far away.

Andesitic Sand Pair

Fig. 5.5:h

n=2, samples: 174, 181

This fabric is characterized by fine to coarse sand sized sub-angular to sub-rounded double spaced dominant andesitic sand inclusions. There are also few to very few rhyolitic sand sized inclusions, and minerals that are largely detrital from the volcanics, including quartz, orthoclase, plagioclase, clinopyroxene, and orthopyroxene. Accessory inclusions include volcanic conglomerate, chalcedony, and glass. The groundmass is brown to red brown with dark brown margins, and optically active. The voids are mostly meso planar and are oriented parallel to the vessel walls, with one sample (181) showing evidence of a join near the carination. Andesite is too common to narrow down a geological source, but the lack of carbonates makes it unlikely that these were locally produced. Both of these samples are dark grey carinated bowls from the MIA citadel at Oğlanqala.

Metamorphic Pair

Fig. 5.6:a

n=2, samples: 62, 120

This fabric is characterized by seriate sized metamorphic inclusions that can range from fine gravel to silt sized, with the rock fragments sometime visibly decomposing into the groundmass. There are two main categories of metamorphic fragments: meta-igneous (phyllite to schist) and meta-sedimentary (slate to schist). The former is primarily quartz and orthoclase with accessory actinolite-tremolite series fibrous amphibole, epidote, and pyroxene. The latter is primarily clay minerals with silt to sand sized quartz/feldspar and fibrous amphibole inclusions. The proportion of inclusions in the meta-sedimentary fragments generally increases with the grade of metamorphism. The seriate grain size and visible decomposition of rock fragments suggests that this is a naturally coarse fabric, and possibly a primary clay. The groundmass is orange brown and the optical activity suggests a low firing temperature in an oxidizing atmosphere.

Both of these samples are jars from the Oğlanqala citadel, with sample 62 coming from a MIA/period 4 brown jar/cooking pot, and sample 120 coming from a LIA/period 3 buff jar.

The closest potential geological source for these is a Precambrian schist near Verachram, though it is not a perfect match. Geological maps indicate that the context by Verachram is primarily characterized by metamorphosed carbonates, though metamorphosed acidic volcanics are also present (*Geological Survey of Iran: Maku*, 1975).

Carbonate Andesite Loner

Fig. 5.6:b

n=1, sample: 47

This fabric is characterized by poorly sorted, medium sand to fine gravel sized micritic, sparitic, and fossiliferous carbonates and andesite rock fragments, with the former more prevalent. Secondary inclusions include (from most to lease prevalent) chert, plagioclase, quartz, orthoclase, quartzite, and pyroxene. Although poorly sorted, the inclusions are bimodally distributed, suggesting that this fabric may contain additive temper. The groundmass is red brown and optically active, indicating that this was low fired in an oxidizing atmosphere. This sample came from a large, period 4 storage jar from the top of the citadel.

This fabric is similar to the Andesite Calcareous Group. It is differentiated by the high frequency and large size of the carbonate inclusions, whereas the andesite fragments are a secondary inclusion, which is the reverse pattern of the Andesite Calcareous Group. It is possible that this is also a local fabric with the raw materials simply combined in different proportions, possibly a local rendering of the otherwise imported massive storage jars made in the Trachyandesite fabric. However, none of the clay samples taken around Şərur had such large carbonate inclusions, indicating that this might come from farther away.

Glassy Welded Tuff Feldspar Loner

Fig. 5.6:c

n=1, sample 23

This fabric is characterized by sub-angular to sub-rounded silt sized to coarse sand sized glassy welded tuff and feldspar, primarily orthoclase. Secondary inclusions include (from most to leaset prevelant) quartz, argillaceous rock fragments, pyroxene, amphibole, plagioclase, and sparitic carbonate. The inclusions are single to double spaced, unimodal, poorly sorted, and have the same mineralogy in the coarse and fine fraction, indicating a naturally coarse fabric. The groundmass is light brown and optically active, with the exception of the interior wall, which is dark brown and optically inactive. It is unclear whether this is from firing or use. This sample comes from a period 4 brown everted rim jar from the top of the citadel. Tuff is too common throughout the region to narrow down the source. Though it is likely to be non-local, tuff can be found locally in small pockets, as seen in Geo43. However, the tuff seen in sample Geo43 is far sandier than the nearly pure glass seen in this ceramic sample.

Micritic Carbonate Loner

Fig. 5.6:d

n=1, sample: 170

This fabric is characterized by moderately well sorted coarse sand to fine gravel sized sub-rounded micritic carbonate inclusions. Secondary inclusions include andesite rock fragments and chert, quartz, and biotite mineral fragments. The inclusions are bimodal, suggesting that they were added as temper, although the fine and course fractions are mineralogically similar. The groundmass is light brown and optically active, indicating that it was low fired in a reducing atmosphere. This sample comes from a period 4 grey tan bowl. This fabric could be local and simply represent a different use of local materials than members of the Andesite Calcareous Group. It minimally represents different local material use, and may be non-local.

Sandstone Rhyolite Loner

Fig. 5.6:e

n=1, sample 305

This fabric is characterized by poorly sorted sub-rounded to angular coarse sand sized to fine gravel sized sandstone, followed by highly weathered medium to coarse sand sized sub-rounded rhyolite rock fragments, with rare andesite siltstone rock fragments. The rest of the inclusions appear to be detrital from the rocks, including quartz, orthoclase, plagioclase, biotite, and pyroxene. The inclusions are single spaced in a continuous range of sizes, indicating that this is likely a naturally coarse fabric. There appears to be a relic soil visible, an expected forming method for such a coarse clay. The groundmass is black and optically inactive, seemingly from firing. This sample comes from a period 4 brown jar with a carinated rim. This sample is not local, and the closest source I was able to determine based on geological maps was Lower Quarternary deposits with both sandstone and mixed volcanic deposits approximately 140 km northwest near the Turkey-Armenia border (Dallegge et al. 2010).

Volcanic Conglomerate Loner

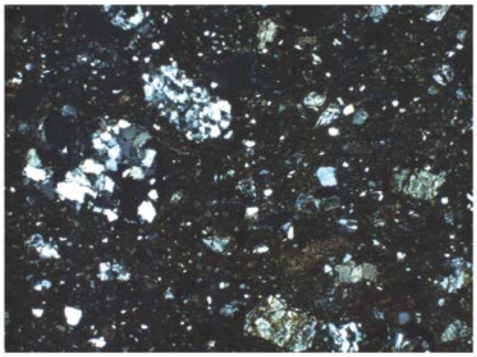
Fig. 5.6:f

n=1, sample: 190

This fabric is characterized by poorly sorted, sub-rounded medium to coarse sand sized rhyodacite and volcanic conglomerate. Secondary inclusions appear to be largely detrital from rock fragments, including quartz, orthoclase, plagioclase, biotite, and amphibole mineral fragments with rare carbonates, though very few of the latter were original inclusions. This sample has high proportions of post-depositional carbonate material that completely coats and often fills voids (strongly impregnated crystalline hypocoatings). The inclusions are single to double spaced with a continuous range of grain sizes, suggesting that this fabric is probably naturally coarse. The groundmass is red brown and optically active, suggesting that it was low fired in an oxidizing atmosphere. This sample comes from a period 4 brown slipped jar with an everted rim from the top of the citadel. This sample is not local, and the closest source for a strong match is the Pliocene aged formation approximately 20-25 km north of Oğlanqala. However, volcanic conglomerate is a generally widespread facies that could have come from many different areas.

Late Iron Age/Period 3

There was very little stylistically diagnostic LIA pottery from Oğlanqala, and no clean LIA excavated contexts. Therefore, only nine samples were analyzed from this period, all of which came from Oğlanqala. The majority of these samples (n=7) are part of the Andesite Calcareous petrogroup (Fig. 5.2:d-f). The remaining samples are part of the Metamorphic Pair (Fig. 5.6:a), and the Sandstone Gabbro Loner (Fig. 5.7).



a) Sandstone Gabbro Loner

Fig. 5.7: Period 3 Petrofabric: XPL, width = 4.45 mm

Andesite Calcareous

See summary description in EIA/Period 5 section on pg. 150. Seven LIA samples belong to this petrogroup.

Sandstone Gabbro Loner

Fig. 5.7

n=1; sample 128

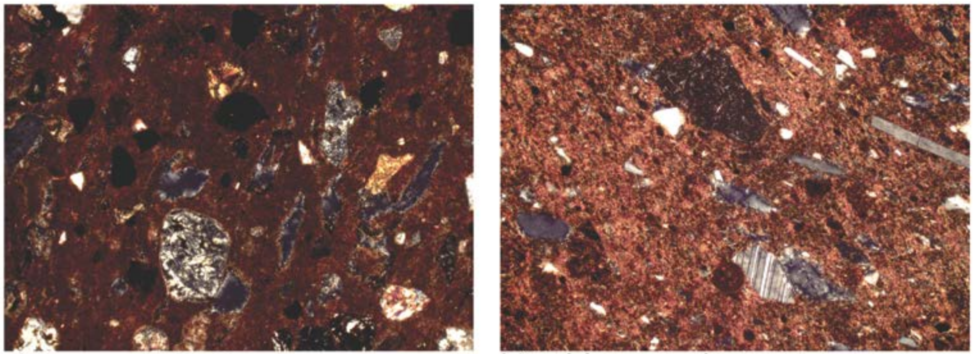
This fabric is characterized by poorly sorted sand to fine gravel size inclusions of sandstone, sparitic carbonate, and gabbro rock fragments. The plagioclase in the gabbro (and detrital from the gabbro) has large amounts of sericite alteration. The fine fraction is primarily detrital quartz from the sandstone, though pyroxene, plagioclase, and sparite in the fine fraction suggests that this is a naturally coarse clay with the same components in the coarse and fine fraction. The groundmass is reddish brown and optically active, suggesting it was low fired in an oxidizing atmosphere. This is a period 3 red brown jar from the Oğlanqala citadel. It is not local to the area, and the closest possible source would be gabbro intrusions in the Upper Trassic age sandstone 18-22 km to the southeast.

Metamorphic Pair

See summary description in MIA/Period 4 section on pg. 169. One LIA sample (120) belongs to this petrofabric.

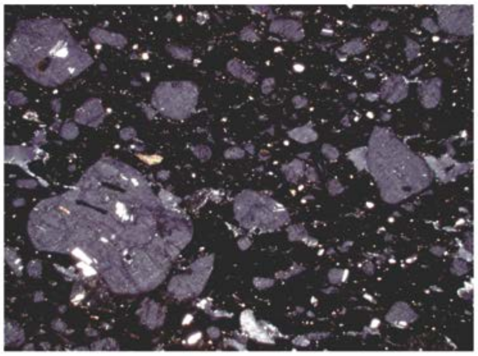
Roman-Parthian Period/Period 2

The 78 ceramic thin sections have been grouped into five petrofabric groups and two single-sample fabrics (i.e. loners). All of these samples came from Oğlanqala. For the first time, the Oğlanqala assemblage is dominated by a single, non-local petrofabric, the Serpentinite Group (n=38). The local Andesite Calcareous Group (n=30) is the second most abundant, with the remaining nine samples divided between five petrofabrics, some of which can be found in earlier periods (e.g., Carbonate Group, Coarse Andesite Group, Dacite Group), while other are single sample loners (i.e., Perlitic Glass Loner, Feldspar Andesite Loner) (Fig. 5.8).



a) Serpentinite Group

b) Feldspar Andesite Loner



c) Perlitic Glass Loner

Fig. 5.8: Period 2 Petrofabrics. All images XPL, image width a, c = 2.25 mm, c = 4.45 mm

Serpentinite Group

Fig. 5.8:a

n=39, samples: 7, 35, 43, 59, 65, 96, 97 106, 107, 111, 113, 119, 123, 124, 137, 140, 141, 150, 152, 201, 215, 216, 218, 220, 222, 226-229, 231, 233, 235, 236, 238, 292, 293, 295, 297-299

This group is characterized by the presence of serpentinite and a range of sedimentary, igneous, and rare, low-grade metamorphic fine to medium sand sized inclusions, single to double spaced with very little fine fraction. This group is relatively homogenous with short (<0.5 mm) planar voids, though the varied optical activity suggests a range of firing temperatures. Inclusions are dominated by a mixture of sub-angular to sub-rounded andesite and felsic-intermediate subvolcanic rock fragments, although felsic and mafic volcanic rock fragments are present as well. There are also micritic, sparitic, and bioclastic carbonate rock fragments. The most distinctive inclusions are only present in small quantities (2-6%): serpentinite with a mesh texture and low grade metamorphic rock fragments (phyllite) in the greenschist facies. Mineral inclusions such as k-feldspar, plagioclase, polycrystalline quartz, amphibole, clinozoisite, epidote, biotite, and pyroxene are detrital from larger rock fragments. The inclusions are found in the coarse fraction, and the clay matrix is unusually fine, which suggests that the coarse fragments were added as temper during clay processing. The clay matrix is red brown, fired in a completely oxidizing atmosphere, and appears higher fired than is common for this assemblage, though still low fired. The continued presence of limestone means that it could not have been fired much above 800°C (Garrels and Christ 1965). The lack of optical activity could be the result of high iron content in the clay, as a clay sample with high iron content[9] fired as a briquette became optically inactive at 700°C.

The serpentinite comes from one of several ophiolitic complexes in the Southern Caucasus. The phyllite's mineralogy suggests that it may belong to the greenschist facies

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[9] High iron content confirmed through neutron activation analysis at the University of Missouri Research Reactor, results in preparation for publication

that is associated with near-by ophiolitic complexes (Azimzadeh et al. 2011; Galoyan et al. 2009; Rolland et al. 2010).

All of the samples in this group come from red-slipped burnished bowls and plates, as well as two lids that went with the ledge rim plate form. The ledge rim plate is only made in the Serpentinite Group fabric. The other shapes, including simple rim bowls, thickened rim plates, one straight rim bowl, and one everted rim bowl can also be made in the locally produced Andesite Calcareous Group (or rarely the Andesite Group and Feldspar Andesite Loner).

Andesite Calcareous

See summary description in EIA/Period 5 section on pg. 150. 30 Roman-Parthian period samples belong to this petrogroup.

Carbonate Group

See summary description in MIA/Period 4 section on pg. 162. Three Roman-Parthian period samples belong to this petrogroup.

Coarse Andesite Group

See summary description in MIA/Period 4 section on pg. 164. Three Roman-Parthian period samples belong to this petrogroup.

Dacite Group

See summary description in MIA/Period 4 section on pg.167. One Roman-Parthian period samples belong to this petrogroup.

Feldspar Andesite Loner

Fig. 5.8:b

n=1, sample: 133

This fabric is characterized by fine to medium sand sized sub-angular to sub-rounded single-double spaced k-feldspar mineral and andesite rock fragment inclusions, though there are some coarse sand sized inclusions. Large portions of the andesite fragments are devitrified, especially the smaller inclusions. In addition, there are argillaceous rock fragments, quartz, plagioclase, and rare pyroxene and amphibole mineral fragments. The groundmass is red brown with high optical activity, meaning that it was fired at a low temperature in an oxidizing atmosphere. This sample comes from a burnished red slipped thickened rim bowl that is stylistically consistent with the rest of the material from Oğlanqala at this time. Though it is technically possible that this was made locally, the absence of carbonates and the narrow range of volcanic inclusions makes this unlikely. However, the materials found in this clay are common, so it is not possible to narrow down the provenience further.

Perlitic Glass Loner

Fig. 5.8:c

n=1, sample: 28

This fabric has rounded perlitic glass fragments, sometimes with plagioclase and biotite inclusions, and a continuous size range from coarse sand to silt size. The other inclusions are (from most to least prevalent) embayed plagioclase and rare biotite, pyroxene, quartz mineral fragments and andesite rock fragments. The groundmass is red at the margins and dark brown in the center, and is relatively highly fired for this assemblage. This sample comes from a simple, open lamp. Since glass is not found in isolation by Oğlanqala, either this vessel or the raw materials must have been imported.

Neutron Activation Analysis (NAA) Results[10]

Principal component analysis (PCA) of 30 elements suggests that greater than 90% (91.2%) of the cumulative variance in the 80 specimen dataset of combined ceramic and geological samples can be explained by six components (appendix E). Although MURR can detect 33 elements, Ni, As, and Sb were excluded from all analyses. As and Sb are highly mobile elements with variation that can often be attributed to agricultural pesticides and herbicides, while Ni concentrations fell below detection limits for a large number of samples. The first principal component (PC1) is positively loaded on rare earth elements Th, Ce, La, Nd, and Tb and negatively loaded on alkaline earth metal Ca. Principal component two (PC2) is positively loaded on the alkaline earth metals Ca and Sr, as well as elements Th and U, while being negatively loaded on transition metals Cr and Co (Table 5.2). A biplot of the first two principal components expresses a grouping structure that is characterized by the variation in elements Ca, Cs, Sr and Cr together with the dilution of the rare earth elements (Figure 5.9). Although clay samples were used as part of the PCA, they have been removed for the purposes of grouping the ceramics. The final groups will then be compared to all clay data.

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[10] Analysis conducted with the guidance of William Gilstrap (MURR)

Variable	PC1	PC2	PC3	PC4	PC5	PC6
%var	50.136	15.301	11.418	5.928	5.103	3.330
cum%var	50.136	65.437	76.854	82.782	87.885	91.215
eigenvalues	0.455	0.139	0.104	0.054	0.046	0.030
Th	**0.228**	**0.283**	-0.151	0.205	0.088	0.056
Ce	**0.228**	0.109	0.100	-0.022	-0.085	0.113
La	**0.226**	0.132	0.045	0.021	-0.078	0.101
Ba	**0.220**	0.170	-0.270	-0.148	0.085	-0.126
Nd	**0.218**	0.078	0.118	-0.012	-0.078	0.099
Zr	**0.214**	0.084	0.064	0.102	-0.132	0.057
Tb	**0.211**	-0.086	0.161	-0.106	0.016	-0.030
Na	0.207	-0.068	**-0.432**	-0.007	0.289	0.179
Sm	0.206	0.022	0.139	-0.066	-0.064	0.071
Eu	0.203	-0.028	0.139	-0.159	-0.040	0.047
Dy	0.193	-0.106	**0.223**	-0.011	-0.066	0.025
Yb	0.192	-0.122	0.176	-0.020	-0.009	-0.014
Hf	0.187	0.046	0.020	0.172	-0.006	0.016
Ta	0.185	0.115	0.116	**0.254**	-0.023	0.185
Rb	0.167	0.208	-0.077	0.068	0.209	-0.066
Lu	0.162	-0.060	0.161	-0.068	-0.083	0.039
K	0.161	0.074	-0.186	0.067	0.249	0.065
Al	0.147	-0.064	-0.077	-0.055	0.109	-0.092
Ti	0.132	-0.082	0.157	-0.042	0.046	0.111
U	0.126	**0.276**	0.148	-0.115	**-0.260**	**0.317**
Cs	0.118	0.423	**0.321**	0.089	**0.309**	**-0.592**
Fe	0.115	-0.130	0.077	-0.177	0.172	-0.011
Zn	0.114	-0.083	0.039	-0.115	0.190	-0.058
Mn	0.113	-0.105	-0.202	-0.092	**0.261**	-0.001
Co	0.103	**-0.223**	0.125	**-0.255**	0.207	0.256
Sc	0.081	-0.189	0.083	**-0.218**	**0.277**	-0.053
V	0.069	-0.120	0.068	**-0.345**	0.063	-0.039
Cr	-0.045	**-0.243**	**0.221**	**0.607**	**0.385**	**0.314**
Sr	-0.063	**0.390**	-0.228	-0.208	0.053	**0.378**
Ca	**-0.415**	**0.360**	**0.362**	**-0.231**	**0.396**	**0.271**

Table 5.2: Principal component analysis of ceramic and geological samples from Naxçıvan, Azerbaijan. The first six PCs are shown accounting for 91.2% of the cumulative variance in the dataset. Strong elemental loading of individual component values are shown in bold font.

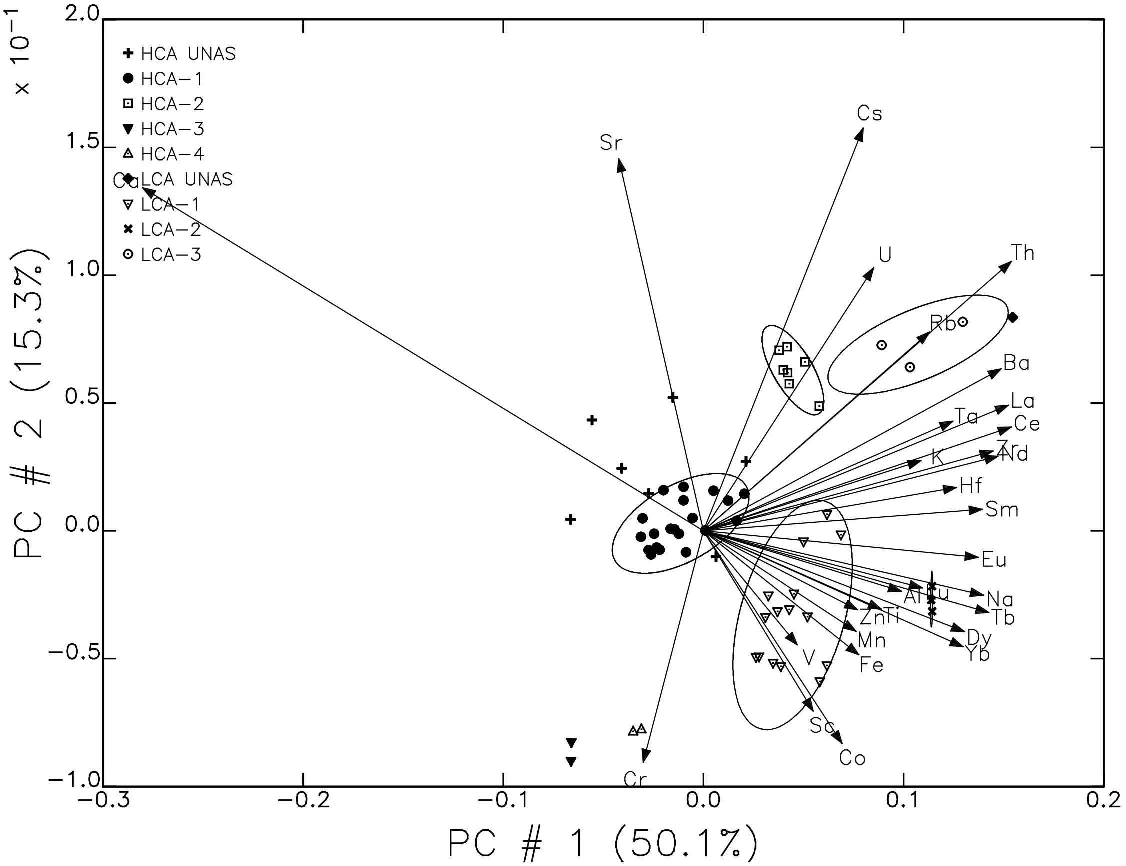


Fig. 5.9: Principal component biplot of PC1 and PC2 (91.2% total variance) showing ceramic samples. Elemental loading vectors are shown and labeled.

The most apparent differences in the dataset are the product of variation of Ca concentrations. A bivariate plot comparing log base-10 concentrations of Ca and Nd demonstrate that the data can be split into two main categories: High and Low Ca concentrations (Fig. 5.10). The ceramic samples with high Ca concentrations form one large core group with three smaller subgroups, and samples with lower Ca concentrations form one large core group with two smaller subgroups.

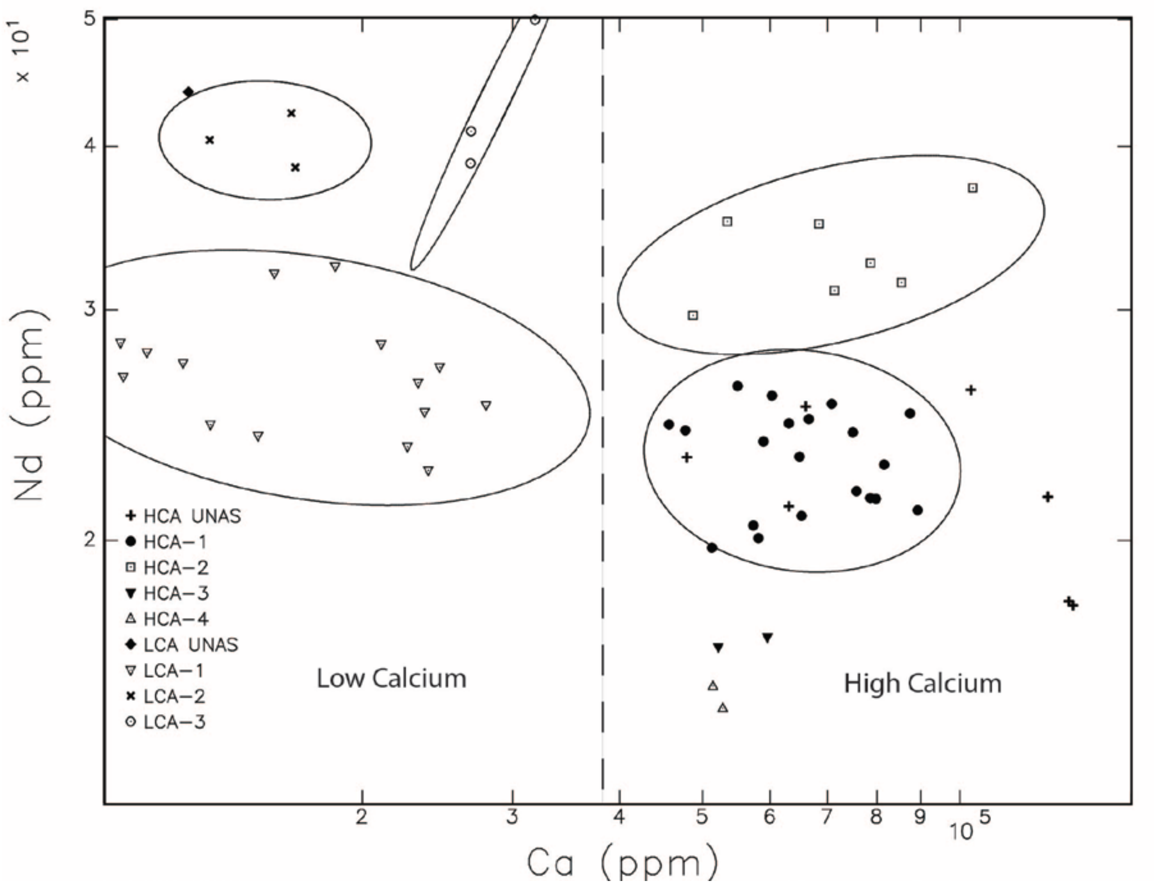


Fig. 5.10: Bivariate plot comparing Ca and Nd concentrations (ppm). There is a clear separation according to Ca concentrations. Ellipses are drawn at the 90% confidence interval.

High Calcium Group

Samples in the High Calcium Group form four subgroups: HCa1, HCa2, HCa3, and HCa4. Membership probabilities were calculated based on the first six components of a PCA using the 38 samples from the High Calcium dataset (Table 5.3). These six PCs form over 92% of the cumulative variance in this dataset. Samples are considered members of the group if they have greater than 5% group membership probability. All of the samples from HCa1 have membership probability values of greater than 5%.

ANID	*p*
SGF021	86.158
SGF025	6.165
SGF026	74.017
SGF028	23.109
SGF031	85.104
SGF035	12.373
SGF041	26.075
SGF051	47.587
SGF052	55.272
SGF060	65.748
SGF062	44.243
SGF063	20.152
SGF064	87.778
SGF065	19.876
SGF067	69.373
SGF068	97.854
SGF072	56.759
SGF073	65.428
SGF077	23.036
SGF079	14.968

Table 5.3: Mahalanobis distance-based probabilities (p) of group membership for HCa1 with distinct outliers removed. HCa1 is treated as a single compositional group. Mahalanobis distances calculated using the first 7 PCs (92% total variance) of the High Calcium group PC analysis.

Groups HCa2, HCa3, and HCa4 have too few members to be tested against each other. However, when tested against HCa1 no samples demonstrate a membership probability of greater than 1%, indicating that members of these groups are discrete from HCa1 (Table 5.4) (Bieber et al. 1976; Bishop and Neff 1989). This separation is reflected in the biplot comparing PCs 1 and 2 from the High Calcium Group dataset (Fig. 5.11) and again in a bivariate plot of the transitional metal Cr against the element Th (Fig 5.12).

Group HCa2

ANID	*p*
SGF050	0.000
SGF061	0.003
SGF069	0.000
SGF071	0.001
SGF074	0.003
SGF075	0.001
SGF076	0.001

Group HCa3

ANID	*p*
SGF078	0.000
SGF080	0.000

Group HCa4

ANID	*p*
SGF033	0.001
SGF034	0.000

Table 5.4: Mahalanobis distance-based probabilities (p) of group memberships for Groups HCa2, HCa3, and HCa4 projected against Group HCa1. Mahalanobis distances calculated using the first six PCs (92% total variance) of the High Calcium group PC analysis.

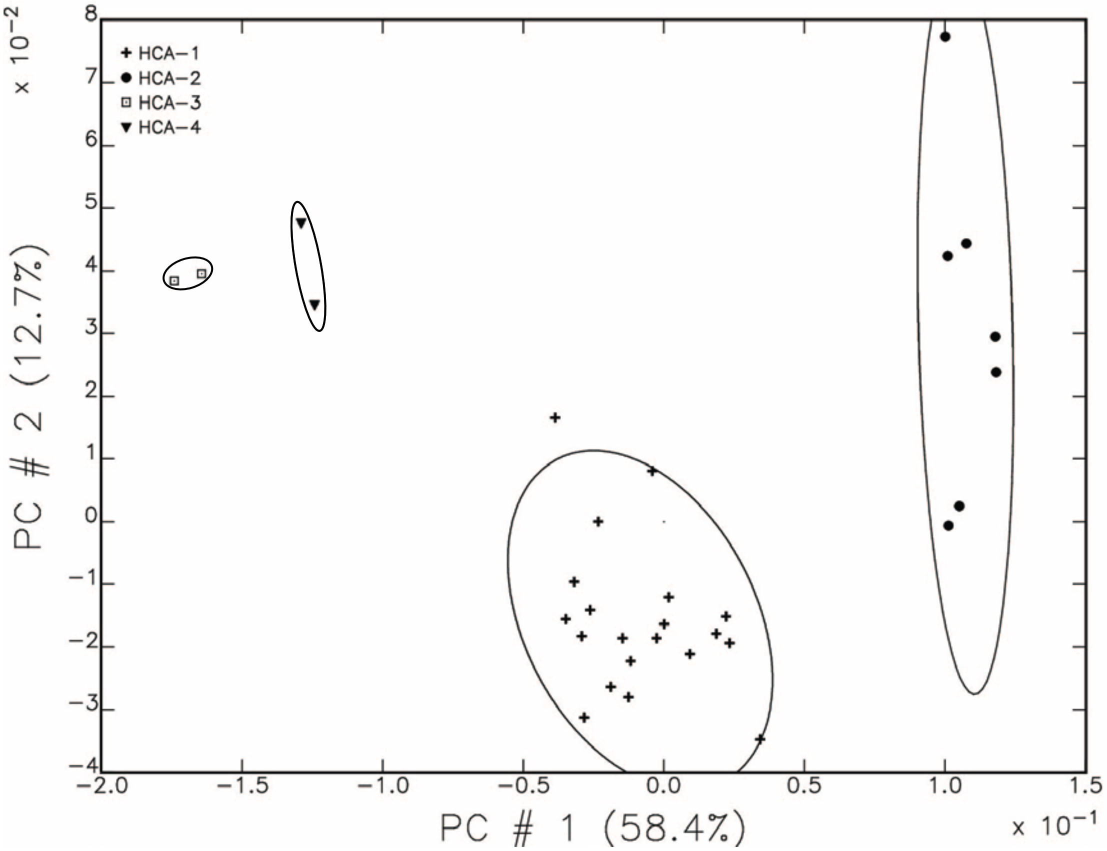


Fig. 5.11: Biplot comparing PC1 and PC2 of the High Calcium Group PCA. Ellipses are drawn at the 90% confidence interval.

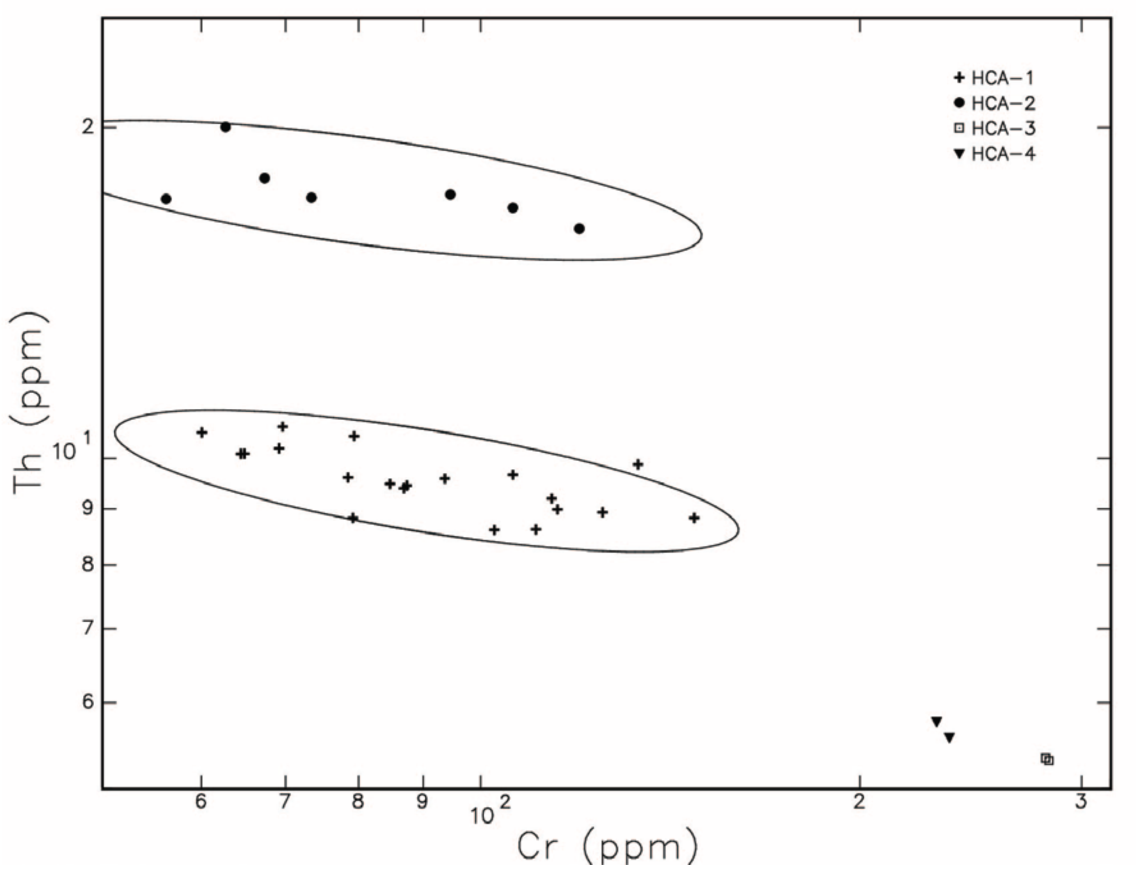


Fig. 5.12: Bivariate plot comparing Cr and Th concentrations (ppm) of the High Calcium Group. Ellipses are drawn at the 90% confidence interval.

While all of four groups have higher Ca concentrations as compared to the High Calcium Group, they are separated by the variation of Cr, Cs, and rare earth elements (REE) (Fig. 5.13). HCa2 has higher concentrations of Cs and REEs, while HCa3 and HCa4 have higher concentrations of Cr. HCa3 and HCa4 are primarily differentiated by their variation in Cr concentrations. HCa1 is relatively depleted in REEs, but overall demonstrates balance of elements for the High Calcium Group assemblage.

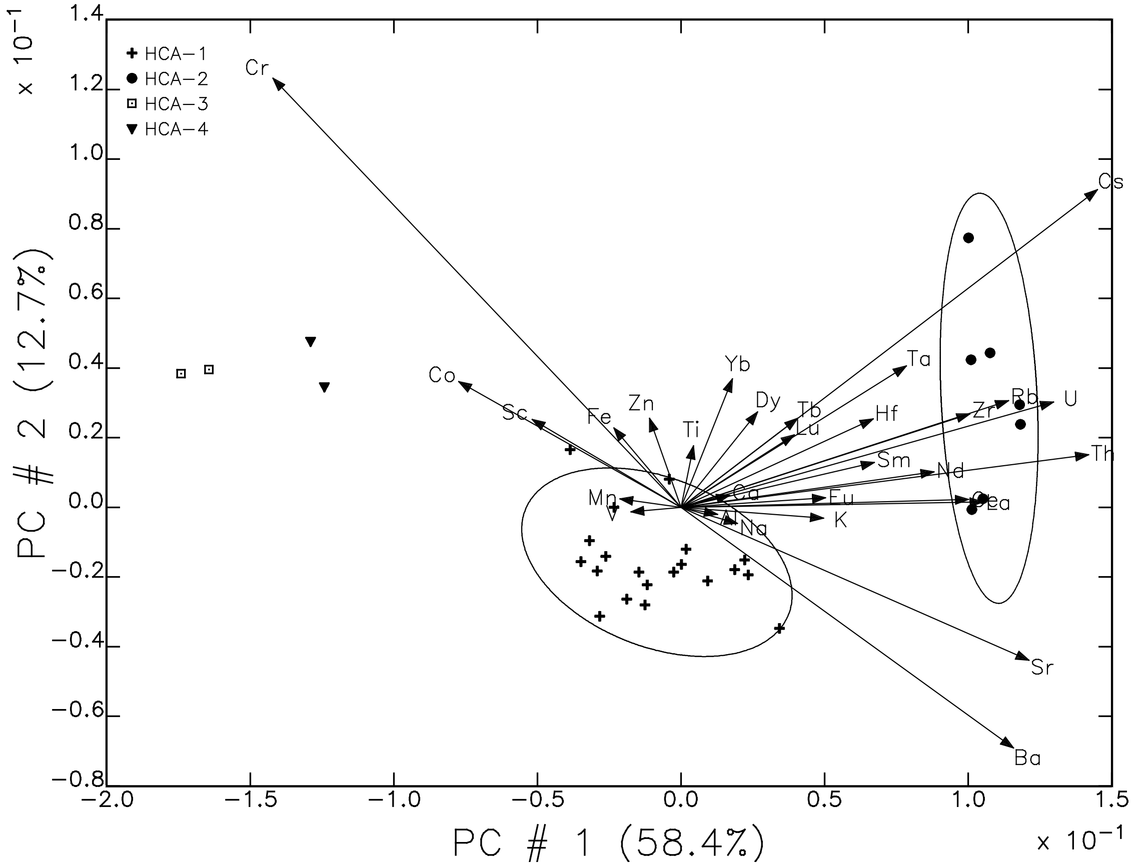


Fig. 5.13: Principal component biplot of PC1 and PC2 (92% total variance) showing High Calcium Groups. Elemental loading vectors are shown and labeled.

Low Calcium Group

Samples in the Low Calcium Group form three subgroups: LCa1, LCa2, and LCa3 (Figs. 5.14 and 5.15). Membership probabilities were calculated using the first five components of a PCA using 22 samples from the Low Calcium Group.

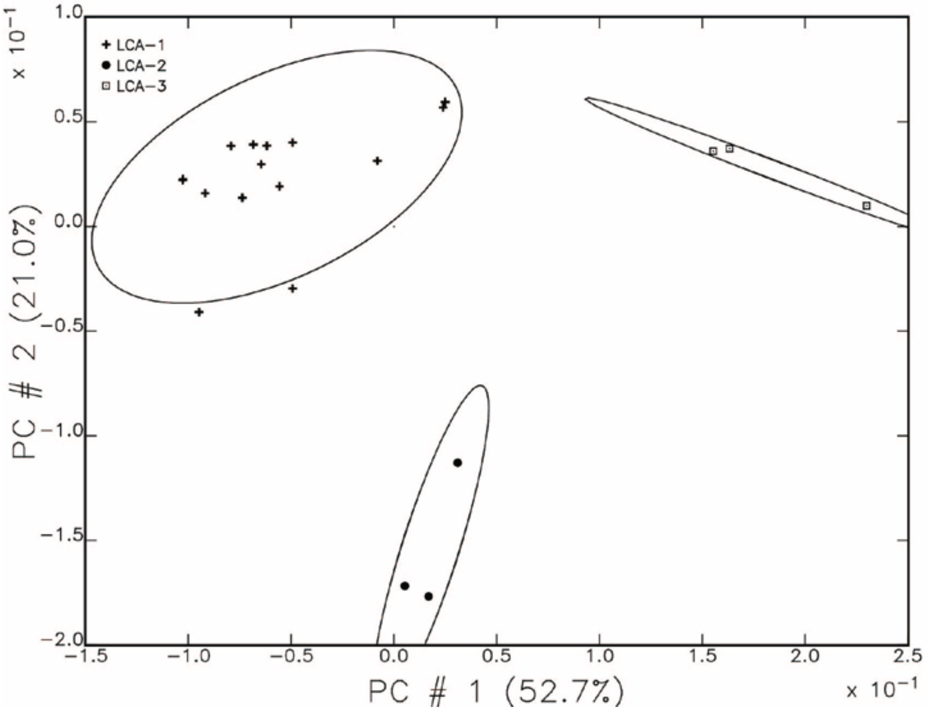


Fig. 5.14: Biplot comparing PC1 and PC2 of the Low Calcium Group PCA. Ellipses are drawn at the 90% confidence interval.

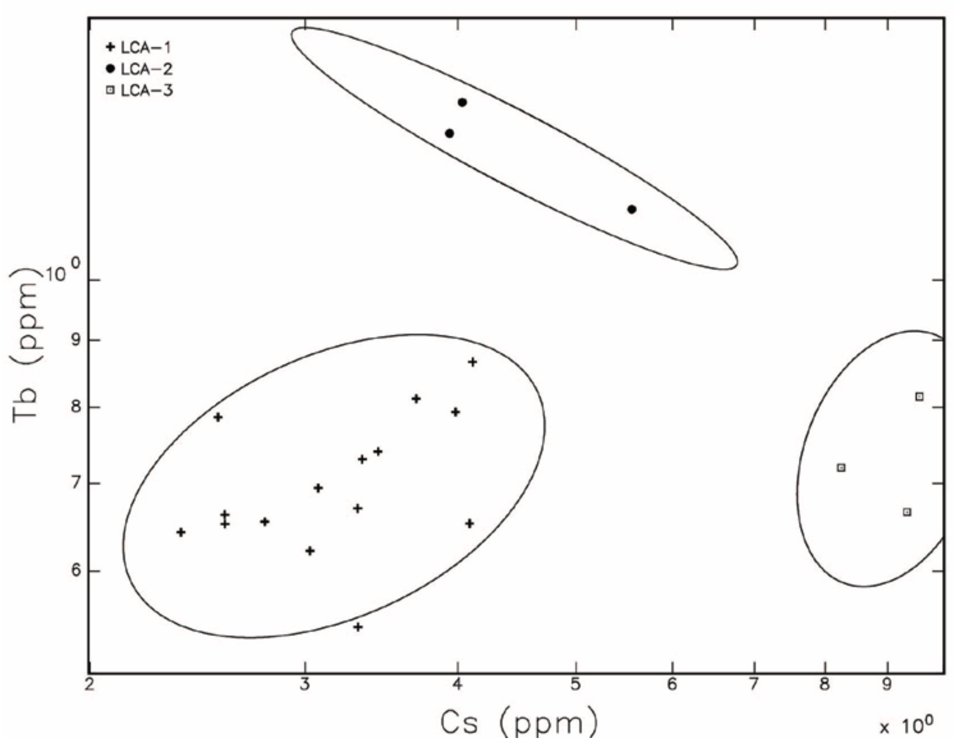


Fig. 5.15: Bivariate plot comparing Cs and Tb concentrations (ppm) of the Low Calcium Group. Ellipses are drawn at the 90% confidence interval.

These five PCs account for 91.7% of the cumulative variance in this data set. Groups LCa2 and LCa3 were projected against LCa1 to measure membership probabilities (Table 5.5).

Group LCa1

ANID	*p*
SGF037	52.403
SGF039	78.694
SGF040	41.582
SGF042	72.466
SGF043	24.931
SGF045	57.036
SGF046	26.484
SGF047	50.863
SGF049	78.218
SGF053	21.456
SGF054	68.231
SGF055	6.990
SGF056	89.475
SGF057	45.206
SGF058	20.926

Group LCa2

ANID	*p*
SGF023	0.001
SGF030	0.067
SGF032	0.001

Group LCa3

ANID	*p*
SGF027	0.206
SGF029	0.101
SGF044	0.067

Table 5.5: Mahalanobis distance-based probabilities (p) of group membership for Groups LCa1, LCa2, and LCa3. Mahalanobis distances calculated using the first five PCs (91.7% total variance) of the Low Calcium Group PCA.

Table 5.5 demonstrates that all of the samples in Group LCa1 have high membership probabilities of at least 5%. Groups LCa2 and LCa3 have too few members to be tested against each other. However, when tested against LCa1 no samples demonstrate a membership probability of greater than 1%, indicating that members of these groups are discrete from LCa1. While SGF024 was not close enough to LCa3 to be placed in that group, a Euclidian Distance Search shows that SGF024 is closer to all three members of the Group LCa3 than any other Low Calcium samples (Table 5.6).

ANID	Distance	Group
SFG029	0.0278	LCA-3
SGF044	0.0284	LCA-3
SGF027	0.0348	LCA-3
SGF053	0.0495	LCA-1
SGF047	0.0519	LCA-1
SGF030	0.0534	LCA-2
SGF043	0.0590	LCA-1
SGF054	0.0642	LCA-1
SGF045	0.0651	LCA-1
SGF046	0.0653	LCA-1

Table 5.6: Squared-Mean Euclidean Distance Search results for sample SGF024 among Low Calcium Group samples. Euclidean Distance Search calculated using the first five PCs (91.7% total variance) of the Low Calcium group PCA.

Therefore, SGF024 is associated with Group LCa3. While all three groups show depleted Ca concentrations as compared to the High Calcium Group, they are separated by their variation of Cr, alkali metals and REEs (Fig. 5.16). LCa1 has relatively depleted concentrations of REEs and high concentrations of Cr. LCa2 has high concentrations of REEs Dy, Yb, Lu, and Tb, while LCa3 has high concentrations of alkali metals Sr and Cs.

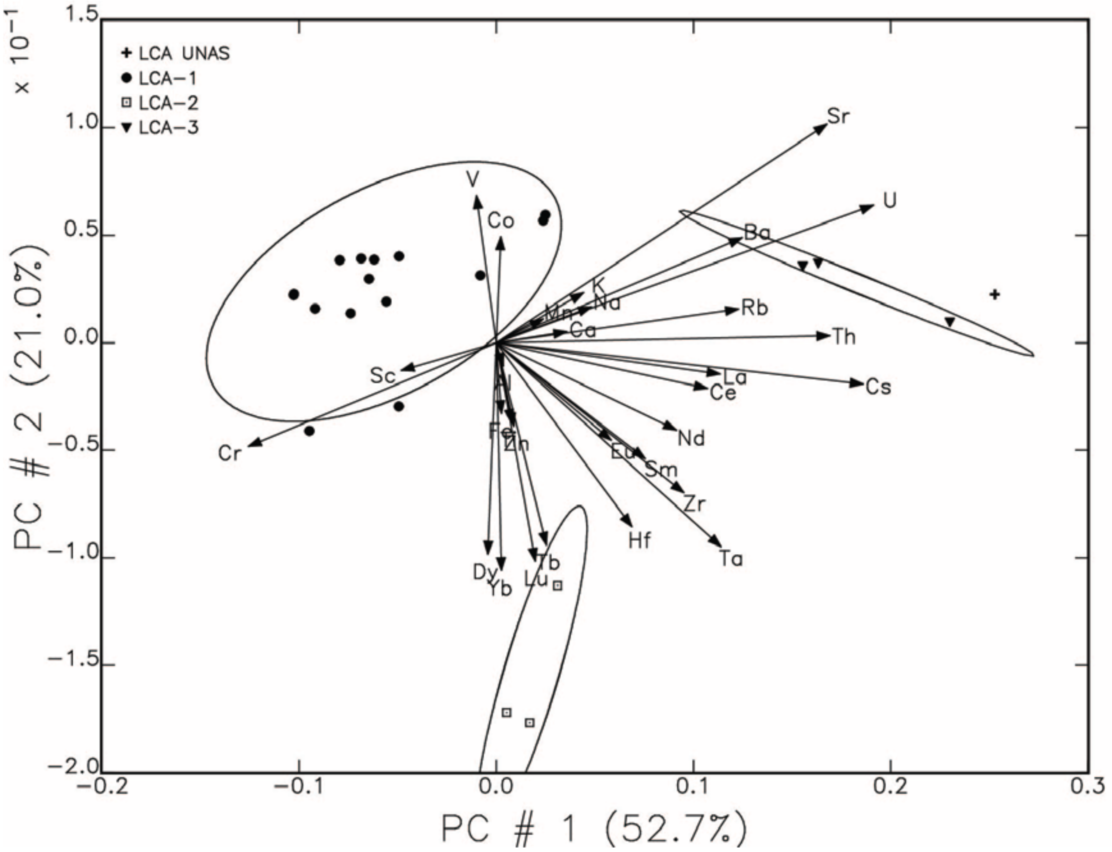


Fig. 5.16: Principal component biplot of first two components (91.7% total variance) showing Low Calcium Groups. Elemental loading vectors are shown and labeled.

Clay

Twenty clay samples representing every geological age deposit present in Naxçıvan were analyzed and compared to the groups discussed above. The clay samples were plotted using Ca as the discriminating element since it was used to separate the High and Low Calcium Groups and it appears that the clays form a similar pattern (Fig. 5.17). Based on this model, SGF012 has low levels of Ca and fit within the 90% confidence ellipsis of LCa1, and SGF018 falls immediately outside of LCa3 in the Low Calcium Group. SGF001, SGF011, SGF014, SGF015, and SGF016 all have higher concentrations of calcium and fit within the 90% confidence ellipsis of HCa1, while

SGF013 falls immediately outside of the ellipsis. The remaining clay samples have considerably higher concentrations of calcium. This bivariate plot can be compared to a biplot (Fig. 5.18) of the first two components of the PC analysis performed on the complete Naxçıvan dataset (Table 5.4). This biplot shows SGF001, SGF014, and SGF016 within the HCa1 confidence ellipsis, with SGF003 immediately outside of the ellipsis, and no samples falling within the LCa1 confidence ellipsis, though SGF018 is close.

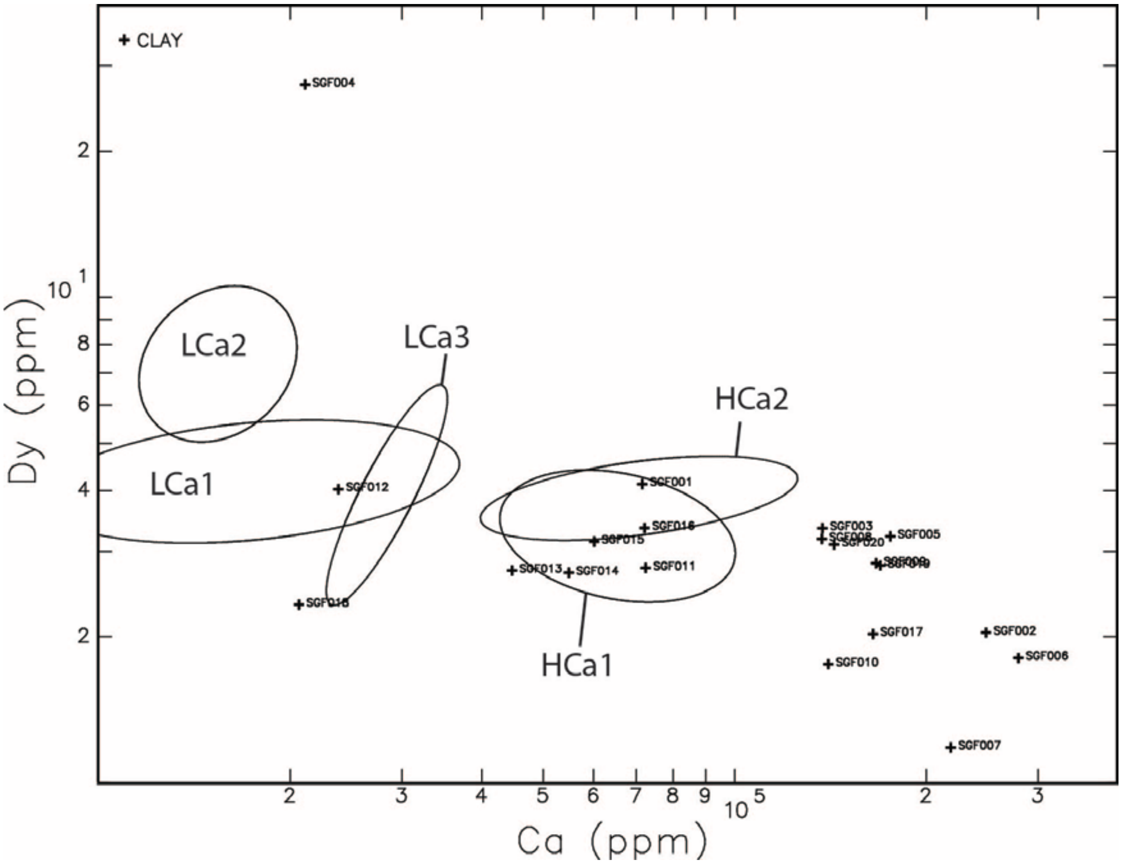


Fig. 5.17: Bivariate plot comparing Ca and Dy concentrations (ppm) showing separation of clays according to Ca concentrations. Ellipses are drawn at the 90% confidence interval.

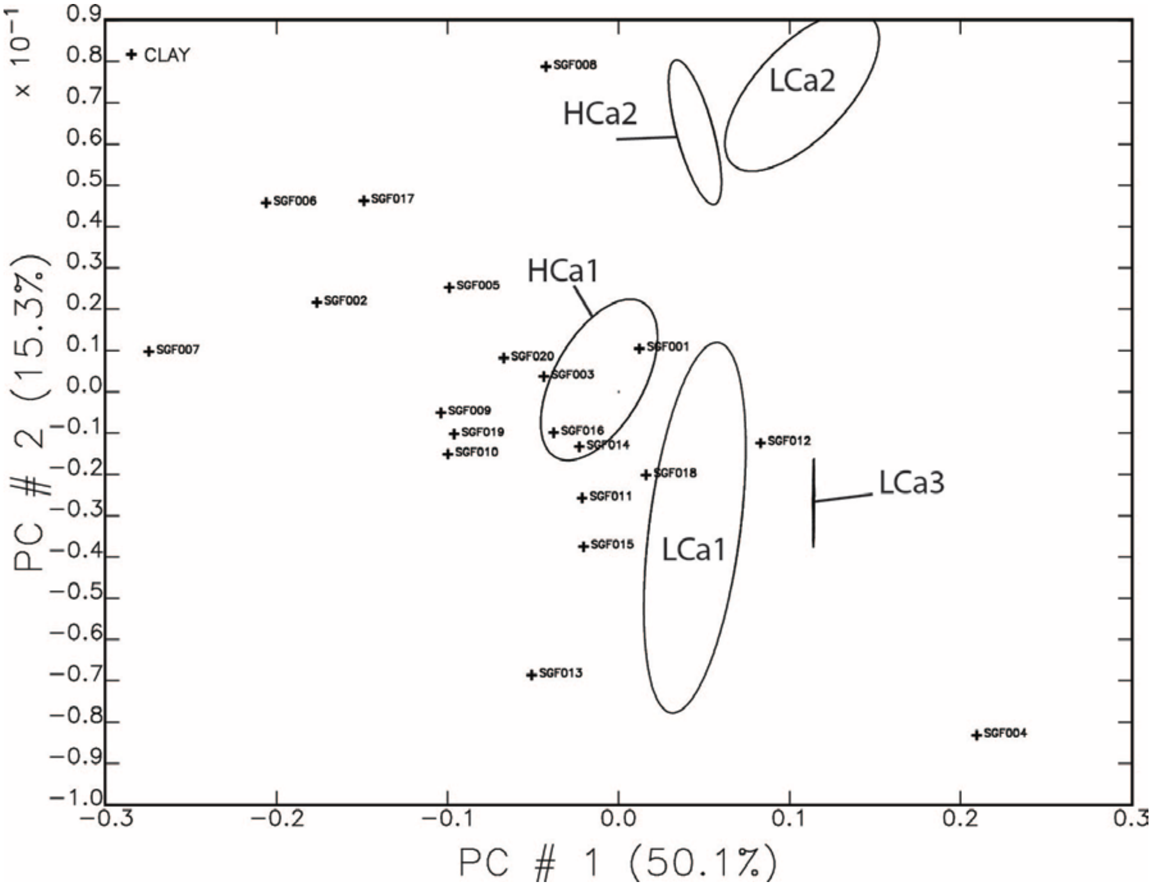


Fig. 5.18: Principal component biplot of first two components (91.2% total variance) showing clay samples in relation to ceramic groups. Ellipses are drawn at the 90% confidence interval.

Membership probabilities were calculated for all clay samples by projecting them against HCa1 and LCa1 (Table 5.7) using the first six components from the PCA performed on the complete Naxçıvan dataset (Table 5.2). These first six PCs account for 91.2% of the cumulative variance in the dataset. Only one clay sample, SGF003 has greater than 1% probability for membership in HCa1, though SGF020 is close. Both of these clays have much higher calcium concentrations than the ceramic samples, though the addition of calcium poor volcanic inclusions may be part of the explanation for this difference. None of the clay samples show a greater than 1% probability of membership in LCa1.

ANID	HCa1(*p*)	LCa1 (*p*)
SGF001	0.295	0.522
SGF002	0.000	0.000
SGF003	**1.277**	0.049
SGF004	0.000	0.000
SGF005	0.000	0.003
SGF006	0.000	0.000
SGF007	0.000	0.000
SGF008	0.000	0.000
SGF009	0.003	0.004
SGF010	0.005	0.000
SGF011	0.006	0.276
SGF012	0.000	0.234
SGF013	0.000	0.004
SGF014	0.009	0.087
SGF015	0.002	0.026
SGF016	0.005	0.070
SGF017	0.000	0.000
SGF018	0.009	0.215
SGF019	0.324	0.001
SGF020	0.819	0.008

Table 5.7: Mahalanobis distance-based probabilities (p) of group membership for all clays projected against HCa1 and LCa2. Mahalanobis distances were calculated using the first six PCs (91.2% total variance) of the total assemblage PCA.

However, when I calculate the membership probabilities using elemental data rather than principal components, there were more potential matches. When I calculated the Mahalanobis distance of the clay samples by projecting them on HCa1 using the 18 most highly loaded elements from the initial PC analysis (Table 5.18), SGF003 from Sədərəkqala and SGF020 from Ovuçulartepesi showed higher than 50% probability of group membership, and sample SGF001

ANID	*p*
SGF001	14.922
SGF002	0.976
SGF003	55.121
SGF004	0.464
SGF005	2.967
SGF006	3.218
SGF007	1.204
SGF008	1.035
SGF009	1.702
SGF010	6.294
SGF011	4.197
SGF012	11.890
SGF013	0.797
SGF014	2.178
SGF015	1.506
SGF016	1.250
SGF017	8.891
SGF018	2.508
SGF019	0.899
SGF020	51.532

Table 5.8: Mahalanobis distance-based probabilities (p) of group membership for all clays projected against HCa1. Mahalanobis distances were calculated using the 18 most highly loaded elements from the total assemblage PC analysis, including Sodium (Na), Calcium (Ca), Scandium (Sc), Vanadium (V), Cromium (Cr), Manganese (Mn), Cobolt (Co), Strontium (Sr), Ziconium (Zr), Caesium (Cs), Barium (Ba), Lanthanum (La), Cerium (Ce),Neodymium (Nd), Dysprosium (Dy), Tantalum (Ta), Thorium (Th), Uranium (U)

from Oğlanqala had a nearly 15% probability. Interestingly, SGF010 (from Xok), SGF012 (from Batabat), and SGF017 (from Nehram) also show 5-12% probability of membership. While Xok can be explained as being part of the Şərur drainage system, the other two samples cannot. Since these probabilities are only calculated with 18 elements rather than 30, it is reasonable that some false matches are more likely to occur, and thus

I employ a higher standard for probability of a match. The probability group membership for clay samples in LCa1 was calculated for the 13 most highly loaded elements, but the results showed no clear patterns.

Comparison with Other Published Groups

The Naxçıvan assemblage chemical groups were compared to several published compositional groups from nearby regions. All comparative material comes from published research.

Comparison with Urartian pottery in Speakman et al. (2004)

Speakman et al. (2004) analyzed pottery assemblages from several Urartian centers in the Van basin, Turkey and northwestern Iran. The composition of this pottery allowed the assemblage to be divided into two core groups distinguished by their relative high or low calcium concentration. These groups were then sub-grouped according to further analyses. Using calcium content as a guide, Speakman et al.'s (2004) High Calcium groups (Ayanis Kalesi, Ayanis 4, Ayanis 6, Ayanis 7, Bastam) were compared to the High Calcium (HCa1, HCa2, HCa3, HCa4) groups for the Naxçıvan assemblage. Speakman et al.'s (2004) Low Calcium groups (Ayanis 1, Ayanis 2, Ayanis 3, Ayanis 5, Kef Kalesi) were similarly compared to the Naxçıvan Low Calcium groups (LCa1, LCa2, LCa3).

A PCA was done for all of the ceramics in both the Speakman et al. (2004) and Naxçıvan assemblages. The first six PCs account for 90.6% of the cumulative variance. A biplot of the first two PCs, accounting for 76% of the total variance for both assemblages, shows that HCa2 can easily discriminated from all of the other groups (Fig 5.19).

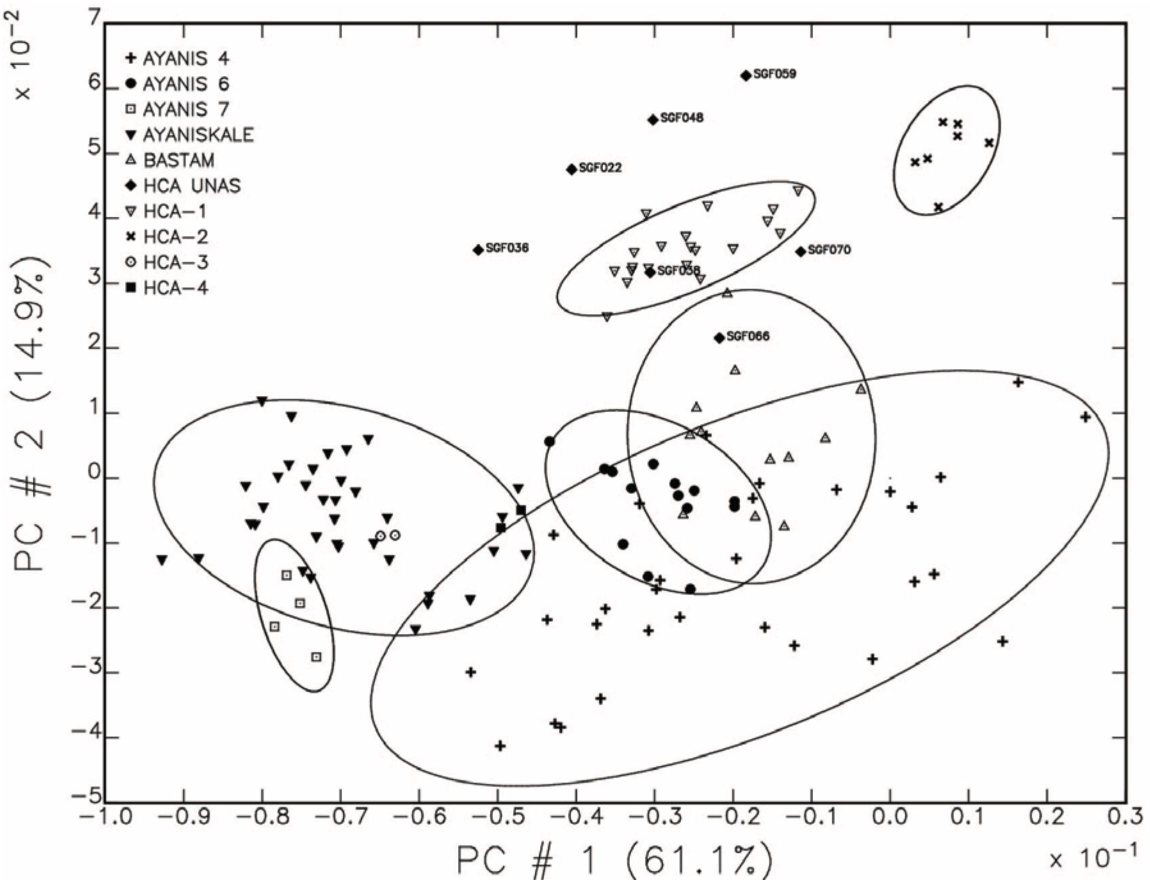


Fig. 5.19: Biplot comparing PC 1 and PC2 of the combined Urartian center assemblage (Speakman et al. 2004) and the Naxcivan assemblage. Groups are shown from the High Calcium groups from each compositional study. Ellipses are drawn at the 90% confidence interval.

However, HCa4 falls comfortably within the ellipsis for Ayanis Kale, and a Mahalanobis distance calculation shows that both HCa4 group members have a relatively high (>5%) probability of being members of this group (Table 5.9). Although HCa3 appears along the edge of both the Ayanis Kalesi and Ayanis 4 groups, Mahalanobis distance calculations show that the probability of HCa3's shared membership with either of these groups is very slim (<1%) (Table 5.10).

ANID	*p*
SGF033	6.748
SGF034	21.166

Table 5.9: Mahalanobis distance-based probabilities (p) of group membership for HCa4 in Ayanis Kale Group. Mahalanobis distances were calculated using the first six PCs (90.6% total variance) of the PCA for both assemblages.

ANID	Ayanis Kale *p*	Ayanis 4 *p*
SGF078	0.260	0.235
SGF080	0.578	0.502

Table 5.10: Mahalanobis distance-based probabilities (p) of group membership for HCa3 in Ayanis and Ayanis 4 Groups. Mahalanobis distances were calculated using the first six PCs (90.6% total variance) of the PC analysis for both assemblages.

Naxçıvan HCa3 was then compared to Ayanis Kalesi and Ayanis 4 using elemental bivariate plots in order to see if the former could be separated from the two latter. HCa3 can be discriminated from the Ayanis groups by plotting Th against K, indicating a distinct chemical composition (Fig. 5.20).

Fig. 5.19 also indicates that some of the unassigned High Calcium samples from Naxçıvan might be related to the Bastam group. A Mahalanobis distance was used to project the unassigned HCa samples against the Bastam group, and found that samples SGF066 and SGF070 both show high probabilities (>24%) of being members of the Bastam group (Table 5.11). It can also be observed in Fig. 5.19 that HCa1 and Bastam group are very close together, and the outliers with high probabilities of Bastam group membership are within or close to the HCa1 ellipsis. A Mahalanobis distance was used to project HCa1 against Bastam, and found quite high probabilities of group membership (>5%) for nine out of twenty samples (Table 5.12).

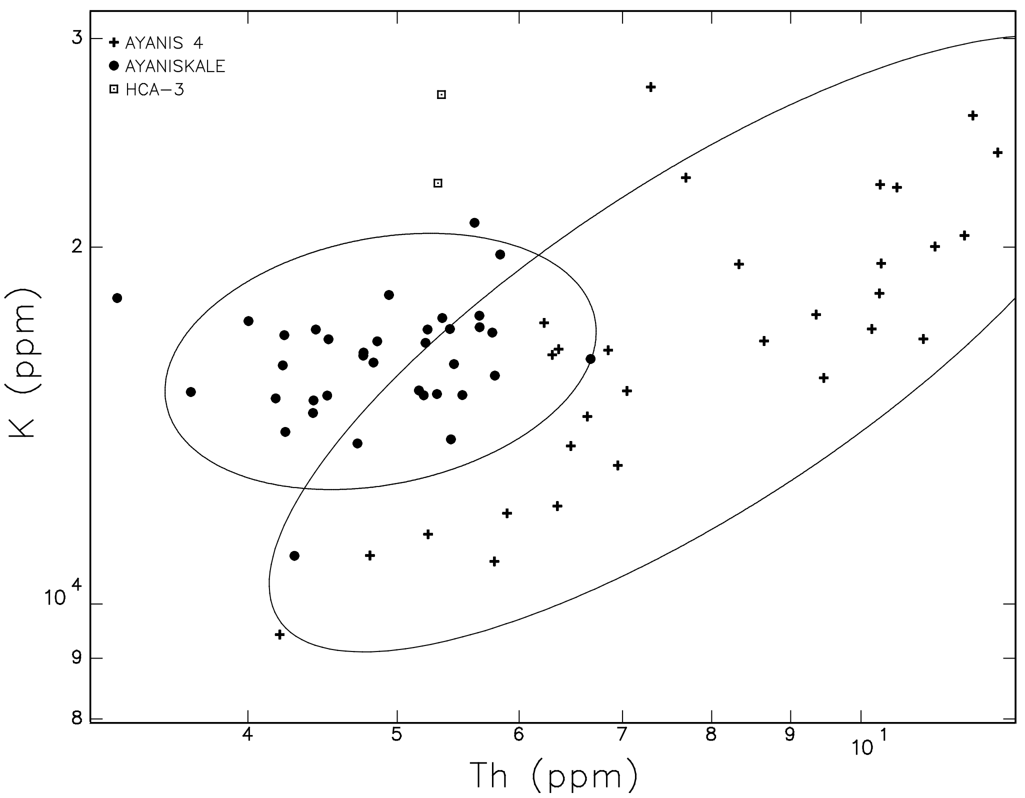


Fig. 5.20: Bivariate plot comparing Th and K concentrations (ppm) showing separation of HCa3 from both Ayanis 4 and Ayanis Kale. Ellipses are drawn at the 90% confidence interval.

ANID	*p*
SGF022	0.751
SGF036	2.111
SGF038	1.565
SGF048	0.163
SGF059	0.287
SGF066	**30.366**
SGF070	**24.302**

Table 5.11: Mahalanobis distance-based probabilities (p) of group membership for HCa unassigned samples in Bastam group. Samples with high probability of relatedness are shown in bold font. Mahalanobis distances were calculated using the first six PCs (90.6% total variance) of the PCA for both assemblages.

ANID	*p*
SGF021	**21.691**
SGF025	**36.311**
SGF026	**19.755**
SGF028	**30.179**
SGF031	**9.661**
SGF035	**41.960**
SGF041	0.929
SGF051	**10.900**
SGF052	0.462
SGF060	1.179
SGF062	**11.898**
SGF063	1.851
SGF064	**5.746**
SGF065	1.669
SGF067	1.830
SGF068	1.561
SGF072	0.683
SGF073	1.999
SGF077	3.314
SGF079	0.262

Table 5.12: Mahalanobis distance-based probabilities (p) of group membership for HCa1 in Bastam group. Samples with high probability of relatedness are shown in bold font. Mahalanobis distances were calculated using the first six PCs (90.6% total variance) of the PCA for both assemblages.

Five of those samples showed probabilities of greater than 20%. HCa1 was compared to Bastam using elemental bivariate plots to discriminate between the two groups. Beyond the discrimination that is visible when plotting PC1 and PC2 (Fig. 5.19), these groups can be discriminated by plotting Cr against Yb (Fig. 5.21). Moreover, the HCa1 outliers show high probabilities of being part of the Bastam.

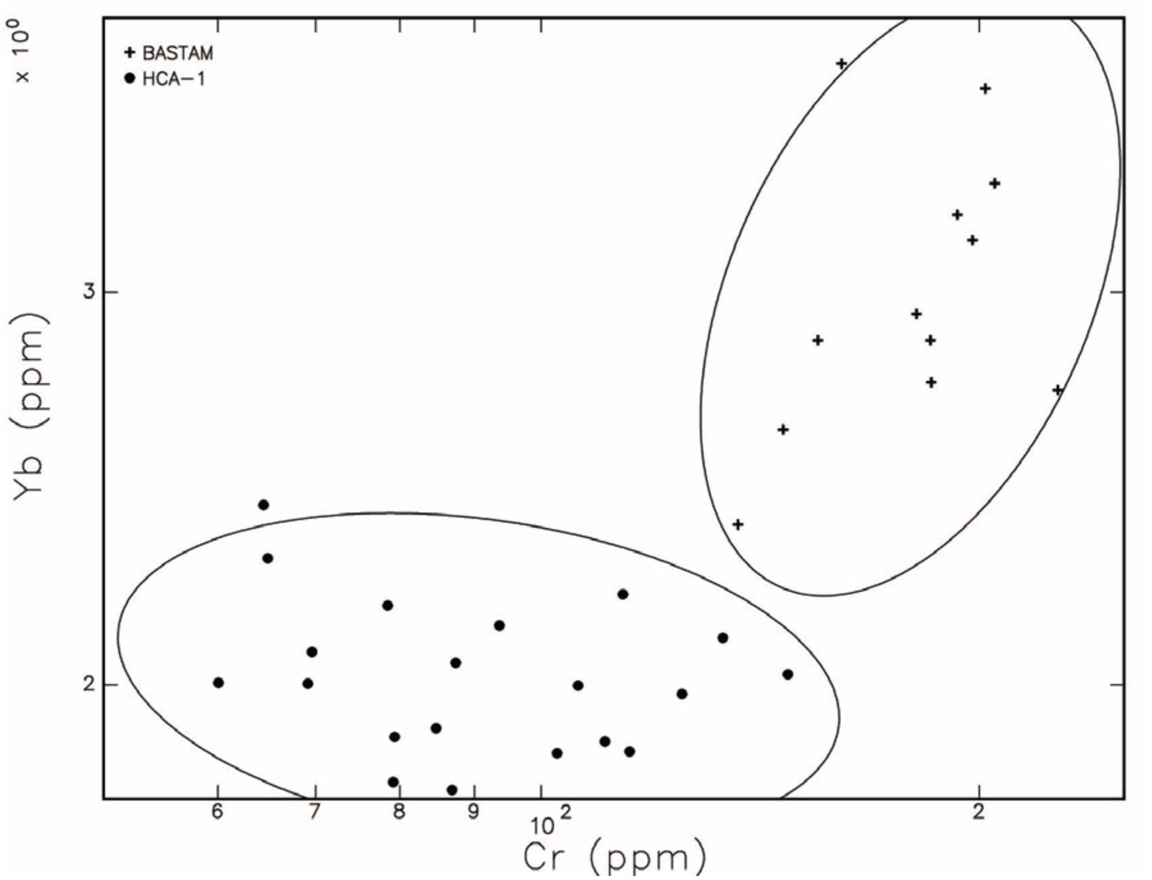


Fig. 5.21: Bivariate plot comparing Cr and Yb concentrations (ppm) showing separation of HCa1 and Bastam Group. Ellipses are drawn at the 90% confidence interval.

Low Calcium Groups were compared in the same manner as the High Calcium groups. A biplot of the first two PCs, accounting for 76% total variance for both assemblages, shows that LCa1 and LCa3 can clearly be discriminated from the Urartian samples (Fig. 5.22). However, LCa2 falls within the ellipses for both Ayanis 1 and Ayanis 5. Speakman et al. (2004:122-123) noted the similarity of these groups, and suggested that both groups likely contain several subgroups that could be detected with more samples. Speakman et al. (2004) further subdivides Ayanis 1 into 1a and 1b, but this differentiation was not found to be meaningful in comparisons with the Naxçıvan material. Group membership probabilities for LCa2 were projected against Ayanis 1 and

Ayanis 5 (Table 5.13). All three LCa2 group members show high probability of membership in Ayanis 5. However, sample SGF030 shows extremely high probability of membership (>84%) in Ayanis 1.

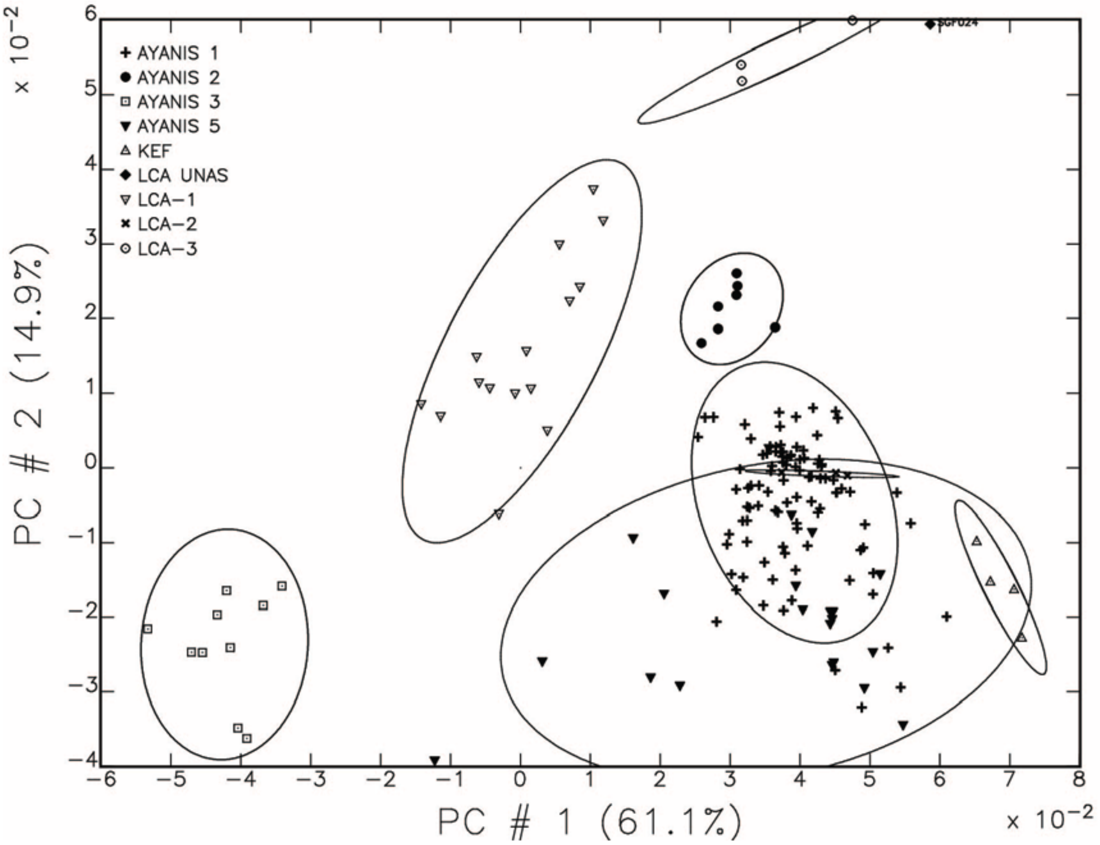


Figure 5.22: Biplot comparing PC1 and PC2 of the combined Urartian center assemblage (Speakman et al. 2004) and the Naxcivan assemblage. Groups are shown from the Low Calcium groups from each compositional study. Ellipses are drawn at the 90% confidence interval.

ANID	Ayanis 1 *p*	Ayanis 5 *p*
SGF023	0.149	4.875
SGF030	84.128	35.329
SGF032	0.136	7.260

Table 5.13: Mahalanobis distance-based probabilities (p) of group membership for LCa2 in Ayanis 1 and Ayanis 5 groups. Mahalanobis distances were calculated using the first six PCs (90.6% total variance) of the PCA for both assemblages

Comparison with LBA pottery from the Tsaghkahovit Plain, Armenia (Lindsay et al. 2008)

Lindsay et al. (2008) analyzed several assemblages from the Tsaghkahovit Plain in Armenia. Although the Tsaghkahovit material is from an earlier period (Late Bronze Age), it was considered because it is relatively geographically close to Naxçıvan (approximately 135 km away), and the area is occupied both immediately preceding and following the Middle Iron Age (Khatchadourian 2007, 2008, 2016). This material was used as a comparative dataset to see if they were using similar raw materials.

Lindsay et al. (2008) were able to divide the Tsaghkahovit material into three discrete compositional groups (ICL-1, ICL-2, ICL-3). These groups were then related to three previously defined groups (group 1, group 2, group 3) (Smith et al. 2004). Most specimens from ICL-1 were included in group 1, most specimens from ICL-3 were included in group 2, and ICL-2 remained a distinct group. For the purposes of this analysis. ICL-1/group 1=Tsa 1, ICL-3/group 2=Tsa 2, group 3=Tsa 3, and ICL 2=Tsa 4.

A PCA was conducted on all of the specimens in the Tsaghkahovit and Naxçıvan specimens. The first eleven PCs account for 90.6% of the cumulative variance. A biplot of PC1 and PC2, accounting for 48.3% of the variance, shows that all of the Naxçıvan samples can be easily distinguished from the Tsaghkahovit with the exception of LCa1, which overlaps with several of the Tsaghkahovit groups (Figs. 5.23, 5.24).

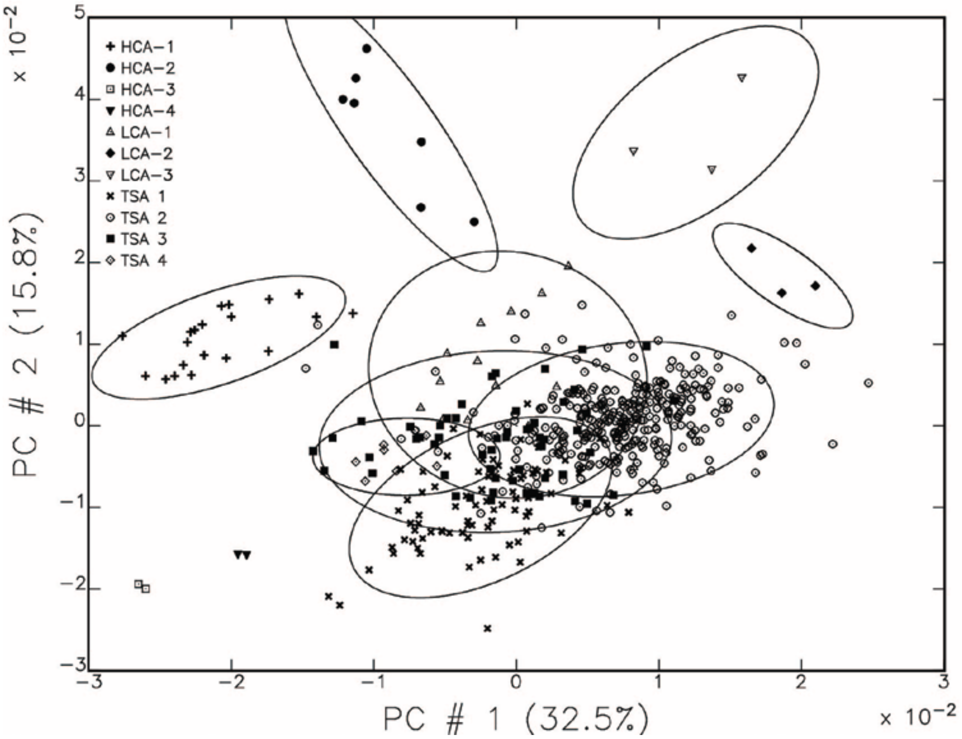


Fig. 5.23: Biplot comparing PC 1 and PC2 of the combined Tsaghkahovit assemblage (Lindsay et al. 2008) and the Naxçıvan assemblage. Ellipses are drawn at the 90% confidence interval.

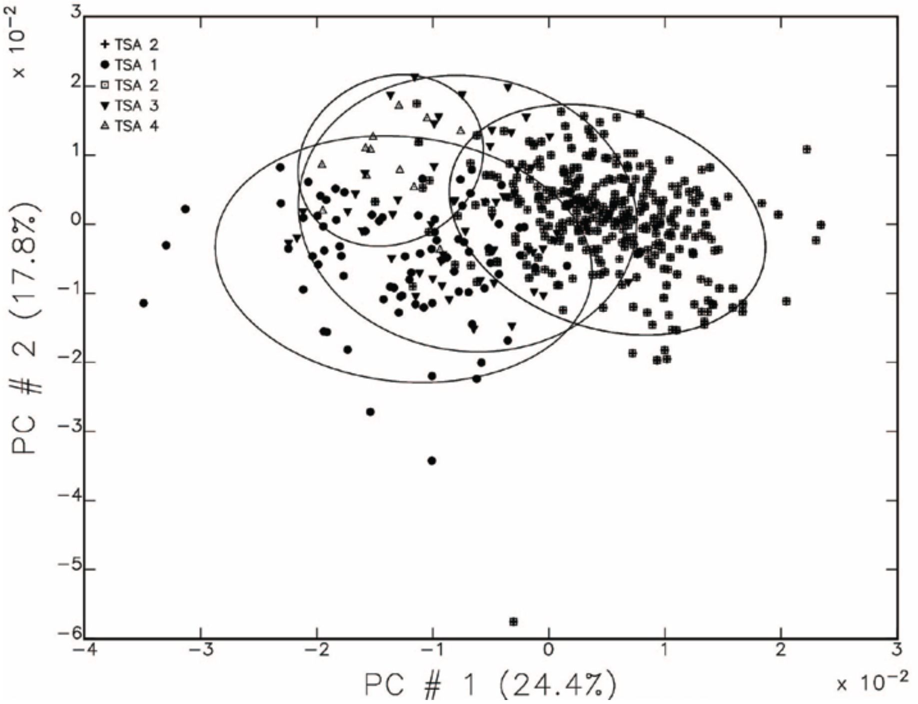


Fig. 5.24: Biplot comparing PC 1 and PC2 of the combined Tsaghkahovit assemblage (Lindsay et al. 2008) and the LCa1. Ellipses are drawn at the 90% confidence interval.

Group membership probabilities were calculated by projecting LCA1 against the three main Tsaghkahovit groups, Tsa 1, Tsa 2, Tsa 3, and Tsa 4 (Table 5.14). This shows that LCa1 has samples with high probabilities of membership in all four groups, though Tsa 3 has the greatest number of high probability memberships. Several specimens show high probabilities of membership in more than one group, with SGF058 showing high probabilities of membership in all four groups. It is possible to discriminate LCa1 from Tsa 4 by examining a biplot of PC 1 and PC2. However, looking closely at the elemental bivariate plots, it is extremely difficult to separate LCa1 from any of the Tsaghkahovit groups, which are indeed difficult to separate from each other.

ANID	Tsa 1 *p*	Tsa 2 *p*	Tsa 3 *p*	Tsa 4 *p*
SGF037	0.048	0.000	**17.219**	4.425
SGF039	0.068	3.074	3.843	**17.331**
SGF040	0.000	0.000	0.004	1.378
SGF042	0.023	0.000	**6.771**	3.655
SGF043	0.000	0.001	0.658	0.594
SGF045	0.000	0.000	0.022	2.224
SGF046	1.122	**85.903**	**76.821**	4.605
SGF047	0.000	0.000	0.269	1.304
SGF049	0.000	0.001	**34.481**	1.338
SGF053	0.000	0.000	0.003	0.841
SGF054	0.000	0.000	0.068	0.879
SGF055	0.000	0.143	0.303	4.243
SGF056	0.239	2.751	3.737	3.709
SGF057	0.000	0.000	0.141	0.888
SGF058	**13.050**	**27.441**	**12.106**	**5.406**

Table 5.14: Mahalanobis distance-based probabilities (p) of group membership for LCa1 in Tsaghkahovit groups Tsa 1, Tsa 2, Tsa 3, and Tsa 4. High probability samples are shown in bold font. Mahalanobis distances were calculated using the first eleven PCs (90.6% total variance) of the PC analysis for both assemblages.

LCa1 is a petrographically diverse group. The specimens that show high probability of membership with the Tsaghkahovit groups come from many different, if chemically related petrogroups. There is no evidence of patterning for a relationship between specific petrogroups and specific chemical groups. While it is possible that some LCa1 samples came from the same geological context as some of the Tsaghkahovit samples, the similar chemistry is unlikely to indicate more generalized exchange. Mahalanobis distances were also calculated for all Naxçıvan groups projected against all Tsaghkahovit groups, and no other relationships were found.

Scanning Electron Microscopy-Electron Dispersing Spectroscopy (SEM-EDS) Results

SEM

Microstructural and microanalysis were conducted on 12 slipped ceramic samples by SEM-EDS. The samples were selected to represent the different chronological phases at Oğlanqala (Table 5.15).

Period	Roman Parthian/ Period 2	Middle Iron Age/ Period 4	Early Iron Age/ Period 5
Number of samples (n)	4	5	3

Table 5.15: SEM-EDS samples by period

The resulting SEM images showed no evidence of sintering or vitrification (Fig. 5.25: Plate 1 and Plate 2). However, higher magnification may have resulted in evidence for higher temperature firing conditions. The temperature at which sintering occurs varies based on firing atmosphere, soaking time, and clay chemistry, but these results indicate that these ceramics were not fired above 750-850°C for any extended period of time, and can be more colloquially defined as "low fired" (Gosselein 1992; Maniatis and Tite 1981). These results are compatible with the observed optical activity in the petrofabrics, with the exception of some Serpentinite Group samples. A lack of evidence for sintering/vitrification, coupled with the high degree of optical activity in the paste suggests that these ceramics were fired to temperatures below 850°C (Maniatis and Tite 1981; Whitbread 1995). Recent methods have made it possible to develop a more precise estimation of firing temperatures below 850°C, including stepped re-firing while measuring magnetic susceptibility and Fourier transformed infrared spectroscopy, and may be pursued in future studies (Karacic 2014; Maritan et al. 2006; Rasmussen et al. 2012).

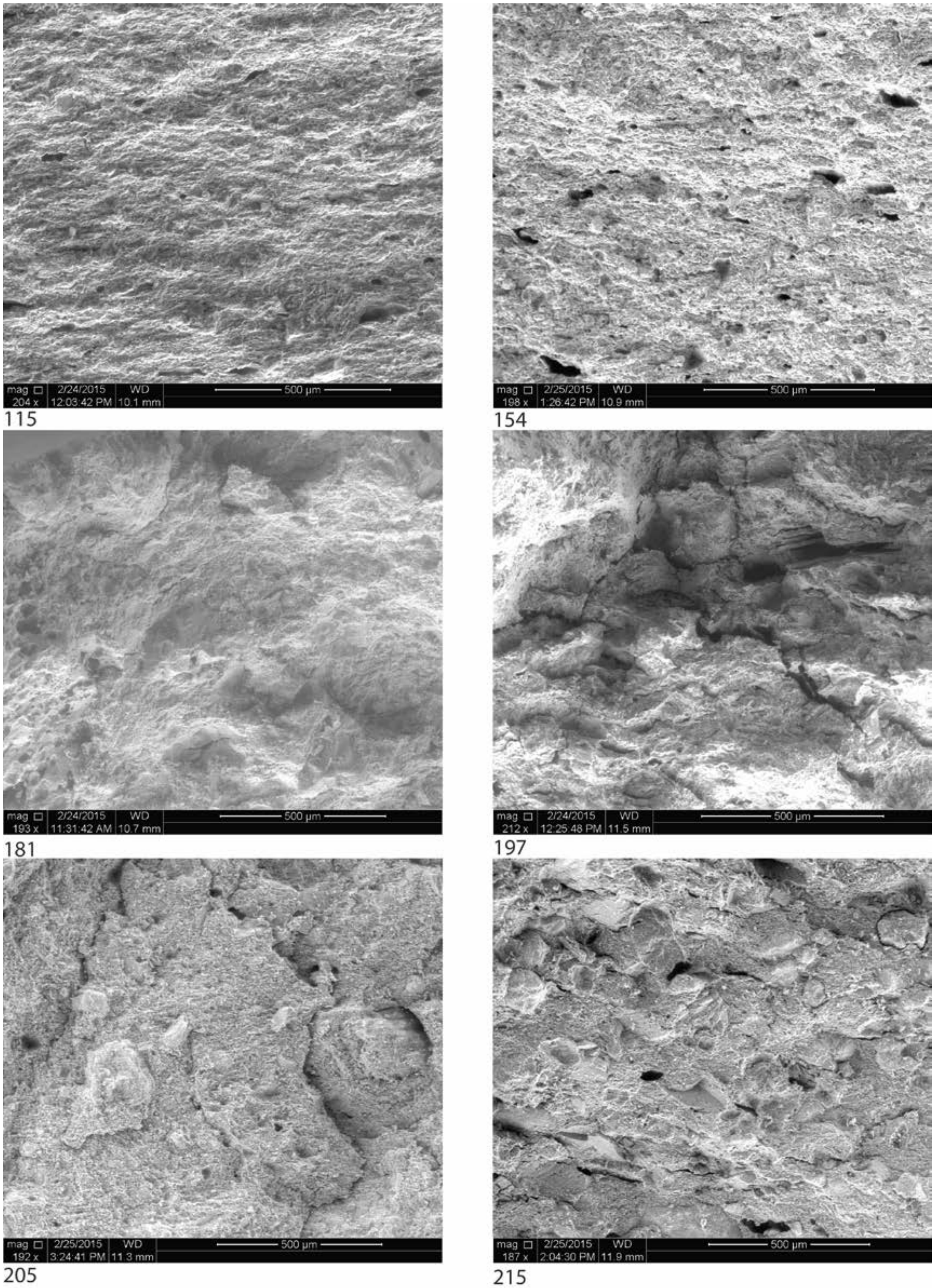
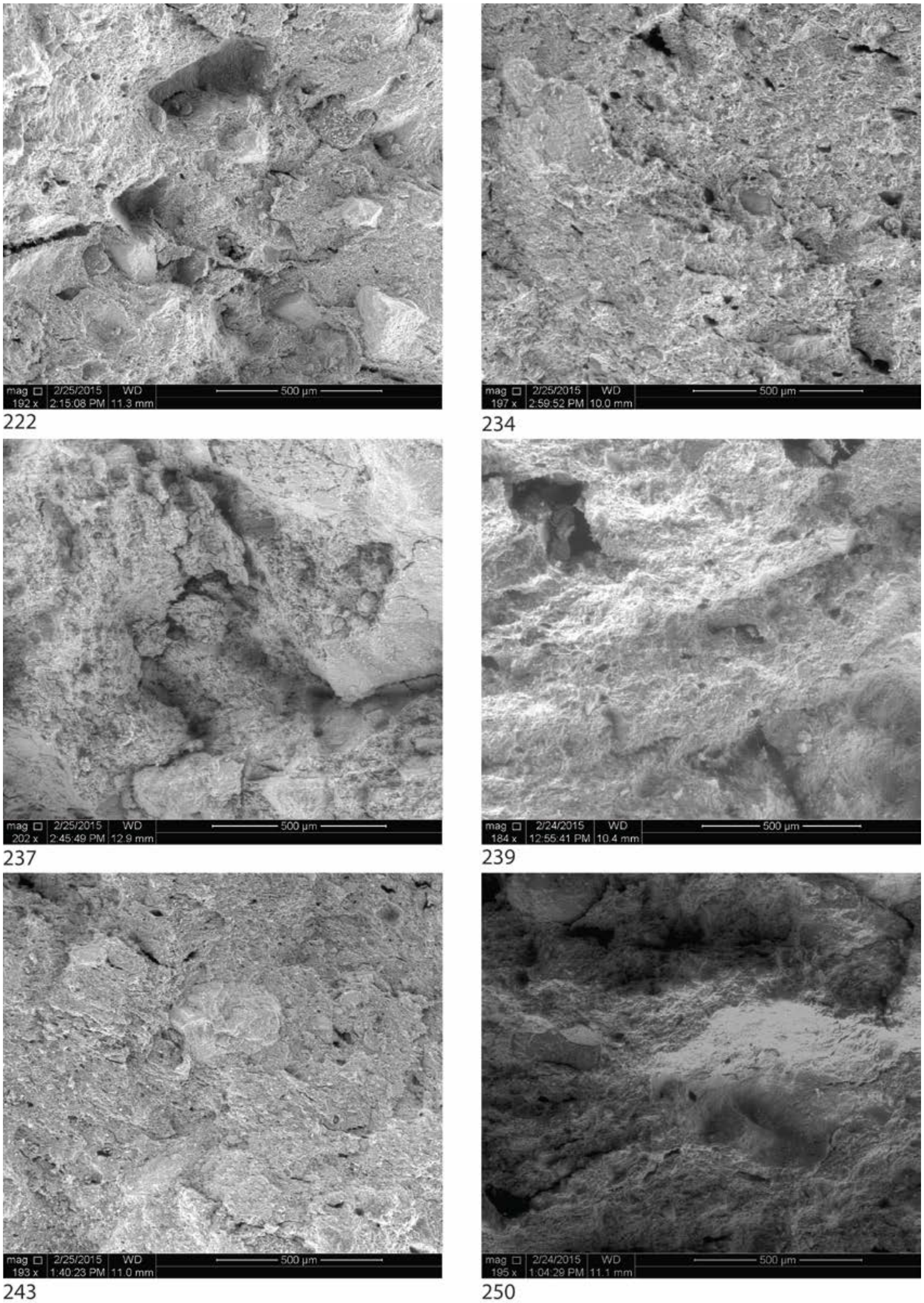


Fig. 5.25: Plate 1, SEM images



222

234

237

239

243

250

Fig. 5.25: Plate 2, SEM images

EDS

The semi-quantitative measurement of the relative weight percentage of the elements Al, Si, Mg, Ca, Na, K, and Fe were recorded for 12 samples using EDS to observe possible chemical relationships between the slips, petrofabrics, NAA groups, and chronological periods. These samples includes three sherds from period 5, five sherds from period 4, and four sherds from period 2 (Table 5.16).

Sample #	Si	Al	Mg	Ca	Na	K	Fe	Period	Petrofabric	NAA #	NAA Group
115s	18.23	11.43	1.23	1.4	1.31	2.54	4.77	4	Carbonate Group: fine	SGF 023	LCa2
154s	11.2	18.4	1.42	1.45	1	1.45	2.74	4	Carbonate Group: fine	SGF 032	LCa2
181s	14.67	10.6	1.22	2.73	1.29	2.78	3.12	4	Andesitic Sand Pair	SGF 042	LCa1
194s	16.83	16.11	1.19	2.48	0.92	2.44	5.81	4	Andesite Calcareous Group	SGF 052	HCa1
205s	18.02	10.26	1.71	3.21	1.38	1.59	2.59	4	Andesite Calcareous Group	SGF 062	HCa1
215s	14.57	13.33	1.23	2.49	2.17	2.7	3.58	2	Serpentinite Group		
222s	9.21	30.55	1.11	3.08	0.59	1.19	2.36	2	Serpentinite Group		
234s	15	11.45	1.21	9.65	0.34	1.77	7.21	2	Andesite Calcareous Group		
237s	11.33	18.57	1.34	3.03	1.35	2.35	2.19	2	Andesite Calcareous Group		
239s	15.15	7.15	1.16	7.6	0.84	2.57	3.65	5	Andesite Calcareous Group		
243s	10.6	21.96	1.4	6.13	0.45	1.47	3.77	5	Andesite Calcareous Group		
250s	15.84	11.26	1.16	4.98	1	2.83	3.62	5	Andesite Calcareous Group		

Table 5.16: Elemental data of slips as a weight percentage for all periods. Blue values represent lower levels of those elements and red values represent higher levels of those elements.

The small sample size makes it necessary to be cautious regarding any apparent patterns. However, a few suggestive similarities and differences can be noted. For example, the Andesite Calcareous samples are similar in clay body and slip across all periods. The clay and slip data for each Andesite Calcareous sample indicates that the latter was considerably altered from the former, or different materials were used. However, the picture becomes more complicated for other production contexts, with the EDS data not always aligning clearly with the petrographic and NAA results. The following results are presented (mostly) chronologically.

Early Iron Age/Period 5

All three period 5 samples have very similar composition, although sample 243 is somewhat divergent (Table 5.17). Sample 243 has lower levels of Si, Na, and K, and higher levels Al, Mg, and Ca. The only, very limited point of differentiation between sample 243 and the other period 5 samples is that sample 243 lacks biotite in the petrofabric while samples 239 and 250 have biotite. Since biotite is more common in Sədərək samples, this could relate to the production context. However, this difference could also simply be the product of the EDS recording data from a point with high aluminum oxide (Al_2O_3), and variation in calcium levels are quite common. The differences between the clay bodies of these ceramics are actually quite minor, and their normal variation appears more significant as a result of the small sample size.

While the EDS results from the sample 243 clay body sample have elevated levels of Al as would be expected from biotite, the slip has much lower levels, indicating a difference in the materials used for the slip and clay recipes (Table 5.18). All three of these samples show significant differences in the slip and clay elemental proportions for all elements measured, similarly suggesting different use of materials for the clay body and slip. However, the fact that the clays are similar to each other and the slips are similar to each other indicate a shared production context and/or raw material use, with different or altered materials used for the clays and the slips.

Sample #	Si	Al	Mg	Ca	Na	K	Fe	Period	Petrofabric
239s	15.15	7.15	1.16	7.6	0.84	2.57	3.65	5	Andesite Calcareous Group
243s	10.6	21.96	1.4	6.13	0.45	1.47	3.77	5	Andesite Calcareous Group
250s	15.84	11.26	1.16	4.98	1	2.83	3.62	5	Andesite Calcareous Group

Table 5.17: Elemental data of slips as a weight percentage for period 5. Blue values represent lower levels of those elements and red values represent higher levels of those elements.

Sample #	Si	Al	Mg	Ca	Na	K	Fe
237c	23.79	14.54	**1.59**	1.86	2.01	**2.93**	6.64
237s	11.33	18.57	**1.34**	3.03	1.35	**2.35**	2.19
239c	22.33	9.01	2.06	2.91	1.73	3.14	4.9
239s	15.15	7.15	1.16	7.6	0.84	2.57	3.65
243c	18.87	7.87	**1.97**	14.39	**0.09**	3.14	11.62
243s	10.6	21.96	**1.4**	6.13	**0.45**	1.47	3.77
250c	20.5	7.68	**1.77**	6.2	**0.56**	3.4	5.05
250s	15.84	11.26	**1.16**	4.98	**1**	2.83	3.62

Table 5.18: Elemental data of slips and as a weight percentage for period 5. C in the sample column refers to clay body, and S refers to slip. Values are in bold font when the clay and slip for a single sample are similar for that measured element.

Middle Iron Age/Period 4

None of the period 4 samples can be placed into clear groups, though samples 115, 194, and 205 are all fairly similar (Table 5.19). This makes sense for samples 194 and 205, since these were placed in the same petrographic group (Andesite Calcareous) and the same NAA group (HCa1). Sample 115 slip has lower levels of Ca, and was placed in the fine Carbonate Group (clay EDS measurement has higher levels of Ca) and NAA group LCa2, associated with Ayanis.

The slip from sample 154 (Carbonate Group, LCa2) is different from sample 115 across nearly all elements measured, despite being the same type of vessel (palace ware), petrofabric, and NAA group. This could indicate different slip components being used in the same or related production contexts, but the sample is too small to establish this. Sample 181 (Andesitic Sand Pair, LCa1) is dissimilar from all other samples, suggesting a different slip recipe in a different production context.

Although the slips from samples 115 and 181 are different from each other, they each share a marked compositional similarity between their slip and clay bodies (Table 5.20). For both samples, the main difference between the slip and clay is elevated proportions of Si and Fe. This could indicate that a similar process was employed to alter the clay body raw materials to make slip for these samples, even in production contexts using different raw materials. This is worth noting as all of the other samples analyzed show very different elemental proportions for the clay and the slip, indicating that either different materials were used for these different parts of the vessel, or that slip was far more extensively altered from the clay body.

Sample #	Si	Al	Mg	Ca	Na	K	Fe	Period	Petrofabric	NAA #	NAA Group
115s	18.23	11.43	1.23	1.4	1.31	2.54	4.77	4	Carbonate Group: fine	SGF 023	LCa2
154s	11.2	18.4	1.42	1.45	1	1.45	2.74	4	Carbonate Group: fine	SGF 032	LCa2
181s	14.67	10.6	1.22	2.73	1.29	2.78	3.12	4	Andesitic Sand Pair	SGF 042	LCa1
194s	16.83	16.11	1.19	2.48	0.92	2.44	5.81	4	Andesite Calcareous Group	SGF 052	HCa1
205s	18.02	10.26	1.71	3.21	1.38	1.59	2.59	4	Andesite Calcareous Group	SGF 062	HCa1

Table 5.19: Elemental data of slips as a weight percentage for period 4. Blue values represent lower levels of those elements and red values represent higher levels of those elements.

Sample #	Si	Al	Mg	Ca	Na	K	Fe
115c	22.83	**11.72**	**0.74**	**1.72**	**1.03**	**3.17**	7.24
115s	18.23	**11.43**	**1.23**	**1.4**	**1.31**	**2.54**	4.77
154c	21.44	11.96	0.68	**2.17**	**0.81**	2.73	5.02
154s	11.2	18.4	1.42	**1.45**	**1**	1.45	2.74
181c	21.33	**10.65**	**0.69**	**2.03**	**0.42**	**3.3**	12.47
181s	14.67	**10.6**	**1.22**	**2.73**	**1.29**	**2.78**	3.12
194c	22.57	9.85	**1.28**	1.62	**1.25**	**2.45**	8.02
194s	16.83	16.11	**1.19**	2.48	**0.92**	**2.44**	5.81
205c	16.51	7.87	2.51	5.38	**1.15**	**2.18**	3.44
205s	18.02	10.26	1.71	3.21	**1.38**	**1.59**	2.59

Table 5.20: Elemental data of slips and clays as a weight percentage for period 4. C in the sample column refers to clay body, and S refers to slip. Values are in bold font when the clay and slip for a single sample are similar for that measured element.

Roman-Parthian Period/Period 2

The slip samples from 215 and 237 have very similar elemental proportions, which is interesting since 215 is a member of the Serpentinite Group and 237 is a member of the Andesite Calcareous Group (Table 5.21). Sample 234, also Andesite

Calcareous Group, is quite similar to these two samples with the exception of elevated proportions of Ca and Fe. Both the slip and clay for 234 were made from calcareous materials, similar to sample 243 (period 5), and distinct from the rest of the assemblage (Table 5.22). This does not mean that all three samples were being made in the same production context, since petrography shows that this is not likely, but rather that these slips were being made from geochemically similar materials.

Sample #	Si	Al	Mg	Ca	Na	K	Fe	Period	Petrofabric
215s	14.57	13.33	1.23	2.49	2.17	2.7	3.58	2	Serpentinite Group
222s	9.21	30.55	1.11	3.08	0.59	1.19	2.36	2	Serpentinite Group
234s	15	11.45	1.21	9.65	0.34	1.77	7.21	2	Andesite Calcareous Group
237s	11.33	18.57	1.34	3.03	1.35	2.35	2.19	2	Andesite Calcareous Group

Table 5.21: Elemental data of slips as a weight percentage for period 2. Blue values represent lower levels of those elements and red values represent higher levels of those elements.

Sample #	Si	Al	Mg	Ca	Na	K	Fe
215c	21.67	9.64	2.13	6.36	1	3.32	9.65
215s	14.57	13.33	1.23	2.49	2.17	2.7	3.58
222c	29.97	10.18	**1.91**	7.08	3.13	1.78	**3.56**
222s	9.21	30.55	**1.11**	3.08	0.59	1.19	**2.36**
234c	15.86	6.12	**1.86**	15.37	**0.69**	2.76	17.91
234s	15	11.45	**1.21**	9.65	**0.34**	1.77	7.21
237c	23.79	14.54	**1.59**	1.86	2.01	**2.93**	6.64
237s	11.33	18.57	**1.34**	3.03	1.35	**2.35**	2.19

Table 5.22: Elemental data of slips and as a weight percentage for period 2. C in the sample column refers to clay body, and S refers to slip. Values are in bold font when the clay and slip for a single sample are similar for that measured element.

In contrast, the slip for sample 222 (Serpentinite Group) is very different from all other samples, with elevated levels of Al and depleted levels of Si, Mg, Na, K, and Fe. This difference indicates that different slip raw materials or preparation methods were being employed for ceramics in the same or geographically proximate production contexts.

Andesite Calcareous Group Comparison

In total, 7 samples were analyzed from the Andesite Calcareous Group, including three samples from period 5, two samples from period 4, and two samples from period 2 (Table 5.23). Considerable variety can be observed in the slips associated with this petrofabric. Samples 234, 237, 239, and 250 are all quite similar, although the former two are period 2 and the latter two are period 5.

Sample #	Si	Al	Mg	Ca	Na	K	Fe	Period	Petrofabric	NAA #	NAA Group
194s	16.83	16.11	1.19	2.48	0.92	2.44	5.81	4	Andesite Calcareous Group	SGF052	HCa1
205s	18.02	10.26	1.71	3.21	1.38	1.59	2.59	4	Andesite Calcareous Group	SGF062	HCa1
234s	15	11.45	1.21	9.65	0.34	1.77	7.21	2	Andesite Calcareous Group		
237s	11.33	18.57	1.34	3.03	1.35	2.35	2.19	2	Andesite Calcareous Group		
239s	15.15	7.15	1.16	7.6	0.84	2.57	3.65	5	Andesite Calcareous Group		
243s	10.6	21.96	1.4	6.13	0.45	1.47	3.77	5	Andesite Calcareous Group		
250s	15.84	11.26	1.16	4.98	1	2.83	3.62	5	Andesite Calcareous Group		

Table 5.23: Elemental data of slips as a weight percentage for Andesite Calcareous Group members for all periods. Blue values represent lower levels of those elements and red values represent higher levels of those elements.

This could indicate that people continued to use similar local materials across a broad time span. The period 4 samples (194 and 205) have elevated Si levels, and sample 243 is somewhat of an outlier for several elements, but all of this variation falls within a reasonable range for a heterogenous raw material group from the same area.

Surface Treatment Analysis Results

A total of 597 ceramic samples were analyzed for their burnish stroke direction. As noted in the methods section, all sherds were identified as belonging to one of seven mutually exclusive categories: horizontal irregular (HI), horizontal regular (HR), vertical (V), horizontal-vertical (HI/V), polished (P), eroded (E), and no slip ever present (N/A) (Fig. 4.10).

Early Iron Age/Period 5

Sixty-two samples were analyzed for surface finishing from the EIA, including 38 from the Oğlanqala citadel, 20 from Sədərək settlement, and four from Sədərəkqala. Of these, 39 were too eroded to see burnish strokes and an additional four were never slipped, leaving 14 samples from Oğlanqala, 3 samples from the Sədərək settlement, and two samples from Sədərəkqala. Of the remaining 19 samples, 14 (74%) had HI burnish strokes, three (16%) samples were polished, one (5%) had V strokes, and one (5%) had HI/V burnish strokes. There does not appear to be any sort of pattern between burnish stroke and vessel type, nor between sites, although the numbers are too small to really assess this. No evidence for manufacturing was visible in the surface features. All the samples that were analyzed petrographically (n=12) belong in the Andesite Calcareous Group, which dominates the EIA.

Middle Iron Age/Period 4

I analyzed 332 Middle Iron Age samples for burnish strokes, including 312 from Oğlanqala, 16 from Sədərək settlement, and 4 from Sədərəkqala. Of these, 176 samples had visible burnish marks, including 170 from Oğlanqala, 3 Sədərək settlement, and 3 from Sədərəkqala. This sample includes 118 (67%) HI burnish strokes, 30 (17%) polished samples, 21 (12%) HI/V burnish strokes, and 7 (4%) have HR burnish strokes.

Polished samples are disproportionately from non-local contexts, but distributed among nearly all non-local petrofabrics. Of 14 polished samples with a known petrofabric, only one is from the Andesite Calcerous Group (193). This means that 93% (13/14) of the polished samples are non-local (Table 5.24). Conversely, the Andesite Calcareous samples were less likely to be finely burnished, and are characterized by HI or HI/V strokes, although many other fabrics are also finished with HI or HI/V strokes (Table 5.25). The variation in burnish stroke application for Andesite Calcareous vessels as compared to non-local vessels is significant (χ^2=7.16, $p < 0.05$), but the small count for the polished Andesite Calcareous sample limits the accuracy of this test.

	HI or HI/V	Polished
Andesite Calcareous	48% (15/31)	7% (1/14)
Coarse Andesite	23% (7/31)	0% (0/0)
Fine Glassy Andesite	0% (0/0)	37% (5/14)
Carbonate	0% (0/0)	21% (3/14)
Rhyolite	13% (4/31)	21% (3/14)
Dacite	6% (2/31)	7% (1/14)
Andesitic Sand Pair	0% (0/0)	7% (1/14)
Loners	10% (3/31)	0% (0/0)

Table 5.24: Distribution of Burnish Stroke Direction by Petrofabric in Period 4

Comparing burnish strokes to specific forms results in sample sizes that are so small that they are no longer useful. However, if you simply compare bowls to jars, it is possible to observe a general difference in burnishing application. Out of the 70 bowls with visible burnish strokes and known forms, 61% (n=43) are HI and 30% (n=21) are polished. In contrast, just 7% (n=5/74) of the jars are polished (Table 5.X). There is a significant difference between the application of horizontal irregular versus polished burnish strokes by form (χ^2=15.2372, $p < 0.05$).

	Bowls	Jars
Horizontal Irregular	61% (43/70)	93% (69/74)
Horizontal Regular	9% (6/70)	0% (0/0)
Polished	30% (21/70)	7% (5/74)

Table 5.25: Distribution of Vessel Type by Burnish Stroke in Period 4

While some of this variation could be the result of differential preservation, it appears that bowls were more likely to be highly burnished than jars.

Only six HR samples were found for the MIA, 3 of which were red slipped. Since only 18% (n=23/176) of the MIA samples in this analysis are red slipped, they are disproportionately represented in this group. However, the number of samples is too small to be meaningful.

It was also possible to see coils in the profile of 11 of 332 samples analyzed (Fig. 5.26), which makes sense as the inclusions in these fabrics are often far too coarse to be made with a wheel without cutting the potter's hand. Additionally, the slip is extremely thick compared to other periods, allowing the vessels to have a fine, smooth, shiny appearance with extensive burnishing to hide the coil built, very coarse vessels.

Fig. 5.26: Coils Visible in Profile

Roman-Parthian Period/Period 2

81 of the 203 Roman-Parthian period samples analyzed for surface treatment had visible burnish marks, 73 of which were categorized as HR. The remaining samples with visible strokes were categorized as HI. Four HI samples were discussed above as red slipped members of the Andesite Calcareous group. An additional buff slipped bowl with HI burnish marks is also part of the Andesite Calcareous group. The three remaining HI slipped sherds that were not sampled for petrography include two simple rim red slipped bowls and a buff slipped base.

The 53 samples of red slipped ceramics that had been analyzed petrograpically were examined for burnish stroke direction. Two types of burnish strokes were identified for this period: horizontal regular (HR) and horizontal irregular (HI). Of these, 57% (n=30) had regular horizontal strokes, 8% (n=4) had irregular horizontal strokes, and 36% (n=19) were too eroded to distinguish. This means that 88% of the sherds with visible strokes were burnished with the same regular horizontal strokes, indicating a shared gesture and possible technological tradition even for vessels made in different areas. Although all of the samples with HI burnish strokes were made in the Andesite Calcareous petrofrabic, nearly the same number (n=3) of Andesite Calcareous samples exhibit the more uniform HR burnish strokes, and the sample size is too small to confidently interpret.

Conclusion

These results provide a rich dataset to reconstruct ceramic production and exchange at Oğlanqala from the Early Iron Age to the Roman-Parthian Period. Each method serves to bolster and refine the results of the other methods. However, describing the results, or listening to what the ceramics say is only part of the project. In order for this data to be useful, I must weave it together into a coherent narrative to understand what, exactly, the ceramics mean.

CHAPTER 6: What The Things Mean: Analysis

In the following discussion I synthesize the results of all analyses, and place them into theoretical, archaeological, and historical context. By moving chronologically from the Early Iron Age to the Roman Period, it becomes possible to observe the long-term shifts in production and exchange enacted in relation to the changing political landscape. The organization of each period's review varies depending on what most clearly communicates the results. Petrofabrics are the broadly organizing factor for most periods, since petrographic analysis is the primary source of data. However, in the Middle Iron Age/period 4 the results are largely organized by vessel type. The complexity of the compositional results for this period made the focus on vessel form a necessary organizing feature.

Defining Local versus Non-Local Production

This research relies heavily on the terms "local" and "non-local," so it is worthwhile to take a moment to consider what is meant by these terms in this context. The Andesite Calcareous petrofabric is considered broadly local, meaning that this group is largely composed of ceramics that were produced close to either Oğlanqala or Sədərək. There are several reasons for this conclusion. This petrofabric is found in every period from the Middle Bronze Age (MBA, 2600-1500 BCE) to the 20th century CE, and for every period it is either the largest or second largest petrogroup (Fishman 2016; Fishman et al. 2015). While most other petrofabrics are restricted to certain periods or forms, the Andesite Calcareous petrofabric is used to make nearly every form in every period, even if only in small amounts. The criterion of abundance (Bishop et al. 1982) suggests that this petrogroup is local. If it is not local, Oğlanqala was consuming pottery from the same or similar, non-local production center(s) for over four millennia, which is unlikely. While NAA was only conducted on period 4 ceramics, all the Andesite Calcareous samples from that period were assigned two groups that did not include any other petrofabrics: HCa1, which is also the largest chemical group (n=20), and HCa2 (n=7). The division of the Andesite Calcareous Group into two chemical groups is likely the result of one clay source from near Sədərək and one from near Oğlanqala, discussed in greater detail below. Moreover, HCa1 has a high probability of being in the same chemical group as one geological sample from Oğlanqala (Geo82/SGF020) and one from Sədərəkqala (Geo21/SGF003). Finally, petrographic analysis of the geological samples from Oğlanqala and Sədərək mineralogically match the Andesite Calcareous Group ceramics.

However, concluding that the Andesite Calcareous Group is local requires several caveats. At least three of the Andesite Calcareous Group samples analyzed with NAA could not be assigned to a chemical group, but were instead placed in the more ambiguous category of HCa unassigned. This is normal for NAA, and would be mitigated by a larger sample size, but it points to the geochemical diversity within this petrogroup. The HCa unassigned samples, as well as HCa1, show some chemical affinity with samples that Speakman et al. (2004) link to Bastam, or northwest Iran more generally, though their samples can be chemically differentiated. This indicates that some of the HCa members may be coming from northwest Iran, even if not from the same source as the Bastam group. However, this potential connection cannot be confirmed with these data. Six of the geological thin sections have a similar mineralogy to the Andesite Calcareous Group, including samples from Xalac (Geo25), Axura (Geo37), Kolani (Geo56/SGF013), Milakh (Geo60/SGF015), Parağa (Geo72), and Kotom (Geo76/SGF019) (Fig. 4.9; appendix C). The low probability of a geochemical match likely excludes Kolani (Geo56/SGF013), Milakh (Geo60/SGF015), and Kotom (Geo76/SGF019) from contributing to the Andesite Calcareous Group. These are also some of the more geographically distant samples. However, these data point to the fact that the raw materials needed to produce ceramics that appear similar to the Andesite Calcareous Group are not geographically limited, but rather widely available. Therefore, while the Andesite Calcareous Group is considered broadly local, it is also likely that at least a small percentage of vessels in that group were produced elsewhere, and it is simply not possible to differentiate between sources.

Defining "local" as any material coming from two sites that are 13 km apart is a broad definition, but it is the closest defensible definition the data will allow. Moreover, non-local is defined as anything produced from materials not available within 10 km of these two sites. This creates somewhat of a false binary, since some material that is treated as "non-local" may have come from Axura, just 12 km from Oğlanqala in the opposite direction from Sədərəkqala. Therein lies the challenge of the geological diversity of the South Caucasus. While the Andesite Calcareous Group is so abundant as to support the proposition of it representing local production, other petrogroups are more ambiguous.

Moreover, local production does not simply refer to a geological range, but to a community of practice for technological production (Druc 2013). Oğlanqala and Sədərək materials were placed in the same petrogroups because they were being made using a similar range of techniques, not just because they were using geologically similar materials. This does not mean that all of this pottery was being made in the same place, such as a single workshop, but that people were producing pottery within a broad technological tradition as part of an extended community. Who this community consisted of, how it was organized, and the range of materials they used changed in each period. In period 5 local pottery production was dispersed, and included potters from the area around Oğlanqala and Sədərək. By period 2, local pottery production was more concentrated with slighty different raw materials. However, in all periods "local" refers to the community/ies of potters producing ceramics relatively close to each site.

The labels "local" and "non-local" are shorthand for materials that could match the local geology and poduction methods immediately surrounding the sites from which ceramic samples were collected, and those that likely do not. For this analysis, the petrographic results produce better data indicating the number of production contexts or the range of material used, rather than the exact location of each context. However, the data are suggestive, and I will continue to use the terms "local" and "non-local".

Early Iron Age/Period 5

The EIA is characterized by ceramics that are consistent with local production, with 94% (n=81/86) of the samples placed in the Andesite Calcareous petrofabric group, made from the same basic calcareous clay mixed with andesitic river sand or sandy river clays in various proportions. When broken down by area, Oğlanqala has 91% (n=56/61) Andesite Calcareous samples, while Sədərək has 100% (n=25) Andesite Calcareous samples. However, there is considerable variation within this very broad group. Therefore, this group has been divided into subgroup A: close spaced sand inclusions that could be natural and/or added, subgroup B: open spaced sand inclusions that could be could be natural and/or added, and subgroup C: sand tempered (i.e. fine clay with sand intentionally added). These subgroups have nebulous boundaries, and are only intended to demonstrate the range of clay recipes that were being employed with the same basic materials, rather than discrete traditions. While all these subgroups are present in every period, they are only evenly distributed in period 5, with no recipe dominating. This indicates relatively distributed, varied local production practices (Table 6.1).

	EIA/Period 5 (n=81)
Andesite Calcareous A	32% (n=26/81)
Andesite Calcareous B	37% (n=30/81)
Andesite Calcareous C	31% (n=25/81)

Table 6.1: Distribution of Andesite Calcareous Subgroups in Period 5

The distribution of these different clay recipes by area and site indicates that tempered fabrics dominate (52%) the Oğlanqala kurgan. However, the subgroups are present in inverse proportions for the Sədərək samples, with fabrics with higher sand density most common (Table 6.2). Since the lines between these subgroups in fungible, these percentages must be taken with a grain (or two) of salt, but the variation is statistically significant ($\chi^2=10.9282$, $p < 0.05$). It is possible that this variation reflects chronological differences among the contexts sampled for this period, rather than different potters working contemporaneously. However, these patterns indicate that there were a range of local clay recipes in use throughout this period, with certain recipes more likely to be used in different contexts.

	Oğlanqala Kurgan (n=23)	Oğlanqala Citadel (n=26)	Sədərək (settlement and fortress) (n=25)
Andesite Calcareous: Subgroup A	17% (4/23)	22% (6/26)	48% (12/25)
Andesite Calcareous: Subgroup B	30% (7/23)	50% (13/26)	36% (9/25)
Andesite Calcareous: Subgroup C	52% (12/23)	27% (7/26)	16% (4/25)

Table 6.2: Distribution of Andesite Calcareous Subgroups by Context in Period 5

I compared the distribution of these subgroups to vessel forms to see if there was a pattern (Table 6.3). The only correlation found was that the tempered fabric (subgroup C) was largely used to make rolled rim jars (90%, n=18/20).

	Andesite Calcareous A	Andesite Calcareous B	Andesite Calcareous C
simple vertical rim bowl	19% (5/26)	13% (4/32)	5% (1/20)
indented rim bowl	15% (4/26)	6% (2/32)	0% (0/20)
simple vertical rim bowl	19% (5/26)	13% (4/32)	0% (0/20)
carinated bowl	4% (1/26)	6% (2/32)	0% (0/20)
clubbed rim bowl	4% (1/26)	0% (0/32)	0% (0/20)
simple rim plate	4% (1/26)	3% (1/32)	0% (0/20)
rolled rim plate	0% (0/26)	3% (1/32)	0% (0/20)
rolled rim jar	4% (1/26)	38% (12/32)	90% (18/20)
simple everted rim jar	23% (6/26)	16% (5/32)	5% (1/20)
storage jar	8% (2/26)	3% (1/32)	0% (0/20)

Table 6.3 Distribution of Andesite Calcareous subgroup by form (when form known)

By combining the vessels forms into their functional categories of bowl/plates and jars, it is possible to show that the relationship between subgroup and vessel type is significant, (χ^2=17.2029, $p < 0.05$) (Table 6.4).

	Andesite Calcareous A	Andesite Calcareous B	Andesite Calcareous C
Bowls/plates	17	14	1
Jars	9	18	19

Table 6.4: Distribution of Andesite Calcareous subgroup by vessel type

The remaining samples from the tempered subgroup include three jar bases that cannot be related to a specific rim, a simple everted rim jar, two body sherds that likely came from jars, and one indented rim bowl. Therefore, it is possible that this subgroup is even more dominated by rolled rim jars than it is possible to establish at present, and all but one sample is a jar of some kind. This pattern suggests that rolled rim jars may have largely been made in production context(s) that can be differentiated from that of the other vessels. This differentiation may have been based on a practical technological consideration, such as potters believed that this clay recipe worked better for the purpose of this vessel class. Or this differentiation may have been the product of different communities of practice, with a separate community of potters mostly producing these types of vessels and simply going about the clay recipe in a different way out of habitual practice (Gosselein 2008; Lave and Wengar 1991). If these potters were producing contemporaneously, ethnographic evidence suggests that these potters would have been aware that there were different clay recipes in use, and either chose or defaulted to one or several depending on the context (Dietler and Herbich 1989; Lemonnier 1993; Gosselain 2008; Sackett 1990). The varied use of similar local materials to make stylistically comparable pottery suggests that pottery production was dispersed, with either individuals or small workshops producing pottery for unrestricted consumption, since the kurgan, citadel, and Sədərək contexts each contain all clay recipes, if in different proportions. There is no evidence for elite sponsored or attached production (Costin 1991).

The five samples that were not Andesite Calcareous all came from the Şərur plain contexts, and are made from materials that can be found nearby. The Glassy Welded Tuff Loner and the Siliceous Carbonate Loner both came from the kurgan, and could be made from materials available in the Şərur valley, though they also could have been produced elsewhere. The additional three samples were all found on the Oğlanqala citadel, including a member of the Coarse Andesite Group (104), the Glassy Andesite Loner, and the Mafic Volcanic Loner. All three of these varieties of andesitic loners could have come from the Jurassic deposits from the neighboring valley of Axura, about 12 km east, or the Paleogene deposits 8 km to the west according to geological maps (although volcanic intrusions were never identified in survey of this area). Alternately, these samples could have come from further away. While these samples show that a very small fraction of these vessels were made in several different production contexts, these contexts need not have been far (Fig. 4.7). Four of the five divergent samples are from jars, indicating that this minimal movement of ceramics may have been primarily to get materials that would have been brought in the jars, rather than the jars themselves. The exception is the Coarse Andesite Group sample (104), which is a dark grey carinated bowl in a style that continues into the MIA, where it often traveled great distances (see MIA section below). It is possible that this sample was in fact made in the MIA, in which case the EIA had even less non-locally produced ceramics. The small proportion of non-local fabrics suggests that these objects were carried incidentally, rather than traded for profit or exchanged to maintain social ties. However, the presence of these non-local ceramics indicate that social and economic ties were maintained, even if the ceramics were incidental passengers instead of the main actors in this process (Latour 2005). Perhaps people were visiting relatives, moving flocks, assisting a neighbor, or engaged in some other social or economic activity, and simply brought along supplies for the short trip: a jar of food, a nice bowl as a present for a relative. There is nothing in the pattern of non-local material to suggest any more formal modes of exchange.

EDS data on the three samples analyzed indicates that the clay bodies and slips were being made with different materials, or the same materials were being altered from each other considerably. All three of the samples (239, 243, 250) have similar elemental proportions. One sample (243) is divergent, but within the range of reasonable local variation. This suggests the use of different slipping materials that produce the same appearance, which further supports the model of dispersed production. However, the sample size is too small to draw any firm conclusions. Burnishing gestures are also varied, with horizontal irregular strokes, vertical strokes, and a combination of the two evenly distributed across vessel types and areas, which also supports dispersed production.

Petrographic and SEM data show that all of these samples were low fired, certainly within 500-800°C, but likely no higher than 700°C. Simple visual analysis shows that these vessels were fired in a reducing atmosphere, and the irregular coloration could indicate simple pit firings rather than the use of a kiln, making small scale pottery production more feasible.

All evidence suggests that EIA Oğlanqala ceramics were locally produced in dispersed production contexts by individuals or small communities, likely by seasonal or part time potters who made pots for a limited number of people. There is no evidence for attached production (Costin 1991). The only evidence for differentiated production of any kind is the greater use of tempered fabrics for jars, potentially indicating a separate production context or set of functional considerations. Beyond ceramics, there is little clear EIA material culture at Oğlanqala, making the reconstruction of ceramic production even more significant, but also more difficult to contextualize. Therefore, we turn to Hasanlu for contextualization. Not simply because the ceramics are similar, but because in nearly every other way these sites are different. While the EIA occupation of Oğlanqala may have been limited, Hasanlu was a bustling, cosmopolitan center, with extensive trade networks and vibrant local craft production (Dyson and Muscarella 1989; Marcus 1996; Muscarella 2006; Reese 1989; Winter 1977). Yet these two sites show remarkable ceramic stylistic similarities, particularly in the Oğlanqala kurgan. Both of these sites belong to the Western Grey Ware tradition found throughout EIA Northwestern Iran and Azerbaijan (Danti 2013; Ristvet et al. 2012a).

Leigh-Ann Bedal et al. (1995) demonstrate that the inhabitants of Oğlanqala and Hasanlu shared more than just a regional ceramic style, since they also both practiced local ceramic production. Bedal et al. (1995) conducted NAA and petrographic analysis on Hasanlu V and Dinka Tepe III ceramics, and their results show only local production, with the people at each site mostly producing pottery to serve their own needs. Therefore, the dominance of local production at Oğlanqala and Sədərək cannot simply be explained away as the product of being a regional backwater. Rather, this suggests that they were part of some kind of cultural *ecumene*, in which geographically distant areas were producing local versions of pottery that would stylistically resonate across a considerable area. While the lack of trade indicates that Oğlanqala and Sədərək were not economically enmeshed with their neighbors (or at least we lack evidence for an economic relationship), the shared ceramic style and forms suggest some shared aesthetic, culinary, and/or cultural traditions. The limited amount of non-local pottery suggests that these vessels were incidental objects brought along while people were engaging in other social and economic activities.

While pots do not equal people, and pottery styles do not equal a shared identity, the widespread production of the same ceramic style does indicate some degree of cultural inter-connectedness. People moved around neighboring communities, saw what other people were making, and their pottery styles converged around a range of burnished grey-ish monochrome styles. Ethnographic research in Niger (Gosselain 2008), Ecuador (Bowser 2000), and Papua New Guinea (Lemonnier 2013) show that communities are quite aware of what their neighbors produce, and will differentiate themselves from others if desired. In Ban Chiang, Thailand from 2500 BCE to 200 CE, the use of paddle and anvil as a secondary forming technique obscured the initial forming techniques, making it possible to manipulate the final appearance of vessels regardless how the vessel was first constructed (Glanzman and Fleming 1985). While scholars have explored the visual appearance of ceramics as a sign of group identity in the semiotic sense (Hodder 1982, Wobst 1977), the dispersed production of this regional style is significant as an embodied, shared community practice, even if does not mean a shared discursive identity (Ingold 2013). Ceramic production is labor intensive and learned within communities of practice (Lave and Wengar 1991). If different communities were making visually similar pottery, known through interactions with neighboring communities, then this was, in some sense, a choice (Dobres 2000). This evidence does not speak to whether this was a conscious choice, or the necessarily unconscious enactment of habitus (Bourdieu 1979). Regardless, it represents the material, embodied enactment of shared cultural practices.

Perhaps this sense of shared traditions was co-opted by the Urartians, not by adopting regional ceramics, but by appealing to a sense of regional identity that was already present. Additionally, these regional relationships may have been deployed by coalitions of resistance such as the Etiuni (Biscione et al. 2002). These possibilities are not mutually exclusive, but in fact complimentary, since they indicate that existing material-social relationships from the EIA were re-imagined and repurposed in many ways in the MIA.

Middle Iron Age/Period 4

Ceramic production and exchange becomes considerably more complicated in the MIA, as the Urartian frontier expands into the Şərur plain. The samples from this period include 7 fabric groups and 7 loners, or single sample fabrics. The Andesite Calcareous Group accounts for just 51 % (n=51) of the entire assemblage, with considerable geographic diversity. The MIA sample includes 78% (n=78) samples from the Oğlanqala citadel, 18% (n=18) samples from the Sədərək settlement, and 4% (n=4) samples from Sədərəkqala. Additionally, NAA was conducted on 60 MIA samples, resulting in two main chemical groups, High Calcium (HCa) and Low Calcium (LCa), with four and three subgroups respectively (HCa1, HCa2, HCa3, HCa4, LCa1, LCa2, LCa3). The results of the NAA complement the petrographic results. In some instances, the NAA data provide greater precision. For example, it is possible to subdivide the Andesite Calcareous petrogroup and the Carbonate petrogroup geochemically. In other instances, the petrographic data make it possible to clearly differentiate between production contexts that the geochemical data lump together. This discussion will synthesize these datasets in addition to the SEM-EDS and surface treatment analysis results, and relate these data to certain ceramic forms and production contexts.

Continuing and Adapting (Mostly) Local Production

Ceramic production at Sədərək remained largely constant from the EIA to the MIA, with 95 % (n=21/22) of the samples Andesite Calcareous. Just one sample from Sədərəkqala is a petrographic loner with sandstone and rhyolite inclusions (sample 305). This sample is also the only hole-mouth jar examined in this study. Although more samples need to be taken, these initial findings suggest that while the Sədərək fortress architecture was more typically Urartian than Oğlanqala in Şərur, local clay preparation methods remained basically unchanged even as they were used to produce new MIA forms. This is even visible in the continued use of local clay recipes in similar proportions to the EIA, with relatively few clearly tempered fabrics (Table 5.1). In contrast, Andesite Calcareous ceramics found at Oğlanqala change, with far fewer tempered ceramics and clay recipe proportions that are much closer to Sədərək, showing a shift to more naturally coarse clays or seriated grain size non-plastic inclusions. In contrast to the EIA, there is no significant difference between the uses of these different clay recipes by site in the MIA (χ^2=90.3415, $p > 0.05$).

	Oğlanqala Citadel (n=28)	Sədərək (settlement and fortress) (n=21)
Andesite Calcareous: A	50% (n=14/28)	42% (n=9/21)
Andesite Calcareous: B	39% (n=11/28)	47% (n=10/21)
Andesite Calcareous: C	11% (n=3/28)	10% (n=2/21)

Table 6.5: Distribution of Andesite Calcareous Subgroups by context in period 4

Since the vast majority of the samples from the Sədərək valley were taken from a settlement rather than the fortress itself, this could indicate different degrees of ceramic change at a small domestic settlement compared to an administrative center, even if the domestic site was more clearly within what we would expect to be imperial territory. This pattern is closer to Liverani's (1988) "network" model of empire than to D'Altroy's (1992) hegemonic model. In Parker's (2006) borderlands system, this pattern could indicate that Şərur was a political frontier with administrative and military connections to Urartu. However, the administrative frontier was not contiguous with cultural or demographic frontiers.

Alternatively, this pattern could suggest that Oğlanqala increased exchange or trade with communities beyond the reach of the Urartian Empire. In this scenario, Oğlanqala's expanded exchange reflects closer ties to allies that could support Oğlanqala's limited engagement with Urartian symbols of power, perhaps as part of an elite exchange system to materialize alliances (Podany 2010; Polanyi 2001). However, since it is not possible to tie the majority of Oğlanqala imports to specific regions, and the ones that can be connected are often Urartian state associated ceramics from Urartian territory (see discussion of NAA below), this explanation is not well supported by the evidence. The functional contrast between the Sədərək settlement and the Oğlanqala fortress is stronger.

In contrast to Sədərək, clay production, style, and ceramic exchange changed significantly at Oğlanqala in the MIA. Just 38% (n=30/78) of the samples are from the Andesite Calcareous Group, 59% (n=46/78) are likely non-local, or at least come from very different production contexts, and just 3% (n=2/78) of samples appear to be local materials prepared in a different way. The high proportion of non-local ceramics is a significant shift from the incidental object carrying of the EIA, (χ^2=34.6317, $p < 0.01$) (Table 6.6). This shift indicates that different types of relationships were being materialized with Oğlanqala's neighbors, the specific nature of which will be discussed below. Even the proportions of different Andesite Calcareous clay recipes change, shifting away from the tempered fabrics mostly found in the EIA kurgan, to a greater emphasis on naturally coarse materials (Tables 5.1).

	Early Iron Age	Middle Iron Age
Local ceramics	92% (56/61)	41% (32/78)
Non-local ceramics	8% (5/61)	58% (46/78)

Table 6.6: Distribution of local versus non-local ceramics at Oğlanqala

As noted above, HCa1 is the largest chemical group (n=20), and it almost perfectly coincides with the Andesite Calcareous petrogroup. Clay samples SGF003 and SGF020, from Sədərək and Oğlanqala respectively, show high probabilities of matching HCa1, and support the proposition that the samples in this group are broadly local. It is notable that the next closest match, SGF001, is also from Oğlanqala. Furthermore, the two Andesite Calcareous samples analyzed with SEM-EDS (194 and 205) are similar to each other in both their slip and clay bodies, though the slip compositions differ from the clay compositions. However, several (n=11) samples from HCa1 and HCa unassigned samples from Oğlanqala show a chemical relatedness to the group that Speakman et al. (2004) associate with northwest Iran. There are no clear formal stylistic patterns to differentiate the samples that may show affiliation with northwest Iran, although the clubbed rim bowls (n=5) and cooking pots (n=3) account for the majority of these samples. All of these samples are part of the Andesite Calcareous petrogroup. While related chemical compositions cannot simply be equated with production centers, this pattern indicates that HCa1 and the Andesite Calcareous group contain evidence that ceramics may have been moving between northwest Iran and Sədərək.

Samples that were assigned to both the Andesite Calcareous Group and HCa1 are considerably diverse, including rolled rim jars, simple everted rim jars, clubbed rim bowls, carinated bowls, thick rim bowls, indented rim bowls, and pointed rim bowls. These vessels are slipped in every shade of grey, brown, and red. The only additional Andesite Calcareous forms that were not assigned to HCa1, either because they were not analyzed with NAA or they were geochemically unassigned, are a storage jar that is stylistically close to EIA forms, and a single ring base. This marks a diversification of ceramic production styles at Oğlanqala, and shows that the potters at Oğlanqala were capable of making most vessel types. This diversification of production likely indicates greater specialization, since potters would either have needed to make more forms, likely taking additional time/skill to master, or potters formed workshops that specialized in certain vessels. Moreover, since some of these locally produced forms, such as thick rimmed bowls, red slipped wares, and massive storage jars (discussed in detail below), were common at Urartian centers but rare in other contexts, they could have been the product of part time attached, or corveé labor similar to what has been observed for the Inka Empire (Costin and Hangstrum 1995; Hayashida 1999).

The only sample in HCa1 that was not identified as part of the Andesite Calcareous Group was not analyzed petrographically, although it is a fine red ware with parallels that fall into other petrographic (Carbonate: subgroup B) and geochemical (LCa2, HCa3) groups. As will be discussed below, it appears that these fine red polished wares were particularly mobile.

HCa2 (n=7) is also composed of samples that were assigned to the Andesite Calcareous petrogroup. However, their chemical distinction from HCa1 is particularly significant because all but one (86%, n=6/7) were sampled from the Sədərək settlement. Similarly, 85% (n=17/20) of the HCa1 specimens were from the Oğlanqala assemblage, with the remaining 15% sampled from the Sədərək settlement. While the sample size is small, these results suggest that either there was a small amount of mutual exchange between these two valleys, or objects were just being incidentally carried between the sites. The entirety of the Sədərək settlement assemblage and Oğlanqala assemblage are stylistically comparable, as are the chemical groups I propose can be associated with these sites. HCa2 has a similar diversity of vessel shapes as HCa1, although the former has several simple rim bowls and lacks rolled rim jars. Moreover, the vessels moving were primarily bowls, including one HCa2 grey carinated bowl found at Oğlanqala, and an HCa1 pink clubbed rim bowl, brown thick rim bowl, and red rolled rim jar found at the Sədərək settlement. With the possible exception of the jar, these vessels were not moving because of the commodities they carried. It seems probable, especially with the mobile pastoralist communities that populated this area, that people were simply moving with some regularity between these two sites. Perhaps they moved to visit family members or conduct business (or both), continuing practices from the EIA.

Two samples (Carbonate Volcanic Loner 47 and Micritic Carbonate Loner 170/SGF036) are petrographically distinct from the Andesite Calcareous group, but are not differentiated geochemically either because they were not analyzed or were unassigned. They both are still geologically within the parameters of local for the purpose of this study. The former is a buff storage jar that is stylistically similar to other MIA storage jars determined to be non-local. It was not analyzed with NAA. The latter is a grey clubbed rim bowl that was designated as HCa unassigned. This means that it could be a local sample that was excluded from HCa1 due to the small sample size, or it could represent an entirely different production context. It is not chemically related to the Speakman et al. (2004) Bastam group.

Ceramics Participating in Exchange Networks

The picture of MIA ceramic production becomes even more complex when we turn to non-local production. The 58% apparently non-local petrographic samples were made from materials that result from at least 10 different geological contexts. However, this sample was selected based on stylistic parallels, which means that forms with parallels to Urartian centers were heavily favored. It is probable that there was far more local pottery present in this period that we are simply not able to date. While there was a significant increase in the amount of non-local pottery in MIA, the dimensions of that shift remain unclear. Below I examine how different vessels were participating in these complex exchange networks.

Storage Jars

Four of the five large storage jars sampled were made with identical andesite tempered clay, called the Trachyandesite Group. These storage jars are extremely large, with rim diameters of over 1 m and wall thicknesses up to 20 cm. While storage jars are characteristic of Urartian rule, these are stylistically different from what is found at known Urartian centers. However, these jars can be petrographically and geochemically differentiated from local materials. The andesite is freshly crushed, likely prepared specifically for the clay in these pots. These vessels were likely the result of elite sponsored, or attached production, as described by Costin (1991). Crushing hard andesite temper is extremely labor intensive, and constructing these jars required considerable technical skill. This labor was employed specifically for vessels that were essential to the "state's" ability to gather, store, and possibly redistribute supplies. The andesite is not local, since there are no andesite sources in the Şərur plain outside of the mixed river sand. I petrographically examined stone from a pile of mafic volcanics on top of the citadel known as "basalt tepe," which was brought to the site at an unknown point, but the lithic textures were completely different: the temper was glassy, and the rocks were much coarser. However, andesite is available near Axura, just 12 km away, and from several other sources not very much more distant. So if the temper was brought in, it need not have traveled very far.

But it is also possible that the entire jars, rather than just the temper, were moving. The two trachyandesite storage jars that were examined with NAA were placed in their own chemical group: HCa4. This group has a high probability of membership in the Ayanis Kalesi group, which was primarily sampled from the Ayanis fortress. However, all samples in the Ayanis Kalesi group were white slipped medium ware sherds with similar decorative markings (Ware-3) (Speakman et al. 2004:125). While these groups are chemically similar, they are stylistically and functionally distinct. It is likely that similar raw materials from around Ayanis were being used to make more than one vessel type, and it is possible that these two related chemical groups reflect this (Erdem 2013). Moreover, while temper can dilute the efficacy of NAA chemical groupings, volcanic temper has much lower proportions of rare earth elements than clay, and is thus less likely to confound groupings, in contrast to grog or sedimentary tempers (Neff et al. 1989). This is especially true since the coarse fraction of these vessels is relatively low for this assemblage (~15%).

It is interesting that one of the five storage jars stands apart as potentially locally produced (47). However, this sample was collected from a mixed context near the surface and lacks the characteristic molding found on the other samples, so it is possible that it belongs to a later period. The petrographic fabric is similar to the dominant Andesite Calcareous fabric, but with a much higher proportion of carbonates. This could indicate a different locale of production or a different local clay paste recipe. Since this fabric is a loner, it was not examined with NAA. It is difficult to draw conclusions based on one sample from a poor context, but this may indicate that massive storage jar production was conducted near Oğlanqala, either by local or itinerant potters, or that massive storage jars were imported from more than one site (LaViolette 2000; London 1989).

This type of storage jar is closely associated with the administration of the Urartian Empire, which means that the extra expenditure to import them from the Urartian heartland was an impressive, but not entirely improbable sign of imperial engagement. While transporting these jars across more than 200 km of mountainous terrain was an impressive expenditure of energy, it was not totally unprecedented. Large storage jars from the Late Bronze Age eastern Mediterranean were extremely mobile (Ben-Shlomo et al 2011; Day et al. 2011; Gilstrap et al. 2016; L.M.V. Smith et al. 2004). While maritime routes certainly simplified this process, ethnographic evidence from the late 19th to early 20th century describes Greek potters transporting massive *pitharia* over 120 km inland by pack animal (Blitzter 1990). Ayden Erdem (2013:202) suggests that large storage jars were transported as part of Urartian taxation. Regardless of whether these vessels were specifically used for taxation, they are only and always found in Urartian centers, making them part of an Urartian administered political economy (D'Altroy and Earle 1985; Kobze et al. 2001; Kroll 1976; Zimansky 1995). The concentration of staple wealth represented by these jars, which enabled the Urartians to withstand siege and to support laborers, is a clear material enactment of political control.

While the examples found at Oğlanqala have a unique arrow shaped molding not found at other sites (Ristvet et al. 2012a), they are otherwise functionally and stylistically similar to the classic Urartian form. The C^{14} samples from Oğlanqala period 4 yield dates a century earlier than those of most Urartian sites, including Ayanis, since the majority of excavated Urartian centers were built by Rusa son of Argishti (ca. 680-640 BCE) near the end of the Urartian rule. Therefore, it is possible this stylistic variation in molding is a result of chronological rather than geographic distance. Both petrographic and NAA data show that these vessels were very likely imported from another area, and possibly indicate that they were transported all the way from the Van Basin.

In Khatchadourian's (2016:xxxv) system of imperial things, these storage jars were delegates: "nonhuman political entities whose material substances and forms matter greatly to imperial agents. Sovereigns rely on delegates for the preservation of the terms of imperial sovereignty." These storage jars were agents of empire in a region where Urartian power was limited. These storage jars enacted Urartian power to move staples over hundreds of kilometers and compelled people to participate in their political economy. (D'Altroy and Earle 1985). The specific material nature of these jars is part of what defines the contours of Urartian power at Oğlanqala (Latour 2005). After all, if they were less heavy, commanding their movement would be less impressive. Since they were part of the Urartian administration, perhaps they needed to be made according to certain specifications of size or style under imperial supervision. Or perhaps the peripheral areas simply did not know how to make such massive vessels initially, and the one locally produced sample indicates the spread of this specialized knowledge of imperial technology. Regardless, the import of Urartian style storage jars demonstrates Oğlanqala's economic and political entanglements with their powerful imperial neighbor.

Red Polished Wares

Red polished wares indicate similar elite sponsored production, since these specialized luxury vessels were closely associated with the Urartian "state assemblage," although in Urartian centers they are found in non-elite contexts as well (Kroll 1979:11.6; Kozbe et al. 2001:1.1–28, 3.16, 4.13; Kroll 1976: type 15; 1979:1.9, 1.11-13; Erzen 1988:37.4; Zimansky 1995). This study included nine samples of this type, with four samples fine enough to be considered likely non-local elite "palace" ware, and five other samples with thicker walls and less lustrous burnish that nonetheless can be identified as related polished red wares. Petrographic and NAA data show that the macroscopic fineness of these wares does not relate to particular production centers, at least within this sample. Seven of these nine samples were analyzed petrographically, and seven were analyzed with NAA, for an overlap of five samples with both analyses (two of the very fine samples were excluded from the petrographic study because microscopy will not provide very much information on fine wares). The results of these analyses show that the polished red wares were made and exchanged in several different areas.

The polished red wares were almost entirely assigned to the Carbonate petrogroup, which has two subgroups: one finer with almost no visible inclusions (subgroup B, n=4 palace ware), and one coarser with a few fine to medium sand sized quartz and carbonate inclusions (subgroup A, n=3 palace ware). Three samples were so exquisitely thin and polished that they were believed to be imported based on style and rarity in the context of this assemblage (30/SGF078, SGF079, SGF080). However, the NAA data suggests that at least one of these samples may have been locally produced, since it was placed in chemical group HCa1 (SGF079). It would be strange to have found so little of this ware at Oğlanqala if it were indeed produced in the same contexts as the rest of the local pottery. It is possible that this sample came from Verachram, the much larger Urartian site close to the intersection of the Arpa and Araxes Rivers 15 km south of Oğlanqala, and thus part of the same Arpa drainage system as the Şərur valley. There are also two Andesite Calcareous samples that are thin and polished enough to be considered polished red wares, one of which is HCa1, but they are visibly coarser and were previously identified as likely imitations (63, 132/SGF028).

Beyond the two Andesite Calcareous samples, and the anomalously fine sample (SGF079), all of the rest of the red polished ware samples appear to have been imported or to be of ambiguous origin. HCa3 includes two very fine palace wares that do not match the local geochemical profile, and thus were likely imported from a specialized elite sponsored production context, although their precise source is unknown (30/SGF078, SGF080). LCa2 includes two samples that were originally identified as possible imitations because the vessel walls were thicker than the finest wares (115/SGF023, 154/SGF032). However, the LCa2 samples show a high probability of membership in the chemical group Ayanis 5, which exclusively consists of red ware pottery sampled from Ayanis and nearby sites. These palace ware samples were likely produced in the Urartian core of the Lake Van Basin, quite possibly as part of the Ayanis production network. However, both LCa2 samples were analyzed with SEM-EDS, and were found to have moderately different elemental proportions. While NAA provides more precise elemental data, this suggests that even the same vessel types produced in the same region exhibit some variation.

The remaining four polished red ware samples are ambiguous members of the Carbonate Group. Only one of these remaining samples was examined with NAA, and was placed in the imprecise HCa unassigned category. Since samples from this petrogroup are so geochemically disparate, it is not possible to posit a source. All of these samples were identified as possible local imitations of palace ware, but the samples in LCa2 show that these macroscopic designations are not terribly accurate. The only MIA member of the Carbonate group that is not a palace ware sherd is a pink rolled rim jar, and geochemically categorized as HCa unassigned.

These conclusions support Speakman et al.'s results (2004), which showed that fine red ware pottery was widely produced at several sites in the Van Basin and Bastam, and that this pottery was circulating between these sites. Speakman et al. do not propose any specific mechanism for this movement, but rather obliquely refer to it as "movement" or "trade." These ceramics only circulate around elite centers, and appear in the highest proportions in areas of great Urartian power. Since macroscopically identical pottery circulated around centers that seemed to have been able to produce their own supply, these ceramics were likely part of some form of gift exchange network to materialize good relations among elites. This is similar to what can be observed in the Late Bronze Age Near East and the Inka Empire (Liverani 2001; Mann 1986; Podany 2010). It appears that Oğlanqala also participated in this exchange network, even if red slipped palace ware ceramics did not account for a large percentage of the overall assemblage.

The fact that even the small number of polished red wares present came from so many different sources indicates that Oğlanqala may have exchanged with many different centers. This could have created a broad network of weaker ties. Should the need arise for allied support, a likely scenario in Oğlanqala's precarous position, these ties could be strenghened.

The material features of these polished red wares made them particularly effective displays of imperial affiliation. Their rich red sheen is entirely distinct from preceding ceramic traditions in most parts of what became the Urartian Empire, and remains markedly recognizable to archaeologists thousands of years after their heyday. Their thin walls and lustrous polish required new types of technical skills and specialized producers who would likely have needed some form of state support to warrant this risky shift in production methods (Costin and Hangstrum 1995; Loney 2007). Though quite different from the storage jars, red polished wares would also be categorized at delegates in Khatchadourian's scheme (2016). These ceramics reordered labor and created new desires, as red slipped wares of varying quality became more common throughout the Urartian sphere (Latour 2005; Mbembe 2001). Red wares started being made for common ceramics as well, including several clubbed rim bowls that will be discussed below. This mimesis enhanced imperial authority as people adopted imperial influences in styles among a larger range of materials. However, it inevitably involved some slippage, which threatened the empire's ability to control its own material enactment (Bhabha 1994).

(Mostly) Brown and Grey Wares

Although red wares are associated with Urartian expansion, and appear at Oğlanqala during this period, brown and grey wares dominate Oğlanqala in the MIA. This is not unusual, since even the known peripheral Urartian site of Horom had a ceramic assemblage containing less than 1% of Urartian style red wares. The grey wares at Oğlanqala generally grew out of regional EIA styles, such as the carinated bowl (Badalyan 1993:6.1, 1998:figs. 27-29; Bahkshaliyev 1997:pl. 27). The brown wares are more closely related to Urartian influence, particularly the thick rim bowls with polished mottled slip (Kozbe et al. 2001:95). The distinction between brown-buff and grey-black wares is common in the literature on MIA pottery in the Urartian sphere (Kohl and Kroll 1999; Kroll 2003; Stronach et al. 2009), but can be overemphasized since so many vessel forms can be both, often quite literally on the same exact vessel. A similar problem with the over identification of period with color caused Danti (2013) to rename LBA/EIA grey wares monochrome burnished wares. The difference in color could point to the difficulty of controlling firing atmosphere, rather than imperial identity. Brown cooking pots are more stylistically generic, but equally common and moving to a similar degree as other forms.

Nearly all imports are brown to grey slipped burnished bowls and cooking pots that look identical to the Oğlanqala versions. Certain shapes, however, are more likely to have been produced in different fabrics, which indicate different production contexts. These include the Rhyolite Group (n=10), the Coarse Andesite Group (n=7), the Fine Glassy Andesite Group (n=7), the Dacite Group (n=4), the Andesitic Sand Pair (n=2), the Metamorphic Pair (n=1), Glassy Welded Tuff Feldspar Loner (n=1) or 41% of Oğlanqala samples (Table 6.7). However, this material is probably over-represented in this study because the forms they are associated with are relatively easy to date.

	Carinated Bowls	Thick Rim Bowls	Pointed Rim Bowls	Clubbed Rim Bowls	Cooking pots	Jars
Andesite Calcareous	29% (4/14)	0	100% (2/2)	75% (9/12)	21% (3/14)	50% (3/6)
Fine Glass Andesite	36% (5/14)	33% (2/6)	0	0	0	0
Dacite	14% (2/14)	0	0	0	0	0
Andesitic Sand	14% (2/14)	0	0	0	0	0
Rhyolite	7% (1/14)	50% (3/6)	0	17% (2/12)	14% (2/14)	33% (2/6)
Coarse Andesite	0	6% (1/6)	0	0	43% (6/14)	0
Metamorphic	0	0	0	0	7% (1/14)	0
Carbonate	0	0	0	0	7% (1/14)	0
Volcanic Conglomerate	0	0	0	0	7% (1/14)	0
Glassy Welded Tuff Feldspar	0	0	0	0	0	16% (1/6)
Micritic Carbonate	0	0	0	8% (1/12)	0	0

Table 6.7: Distribution of (mostly) brown and grey wares by fabric and form

The majority of MIA Oğlanqala ceramics analyzed for this research were brought to Oğlanqala from many different areas, with no one area dominating the exchange relationship. Moreover, the same forms were often produced in several different areas, indicating broad circulation rather than regional workshop specialization in certain types of pottery. The small number of samples associated with any form in a specific fabric makes it impossible to check the significance of any associations between form and fabric. It appears that Oğlanqala was participating in broad imperial exchange networks within a region with earlier stylistic connections that grew into new political-economic relationships.

NAA was successful in differentiating these fabrics from the local Andesite Calcareous HCa1 and HCa2, but was not able to differentiate these very coarse non-local petrogroups from each other. The majority of these samples are grouped into LCa1 (n=15), which includes samples from the Rhyolite (n=5), Fine Glassy Andesite (n=5), Dacite (n=3) and Andesitic Sand Pair (n=2) petrogroups. All of these samples are grey-brown burnished carinated and thick rim bowls. Petrographic analysis shows that these specimens were clearly produced using at least four distinct sets of raw materials and using different production practices, although they are geochemically similar. The fact that this group does not represent a single context, but rather a mélange of chemically-related non-local material means that the limited similarities between LCa1 and chemical groups from the Tsaghkahovit Plain in Armenia are not meaningful (Lindsay el al. 2008). LCa2 contains a Coarse Andesite petrogroup cooking pot and two polished red ware samples, and is associated with Ayanis chemical groups. While these samples fall into the same chemical group for this study, they have greater probabilities of membership with different Ayanis groups. Although the red wares are closer to chemical group Ayanis 5, the cooking pot is closer Ayanis 1. Speakman et al. (2004) note that these groups are very similar, and likely result from natural variation in clay deposits from the Van Basin. Finally, LCa3 contains two brown cooking pots similar to the sample in LCa2 and one bowl in the same style as several in LCa1. All three samples in LCa3 are part of the same Coarse Andesite petrogroup, and they cannot be identified with any particular provenience beyond "non-local." Since petrography provides more precise data for these coarser samples, I will emphasize it in the remaining discussion.

Carinated Bowls

Sixteen carinated bowls were analyzed from MIA Oğlanqala, demonstrating an impressive variety of raw materials used (Fig. 6.1; Table 6.7). This sample includes 31% (n=5) Fine Glassy Andesite Group vessels, 25% (n=4) Andesite Calcareous Group vessels, 25% (n=4) Dacite Group vessels, 13% (n=2) Andesitic Sand Pair vessels, and 7% (n=1) Rhyolite Group vessels. These bowls were made from materials that come from five different geological contexts, 75% of which are not local to Oğlanqala. While these petrofabrics are minerallogically distinct, they are technologically similar. All of these fabrics have coarse, seriate sized volcanic inclusions fired in a reducing atmosphere (with the exception of the Fine Glassy Andesite Group, which has finer inclusions). The SEM-EDS results for an Andesitic Sand vessel (181) show that the slip for this vessel is very different from the rest of the MIA samples analyzed in this way, further supporting a separate production context. These bowls have thick, highly burnished slips in grey, brown, tan, and/or black, creating a fine surface appearance for these coarse fabrics. Of the twelve carinated bowls with visible burnish marks, seven were polished, or 58%. Just one MIA carinated bowl was sampled from the Sədərək fortress. It was made in the Andesite Calcareous fabric and is comparable to the forms found at Oğlanqala.

It is not possible to differentiate between these vessels macroscopically-- they are all formed and finished in a similar manner using different materials, likely in different areas. While these carinated forms grew out of existing carinated bowl types present in the EIA, EIA pottery was produced in a variety of ways using the same local materials (Avetisyan and Bobokhyan 2012; Badaljan 1993:6.1, 1998:figs. 27-29). In contrast, the MIA carinated bowls were produced in the same way using geographically disparate materials. The similarity in production methods across a broad area could indicate a shared tradition of elite pottery production that developed in the MIA, although more analysis would be necessary to confirm this hypothesis. This pattern could indicate a very incomplete sort of standardization, or at least norms for the production of certain forms, with production more restricted than it had been previously. This technological knowledge was not geographically restricted; perhaps potters in each region became more specialized, or itinerant potters with specialized knowledge traveled from center to center (Clark and Parry 1990; Costin 1991; LaViolette 2000; London 1989; Peacock 1982; Rice 1991).

Thick Rim Bowls and Pointed Rim Bowls

Thick rim bowls and pointed rim bowls are very similar, in that they are both thick walled, relatively shallow bowls with a squared rim. However, the rims on thick rim bowls are closer to 90° angles, or an actual square, whereas the pointed rim bowls have rims with an acute and obtuse angle, forming half of a rhombus, since they curve up more (appendix A: Plates 4: l, m). I emphasize both the similarities and differences of these forms because the pointed rim bowl may be a local version of the thick rim bowl, though the thick rim bowl can also be produced locally. I analyzed six thick rim bowls from MIA Oğlanqala, all non-local including three Rhyolite Group vessels, two Fine Glassy Andesite samples, and one Coarse Andesite Group vessel. In contrast, the two pointed rim bowls I analyzed were both members of the local Andesite Calcareous petrogroup. All of these vessels have a thick grey, brown, black and/or tan slip that is usually highly burnished. These vessel forms and their often mottled brown finish are similar to forms seen in Urartian contexts (Kozbe et al. 2001:95; Kroll 1976; Ristvet et al. 2012a). Of the six thick rim bowls analyzed for burnish marks, four (67%) were polished. With the exception of the differentiation between the rim angles, it would not be possible to determine macroscopically that these vessels were made from different materials. A larger sample size would strengthen the association between form and petrofabric.

However, two thick rim bowls from the Sədərək settlement look macroscopically comparable to the samples found at Oğlanqala, but were made in the local Andesite Calcareous fabric. One sample (286/SGF077) was placed in geochemical group HCa1, and the other sample (302) was not examined with NAA. The sample size is too small to draw any firm conclusions, but it is possible to speculate that while the Sədərək settlement did not experience the same economic integration as Oğlanqala, perhaps local potters adopted this Urartian form more readily.

Similar to the carinated bowls, the thick rimmed bowls were made in a unified style using similar production methods across a geographically expansive area. The presence of the two local versions at the Sədərək settlement shows that local potters were perfectly capable of producing this form. However, the locally produced pointed rim bowl variant at Oğlanqala indicates that potters chose to manipulate these forms according to local preferences, engaging in mimicry that enlisted an Urartian associated style in local predilections (Bhabha 1994). Yet these mottled brown bowls were not as unambiguously Urartian as some of the other ceramics discussed. While the polished red wares and storage jars were more clearly part of the Urartian "state assemblage," mottled brown thick rim bowls appear to have acted as Urartian-associated free agents. Archaeologists associate this style with the Urartian expansion, but it is unclear whether ancient people's would recognize them as such (Ristvet et al 2012a:345). They became more common in Urartian controlled spaces, but do not appear to be directly implicated in Urartian state practices. Perhaps they represent shifting commensal or aesthetic preferences associated with Urartian expansion. This could indicate a shifting cultural frontier to coincide with the political frontier materialized through the storage jars (Parker 2006). These bowls are also the only locally produced Urartian associated form that had an apparent local variation in the pointed rim bowl. Since local versions of these thick rim bowls were found at Sədərək, I propose that the pointed rim variant was a choice rather than a poor copy of an imported style (Dobres 1999, 2000) As such, they might be seen as materializing a more flexible, hybrid, local instantiation of Urartian-affiliated cultural practices.

Cooking Pots and Jars

Fourteen cooking pots from MIA Oğlanqala were examined for this project, all with rolled rims. This vessel sample consists of 43% (n=6) Coarse Andesite vessels, 21% (n=3) Andesite Calcareous vessels, 14% (n=2) Rhyolite vessels, and 7% (n=1) Metamorphic Pair vessel, 7% (n=1) Carbonate Group vessel, and 7% (n=1) Volcanic Conglomerate Loner. This vessel type has even more variety than these groups suggest on the surface, because the Coarse Andesite Group does not represent a geologically/geographically-bounded area, but rather many areas producing ceramics in a similar way. It is possible, even likely, that some of the Coarse Andesite Group members were produced very close to Oğlanqala, while others were produced farther away. One Coarse Andesite vessel (143/SGF030) was assigned to the chemical group LCa2, which is associated with the Ayanis chemical groups. Since cooking pots need to meet specific technological requirements for culturally predicated cooking practices, the wide spread production and circulation of similar cooking pots could indicate shared commensal practices across a broad region. This pattern, in turn, suggests another means of materializing some degree of regional cultural integration.

One Andesite Calcareous rolled rim cooking pot from Oğlanqala (126/SGF066) was geochemically designated as HCa unassigned, and shows a high probability of group membership in Speakman et al.'s Bastam group. This sample had previously been noted as an outlier because it contained some unusual inclusions (iddingsite). As noted before, the Bastam group in Speakman et al.'s study may not actually have been from Bastam, but was likely from northwest Iran generally (Speakman, pers. comm., Feb 29, 2016). All sampled cooking pots were brown slipped, and their composition demonstrates that cooking pots were participating in broad circulation networks just like the bowls. It is unclear precisely how these cooking pots were moving, since cooking pots are an unlikely candidate for elite gift exchange (D'Altroy and Earle 1985; Feldman 2002; Mauss 1925). Yet the fact that these pots were coming from so many places does not suggest large scale trade for profit from a particular distribution center. If these cooking pots were mainly circulating around elite centers, perhaps they were brought there by traveling elites who were supporting their retinue on the road, or gathering for feasting events. These types of trips would have enacted political ties between disparate polities in a period of political integration (Knudson et al 2012; LeCount 2001; Ristvet 2014).

The remaining Oğlanqala jar samples could have been cooking pots as well, but the forms were less clear so they were assigned the more generic term "jar." This included five simple everted rim jars and one rolled rim jar. These samples included three Andesite Calcareous vessels, two Rhyolite vessels, and one Glassy Welded Tuff Feldspar Loner. Once again, these vessels were all brown slipped, and not as highly burnished as the bowls. All of the jars analyzed for burnish strokes where the petrofabric is known (n=10) have horizontal irregular strokes, sometimes with the addition of vertical strokes.

Since the Sədərək settlement material was collected from augur pits rather than excavation, and contains a much narrower range of petrofabics, the assemblage typology is less well understood. This makes it difficult to differentiate between jars and cooking pots, so they will be treated together. Although all seven jars (six rolled rim, one simple everted rim) were made in the Andesite Calcareous fabric, their color also differentiates them from the Oğlanqala assemblage. Only one of these jars is brown. The others are shades of buff, pink, or even red. This difference suggests different firing practices, and possibly different aesthetics for this site. Just three of these samples were analyzed geochemically, and were associated with HCa1 (SGF072), HCa2 (SGF074), and HCa unassigned (SGF070), with the latter showing chemical affiliation with the Bastam group. The variety in these chemical groups may indicate some local exchange, or perhaps inter-regional feasting activities similar to what I propose for Oğlanqala, but this is difficult to determine based on this sample.

Clubbed Rim Bowls

Twelve clubbed rim bowls from MIA Oğlanqala were analyzed for this project. While this form was composed of diverse raw materials, the majority were made with local materials, including nine Andesite Calcareous Group samples, two Rhyolite Group samples, and one Micritic Carbonate Loner (the latter of which could also be local). All of the Andesite Calcareous samples examined with NAA (n=6) were placed in the HCa1 group, though three of them show geochemical similarities to the Bastam group.

Moreover, these bowls show a greater variety of slip colors, with three red slipped samples along with the usual variety of brown, grey, and /or tan slipped samples. The red slipped samples include two Andesite Calcarous vessels (31, 210/SGF065) and one Carbonate vessel (52). Once again, these bowls were all slipped and burnished, with a macroscopic appearance that does not correlate with the microscopic composition. In contrast to the carinated and thick rim bowls, which are mostly non-local and highly polished, the majority of the clubbed rim bowls show horizontal irregular burnish stokes (63%, n=5/8) and are locally produced.

Two additional clubbed rim bowls were analyzed from the Sədərək settlement, both of which were Andesite Calcareous and HCa1 (280/SGF073) and HCa2 (272/SGF069). Both of these samples were too eroded for there to be visible slip, but were fired a pink buff color that indicates an oxidizing firing atmosphere. In general, the club rimmed bowls seem to indicate a continuation of the dispersed, independent local production observed in the EIA (Costin 1991). However, the expanded range of slips and firing conditions show that local potters experimented with new technologies employed in the production of Urartian-influenced forms. This is analogous to the hybrid Punic-local settlement styles observed by Van Dommelen (2005) in the Western Mediterranean. While these clubbed rim bowls were not Urartian, there were shifts in local pottery production technology that appear to be the result of inspiration or actual knowledge transfer from the production of Urartian materials.

Miscellaneous

The only MIA Oğlanqala forms not mentioned above are a lamp, made in the Dacite Group fabric, and two indented rim bowls made in the EIA style greyware from the Andesite Calcareous Group fabric. However, the context for the two bowls is mixed, and since the style extends into the EIA, it is possible that these samples belong to that period.

(Mostly) Grey and Brown Ware Discussion

For most of the volcanic petrofabrics that characterized the grey and brown wares, it is not possible to propose a provenience, since there are simply too many possible sources, particularly for andesite. Axura is the closest possible source, and lies even farther than Oğlanqala from direct Urartian control. The ridge between Sədərək and Oğlanqala is another option according to geological maps, but I could not find a match in survey. Frankly, there are too many andesitic formations in the region to narrow it down very much. While the Fine Glassy Andesite Group, the Andesitic Sand Group, and

Andesite Group represent the use of materials from several different geological formations, I can only say that they are not from the Şərur plain.

Both the Rhyolite Group and the Dacite Group were each produced in a single, distinct location, possibly with the materials from each group coming from a single outcrop. The closest sources for the material found in both the Rhyolite Group and the Dacite Group are Tertiary deposits near the Urartian center of Erebuni, and the Urartian border fortress of Tsovinar, both about 70 km from Oğlanqala (Fig. 4.6).

The brown and grey slipped wares were produced in many different places, including Oğlanqala, using similar methods-- very coarse volcanic fabric fired in a reducing atmosphere-- and resulted in stylistically cohesive vessels. The carinated and thick rim bowls have particularly thick and well burnished slip, which creates a fine finish for these coarse fabrics. These forms were also far more likely to be non-local. Bowls were more likely than jars to be polished, and non-local bowls were the most likely to be polished. In contrast, cooking pots, jars, and locally produced bowls were more likely to have horizontal irregular burnish marks. It is possible to see a relic coil in the thin section sample 130, Rhyolite Group, as well as in hand samples of eleven samples that were analyzed for surface features. This is primary evidence for the inference that these vessels were hand built, since they would have been too coarse to throw on a wheel. It should be noted that the Oğlanqala versions were the only ones with non-volcanic inclusions and were fired in a less completely reducing atmosphere.

Some producers may have specialized in certain forms. After all, the Glassy Andesite Group and the Dacite Group produce the majority of the carinated bowls. The

Rhyolite group produced the largest number of thick rimmed bowls, and the Coarse Andesite Group (which is a geographically distributed group anyway) produced the most cooking pots. Finally, the Andesite Calcareous Group produced the most clubbed rim bowls (Table 6.7). However, the sample sizes are too small to test the relationship between form and fabric to determine if it is statistically significant. All of these groups are mixed, and each production context can make and trade at least two types of vessels. The high proportion of non-local ceramics indicates that their movement was not incidental, but rather a significant component of consumption practices at Oğlanqala. Even if there was more local pottery at MIA Oglanqala than this sample indicates, there was clearly a significant rise in non-local pottery consumption. The fact that the same vessel types came in small numbers from many different places makes it unlikely that they were imported as part of large-scale trade for profit. Instead, I argue that these vessels were part of elite consumption practices that served to materialize ties between polities (Brumfiel and Earle 1987; Liverani 2001; Podany 2010; Polanyi 1966). In this reconstruction, representatives traveled to Oğlanqala from different communities, during which they brought their own bowls and cooking ware. These visits could have occurred at varying scales over an extended period of time, from visits by representatives from a single polity, to larger, more complex gatherings involving representatives from many communities and feasting activities. The contexts on Oğlanqala are simply too disturbed to distinguish between these types of events. Beautifully executed bowls may have served as gifts, while bowls and cooking pots may have supported the traveling guests.

The fact that all of these vessels were produced using similar technological methods across a broad geographic area points to some degree of technological convergence. Perhaps craftspeople, including potters, traveled as part of elite entourages. The regional stylistic convergence could be viewed analogous to the 'international style' proposed by Marian Feldman (2002) for fine crafts in the Late Bronze Age Mediterranean, creating a style that was able to connect an otherwise disparate community of elites. However, these MIA brown and grey wares developed from EIA styles that were already in use across an extensive area.

The clubbed rim bowls stand apart in this scenario because they were mostly locally produced and had a greater variety of finishes. A few non-local varieties, however, indicate that this form was not specific to Oğlanqala. Rather, these vessels indicate the continuation of dispersed, local, independent production, and experimentation with some new styles and technologies. While there was nothing particularly Urartian about these bowls, they show how even seemingly non-imperial objects become entangled in imperial production. Local potters learned to produce in new styles, and local style vessels shifted in response (Dietler 2010; Stockhammer 2012a.b).

MIA Discussion

Oğlanqala pottery went from 91% local material in the EIA to 41% local material in the MIA, showing that the expansion of Urartu dramatically affected pottery production and exchange for many classes of ceramic vessels in peripheral contexts as well as major centers. Oğlanqala was minimally involved in ceramic exchange with areas primarily to the north or northwest up to 70 km away, mostly places subject to the

Urartian Empire, as well as the Urartian heartland of the Van Basin. However, at least some Urartian style ceramics may have been imported short distances from the east, and many of the grey and brown wares were imported from a range of locations in many possible directions, analogous to the expansion of Roman style ceramic production in pre-conquest Britain (Freestone and Rigby 1988). This research points to a previously undocumented degree of ceramic exchange in the Urartian sphere of influence. NAA conducted at MURR established that polished red wares were produced at and moving between many Urartian centers, including Ayanis, Kef Kalesi, and Bastam (Speakman et al. 2004). It is perhaps not surprising that elite materials were moving around in elite contexts in an empire that seems to have been at least partially based on a shared culture of luxurious or difficult to attain materials.

Yet polished red wares were not the only ceramics circulating. The different types of ceramics carried into Oğlanqala materialized different types of relationships, and the material specificity of those vessels was essential to the types of relationships they enacted (Latour 2005). The storage jars and polished red wares both enacted ties to the Urartian state. Storage jars acted as the means of Urartian taxation and/or staple management, as well as a heavy burden to carry across the mountains, displaying the might of Urartian compulsion. The polished red wares were fine luxuries that were only available in elite contexts or Urartian centers, and likely participated in elite gifting networks. Their scarcity in peripheral areas, association with power, and distinctiveness may have made them the Birkin bag of the MIA South Caucasus. The storage jars and several polished red wares appear to have come from the Van Basin, the Urartian heartland, and each connects Oğlanqala to that heartland in their own way.

The thick rim bowls, carinated bowls, and cooking pots materialized different relationships, practiced through traveling elite consumption in order to develop more regional political ties, rather than connected to an imperial core. Just one cooking pot appears to come from the Van Basin (143/SGF030). Otherwise, these networks are more difficult to locate geologically, but they are certainly diverse. The most probable sources for the Dacite and Rhyolite samples are to the north near Erebuni and Tsovinar, while the remaining samples could have come from a broad range of geological contexts. These vessels were coming from many different areas. Although just a few vessels came from each region, in aggregate they far outnumbered local production examples of these forms. But these forms were produced locally. I propose that these vessels were part of elite practices to develop ties among other elites, through visits, and possible feasting and gifting (Brumfiel and Earle 1987; Liverani 2001; Podany 2010; Polanyi 1966). While the storage jars and polished red wares were distinctly Urartian, the brown and grey wares were closer to existing regional styles, and may have presented greater opportunities to develop a converging visual and technological style to connect communities across distances. This regional style did not represent social ties, but enacted them as potters created vessels in a similar manner for consumers who wanted to use similar pottery (Latour 2005). The local pointed rim bowls at Oğlanqala may indicate a local variation of a regional vessel form, and the variety of grey, brown, buff, and red club rim bowls suggest local experimentation with hybrid styles (Bhabha 1994; Van Dommelen 2005).

These vessels point to greater regional political integration with the expansion of the Urartian Empire, but aspects of this integration were being enacted through materials that archaeologists have not associated with the Urartian state assemblage.

Nearly every vessel type known from this period was likely made in the area around Oğlanqala, even if the majority of the samples for that vessel were non-local. This indicates a higher degree of specialization, since potters were producing a much broader variety of forms than in previous periods, and doing so in a way that was regionally consistent. These include the variable clubbed rim bowls, thick rim and carinated bowls, and possibly even the Urartian state style storage jars and polished red wares. The increase in non-local pottery would have resulted in a re-organization of local labor practices. These shifts in production were part of the "whole cluster of re-orderings of society, culture, and identity" that created imperial entanglements (Mbembe 2001:66). People made and used different things because of their imperial entanglements, even materials that may not have been specifically "imperial."

There are many ways that Urartu's imperial expansion may have encouraged greater integration. For example, roads and administrative apparatuses that were developed for political-military control and taxation may have facilitated movement between different regions. The widely applied policy of forced resettlement of people from conquered areas may have also encouraged greater inter-regional connectivity (Ayvazian 2012; Kroll et al. 2012; Zimansky 1985; Smith 2003). Elites that previously fought each other were compelled to develop stronger ties, both to engage with and resist Urartu. In an age of imperial expansion, polities could not safely ignore their neighbors.

The deposition of a geologically diverse, stylistically narrow range pottery at the Oğlanqala citadel indicates that elites were visiting each other more. In contrast, the non-elite Sədərək settlement, geographically closer to what is generally considered Urartian territory, continued to use locally produced pottery throughout this period.

Seleucid Period/Period 3

Period 3, or the Seleucid Period, was largely left out of this study simply because there are very few ceramics that can confidently be dated to this period. Although there is impressive architectural evidence in the form of an unfinished palace, no one ever occupied that palace, nor left their dishes in middens for future archaeologists to riffle through. Therefore, only nine samples were analyzed from this period, and petrography was the only method employed. These samples included six bowls and three rolled rim jars. The bowls include three red slipped carinated bowls, two buff clubbed rim bowls, and a red slipped simple rim bowl. Two of the jars are pink and one is grey.

Seven out of these nine samples (78%) were placed in the local Andesite Calcareous petrogroup. The remaining two non-local samples are both pink jars, and include one of the Metamorphic Pair (120) and the Sandstone Gabbro Loner (128). The closest source for the metamorphic sample is across the Araxes River by Verachram, and the closest source for the Sandstone Gabbro Loner is Upper Trassic age sandstone with gabbro instrusians 18-22 km to the southeast. Although the carinated bowl clearly existed in earlier periods, in the Achaemenid period the shorter neck carinated bowl became a symbol of the Persian Empire (Dusinberre 1999, 2003; Khatchadourian 2016; Knauss 2006; Lordkipanidze 2000; Stern 1982; Summers 1993; Sumner 1986). The shift from grey to red ceramics is also characteristic of more Hellenistic influence in later periods, as is evident in the Roman-Parthian period. The Seleucid period is also where we see the first of the red slipped simple rim bowls, which dominate the assemblage in the following period. Overall, the small sample from period 3 indicates a return to local production.

Roman-Parthian Period/Period 2

Ceramics were clearly moving in this period, since 57% (n=45/79) of the samples analyzed appear to be non-local. However, they were moving in very different ways than in the MIA. While the MIA ceramics were characterized by widespread, dispersed production and exchange, the Roman-Parthian period ceramics had high proportions of imported pottery, limited to just a few forms, and from only one non-local production context. The largest petrogroup in this sample is the Serpentinite Group, which accounts for 51% (n=40/79) of the entire assemblage. The Serpentinite petrofabric was only used to make red-slipped bowls, plates, and lids, including 54% (n=15/28) of the red slipped bowls and 88% (n=22/25) of the plates. Fortunately, the Serpentinite Group has a very specific geological signature that could only have resulted from an ophiolitic complex. There are four nearby ophiolitic complexes that mineralogically match the profile of the Serpentinite Group, including Khoy, northwest Iran; Zangezur, eastern Naxçıvan; and Sevan and Vedi, both in Armenia (Azimzadeh et al. 2011; Galoyan et al. 2009; Rolland et al. 2010). However, the Vedi Ophiolitic complex is geographically closest to Oğlanqala, and Artashat was located in this area. As the Artaxiad capital during this time, Artashat was a regional center of trade and production, located just 55 km up the Araxes River, making it a logical locus of exchange for the inhabitants of Oğlanqala (Invernizzi 1998;

Tiratsyan 2003; Tonikyan 1997a,b). Not only are the other three options more distant from Oğlanqala, but they are also closer to Parthian and/or Sarmatian spheres of influence. The burnished red-slipped plates and bowls that characterize the Serpentinite Group are related to Eastern Red Slipped Ware, with parallels to material found at Artashat (Khachatrian 1998: fig. 43.6-7, fig. 49). Therefore, it appears that approximately half of the ceramics used in Oğlanqala during this time were red-slipped plates and bowls likely imported from Artashat.

However, local ceramic production continued, and produced a greater variety of shapes and vessel classes than the imported material, with 38% (n=30) of the assemblage represented by Andesite Calcareous vessels.

	Roman/Period 2
Andesite Calcareous: Subgroup A	83% (n=25/30)
Andesite Calcareous: Subgroup B	10% (n=3/30)
Andesite Calcareous: Subgroup C	7% (n=2/30)

Table 6.4: Distribution of Andesite Calcareous subgroups in period 2

While in previous periods the non-plastic inclusions tended to be larger and more open spaced (subgroups B and C), there was a gradual shift to smaller inclusions that were closer spaced (subgroup A) (Table 6.4). This trend had a deep local history at Oğlanqala (Table 5.3), but the result was that the Andesite Calcareous petrofabric in the Roman-Parthian period was nearly identical to the Serpentinite petrofabric, with the exception of the mineralogically distinct inclusions. Both petrofabrics had single to double spaced fine to medium sand sized inclusions fired in a completely oxidizing atmosphere. Local

Oğlanqala potters had long been shifting towards paste recipes that converged with Artashatian production methods.

While materials from the Arpa River were used to make a range of vessel types in this period, the most common was the ubiquitous burnished red-slipped bowls and plates (n=15), mainly of the simple rim bowl variety (n=13), but occasionally the thickened rim plate variety was made as well (n=2). Even the burnish strokes were identical; regular horizontal strokes for nearly all red slipped vessels, creating an almost ridged texture on the surface. Although there were red burnished ceramics in the MIA, the method of slip application changed chronologically, and there is minimal evidence (4%, n=7) for earlier use of the HR burnishing method. Moreover, the MIA sherds were characterized by at least four kinds of burnish application with a more even distribution of each category, along with far greater diversity of petrofabrics, indicating dispersed production. The largest category, HI, accounts for 67% (n=118) of the samples with visible burnish strokes in the MIA. In contrast, the uniformity of the burnish stroke direction in the Roman-Parthian period, along with the narrower range of petrofabrics may indicate more centralized production with some degree of standardization (Lepère 2014).

The SEM-EDS results for this period are difficult to interpret, since they indicate that the two most similar slip compositions are from an Andesite Calcareous sample (237) and a Serpentinite sample (215). Sample 234, Andesite Calcareous, is also quite similar, pointing to geochemically and perhaps technologically similar slip recipes in at least two different locations. One Serpentinite sample (222) is compositionally different from the rest of Andesite Calcareous samples, as expected, but also from the other

Serpentinite sample, possibly indicating variation in slip raw materials or preparation methods in the area surrounding Artashat.

Even accounting for the variation observed in the EDS data from one sample, the fact that the paste recipe is petrographically identical except for the mineralogy and the surface decoration is applied in the same manner for the majority of sherds for both petrofabric groups suggests that most of this pottery may have been produced within a single technological tradition. This conclusion would be strengthened by data on forming, a step in the chaîne opèratoire that can be tied to pedagogical communities of practice (Chilton 1998; Clark 2007; Crown 1999; Loney 2007; Vandiver 1987). Unfortunately, surface features that can reveal forming methods were erased by the nearly universal practice of slipping and burnishing ceramics, and radiography was not a viable option in the context of this project (Berg 20008; Glanzman and Fleming 1985; Pierret et al. 1996; Roux 2003; Roux and Courty 1998). Petrographic analysis of microstructure was inconclusive. Khachatrian (1998:125) says that there was expanded use of the wheel at Artashat in the first century BCE, though no evidence for this is offered. The smaller inclusion size and regularity of the vessels in this period would support this conclusion, but I found no direct evidence at Oğlanqala. However, finishing practices are a meaningful way to differentiate production contexts. There is evidence that the Roman-Parthian period saw the introduction of new finishing methods that differentiate this period's red burnished wares from earlier incarnations. It is significant that the same vessel types were produced in at least two different areas and finished using the same methods, methods which were distinct from previous finishing practices.

Minimally there was considerable contact between these two production centers, and quite possibly they were part of the same technological tradition. Perhaps potters who trained in Artashat or similar workshops moved to Oğlanqala and produced pottery. It is also possible that itinerant potters traveled throughout the region making the same style of pottery using different local materials (LaViolette 2000; London 1989). Arrentine ceramics have been found stamped with Armenian names, indicating that there was movement of people and expertise between the Mediterranean and the South Caucasus (Dragendorf 1938; Khachatrian 1998:125) While local potters may have adopted this Roman-inspired style in order to appeal to a broader customer base, as happened elsewhere in the Roman periphery, the high degree of correspondence between the local and non-local methods of production makes this less likely (Dietler 2010; Wells 1999).

Shape and context turned out to be an important distinction when sorting out local and non-local production of red wares in this assemblage. All of the ledge rim plates and their lids (n=13) and 76% (n=11/14) of the thickened rim plates were made in the Serpentinite fabric probably imported from Artashat. In contrast, nearly half of the simple rim bowls (n=13/27) were made from the local Andesite Calcareous fabric, while the other half (n=13) were made from the Serpentinite fabric, as well as one Andesite fabric bowl.

Moreover, the local and non-local simple rim bowls have inverse distributions for the houses and the citadel, with 69% (n=9/13) of the simple rim bowls from the houses locally produced, while just 29% (n=4/14) are locally produced from the citadel, a significant difference ($\chi^2=4.4636$, $p < 0.05$). The houses have no examples of ledge rim plates in the entire excavated assemblage. Overall, the samples analyzed from the houses were 53% (n=9/17) locally produced, while the samples analyzed from the citadel were 15% (5/33) locally produced, also a significant difference (χ^2=7.9478, $p < 0.01$). All available red-slipped pottery from the houses area of the excavation were sampled for this analysis. While the sample size of red slipped forms (n=56) may appear small when broken down into areas, only 139 of these forms were found in excavated contexts throughout the site.

Additionally, a thickened rim plate was sampled from the citadel that was made using the Feldspar Andesite fabric. The co-presence of the Andesite fabric simple rim bowl, the Feldspar Andesite thickened rim plate, the Andesite Calcareous bowls/plates, and the dominant Serpentinite bowls/plates shows that these red slipped vessels were produced in at least four workshops, both locally and non-locally. Although the majority of this style of vessel was coming from Artashat (n=38), a significant minority was being produced locally (n=15) or brought in from elsewhere (n=2). Since the ledge rim plates were only made at Artashat and find their best parallels there, this might be a particularly Artashatian expression of Hellenistic influenced identity. Perhaps these plates were not associated with Rome so much as the Artaxiads, or were part of a specific workshop tradition that was recognizably Artashatian. In contrast, the simple rim bowls and thickened rim plates were produced in at least four different workshops, representing a more general stylistic repertoire.

While these vessels were not terra sigillata, they appeared at the same time as the more general "tableware boom," with red slipped wares appearing throughout the Roman

Empire and leading to arguments for large scale cultural integration (Poblome et al. 2007). Artashat was not quite in the Roman empire in this period, but rather a subject of its repeated conquest and neglect. Artashat was both part of and beyond the Roman sphere, in some ways similar to a modern colonial periphery where the core's goal was geo-political expansion rather than resource exploitation (Wallerstein 1979). It is unlikely that the proliferation of red slipped wares would have meant the same thing in a conflict-torn Roman periphery than in Roman provinces. The simple rim bowl is a classic Roman-influenced form, but it may have not have been clearly associated with the Roman Empire this far out. Local versions were produced around Oğlanqala and elsewhere, and may have simply become part of the local repertoire, similar to Coca-Cola in many parts of the world (Miller 1998). Yet Coca-Cola is still implicated in American imperialism, even when it is not explicitly recognized as such. As noted above, people from Artashat were traveling to Rome, some specifically to make red slipped pottery. While eastern red slipped ware was part of the materialization of Roman imperialism in the South Caucasus, it was part of a cultural or economic frontier rather than the extension of an administrative border (Parker 2006; Willis 1996). In this frontier, the implications of red slipped pottery were likely the subject of continuous negotiation.

Beyond red-slipped bowls and plates, the rest of the sampled vessels were largely produced locally. All three non-red slipped bowls were buff slipped, thicker than the red slipped vessels, and clubbed rim. These bowls, along with all six pithoi and one tray, were all produced with the Andesite Calcareous fabric. All of the four trays sampled came from the citadel and were locally produced, with three made from the Carbonate fabric. Both the tray form and fabrics (Carbonate and Andesite Calcareous) suggest that they were little altered mud quickly shaped to serve their purpose.

The four of the five cooking pots sampled (all rolled rim) were brown-slipped, and one was red slipped (16). All were found on the citadel. Three jars were made with the local Andesite Calcareous fabric (18, 54, 237), one was made with the Coarse Andesite fabric (110), and one was made with the Dacite fabric (16). The two lamps sampled were also found on the citadel, as were all lamps in this period, and they were made in the non-local Perlitic glass fabric and the non-local Andesite fabric. These lamps are fairly crude, and it is interesting that they were brought to the site from elsewhere. Like the two imported cooking pots, it is possible that these fabrics met specific technological requirements for heat.

Roman-Parthian Period Discussion

Overall, the Roman-Parthian period Oğlanqala ceramic assemblage has a high proportion of material that likely came from Artashat, the capital of Artaxiad Armenia. However, nearly all of the material falls within a narrow range of red-slipped plates and bowls. The rest of the vessel classes, including pithoi, trays, and jars, were produced locally or near locally. While bowls and plates were mostly brought from Artashat, local versions of the red slipped style, particularly the simple rim bowl, were also produced, as well as a few buff bowl styles. However, this material was not distributed evenly throughout the site. In general, the citadel had a much greater variety of vessel classes and petrofabrics then either the houses or the walls. This variation can partially be explained by the greater sample size taken from the citadel, and differential distribution of certain forms. However, when petrofabrics were compared within vessel classes, such as the simple rim bowls, it became apparent that the citadel had a higher percentage of imported material than the houses.

While this analysis presents compelling patterns, interpreting these patterns is far from simple. These data provide evidence for Oğlanqala's relatively high degree of cultural and economic integration with Artashat, but this integration cannot be equated with political authority. There are several different potential interpretations for this evidence, and we do not currently have the means of fully assessing the various possibilities. Interpretations of the differences between the houses and pits can be placed into two broad categories: functional and demographic. The functional interpretation posits that the pits represent the remains of feasting or ritual activities by the occupants of the houses and possibly the surrounding area. In this scenario, "feasting among the ruins" was a way to connect to the inhabitants' semi-mythical ancestors by constructing social memory (Ristvet 2012a:340). Hellenistic and Roman burials in Iron Age ruins have been noted in other parts of the South Caucasus, which indicates that this type of memory construction in association with ancient architecture was a regional phenomenon (Khatchadourian 2007). The location of the pits among the ruins is a significant part of that interpretation, since the contents of the pits could be the product of a range of consumption activities. By placing the evidence in this framework, it appears that the imported pottery from Artashat may have been the "good china," the finer dishware brought out for special occasions. While local versions of some of the simple rim bowls were used in the houses, the fine imported materials would have been specifically designated for feasting activities.

Demographic differences provide an alternate interpretation for the differential deposition of pottery. This interpretation is based on a consideration of the political context, discussed in textual sources, and attention to the refortification of the citadel. Further excavation of the domestic contexts could significantly alter this picture, and I hope to be able to reassess this reconstruction with more data in the future.

The patterned deposition of local versus non-local pottery could indicate that different communities may have been present at Oğlanqala during this period: a small community that produced pottery nearby, with some part of that community spending at least some of their time living on the southern side of Oğlanqala, and a community that deposited significant proportions of pottery made in Artashat in refuse pits on top of the citadel. It would be strange for members of the same community to dispose of their non-local, but otherwise identical simple red slipped bowls in a different place than they disposed of their locally produced material. The domestic structures do not necessarily indicate extensive long term use, and no domestic contexts have been directly related to the refuse pits, meaning that the people who created these pits were not necessarily settled on or near the citadel. The C^{14} dates all indicate a date of 150 BCE-50 CE for both of these contexts (Ristvet 2012a). This timespan could encompass more than one occupation of the site, or multiple overlapping occupations.

If there was more than one community, than the community that deposited material on the citadel was likely from closer to Artashat and supplied by Artashat workshops. The refortification of the citadel in this period in combination with the rapid deposition of debris in pits during this occupation could indicate that this was a response to military upheaval. This context could represent a military outpost from Artashat, but if so it was extremely transitory, since there is no evidence for barracks or weapons. Alternately, this occupation could be the product of residents from Artashat's environs fleeing from one of Rome's campaigns. Zooarchaeological data from the refuse pits indicate varied consumption of animal products, which could equally be interpreted as feasting or residents fleeing with supplies (Lau ND; Ristvet 2012a: 352-354). Since both Pompey and Marc Anthony marched on Artashat, there were at least two occasions in this time span during which people in the environs of Artashat may have chosen to flee to their neighbors. D.T. Potts (2002) proposed that Oğlanqala can be identified as Olane, an Orontid controlled fortress mentioned by Strabo. Since the extent of Armenian territorial control contracts and expands considerably under the Artaxiads, it is unclear what the political status of Oğlanqala was during this period. However, the people of Artashat would have known that there was fortified ground nearby where they could seek refuge from the Romans.

The fact that the locally produced red slipped simple rim bowls from the domestic structures were made in the same manner as the Artashatian versions indicates that the potting communities making these bowls were engaged with each other to some degree. I propose that the technological similarity points to previously existing ties between these areas that encouraged people to seek safety at Oğlanqala. Perhaps there was even a feast at some point to cement social ties. Greater exposure of the area surrounding the excavated domestic structures would greatly improve our ability to reconstruct how this local settlement functioned.

Roman influenced pottery is not terribly prevalent in the South Caucasus outside of a few centers such as Artashat and Qabala. Artashat was a center of Hellenistic culture in the South Caucasus, and the locus of Roman efforts to control the region. Although this region was not the subject of settler colonialism, it was the subject of imperial interventions by both the Romans and Parthians. The presence at Oğlanqala of a Parthian style pithos burial with objects and human remains from throughout the eastern Mediterranean world shows that Rome was not their only cosmopolitan influence. The red slipped pottery present at Oğlanqala was entangled in imperial webs, as society was restructured in response to new ways of justifying power (Mbembe 2001). No aspect of the Roman administration commanded potters at Artashat to start producing red slipped pottery at the same time as the rest of the Mediterranean world. This pottery style and perhaps new production methods were inspired by Rome to some degree, and were likely implicated in some subset of Artashat residents' attempts to position themselves in relation to this power. Labor and production methods shifted in response to this impetus. Whether or not this pottery was explicitly recognized as Roman, Roman-style pottery had become the standard. Yet these local interpretations of Romanizing styles were necessarily hybrid, imperfect from the perspective of sigillata manufactories, but a creative engagement with imperial forms that both extended and challenged the reach of the empire (Bhabha 1994).

Moreover, if the interpretation of Oğlanqala as a site of refuge during military upheaval is accurate, than this research also provides insight into the subaltern experience of imperialism (Guha 1982, 1997, 1999; Guha and Spivak 1988). While archaeological reconstructions of empire typically focus on monumental architecture and luxury goods, including my own reconstruction of MIA Oğlanqala, these data provide evidence for the other side of imperialism. The side that involves conquest, human displacement, and terror as an expansionist power claims its right to rule. Moreover, it presents a perspective in which peripheral subalterns find ways to support each other in response to competing expansionist powers. Oğlanqala is a periphery of peripheries in this period. It's relationship to Rome or Parthia is even more attenuated than Artashat's. Yet the presence of a hybrid Roman-Parthian style burial, and upheaval from military campaigns shows that even this relatively remote area was caught up in larger imperial forces. Moreover, the selective adoption of Roman or Parthian style ceramics, continued production of local forms, and engagement with Artashat show that the inhabitants of Oğlanqala were actively constituting complex material relationships. They were building local cultures in the space between empires, and serving as the connective tissue and refuge between more clearly marked imperial spaces.

Discussion

The results of this analysis show how political contexts shape technological choices, and that technological and material conditions contribute to the creation of a particular political and social reality. In the EIA, Oğlanqala and Sədərək ceramics were largely locally produced in dispersed production contexts. However, this ceramic production did not occur in isolation. These ceramics were produced in a style that was clearly recognizable across a broad geographic area, though locally produced in at least two very disparate archaeological sites-- Hasanlu and Oğlanqala. While the grey ware tradition varied from location to location, and did not necessarily carry the same meaning for each community producing similar bowls, the shared shapes and aesthetics speak to regional interconnections. Regardless of whether or not everyone who used grey wares subscribed to a collective identity, since they likely did not, they were sharing similar material practices. As such, these ceramics did not *represent* a shared identity, their material existence *was* a relationship in and of itself (Latour 2005). They shared an idea of what makes a beautiful, correct, or simply "normal" pot.

These relationships must be viewed in relation to other evidence for coalescing groups in the LBA to the EIA, such as the politically fragmentary but materially consistent fortress complex that arose in the South Caucasus (Smith 2015). The Nairi kings mentioned in Assyrian texts, as well as inscriptions in Eastern Turkey, speak to the rise of fragmentary but potent principalities following the power vacuum after the fall of the Hittites (Belli 2005; Belli and Konyar 2001, 2003; Çilingiroğlu 1991; Grayson 1976; Sevin 1999; Sevin and Kavaklı 1996). These fortresses in Eastern Turkey and the South Caucasus did not represent the same groups or identities, and the grey ware pottery found at Oğlanqala was stylistically connected to northwest Iran. These relationships were not contiguous with each other, and likely functioned on different frequencies, linking different aspects of different identities. However, all of these strands point to the material practices of fiercely independent communities converging, creating the relationships that enabled them to come together when threatened by Assyrian forces (Muscarella 2012; Smith and Thompson 2004; Zimansky 1985).

However, the expansion of the Urartian Empire was not simply a group of willing participants coming together in mutual self-defense, even if in some sense it may have begun that way. The Urartian Empire, like the Assyrian Empire, the Roman Empire, and the early modern European colonial empires, conquered. They destroyed agriculture, razed fortresses, and forced populations to migrate to new regions where they could not easily coordinate a resistance (Burney 2012; Smith 2003). But in the EIA there was a convergence of material practices that co-existed with political fragmentation and perhaps created a path to more complex political coalitions. These fragmentary coalitions were exploited by the Urartians in their path to domination, but they also posed a challenge to Urartian rule; a mirror image of Bhabha's (1994) ambivalence regarding colonized mimicry.

This tension, between conquest and coalition, negotiation and resistance can be observed in the shifts in the material culture at Oğlanqala in the MIA. There is very little about Oğlanqala's material culture that 'looks' characteristically Urartian. Beyond a few palace ware sherds and some cuneiform volume markers, most of the ceramics do not look like what one typically finds at a large fortress under Urartian control. The storage jars even have different molding. The fortress itself, perhaps the ultimate symbol of Urartian authority, is all wrong-- haphazard, built in a combination of different masonry styles, and following the irregular topography of the landscape rather than razing those protuberances to the ground (Risvet et al. 2012a). Yet the geography of Oğlanqala led

Paul Zimansky (1985), one of the leading experts on Urartu, to posit that this area was incorporated into Urartu. How can it possibly share the Şərur plain with the Urartian fortresses of Sədərək and Verachram and not be part of Urartu as well?

The results of my ceramic analysis of Oğlanqala show that the largely stylistic criteria of the Urartian "state assemblage" does not account for all of the changes occurring in relation to the Urartian expansion. There was a more substantial shift in ceramic production and elite interactions resulting from Oğlanqala's entanglement with Urartian imperialism (Mbembe 2001). The specific material conditions of different ceramics materialized different relationships between Oğlanqala and their neighbors (Latour 2005). The atypical storage jars seem to have been brought all the way from the Van basin, indicating that the stylistic difference may be the product of chronological distance from previously excavated Urartian centers rather than geographic distance. The technical knowledge required to construct these storage jars, their production according to imperial specifications, and the difficulty of moving them across hundreds of kilometers of mountainous terrain were specific material instantiations of imperial power. These massive storage jars are relatively common at Oğlanqala, accounting for nearly 5% of the diagnostic sherds found on the site. Their presence at Oğlanqala shows that this area was incorporated into the Urartian administrative apparatus.

The small number of polished red wares found at Oğlanqala from this period traveled from far and wide, including the Van basin. These luxury display objects enacted a different link between Oğlanqala and Urartu than the onerous storage jars: a beautiful gift to encourage positive relations. Far from the Urartian core, these material enactments of empire were even more consequential at Oğlanqala than at centers such as Ayanis or Bastam, since for large portions of time these materials *were* Urartu in this area. Urartu was not present here as a canonical fortress, or adjudicating disputes on cuneiform tablets. The military conquered and inscribed their successes on mountainsides, but there is no evidence for any occupying force in the region. Rather, these vessels, their style, production, and movement, incorporated this territory into Urartu. The extension of Urartu into Naxçıvan is more difficult to recognize archaeologically because just a few imperial actors negotiated with a range of local actors to develop a contingent, limited form of empire.

However, the majority of non-local ceramics come from grey and brown bowls and cooking pots in a limited range of forms, which traveled to Oğlanqala from a broad geographic area. The gradual shift from earlier styles belies the extensive changes in ceramic production and movement. Only 39% of Oğlanqala ceramics analyzed for this project were likely locally made, with 61% either imported or too ambiguous to determine. Even though local pottery was likely under-represented in this research, there was significantly more non-local pottery than there had been previously, and it comes from distributed geological contexts. These ceramics appear visually identical, but each vessel form is made in many different areas, and each area only contributes a few vessel forms. Moreover, there is evidence that all of the most characteristically Urartian style pottery, such as palace ware, storage jars, and thick rim bowls, were produced locally as well as imported, even if in small quantities. New ceramic technology and styles were being integrated into local ceramic production, either with local potters learning new styles or itinerant potters producing imperial forms. This pattern indicates that these vessels were part of elite travel and consumption practices, with representatives from different communities traveling to Oğlanqala to foster political ties (D'Altroy and Earle 1985; Podany 2010; Polanyi 1976).

Particular raw materials used in specific production contexts, made into certain ceramic forms and then exchanged as part of certain networks is part of what enacted the political complexity of Oğlanqala (Latour 2005). While many of the imported ceramics were from unknown origins, it is likely that at least some came from beyond the reach of Urartian imperial authority. This increase in interconnectivity was a strategy that people at Oğlanqala employed in its precarious position at the edge of the Urartian political sphere. Urartu's imperial frontier simply did not coincide with Oğlanqala's regional political, cultural, or economic frontiers (Parker 2006). Oğlanqala was not just at the edge of Urartu, but positioned at the crossroad of Urartian and non-Urartian space. It was beneficial for people at Oğlanqala to maintain some type of non-violent relations with their neighbors, including anti-Urartian confederations such as the Etiuni. This material diplomacy may partially explain the politically ambivalent nature of the ceramic styles seen at Oğlanqala, adapting aspects of imperial styles while remaining decidedly difficult to categorize. The patterned misinterpretation described by Middle Ground Theory is a useful model for the ways that different groups may have been able to come to different conclusions about Oğlanqala's political positioning based on their material culture (White 1991).

The Roman-Parthian period at Oğlanqala demonstrates an entirely different model of imperial engagement. This is perhaps not surprising considering the significant differences in the composition and mechanics of the Urartian and Roman empires. Rome's recognizable material style extended far beyond their administrative borders, whereas Urartu's material influence barely extended *to* their administrative borders. While the large storage jars from the Van basin show that Oğlanqala was connected to the Urartian administrative apparatus, the material culture remains difficult for archaeologists to recognize. In the Roman-Parthian period, Oğlanqala was barely on the Roman periphery, but rather on the periphery of a disputed vassal, with no evidence for Roman administration. Yet, Roman influenced ceramics were present, showing the far reaching nature of the Roman "brand".

In this period, approximately half of the ceramics came from Artashat, and locally produced ceramics were dominated by the Roman influenced style of eastern red slipped ware. However, local ceramics continued to be produced in a wide range of styles, and were favored in domestic space over the non-local pottery found in pits on the citadel. This context differentiation could have a functional explanation, in which the residents of the houses used their finer imported pottery to feast among the ruins. Alternatively, these two contexts may represent two different communities: a local settlement and a transitory occupation of people from closer to Artashat seeking safety from military upheaval. The stylistic and technological similarities of the red slip wares produced near Oğlanqala and Artashat indicate that these communities were closely connected, and perhaps they gathered at different points for both feasting and safety.

The pithos burial found outside of the western fortification walls at Oğlanqala shows evidence for material interactions from throughout the eastern Mediterranean, including rings, coins, and glass vessels. While the ceramics from this period indicate closer relations with a single polity than observed in any other period, they also show selectivity in how these non-local ceramics and ceramic styles were incorporated into local repertoires. While in the MIA, Oğlanqala stood at the edge of one empire, in this period Oğlanqala had to find a way to exist in the crossroads (or crossfire) of two empires. There is a high proportion of imported ceramics in both periods, indicating that imperial expansions can increase material exchange, but this is where the similarities end. While the MIA inhabitants engaged in widespread movement of largely ambiguous styles, Roman period Oğlanqala ceramics came from just one polity in a very narrow stylistic range.

This divergence indicates the necessary adaptiveness and fluidity of technological production at imperial crossroads. Rather than assert a model for local-imperial engagements, this research asserts the particularity of these engagements, and demonstrates the power of technological analyses to explore that particularity. Urartu and Rome were very different empires, and Oğlanqala was was positioned differently in relation to each of them. From the EIA to the Roman period, the inhabitants of Oğlanqala used ceramic technology to define and obscure relationships with their neighbors. Ceramic production created political and social relationships that would have been different if they developed through another media. The ubiquity and malleability of ceramics makes them exceptionally well qualified for this purpose.

CHAPTER 7: Epilogue: The Politics of Things

This research began with a few simple questions: does ceramic technological production shift with political change in the Iron Age South Caucasus? If so, what is the nature of this relationship? This first question has a relatively straightforward answer: yes, ceramic technological production does shift in relation to political change in this context. The question of causation, or the nature of this change is not straightforward. Neither Urartu nor Rome rolled into Naxçıvan and demanded that potters change their behaviors. It remains unclear the degree to which this area was ever under direct imperial control. However, ceramic production and exchange did shift in each political period.

Perhaps change in and of itself is not surprising. After all, this project examined ceramics from a period of roughly 1,300 years; complete continuity over this time span would be far more remarkable. Change in ceramic style over time is the basis of archaeological typologies, and technology rarely remains stagnant. But the type of change is significant. Potters choose to change in ways they believe will be advantageous, and people generally adopt new forms because they prefer them for some reason (Gosselain 2000, 2008; Loney 2000). New styles, methods of production, and paths of circulation create new relationships that are specific to the material conditions enacting those relationships (Latour 2005). For example, while EIA grey wares existed as a regional style, they were produced and used locally. Even at Hasanlu, where there was clearly extensive exchange of many different materials, pottery was not part of those networks. Yet in the MIA, pottery was widely circulated and played an important role in materializing elite ties. In this period, the stylistic similarity of these disparately produced vessels made it possible for them to travel, yet always appear at home (Feldman 2002). These vessels could act as gifts, table wares, or cooking pots in any of the far flung locations where these materials were produced.

Moreover, this assemblage demonstrates that Urartian imperial entanglements were enacted through materials that were not previously considered a central part of the Urartian "state assemblage." Urartu is the fortress empire, defined by its very specific architecture. Yet Oğlanqala's architecture was all wrong, with meandering EIA style masonry. Even the storage jars, which appear to be Oğlanqala's most critical link to Urartu, were stylistically atypical. There was no metal, very little cuneiform, and just a handful of polished red wares (Ristvet el al. 2012a). These results highlight the fact that our reconstructions of Uratru are based on a few, very large centers that were mostly built and destroyed in a narrow chronological period towards the end of Urartian imperialism (Zimansky 1995).

Oğlanqala appears to represent an earlier, more peripheral version of Urartian imperialism. The significantly increased circulation of bowls and cooking pots points to greater regional integration among elites. This increased focus on building elite ties may have been directed by Urartu in some way, but it also could have been a more localized response by regional elites to growing imperialism. These ties would have created greater regional solidarity for local elites to assert themselves in a landscape dominated by larger political powers. The presence of storage jars and polished red wares from Van enacted political connections to Urartu, but these were not the only connections developed through ceramic vessels. Oğlanqala was occupied towards the beginning of Urartu's expansion, and possibly abandoned before Urartu's loss of power. Perhaps this site represents a less total, more negotiated form of engagement with Urartian imperialism, which was not able to exist contemporaneously for long with Verachram, a more complete assertion of Urartian might. Only further excavation of smaller, non-elite, and/or peripheral Urartian period sites will enable us to reconstruct a more nuanced understanding of Urartian imperialism.

The political landscape of Oğlanqala in the Roman-Parthian period was significantly different from that of the Urartian period. The imperial projects of Rome and Parthia were different from Urartu and from each other. Urartu was a fortress empire in the mountains, and Parthia largely co-opted local material cultures and methods of rule. Rome produced some of the most expansive and stylistically coherent material culture in the archaeological record. This means that evidence for Rome's cultural and economic influence is visible far beyond the extent of their administrative borders (Parker 2006; Freestone and Rigby 1988; Willis 1996; Woolf 1992). Moreover, Oğlanqala was in the periphery of a periphery during this period, with clear material links to Artashat, the capital of ancient Armenia. While MIA Oğlanqala increases our understanding of Urartian imperialism at the edge of their empire, in the Roman-Parthian period Oğlanqala speaks to how Roman imperialism extended beyond the edge of their administration.

During the first century BCE/CE, Armenia was alternately dominated by Rome and Parthia, sometimes benefitting from benign neglect, and other times suffering from intense military campaigns. Yet it is Rome's material influence that was apparent in the ceramics, with Artashat potters producing a local variant of eastern red slip ware.

Approximately half of the ceramics sampled from this period were red slipped wares produced at Artashat, while the next largest category was red slipped wares produced at Oğlanqala. This pattern alone is enough to confirm a substantial economic and cultural relationship between these two neighbors, even if it cannot speak to political organization or authority. The stylistic and technological links enacted by producing similar Roman-influenced pottery created a shared cultural network in this precarious periphery. These links were materialized through similar production methods, which point to shared communities of practice, as well as a shared stylistic repertoire (Lave and Wengar 1991; Herbich and Dietler 1989). The relationships enacted by these materials would be of a different nature if they were enacted through different material forms (Latour 2005).

The differing depositional patterns for visually similar local and non-local pottery indicate that there were two different communities or activities present on the Oğlanqala citadel. While there is a range of possible interpretations for these patterns, I propose that the non-local pottery on the citadel may represent a displaced group of people seeking safety during military upheaval that resulted in the repeated conquest of their city. If correct, then Oğlanqala is evidence for the bitter consequences of expansionist imperialism, and the ways that local people attempted to survive in the shadow of empires. Bhabha (1994) notes that colonized people often adopt aspects of their colonizer's culture, but in doing so adapt it, remake it into something new and particular, or hybrid. While the red slipped wares were Roman influenced, their local production was part of what enacted the local ties of solidarity that may have provided refuge from the Romans.

This pattern finds parallels in evidence from the Roman frontier in Britain. Tacitus (Agricola 30) paraphrases a (probably composite, ahistorical) Celtic chief's description of Rome as: "They plunder, they slaughter, and they steal: this they falsely name Empire, and where they make a wasteland, they call it peace." Regardless of the historicity of that particular quote, it speaks to Britain's intense resistance to Roman expansion, even as people in the area adopted some Roman-style pottery in advance of actual conquest. The adoption of imperial styles by those resisting imperial domination is not an anomaly, but a common feature of colonization (Dietler 2010). The political border of Roman conquest was not contiguous with the cultural frontier of their material culture (Parker 2006). Yet it is problematic to call red slipped ware "Roman culture," because its deployment in the borderlands was entangled in a range of local and imperial networks. This style of pottery does not have the secondary agency Gell (1998) attributed to art that was guided by the intentions of the artist. Rather, objects in this style acted upon their surrounding context in new ways as the context changed (Appadurai 1986; Khatchadourian 2016; Latour 2005; Miller 2005; Olsen 2010). These peripheral areas were making local cultures at an imperial crossroad.

This analysis shows two very different ways that the inhabitants of Oğlanqala engaged with imperial neighbors over time, choosing different strategies and alignments in different contexts. These results speak to selective imperial integration and resistance. After all, our things make us who we are, and make the reality in which we situate ourselves. This is true for the present as well as the past, and is perhaps most clear in ritual contexts. After all, the "Christmas season" does not begin on a certain date, but is enacted through materials, usually when corporations decide it will be economically advantageous to do so (Warner and Barsky 1995). On Friday night, lighting candles transforms my apartment into a Jewish home, and drinking wine from the "nice" stemware differentiates the meal from other dinners. Without these material things, Friday night is simply Friday night. Archaeologists have long been in the habit of attending to things, largely out of necessity. Things make up our data. In archaeological literature, imperial territories are typically demarcated by the presence of material correlates, such as the Urartian "state assemblage." While important, this formulation does not give people or things enough credit for creativity. Rather than viewing materials as signaling the presence of imperial authority, more recent research has taken into account the way that the same materials can be deployed to create different effects (Khatchdourian 2016). The flexibility of things belies the "edge of empire" metaphor. This image creates the impression that it is somehow possible to fall off the edge of empire-- that one can cross an invisible threshold from imperial to non-imperial space, even if some materials or societies can balance on the edge. But things are far more complicated than that model implies. Gell's (1998) concept of "secondary agency" for objects does not account for the way that objects may be redeployed in ways never imagined by their creator (Appadurai 1986; Buchli 2002; Clark 2007; Dant 1999). A Roman-style cup may be used in Gaulish feasting practices, and Coca-Cola can be deployed in Trinidadian identity politics that do not discursively reference the corporation based in the U.S. state of Georgia (Dietler 2010; Miller 1999). Things can make a new reality even as their cultural points of reference shift.

This flexibility is important when interpreting the use of imperial cultures at Oğlanqala. There has been some discussion about Oğlanqala's position *vis-a-vis* her imperial neighbors-- is Oğlanqala Urartian or not (Dan 2014; Ristvet et al. 2012a)? What about Roman, or Parthian? Is Oğlanqala balanced on the edge, just waiting for the weight of a few more palace ware sherds to tip it over? Perhaps a better question would be: how is Oğlanqala entangled with Urartu, Rome and Partia? Returning to Mbembe (2001:68), entanglement refers to "a whole cluster of re-orderings of society, culture, and identity, and a series of recent changes in the way power is exercised and rationalized." Research on "frontiers" demonstrates that borderlands can encompass geographic, political, demographic, cultural, and economic boundaries, each of which can range along a continuum from relatively static boundaries to more fluid frontiers (Alconini 2016; Parker 2003, 2006). My research demonstrates that the inhabitants of Oğlanqala were entangled with economic networks of exchange and stylistic rationalizations of power that stemmed from the continuum of Urartian, Roman, and Parthian imperialism.

By focusing on technological production as a process of making or becoming, it becomes possible to observe the material instantiation of new political orders. The exchange networks revealed are not abstract economic models, but are the material reality of making a pot in one place and then transporting it to another. As pastoralists, people in this area were likely often on the move. Movement was not new in the Urartian or Roman periods, but the choices people made about carrying and exchanging ceramics shifted, as did the decisions people made about types of ceramics and exchange partners.

The power of things to participate, directly and indirectly in political networks is highly relevant to our present moment. As globalization and neoliberalism come to define world politics and commerce, the importance of things in defining international relationships and local identities comes into sharp focus. Trade and sanctions serve as the diplomatic carrot and stick for U.S. negotiations with Russia and Iran. As neoliberalism demands that states shrink in favor of private enterprise, the choice of material possessions becomes a form of voting (Hilgers 2012; Joronen 2013; Koning 2012). For example, the decision to buy or boycott Chobani yogurt for employing Syrian refurgees, or Kellogg's brand foods for pulling their advertising from Breitbart are ways for individuals to materially enact political positions-- of course resulting in people with greater financial resources having a greater "vote" (Andrews 2016; Gelles 2016). Things matter in political organization. Understanding how things have been used in the past to create new political realities gives us practical insight into present practice. Things are not neutral, in contrast to Mark Zuckerberg's claims regarding Facebook's algorithms (Wingfield et al. 2016). Things have political agendas, but the agendas of things are not fixed, and can be redeployed to create relationships that their creators never imagined.

APPENDIX A: Simplified Oğlanqala Ceramic Typology

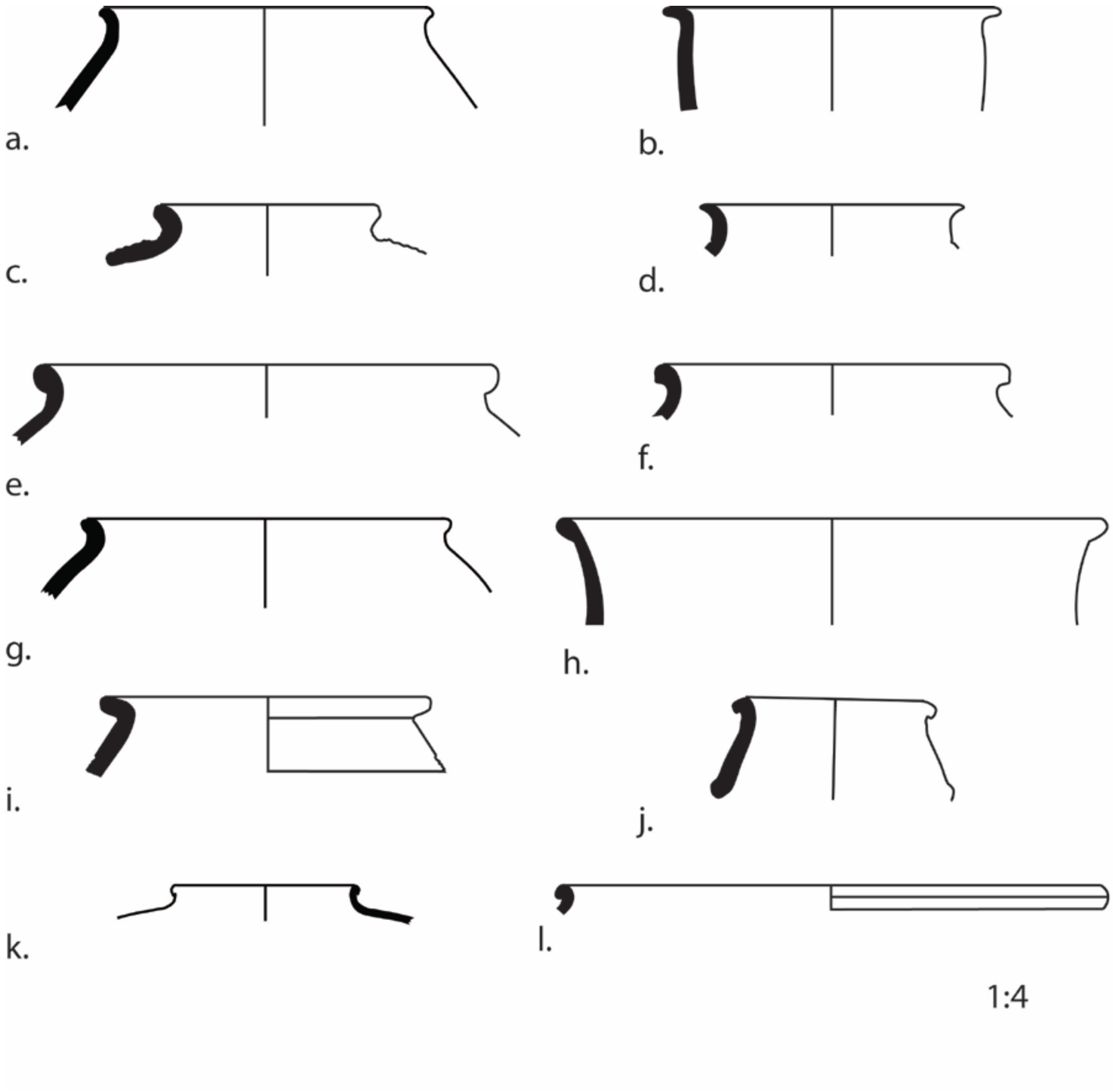


PLATE 1: **Early Iron Age jars**. Mineral inclusions and burnished unless otherwise noted; **simple everted rim jars**: *a, c*: grey-tan slip exterior and interior, fine-medium inclusions; *b, d*: grey-tan, or rare brown, pink slip exterior and interior, HI burnish strokes, fine-medium inclusions. **rolled rim jars**: *e*: grey-tan slip exterior and interior, fine-medium inclusions; *f*: buff no slip, coarse inclusions; *g*: grey-tan slip exterior and interior, fine-medium inclusions; i: grey slip exterior and interior, medium inclusions; *j*: grey slip exterior and interior, medium inclusions; *k:* buff no slip, no burnish, medium inclusions; *l*: grey eroded, fine-medium inclusions.

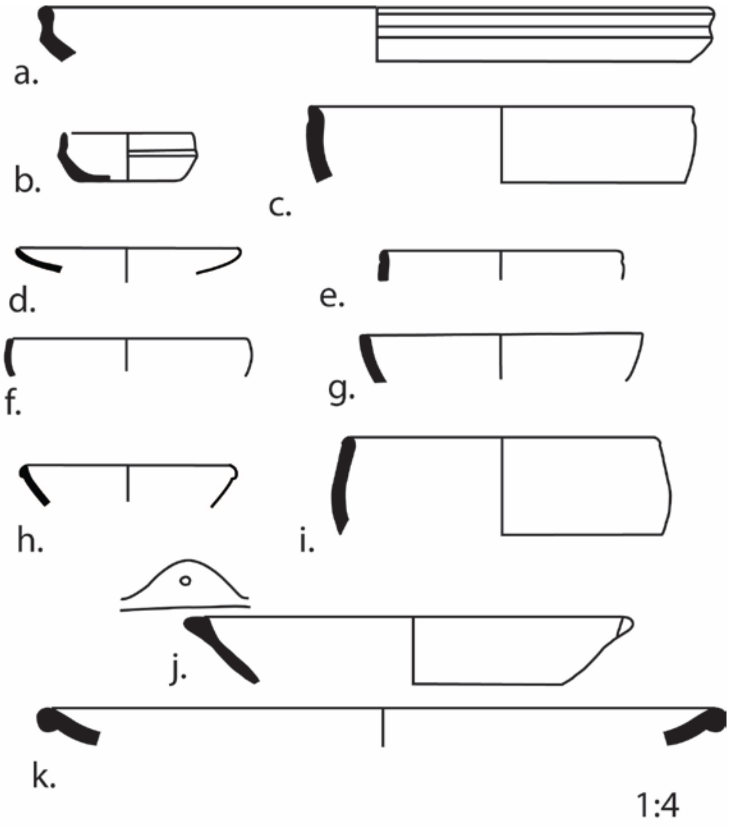


PLATE 2: **Early Iron Ages bowls and plates**. Mineral inclusions and burnished unless otherwise noted. **Carinated bowls**: *a:* grey slip exterior and interior, HI burnish strokes, fine-medium inclusions; *b*: grey-brown slip exterior and interior, medium inclusions. **Indented rim bowls**: *c*: grey, tan-grey, or dark grey slip exterior and interior, HI burnish strokes, fine-medium inclusions; *e*: grey, brown slip exterior and interior, medium fine-medium inclusions. **Simple rim bowl**: *f*, *g*: brown slip exterior and interior, P burnish, fine-medium inclusions. **Clubbed rim bowl**: *h*: grey slip eroded, fine-medium inclusions. **Simple vertical rim bowl**: *i*: grey, brown-grey slip exterior and interior, fine-medium inclusions; *j*: grey slip exterior and interior, fine-medium inclusions. **Simple rim plates**: *d*: grey, tan slip exterior and interior, HI burnish strokes, fine-medium inclusions. **Rolled rim plates**: *k*: grey slip exterior and interior, fine-medium inclusions.

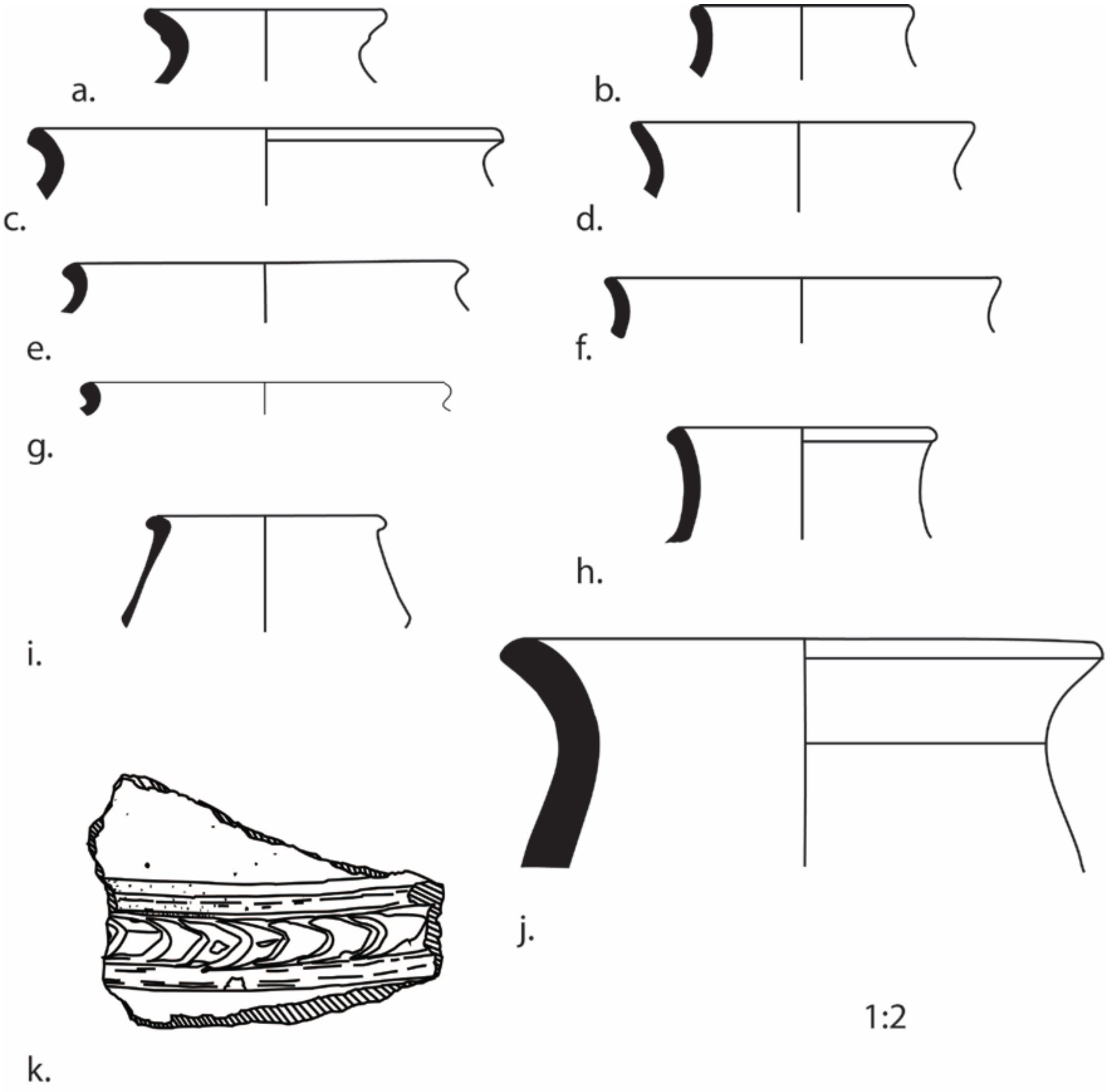


PLATE 3: **Middle Iron Age jars and cooking pots**. Mineral inclusions and burnished unless otherwise noted. a-e: **Simple everted rim jar**: *a*: brown slip exterior and interior, medium inclusions; *b*, *c*, *e*: brown slip exterior and interior, medium inclusions; *d*: brown slip exterior and interior, HI burnish strokes, medium inclusions. **Rolled rim jars**: *g*: tan, rare red slip exterior and interior, medium inclusions; *h*: tan, rare red slip exterior and interior, medium inclusions. **Simple everted rim cooking pots**: f: brown-grey slip exterior and interior, HI burnish strokes, medium-coarse inclusions. i-j: **Rolled rim cooking pots**: *i*: tan, grey slip exterior and interior, HI/V burnish strokes, medium-coarse inclusions; *j*: mainly brown-tan, rare grey, pink slip exterior and mostly interior, HI or HI/V burnish strokes, medium-coarse inclusions. **Storage jar**: *k*: buff, no slip, no burnish, coarse inclusions.

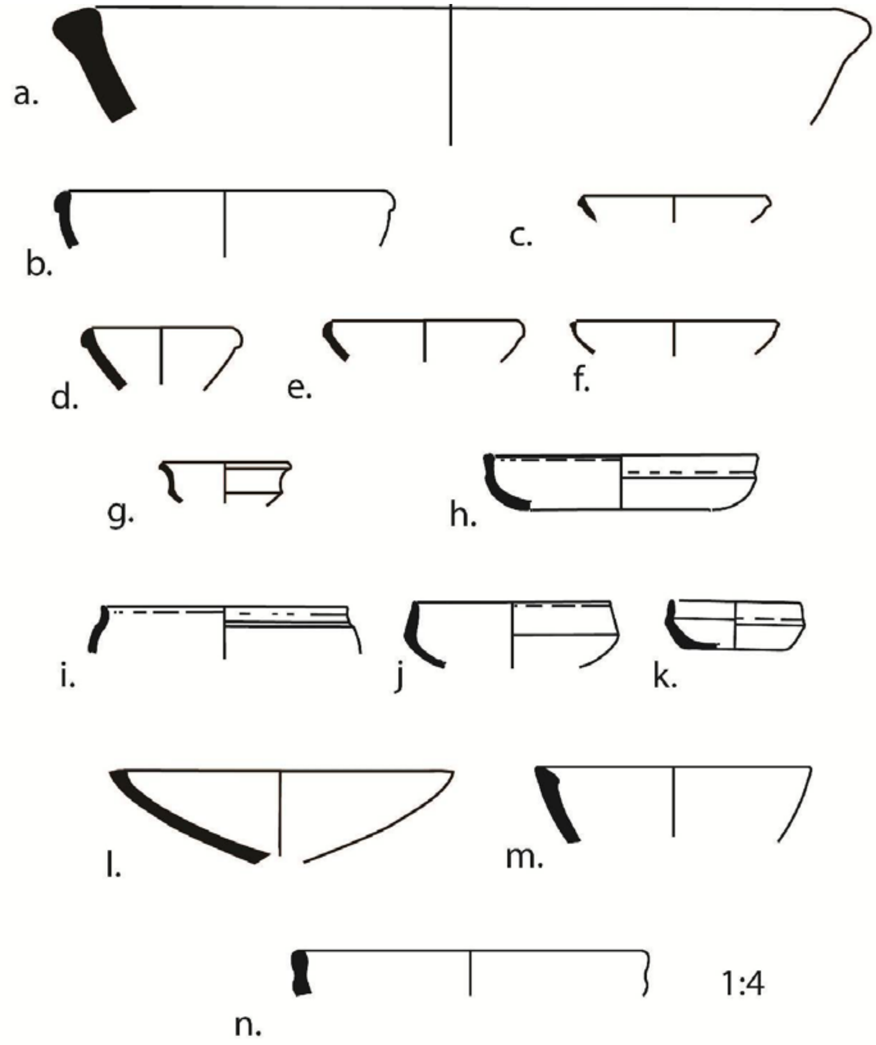


PLATE 4: **Middle Iron Age bowls**. Mineral inclusions and burnished unless otherwise noted. **Clubbed rim bowls**: *a*: grey, brown-grey, and pink slip exterior and interior, P and HI burnish strokes, medium-coarse inclusions; *b*, *d*: red slip exterior and interior, P burnish, fine-medium inclusions; *c*: red, brown, tan slip exterior and interior, HI or HR burnish strokes, fine-medium inclusions; *e*: brown grey slip exterior and interior, medium inclusions. **Incised clubbed rim bowl**: *f*:red slip exterior and interior, P or HR burnish strokes, fine inclusions. **Carinated bowls**: *g*: brown-grey, black slip exterior and interior, P burnish, medium inclusions; *h*: brown-grey, brown slip exterior and interior, P or HI burnish strokes, medium inclusions; *i*: brown-grey slip exterior and interior, P burnish, fine-medium inclusions; *j*: brown-grey, grey slip exterior and interior, mainly P, rare HR burnish strokes, fine-medium inclusions; *k*: dark slip, HR burnish strokes, medium inclusions. **Thick rim bowls**: *l*: brown, grey, brown-grey slip, P or HI burnish strokes, medium-coarse inclusions. **Pointed rim bowls**: *m*: tan, brown slip exterior and interior, fine-medium inclusions. **Indented rim bowl**: *n*: grey slip exterior and interior, fine-medium inclusions.

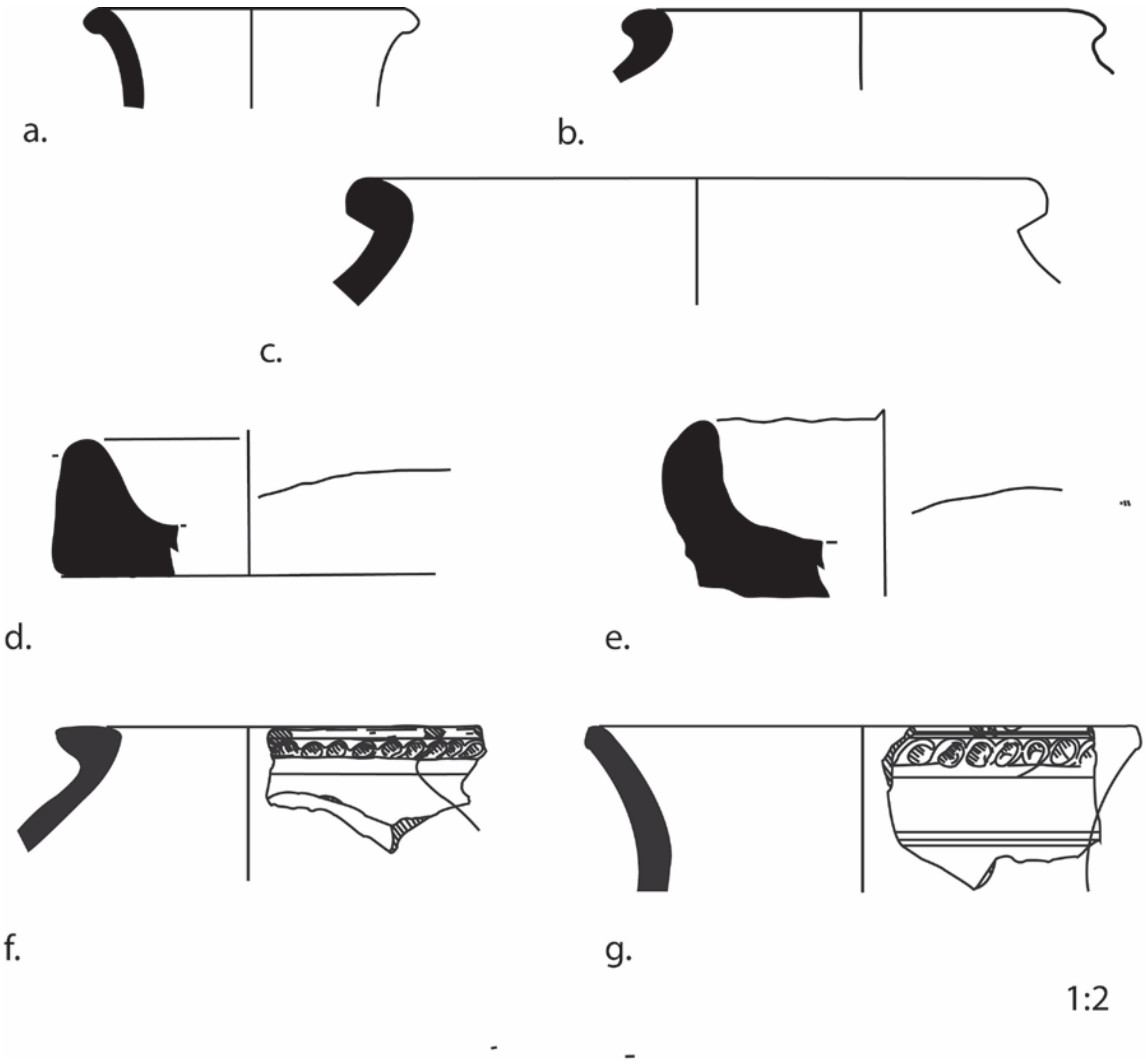


PLATE 5: **Late Iron Age to Roman-Parthian Period jars**: Mineral inclusions and burnished unless otherwise noted. **Rolled rim jars**: *a*:grey, red slip exterior and interior, HI or HI/V burnish strokes, medium-coarse inclusions; *b*: buff, no slip, no burnish, medium inclusions. *c*. pink slip exterior and interior, medium inclusions. **Trays**: *f*, *g*: buff, no slip, no burnish, medium-coarse inclusions. **Pithoi**: *f*, *g*: buff, rare slip exterior (if slipped, burnished), medium-coarse inclusions.

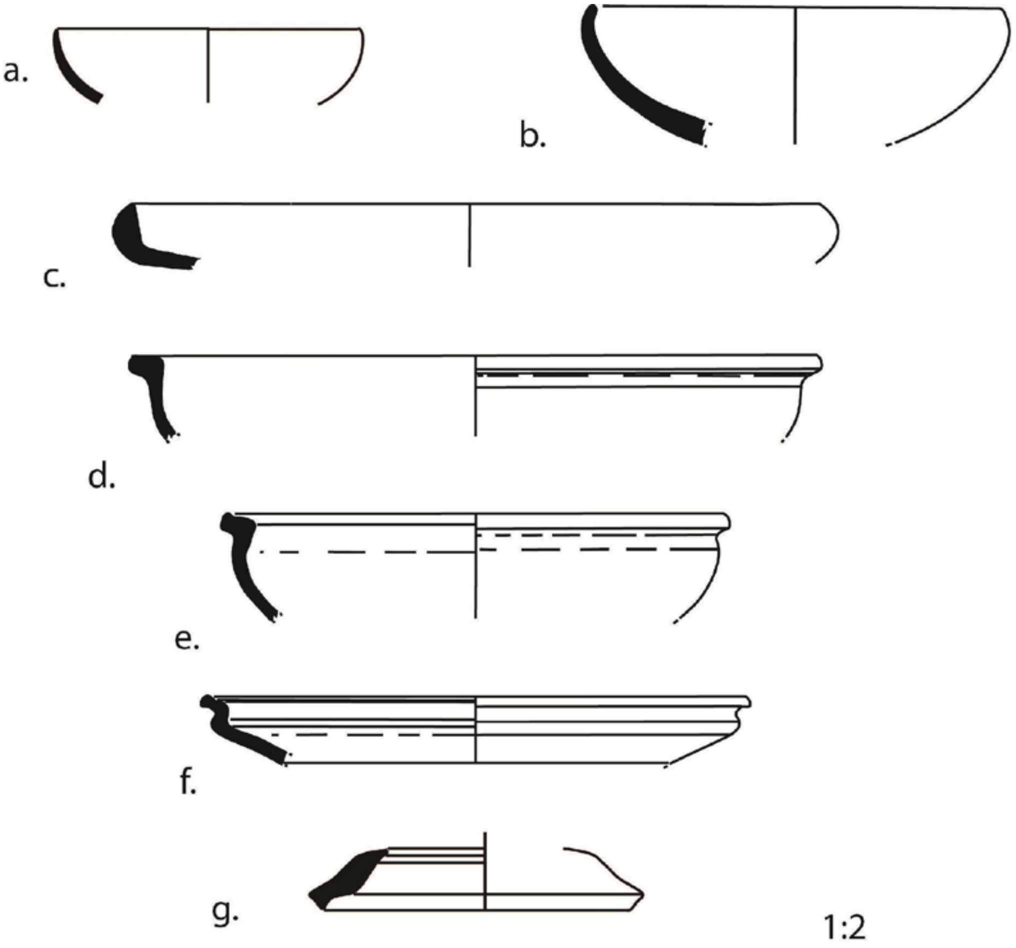


Plate 6: **Roman-Parthian Period bowls and plates**: Mineral inclusions and burnished unless otherwise noted. **Simple rim bowls**: *a*, *b*: red slip exterior and interior, HR or HI burnish strokes, fine-medium inclusions. **Thickened rim plates**: *c*: red slip exterior and interior, HR burnish strokes, fine-medium inclusions. **Ledge rim plates**: *e*, *f*: red slip exterior and interior, HR burnish strokes, fine-medium inclusions. **Lids**: *g*. red slip exterior and interior, HR burnish strokes, fine-medium inclusions.

APPENDIX B: Sample Data Table

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
2	Andesite Calcareous Group: Subgroup A			2	Citadel	simple rim bowl		pink slip
3	Andesite Calcareous Group: Subgroup B			3	Citadel	clubbed rim bowl		pink slip
4	Andesite Calcareous Group: Subgroup B			2	Citadel	pointed rim bowl		tan slip
7	Serpentinite Group			2	Citadel	thickened rim plate		red slip
10	Andesite Calcareous Group: Subgroup A			2	Citadel	tray		buff
11	Carbonate Group: Subgroup A			2	Citadel	tray		buff
13	Carbonate Group: Subgroup A			2	Citadel	tray		buff
15	Andesite Calcareous Group: Subgroup A			4	Citadel-surface	jar with applied decoration		tan-grey slip
16	Dacite Group			2	Citadel-surface	rolled rim cooking pot		red slip
17	Andesite Calcareous Group: Subgroup A			2	Citadel	rolled rim jar		buff
18	Andesite Calcareous Group: Subgroup C			2	Citadel-surface	rolled rim cooking pot		grey slip
21	Andesite Calcareous Group: Subgroup A			5	Citadel-surface	simple vertical rim bowl		grey slip

Pet. ID	**Petrofabric**	**NAA ID**	**NAA Group**	**Period**	**Context**	**Form**	**Burnish Stroke**	**Ext. Finish**
23	Glassy Welded Tuff Feldspar Loner			4	Citadel	simple everted rim jar		brown slip
24	Rhyolite Group			4	Citadel	clubbed rim bowl		grey slip
28	Perlitic Glass Loner			2	Citadel	lamp		red
29	Andesite Calcareous Group: Subgroup A			4	Citadel-surface	simple rim bowl		red slip
30	Carbonate Group: Subgroup B	SGF078	HCa3	4	Citadel	body sherd		red slip
31	Andesite Calcareous Group: Subgroup A			4	Citadel	clubbed rim bowl		dark red
35	Serpentinite Group			2	Citadel	ledge rim plate		red slip
36	Carbonate Group: Subgroup A			2	Citadel	tray		buff
37	Andesite Calcareous Group: Subgroup A			5	Citadel-surface	indented rim bowl		brown slip
38	Andesite Calcareous Group: Subgroup A			2	Citadel-surface	storage jar		buff
39	Andesite Calcareous Group: Subgroup B			2	Citadel	clubbed rim bowl		pink-eroded
42	Andesite Calcareous Group: Subgroup B			3	Citadel-surface	carinated bowl		red-eroded
43	Serpentinite Group			2	Citadel	ledge rim plate		red slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
47	Carbonate Volcanic Loner			4	Citadel	storage jar		buff
48	Andesite Calcareous Group: Subgroup B			3	Citadel-surface	carinated bowl		red slip
49	Andesite Calcareous Group: Subgroup A			4	Citadel-surface	ring base		brown slip
50	Trachyandesite Group			4	Citadel	storage jar		buff
52	Carbonate Group: Subgroup A			4	Citadel	clubbed rim bowl	P	red slip
53	Andesite Calcareous Group: Subgroup B			5	EIA kurgan	rolled rim jar		tan-grey slip
54	Andesite Calcareous Group: Subgroup A			2	Citadel-surface	rolled rim cooking pot		brown slip
58	Trachyandesite Group			4	Citadel	storage jar		buff
59	Serpentinite Group			2	Citadel-surface	ledge rim plate		red slip
60	Andesite Calcareous Group: Subgroup A			3	Citadel-surface	simple rim bowl		red slip
62	Metamorphic Pair			4	Citadel	rolled rim jar-cooking pot		light brown
63	Andesite Calcareous Group: Subgroup A			4	Citadel-surface	rolled rim jar		red slip
65	Serpentinite Group			2	Citadel	thickened rim plate		red slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
69	Andesite Calcareous Group: Subgroup A			2	Citadel	storage jar		buff
70	Andesite Calcareous Group: Subgroup B			5	EIA kurgan-surface	rolled rim plate		grey slip
72	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	flat based jar		grey slip
73	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	flat based jar		tan grey slip
74	Andesite Calcareous Group: Subgroup A			5	EIA kurgan	ring base		buff slip
75	Andesite Calcareous Group: Subgroup A			5	EIA kurgan	flat based jar		grey slip
76	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		tan-grey slip
77	Glassy Welded Tuff Loner			5	EIA kurgan	flat based jar		tan-grey slip
78	Silaceous Sedimentary Loner			5	EIA kurgan	rolled rim jar		buff
79	Andesite Calcareous Group: Subgroup B			5	EIA kurgan	simple everted rim jar		tan slip
80	Andesite Calcareous Group: Subgroup A			5	EIA kurgan	rolled rim jar		grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
81	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		grey slip
82	Andesite Calcareous Group: Subgroup B			5	EIA kurgan	rolled rim jar		grey slip
83	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		grey slip
84	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		grey slip
85	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		grey slip
86	Andesite Calcareous Group: Subgroup A			5	EIA kurgan	simple everted rim jar		tan grey slip
87	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		buff
88	Andesite Calcareous Group: Subgroup B			5	EIA kurgan	rolled rim jar		tan grey slip
89	Andesite Calcareous Group: Subgroup B			5	EIA kurgan	rolled rim jar		tan slip
90	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
91	Andesite Calcareous Group: Subgroup B			5	EIA kurgan	simple everted rim jar		tan slip
92	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		tan slip
93	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	rolled rim jar		tan slip
94	Andesite Calcareous Group: Subgroup C			5	EIA kurgan	flat based jar		grey slip
96	Serpentinite Group			2	Citadel-surface	thickened rim plate		red slip
97	Serpentinite Group			2	Houses	simple rim bowl	HR	red slip
98	Andesite Calcareous Group: Subgroup A			3	Houses	carinated bowl		red slip
99	Andesite Calcareous Group: Subgroup B	SGF021	HCa1	4	Citadel-walls	clubbed rim bowl	HI	pink slip
100	Carbonate Group: Subgroup B	SGF022	Hca unassigned	4	Citadel	incised club rim bowl	P	red slip
101	Andesite Calcareous Group: Subgroup A			5	Citadel	simple vertical rim bowl		grey slip
102	Andesite Calcareous Group: Subgroup A			5	Citadel	simple vertical rim bowl		grey slip
103	Andesite Calcareous Group: Subgroup B			5	Citadel	indented rim bowl		tan grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
104	Andesite Group			5	Citadel	carinated bowl		brown grey slip
105	Andesite Calcareous Group: Subgroup C			2	Citadel	thickened rim plate		red slip
106	Serpentinite Group			2	Citadel	simple rim bowl		red slip
107	Serpentinite Group			2	Citadel-walls	ledge rim plate	HR	red slip
108	Andesite Group			2	Citadel	lamp		buff
109	Andesite Calcareous Group: Subgroup A			2	Citadel	simple rim bowl	HI	red slip
110	Andesite Group			2	Citadel	rolled rim cooking pot	HI	brown slip
111	Serpentinite Group			2	Citadel	simple rim bowl		red slip
112	Andesite Calcareous Group: Subgroup A			5	Citadel	indented rim bowl	HI	Dark grey slip
113	Serpentinite Group			2	Citadel	simple rim bowl		red slip
114	Andesite Calcareous Group: Subgroup B			3	Citadel	clubbed rim bowl	HR	pink slip
115	Carbonate Group: Subgroup B	SGF023	LCa2	4	Citadel	incised club rim bowl	HR	red slip
116	Andesite Calcareous Group: Subgroup A			3	Citadel	rolled rim jar	HI	grey slip
117	Coarse Andesite Group	SGF024	Lca unassigned	4	Citadel	rolled rim cooking pot	HI	grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
118	Andesite Calcareous Group: Subgroup B			4	Citadel	rolled rim cooking pot	HI	tan slip
119	Serpentinite Group			2	Citadel-walls	ledge rim plate	HR	red slip
120	Metamorphic Pair			3	Citadel	rolled rim jar		pink slip
121	Andesite Calcareous Group: Subgroup A	SGF025	HCa1	4	Citadel	clubbed rim bowl		red slip
122	Andesite Calcareous Group: Subgroup A	SGF026	HCa1	4	Citadel-walls	rolled rim jar-cooking pot		tan slip
123	Serpentinite Group			2	Citadel	thickened rim plate	HR	red slip
124	Serpentinite Group			2	Citadel	thickened rim plate		red slip
125	Andesite Calcareous Group: Subgroup C			5	Citadel	rolled rim jar	HI	black slip
126	Andesite Calcareous Group: Subgroup A	SGF066	Hca unassigned	4	Citadel-walls	rolled rim cooking pot	HI/V	tan slip
127	Coarse Andesite Group	SGF027	LCa3	4	Citadel	rolled rim cooking pot		brown slip
128	Sandstone Gabbro Loner			3	Citadel	rolled rim jar	HI/V	red slip
129	Carbonate Group: Subgroup A			4	Citadel-walls	incised club rim bowl		red slip
130	Rhyolite Group			4	Citadel	rolled rim cooking pot		grey slip
131	Coarse Andesite Group			4	Citadel	rolled rim cooking pot	HI	brown slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
132	Andesite Calcareous Group: Subgroup A	SFG028	HCa1	4	Citadel-walls	clubbed rim bowl	HI	red slip
133	Feldspar Andesite Loner			2	Citadel	thickened rim plate	HR	red slip
134	Dacite Group			4	Citadel	lamp		red
135	Carbonate Group: Subgroup B			4	Citadel	incised body sherd	P	red slip
136	Coarse Andesite Group	SGF029	LCa3	4	Citadel	rolled rim cooking pot	HI	brown slip
137	Serpentinite Group			2	Citadel-walls	ledge rim plate	HR	red slip
138	Andesite Calcareous Group: Subgroup A			5	Citadel	simple everted rim jar		grey-eroded
139	Andesite Calcareous Group: Subgroup C			5	Citadel	rolled rim jar		tan slip
140	Serpentinite Group			2	Citadel	thickened rim plate		red slip
141	Serpentinite Group			2	Citadel	lid		red slip
142	Glassy Andesite Loner			5	Citadel	simple everted rim jar	HI	brown slip
143	Coarse Andesite Group	SGF030	LCa2	4	Citadel	rolled rim cooking pot	HI	brown slip
144	Coarse Andesite Group			4	Citadel	rolled rim cooking pot	HI	brown slip
145	Andesite Calcareous Group: Subgroup B	SGF031	HCa1	4	Citadel	clubbed rim bowl		buff-eroded
146	Andesite Calcareous Group: Subgroup B			5	Citadel	rolled rim jar		black slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
147	Andesite Calcareous Group: Subgroup B			5	Citadel	simple vertical rim bowl		grey slip
148	Andesite Calcareous Group: Subgroup B			5	Citadel	carinated bowl	HI	grey slip
149	Andesite Calcareous Group: Subgroup B			5	Citadel	rolled rim jar		grey slip
150	Serpentinite Group			2	Citadel	simple rim bowl		red slip
151	Andesite Calcareous Group: Subgroup C			5	Citadel	rolled rim jar		grey slip
152	Serpentinite Group			2	Citadel	lid		red slip
153	Andesite Calcareous Group: Subgroup A			5	Citadel	carinated bowl		grey slip
154	Carbonate Group: Subgroup B	SGF032	LCa2	4	Citadel	incised club rim bowl	HR	red slip
155	Andesite Calcareous Group: Subgroup A			2	Citadel	simple rim bowl		red slip
157	Trachyandesite Group	SGF033	HCa4	4	Citadel	storage jar		buff
158	Trachyandesite Group	SGF034	HCa4	4	Houses	storage jar		buff
159	Andesite Calcareous Group: Subgroup B			5	Şərur survey	incised body sherd		grey slip
160	Andesite Calcareous Group: Subgroup A			2	Citadel	storage jar		buff
161	Andesite Calcareous Group: Subgroup A			2	Citadel	storage jar		buff

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
162	Andesite Calcareous Group: Subgroup A			2	Citadel-walls	storage jar		buff slip
163	Andesite Calcareous Group: Subgroup B			5	Citadel	rolled rim jar		grey
164	Andesite Calcareous Group: Subgroup A			5	Şərur survey	incised body sherd		grey-eroded
165	Andesite Calcareous Group: Subgroup A			5	Şərur survey	incised body sherd		grey-eroded
166	Andesite Calcareous Group: Subgroup C			5	Şərur survey	incised body sherd		grey-eroded
167	Andesite Calcareous Group: Subgroup C			5	Şərur survey	incised body sherd		grey-eroded
168	Andesite Calcareous Group: Subgroup A			5	Şərur survey	incised body sherd		grey-eroded
169	Andesite Calcareous Group: Subgroup C	SGF035	HCa1	4	Citadel	clubbed rim bowl	HI	tan grey slip
170	Micritic Carbonate Loner	SGF036	Hca unassigned	4	Citadel	clubbed rim bowl	HI	tan grey slip
171	Andesite Calcareous Group: Subgroup B			2	Citadel	clubbed rim bowl		buff slip
172	Andesite Calcareous Group: Subgroup B			2	Citadel-surface	clubbed rim bowl		buff slip
173	Andesite Calcareous Group: Subgroup A			2	Citadel-walls	thickened rim plate		red slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
174	Andesitic Sand Pair	SGF037	LCa1	4	Citadel	carinated bowl		black slip
175	Rhyolite Group			4	Citadel	simple everted rim jar		brown slip
176	Rhyolite Group			4	Houses	rolled rim cooking pot		brown slip
177	Carbonate Group: Subgroup A	SGF038	Hca unassigned	4	Citadel	rolled rim cooking pot		pink slip
178	Fine Glassy Andesite Group	SGF039	LCa1	4	Citadel	carinated bowl	HR	brown grey slip
179	Fine Glassy Andesite Group	SGF040	LCa1	4	Citadel	thick rim bowl	P	brown slip
180	Andesite Calcareous Group: Subgroup B	SGF041	HCa1	4	Citadel	clubbed rim bowl	HI	brown slip
181	Andesitic Sand Pair	SGF042	LCa1	4	Citadel	carinated bowl	P	brown grey slip
182	Dacite Group	SGF043	LCa1	4	Citadel	carinated bowl		black slip
183	Andesite Calcareous Group: Subgroup B			4	Citadel	clubbed rim bowl	HI	brown slip
184	Fine Glassy Volcanic Group			4	Citadel	carinated bowl	P	grey slip
185	Andesite Calcareous Group: Subgroup A			4	Citadel	carinated bowl	HI	brown slip
186	Coarse Andesite Group	SGF044	LCa3	4	Citadel	thick rim bowl	HI	grey slip
187	Fine Glassy Andesite Group	SGF045	LCa1	4	Citadel	thick rim bowl	P	brown slip
188	Fine Glassy Andesite Group	SGF046	LCa1	4	Citadel	carinated bowl	P	brown grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
189	Dacite Group	SGF047	LCa1	4	Citadel	carinated bowl	HI	brown grey slip
190	Volcanic Conglomerate Loner	SGF048	Hca unassigned	4	Citadel	rolled rim cooking pot		brown slip
191	Rhyolite Group	SGF049	LCa1	4	Citadel	thick rim bowl	P	brown grey slip
192	Andesite Calcareous Group: Subgroup A	SGF050	HCa2	4	Citadel	carinated bowl		grey slip
193	Andesite Calcareous Group: Subgroup B	SGF051	HCa1	4	Citadel	carinated bowl	P	brown grey slip
194	Andesite Calcareous Group: Subgroup A	SGF052	HCa1	4	Citadel	clubbed rim bowl		brown grey slip
195	Dacite Group	SGF053	LCa1	4	Citadel	carinated bowl	P	brown grey slip
196	Rhyolite Group	SGF054	LCa1	4	Citadel	thick rim bowl	P	brown grey slip
197	Rhyolite Group	SGF055	LCa1	4	Citadel	carinated bowl	P	brown grey slip
198	Fine Glassy Andesite Group	SGF056	LCa1	4	Citadel	carinated bowl	P	brown grey slip
199	Rhyolite Group	SGF057	LCa1	4	Citadel	clubbed rim bowl	P	brown grey slip
200	Rhyolite Group	SGF058	LCa1	4	Citadel	thick rim bowl	HI	grey slip
201	Serpentinite Group			2	Citadel	rolled rim jar		red slip
202	Andesite Calcareous Group: Subgroup C	SGF059	Hca unassigned	4	Citadel	rolled rim jar		tan slip
203	Andesite Calcareous Group: Sub. B	SGF060	HCa1	4	Citadel	simple everted rim jar		brown grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
204	Andesite Calcareous Group: Subgroup C			4	Citadel	simple everted rim jar		brown slip
205	Andesite Calcareous Group: Subgroup B	SGF062	HCa1	4	Citadel	simple everted rim jar	HI	brown slip
206	Rhyolite Group			4	Citadel	simple everted rim cooking pot	HI	brown grey slip
207	Andesite Calcareous Group: Subgroup B	SGF063	HCa1	4	Citadel	vertical indented bowl		brown grey slip
208	Andesite Calcareous Group: Subgroup A			4	Citadel	pointed rim bowl		tan slip
209	Andesite Calcareous Group: Subgroup A	SGF064	HCa1	4	Citadel	indented rim bowl		grey slip
210	Andesite Calcareous Group: Subgroup B	SGF065	HCa1	4	Citadel	clubbed rim bowl	HR	tan slip
211	Andesite Calcareous Group: Subgroup C			4	Citadel	rolled rim jar		tan slip
212	Fine Glassy Andesite Group			4	Citadel	carinated bowl		brown grey slip
213	Andesite Calcareous Group: Subgroup A	SGF067	HCa1	4	Citadel	pointed rim bowl		brown slip
214	Andesite Calcareous Group: Subgroup B	SGF068	HCa1	4	Citadel	carinated bowl		brown grey slip
215	Serpentinite Group			2	Citadel	simple rim bowl	HR	red slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
216	Serpentinite Group			2	Citadel	simple rim bowl		red slip
217	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl		red slip
218	Serpentinite Group			2	Citadel	simple rim bowl	HR	red slip
220	Serpentinite Group			2	Citadel	ledge rim plate	HR	red slip
221	Coarse Andesite Group			2	Houses	simple rim bowl	HR	red slip
222	Serpentinite Group			2	Citadel	simple rim bowl	HR	red slip
223	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl	HI	red slip
224	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl		red slip
225	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl	HI	red slip
226	Serpentinite Group			2	Citadel	ledge rim plate	HR	red slip
227	Serpentinite Group			2	Citadel	ledge rim plate	HR	red slip
228	Serpentinite Group			2	Citadel	simple rim bowl	HR	red slip
229	Serpentinite Group			2	Citadel	ledge rim plate	HR	red slip
230	Andesite Calcareous Group: Subgroup A			2	Houses	ledge rim bowl		red slip
231	Serpentinite Group			2	Citadel	ledge rim plate		red slip
232	Dacite Group			4	Citadel	carinated bowl	HR	black slip
233	Serpentinite Group			2	Citadel	simple rim bowl	HR	red slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
234	Andesite Calcareous Group: Subgroup A			2	Citadel	simple rim bowl	HR	red slip
235	Serpentinite Group			2	Citadel	carinated bowl	HR	red slip
236	Serpentinite Group			2	Citadel	thickened rim plate	HR	red slip
237	Andesite Calcareous Group: Subgroup A			2	Citadel	rolled rim cooking pot	HI	brown slip
238	Serpentinite Group			2	Citadel	ledge rim plate	HR	red slip
239	Andesite Calcareous Group: Subgroup B			5	Citadel	simple everted rim jar		grey slip
240	Andesite Calcareous Group: Subgroup B			5	Citadel	simple everted rim jar		pink slip
241	Andesite Calcareous Group: Subgroup C			5	Citadel	rolled rim jar	HI	grey
242	Andesite Calcareous Group: Subgroup C			5	Citadel	simple everted rim jar		brown slip
243	Andesite Calcareous Group: Subgroup B			5	Citadel	simple rim plate		tan slip
244	Andesite Calcareous Group: Subgroup B			5	Citadel	rolled rim jar	V	grey
245	Andesite Calcareous Group: Subgroup C			5	Citadel	rolled rim jar		pink slip
246	Andesite Calcareous Group: Subgroup C			5	Citadel	indented rim bowl		grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
247	Mafic Volcanic Loner			5	Citadel	simple everted rim jar		brown slip
248	Andesite Calcareous Group: Subgroup B			5	Citadel	simple everted rim jar		grey slip
249	Andesite Calcareous Group: Subgroup B			5	Citadel	simple vertical rim bowl	HI	grey slip
250	Andesite Calcareous Group: Subgroup B			5	Citadel	simple vertical rim bowl		brown grey slip
251	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	storage jar		grey slip
252	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	storage jar		red slip
253	Andesite Calcareous Group: Subgroup B			5	Sederek settlement	storage jar	HI	buff slip
254	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	indented rim bowl		grey-eroded
255	Andesite Calcareous Group: Subgroup B			5	Sederek settlement	rolled rim jar		grey-eroded
256	Andesite Calcareous Group: Subgroup B			5	Sederek settlement	indented rim bowl		grey slip
257	Andesite Calcareous Group: Subgroup C			5	Sederek settlement	rolled rim jar		brown-eroded
258	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	simple everted rim jar		grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
259	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	simple vertical rim bowl		grey slip
260	Andesite Calcareous Group: Subgroup B			5	Sederek settlement	carinated bowl		grey slip
261	Andesite Calcareous Group: Subgroup B			5	Sederek settlement	rolled rim jar		grey slip
262	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	simple vertical rim bowl		grey slip
263	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	simple everted rim jar	HI	grey slip
264	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	simple everted rim jar		grey slip
265	Andesite Calcareous Group: Subgroup C			5	Sederek settlement	rolled rim jar		brown slip
266	Andesite Calcareous Group: Subgroup B			5	Sederek settlement	simple rim bowl	P	brown slip
267	Andesite Calcareous Group: Subgroup B			5	Sederek settlement	simple vertical rim bowl		grey slip
269	Andesite Calcareous Group: Subgroup C			5	Sederek settlement	rolled rim jar		brown-eroded
270	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	clubbed rim bowl		grey-eroded

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
271	Andesite Calcareous Group: Subgroup A			4	Sederek settle-ment	rolled rim jar		buff-eroded
272	Andesite Calcareous Group: Subgroup A	SGF069	HCa2	4	Sederek settle-ment	clubbed rim bowl		buff-eroded
273	Andesite Calcareous Group: Subgroup B			4	Sederek settle-ment	rolled rim jar		brown-eroded
274	Andesite Calcareous Group: Subgroup A			4	Sederek settle-ment	rolled rim jar		red slip
275	Andesite Calcareous Group: Subgroup C	SGF070	Hca unassigned	4	Sederek settle-ment	rolled rim jar		pink-eroded
277	Andesite Calcareous Group: Subgroup B	SGF071	HCa2	4	Sederek settle-ment	simple rim bowl	HI	red slip
278	Andesite Calcareous Group: Subgroup A	SGF072	HCa1	4	Sederek settle-ment	rolled rim jar	HI	red slip
279	Andesite Calcareous Group: Subgroup B			4	Sederek settle-ment	vertical indented bowl		brown slip
280	Andesite Calcareous Group: Subgroup B	SGF073	HCa1	4	Sederek settle-ment	clubbed rim bowl		pink slip
281	Andesite Calcareous Group: Subgroup B	SGF061	HCa2	4	Sederek settle-ment	simple rim bowl	HI	red slip
282	Andesite Calcareous Group: Subgroup A	SGF074	HCa2	4	Sederek settle-ment	simple everted rim jar		brown slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
283	Andesite Calcareous Group: Subgroup B	SGF075	HCa2	4	Sederek settlement	carinated incised bowl		red slip
284	Andesite Calcareous Group: Subgroup A			5	Sederek settlement	simple everted rim jar		brown-eroded
285	Andesite Calcareous Group: Subgroup B	SGF076	HCa2	4	Sederek settlement	simple rim bowl		red slip
286	Andesite Calcareous Group: Subgroup C	SGF077	HCa1	4	Sederek settlement	thick rim bowl		brown-eroded
287	Andesite Calcareous Group: Subgroup C			5	Sederek settlement	rolled rim jar		buff slip
289	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl		tan slip
290	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl		pink-eroded
291	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl	HI	tan slip
292	Serpentinite Group			2	Houses	thickened rim plate		red slip
293	Serpentinite Group			2	Houses	simple rim bowl	HR	red slip
294	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl	HR	red slip
295	Serpentinite Group			2	Houses	thickened rim plate	HR	red slip
296	Andesite Calcareous Group: Subgroup A			2	Houses	simple rim bowl	HR	red slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
297	Serpentinite Group			2	Houses	thickened rim plate		red slip
298	Serpentinite Group			2	Houses	thickened rim plate	H	red slip
299	Serpentinite Group			2	Houses	simple rim bowl	HR	red slip
300	Andesite Calcareous Group: Subgroup A			4	Sederek settle-ment	rolled rim jar		buff-eroded
301	Andesite Calcareous Group: Subgroup B			4	Sederek settle-ment	clubbed rim bowl		pink-eroded
302	Andesite Calcareous Group: Subgroup B			4	Sederek settle-ment	thick rim bowl		grey slip
303	Andesite Calcareous Group: Subgroup A			4	Sederek settle-ment	simple rim bowl		red slip
304	Andesite Calcareous Group: Subgroup B			4	Sederek-qala	simple rim bowl	HI/V	brown slip
305	Sandstone Rhyolite Loner			4	Sederek-qala	hole mouth jar		brown-eroded
306	Andesite Calcareous Group: Subgroup A			4	Sederek-qala	simple rim bowl	HI	brown slip
307	Andesite Calcareous Group: Subgroup A			4	Sederek-qala	carinated bowl	HI	brown slip
308	Andesite Calcareous Group: Subgroup B			5	Sederek-qala	rolled rim jar	P	grey slip
309	Andesite Calcareous Group: Subgroup A			5	Sederek-qala	indented rim bowl		grey slip

Pet. ID	Petrofabric	NAA ID	NAA Group	Period	Context	Form	Burnish Stroke	Ext. Finish
310	Andesite Calcareous Group: Subgroup A			5	Sederek-qala	simple rim plate	HI	grey slip
311	Andesite Calcareous Group: Subgroup B			5	Sederek-qala	rolled rim jar		grey slip

APPENDIX C: Geological Sample Descriptions

Geo ID	**NAA ID**	**Location**	**Field soil test**	**Context**	**Ground mass**	**modality/ sorting/ grain size**	**Coarse fraction (most -> least prevelent)**	**Fine fraction (most->least prevelent)**	**Firing temp. (C°)**	**Comments**
Geo 1	n/a	Oglanqala	n/a	mud brick wall	brown (PPL)/ light brown (XPL)/ optically active	unimodal/ very poorly sorted/ >16 mm, mode 1.08 mm	micrtic carbonate, sr; sparitic carbonate, sr; volcanic glass (rare), sa	quartz, sr; orthoclase, sr; plagioclase, sr; pyroxene, sr	not fired	grain suspension
Geo 2.1	n/a	Oglanqala	silty clay	1.5 m bs, IA kurgan	orange brown (PPL/ XPL), optically active	unimodal/ very well sorted/ <0.72 mm, mode 0.2 mm	Micritic carbonate, sr-r; acidic volcanic, sr; quartz, sr; biotite, sa; plagioclase, sr	Micritic carbonate, sr-r; acidic volcanic, sr; quartz, sr; biotite, sa; plagioclase, sr	500˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<2.12 mm) common throughout ground mass. All sample 2 descriptions based on 2b, except for ground mass
Geo 2.2	SGF 001	Oglanqala	silty clay	1.5 m bs, IA kurgan	orange brown (PPL/XPL), optically active	unimodal/ very well sorted/ <0.72 mm, mode 0.2 mm	Micritic carbonate, sr-r; acidic volcanic, sr; quartz, sr; biotite, sa; plagioclase, sr	Micritic carbonate, sr-r; acidic volcanic, sr; quartz, sr; biotite, sa; plagioclase, sr	700˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<2.12 mm) common throughout groundmass. All sample 2 descriptions based on 2b, except for ground mass

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 2.3	n/a	Oglanqala	silty clay	1.5 m bs, IA kurgan	red (PPL/XPL), low optical activity	unimodal/ very well sorted/ <0.72 mm, mode 0.2 mm	acidic volcanic, sr; quartz, sr; biotite, sa; plagioclase, sr	acidic volcanic, sr; quartz, sr; biotite, sa; plagioclase, sr	900˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<2.12 mm) common throughout ground mass. Description based on 2B; 2A and 2C altered for ground mass and inclusions
Geo 3.1	n/a	Oglanqala		canal nw Oglan-qala	light orange brown (PPL/XPL), optically active	unimodal/ very well sorted/ <0.6 mm, mode 0.2 mm	volcanic sandstone with carbonate cement, sr; quartz, sa; acidic volcanic, sr; micritic carbonate, r; orthoclase, sr; chert, sr; plagioclase, sr; pyroxene, sr; microcline, sr	quartz, sa; acidic volcanic, sr; micritic carbonate, r; k-feldspr, sr; chert, sr; plagioclase, sr; pyroxene, sr	500˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<1.34 mm) common throughout ground mass. Description based on 3B; 3A and 3C altered for ground mass and inclusions

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 3.2	n/a	Oglanqala		canal nw Oglan-qala	orange brown (PPL/XPL), optically active	unimodal/ very well sorted/ <0.6 mm, mode 0.2 mm	volcanic sandstone with carbonate cement, sr; quartz, sa; acidic volcanic, sr; micritic carbonate, r; orthoclase, sr; chert, sr; plagioclase, sr; pyroxene, sr; microcline, sr	quartz, sa; acidic volcanic, sr; micritic carbonate, r; k-feldspr, sr; chert, sr; plagioclase, sr; pyroxene, sr	700˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<1.34 mm) common throughout ground mass. Description based on 3B; 3A and 3C altered for ground mass and inclusions
Geo 3.3	n/a	Oglanqala		canal nw Oglan-qala	red (PPL/XPL), low optical active	unimodal/ very well sorted/ <0.6 mm, mode 0.2 mm	quartz, sa; acidic volcanic, sr; orthoclase, sr; chert, sr; plagioclase, sr; pyroxene, sr; microcline, sr	quartz, sa; acidic volcanic, sr:k-feldspr, sr; chert, sr; plagioclase, sr; pyroxene, sr	900˚C	Higher optical densiity, brown, round, clear-diffuse pellets (0.76 mm) common throughout groundmass. Description based on 4B; 4A and 4C altered for groundmass and inclusions IDs

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 4.1	n/a	Oglanqala	silty clay	canal nw Oglanqala	light orange brown (PPL/XPL), optically active	unimodal/ very well sorted/ <1.12 mm, mode 0.28 mm	quartz, sr-sa; micrtic carbonate, sr; volcanic, sr; plagioclase, sr; orthoclase, sr; sandstone, sr; amphibole, sr	quartz, sr-sa; micrtic carbonate, sr; volcanic, sr; plagioclase, sr; orthoclase, sr; amphibole, sr	700˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<0.76 mm) common throughout groundmass. Description based on 3B; 3A and 3C altered for ground mass and inclusions
Geo 4.2	n/a	Oglanqala	silty clay	canal nw Oglanqala	orange brown (PPL/XPL), optically active	unimodal/ very well sorted/ <1.12 mm, mode 0.28 mm	quartz, sr-sa; micrtic carbonate, sr; volcanic, sr; plagioclase, sr; orthoclase, sr; volcanic conglomerate, sr; amphibole, sr	quartz, sr-sa; micrtic carbonate, sr; volcanic, sr; plagioclase, sr; orthoclase, sr; amphibole, sr	700˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<1.34 mm) common throughout groundmass. Description based on 3B; 3A and 3C altered for groundmass and inclusions

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 4.3	n/a	Oglanqala	silty clay	canal nw Oglanqala	red brown (PPL/ XPL), low optical active	unimodal/ very well sorted/ <1.12 mm, mode 0.28 mm	quartz, sr-sa; volcanic, sr; plagioclase, sr; pyroxene, sa; orthoclase, sr; volcanic conglomerate, sr; amphibole, sr	quartz, sr-sa; micrtic carbonate, sr; volcanic, sr; plagioclase, sr; orthoclase, sr; amphibole, sr	900˚C	Higher optical densiity, brown, round, clear-diffuse pellets (<0.76 mm) common throughout ground mass. Description based on 3B; 3A and 3C altered for ground mass and inclusions
Geo 13.1	n/a	Oglanqala	silty sand	Arpa river-bed adjacent /flood plain	light brown (PPL), yellow brown (XPL), optically active	unimodal/ poorly sorted/ <11.2 mm, mode 1.92 mm	andesite w/ pyroxene, plagioclase, k-feldspar, amphibole phenocrysts,sericite altered, sr; rhyo-dacite w/amphibole,biotite ,orthoclase, quartz phenocryst, sr; acidic volcanic, sr; micritic carbonate, sr; fossiliferous/sparitic/siliceous carbonate, sr; siltstone, sa-sr; pryoxene, sr; plagioclase, sa; quartz, sr; pitchstonew/ pyroxene, feldspar phenocryst, sr; chert, sr; amphibole, sr; muscovite, sa	volcanics, sr; carbonate, sr; pryoxene, sr; plagioclase, sa; quartz, sr; glass, sa; chert, sr; amphibole, sr; muscovite, sa	500˚C	fairly even mix of inclusion types, lots of sericitization. Based on 13B description, just altered ground mass for diff firing temp

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 13.2	n/a	Oglanqala	silty sand	Arpa riverbed adjacent/ floodplain	brown (PPL/ XPL), optically active	unimodal/ poorly sorted/ <11.2 mm, mode 1.92 mm	andesite w/ pyroxene, plagioclase, k-feldspar, amphibole phenocrysts, often highly sericite altered, sr; rhyodacite w/ amphibole, biotite, orthoclase, and quartz phenocrysts, sr; acidic volcanic (rhyolite? No mafics), sr; micritic carbonate, sr; fossiliferous/sparitic/siliceous carbonate, sr; siltstone, sa-sr; pryoxene, sr; plagioclase, sa; quartz, sr; pitchstone w/pyroxene and feldspar phenocrysts, sr; chert, sr; amphibole, sr; muscovite, sa	volcanics, sr; carbonate, sr; pryoxene, sr; plagioclase, sa; quartz, sr; glass, sa; chert, sr; amphibole, sr; muscovite, sa	700˚C	fairly even mix of inclusion types, lots of sericitization

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most ->least prevelent)	Firing temp. (C°)	Comments
Geo 14	n/a	Oglanqala	sandy gravel	Arpa riverbed	n/a	unimodal/ very poorly sorted/ <22 mm, mode 4.92 mm	andesite w/ plagioclase, pyroxene, biotite, amphibole, and rare olivine phenocryts, sr; interbedded fossilerous, sparitic, micritic, and siliceous carbonate, r; sandstone with carbonate and/or clay cement, sr; chert, sr; pyroxene, sr; quartz, sa; plagioclase, sa	n/a	grain suspension	
Geo 15	SGF 002	Sederek settlement	clayey loam	ground?	brown (PPL)/ light brown (XPL)/ optically active	bimodal/ poorly sorted/ <5.28 mm, mode 1.12 mm	micritic carbonate with rare chert, sa-sr; sparitic carbonate, sa-sr; fossiliferous carbonate, sr; argillaceous rock fragment with high optical density, dark red with silt sized quartz inclusions, sa-sr; chert, sr; feldspar, sa-sr	micritic carbonate sr; sparitic carbonate, sa-sr; argillaceous rock fragment sa-sr; chert, sr; feldspar, sa-sr	700˚C	
Geo 19	n/a	Oglanqala	rock	basalt tepe			coarse balsatic andesite-diabase, acicular plagioclase (<0.68) with interstitial pyroxene			

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 20	n/a	Sederek-qala	sand	bulldozer cut		unimodal/ moderately well sorted/ <2.44 mm, mode 0.56 mm	intermediate volcanic with rare k-feldspar, plagioclase, and clino-pyroxene pheno-crysts, sr; plagioclase, sa-sr; k-feldspar, sa-sr; pyroxene, sa-sr;micritic carbonate, sr; sparitic carbonate, sr; grey-wacke, sr; quartz, sa; amphi-bole, sr		700˚C	
Geo 21	SGF 003	Sederek-qala	clayey silt	hillside	light brown (PPL/XPL), optically active	unimodal/ very poorly sorted/ <3.64, mode 0.6 mm	sparitic, micritic, siliceous, fossiliferous carbonate (predominant), sr-sa; quartz, sr; plagio-clase, sr; unidentifiable volcanic, sr; pyroxene (very rare),sr	carbonate, r; quartz, sr; orthoclase, sr; plagioclase, sr; volcanic, sr	700˚C	
Geo 23	SGF 004	Xalac	clay	large deposit adjacent to Araxes	Red (PPL/XPL), low optical activity	unimodal/ poorly sorted/ <6.16, mode 1.28 mm	highly sparitic altered volcanic, sr; micritic carbonate, sr; rhyolite, sr; quartz, sa	highly sparitic altered volcanic, sr; micritic carbonate, sr; rhyolite, sr; quartz, sa	700˚C	

Geo ID	**NAA ID**	**Location**	**Field soil test**	**Context**	**Ground mass**	**modality/ sorting/ grain size**	**Coarse fraction (most -> least prevelent)**	**Fine fraction (most->least prevelent)**	**Firing temp. (C°)**	**Comments**
Geo 24	n/a	Xalac	clayey loam	large deposit adjacent to Araxes	red brown (PPL/XPL), moderately optically active	unimodal/ poorly sorted/ <3.16 mm, mode 0.7 mm	highly sparitic altered volcanic, sr; argillaceous rock fragment- red, high optical density, fine sand sized feldspar inclusions, sr; micritic carbonate, sr; rhyolite, sr; quartz, sa	highly sparitic altered volcanic, sr; argillaceous rock fragment- red, high optical density, sr; micritic carbonate, sr; rhyolite, sr; quartz, sa	700˚C	
Geo 25	n/a	Xalac	clayey silt	irrigation canal	orange brown (PPL/XPL), optically active	unimodal/ well sorted/ <1.04 mm, mode 0.32 mm	felsic to intermediate volcanics, some sericite altered, sr; quartz, sa-sr; pryoxene, sr; orthoclase, sa-sr, plagioclase, sa-sr; micritic carbonate, sr	felsic to intermediate volcanics, some sericite altered, sr; quartz, sa-sr; pryoxene, sr; orthoclase, sa-sr, plagioclase, sa-sr; micritic carbonate, sr	700˚C	
Geo 26	n/a	Oguz Kand	silty sand	road cut		bimodal/ very poorly sorted/ <12 mm or 4.2 mm, mode 0.48 mm	sparitic carbonate, sr (dominant); micritic carbonate, sr (dominant); plagioclase, sa; orthoclase, sa-sr; quartz, sa-sr; unidentifiable volcanic, sr; pyroxene, sa-sr; biotite, sr	sparitic carbonate, sr (dominant); micritic carbonate, sr (dominant); plagioclase, sa; orthoclase, sa-sr; quartz, sa-sr; unidentifiable volcanic, sr; pyroxene, sa-sr; biotite, sr	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 28	SGF 005	Tanaman	clay	hillside	Red brown (PPL/XPL)/ optically active	unimodal/ moderately sorted/>3.12, mode 0.6 mm	sparitic carbonate, sr-sa; micritic carbonate, sr; sandstone (rare), sr	carbonate, r; quartz, sr; ortho-clase, sr; plagio-clase, sr; muscovite, sr	700˚C	
Geo 31	SGF 006	Tanaman	clayey loam	Jurrasic ridge	light brown (PPL/XPL), optically active	bimodal/ poorly sorted/ <3.92 mm, mode 1.28 mm	micritic carbonate (predominant), sa-sr; sparitic carbonate, sa-sr, sericite altered chert, sr	micritic carbonate (predominant), k-feldspar/quartz, sa-sr; sa-sr; sparitic carbonate, sa-sr	700˚C	
Geo 33	SGF 007	south of Tanaman	silty loam	road cut/alluvium	light brown (PPL/XPL), optically active	unimodal/ very poorly sorted/ <5.64 mm, mode 1.4 mm	micritic carbonate (dominant), sr; sparitic carbonate (dominant), sr; siliceous carbonate, sr; chert, sr; highly weathered volcanic, sr; quartz, sa-sr; k-feldspar, sa-sr	micritic carbonate, sr; quartz, sa-sr; k-feldspar, sa-sr; sparitic carbonate, sr; chert, sr; highly weathered volcanic, sr; quartz, sa-sr; k-feldspar, sa-sr	700˚C	
Geo 34	n/a	Axura	gravelly sand	Triassic ridge			Fossiliferous carbonate, sr; sparitic carbonate, sr; micritic carbonate, sr			grain mounted
Geo 36	SGF 008	Axura	clay	Triassic ridge	light brown (PPL/XPL), optically active	bimodal/ moderately well sorted/ <2.2 mm, mode 0.72 mm	micritic carbonate, often with diffuse boundaries, (predominant), sr-r; weathered volcanic (very rare),sr	micritic carbonate, r	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 37	n/a	Axura	clayey loam	Upper Triassic-hillside	orange brown (PPL/XPL), optically active	unimodal/ moderately well sorted/ <1.6 mm, mode 0.64 mm	acidic volcanic, equigranular and bimodal with k-feldspar phenocrysts, some seritization, sa-sr; k-feldspar, sa-sr; plagioclase, sa-sr; micritic carbonate, sr; microfossils (forminifera), r; greywacke, sr; quartz, sa; diabase, sr	acidic volcanicsa-sr; k-feldspar, sa-sr; plagioclase, sa-sr; micritic carbonate, sr; quartz, sa	700˚C	notable lack of mafics
Geo 40	SGF 009	Axura	clayey silt	trail cut	light brown (PPL/XPL), optically active	unimodal/ well sorted/ <0.88 mm, mode 0.28 mm	micritic carbonate (dominant), sr-r; k-feldspar, sr; chert, sr; quartz, sa-sr; biotite, sr	micritic carbondate (dominant), sr-r; k-feldspar/quartz, sr; chert, sr	700˚C	
Geo 41	n/a	Axura	silty sand	outcrop			micritic carbonate, sr-r; plagioclase, sa-sr; trachyandesite with uralized pryoxene and plagioclase phenocrysts; k-feldspar, sa-sr; amphibole, sr; pyroxene, sr; biotite, sr; quartz, sa			
Geo 43	n/a	Oglanqala	rock	outcrop by Arpachay			sandy tuff: medium to coarse sand sized quartz grains in glassy and fibrous silicate matrix			

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 44	n/a	Oglanqala	sand	outcrop by Arpachay		unimodal/ very poorly sorted/ <13 mm, mode 1.88 mm	sandstone (predominant): medium to coarse sand sized quartz grains in clay and fibrous silicate matrix, some muscovite present, sr; sandy tuff, sr; siltstone, sr; micritic carbonate, sr; quartz, sa; k-feldspar, sa-sr; sparitic carbonate, a; andesite, sr; pyroxene, sr			grain mounted
Geo 46	SGF 010	Xok	silty loam	bulldozer cut	brown (PPL/XPL), optically active	unimodal/ poorly sorted/ <5.76, mode 1.08 mm	micritic carbonate, sr-r; sparitic carbonate, sr-r; highly weathered volcanics, sr; chert, sr; k-feldspar, sa-sr; quartz, sa; plagioclase, sa-sr	micritic carbonate, sr-r; sparitic carbonate, sr-r; k-feldspar, sa-sr; quartz, sa; plagioclase, sa-sr; highly weathered volcanics, sr; chert, sr	700˚C	
Geo 47	n/a	Duz Dag	silty clay	bulldozer cut	orange brown (PPL), yellow brown (XPL), very optically active	unimodal/ moderately sorted/ <1.08 mm, mode 0.6 mm	chert, sr; micrtic carbonate, sr; quartz/k-feldspar, sa	cherty micrtic carbonate, sr; chert, sr; k-feldspar, sa		
Geo 48	SGF 011	Duz Dag	clay	hillside	light brown (PPL/XPL), optically active	unimodal/ very well sorted/ <0.36 mm, mode 0.16 mm	quartz, sa; micritic carbonate, sr; k-feldspar, sa-sr; chert, sr	quartz, sa; micritic carbonate, sr; k-feldspar, sa-sr; chert, sr	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 49	n/a	Batabat	clayey loam	road cut	dark brown (PPL/XPL), moderately optically active	unimodal/ poorly sorted/ <4.8 mm, mode 0.76 mm	andesite with pyroxene, amphibole, biotite, and plagioclase phenocrysts, sa-sr; plagioclase, sa-sr; pyroxene, sa-sr; amphibole, sa-sr; biotite, sa-sr; glass, sa	andesite, sa-sr; plagioclase, sa-sr; pyroxene, sa-sr; amphibole, sa-sr; biotite, sa-sr; glass, sa	700˚C	
Geo 53	n/a	Batabat	sandy gravel	mountain side			andesite with pyroxene, amphibole, biotite, and plagioclase phenocrysts, sa-sr			grain suspension
Geo 54	SGF 012	Batabat	silty clay	road cut	orange brown (PPL/XPL), optically active	unimodal/ moderately sorted/ <1.2 mm, mode 0.48 mm	andesite with proxene, amphibole, and plagioclase phenocrysts, sr; plagioclase, sa-sr; pyroxene, sr; k-feldspar, sa-sr; quartz, sa	plagioclase, sa-sr; k-feldspar, sa-sr; andesite sr; quartz, sa	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 55	n/a	Bianchak (south of Batabat)	clayey loam	riverbed	brown (PPL/XPL), optically active	unimodal/ poorly sorted/ <4.2 mm, mode 0.84 mm	andesite with amphibole, pyroxene, biotite, plagioclase, and k-feldspar phenocrysts, sa-sr; felsic volcanic with biotite, k-felspar, and amphibole phenocrysts, sa-sr; plagioclase, sa-sr; pyroxene, sa-sr; amphibole, sr; k-feldspar, sa-sr; biotite, sr; quartz, sa	plagioclase, sa-sr; volcanics, sa-sr; pyroxene, sa-sr; amphibole, sr; k-feldspar, sa-sr; biotite, sr; quartz, sa	700˚C	
Geo 56	SGF 013	Kolani	silty loam	road cut	brown (PPL/XPL), optically active	unimodal/ poorly sorted/ <2.6 mm, mode 1.0 mm	andesite, often highly weathered and sericite altered, sa-sr; calcaerous volcanic conglomerate, sr; plagioclase, sa-sr; k-feldspar, sa-sr; pyroxene, sa; micritic carbonate, sr; amphibole, sr; biotite, sr; quartz, sa	andesite, sr; plagioclase, sa-sr; k-feldspar, sa-sr; pyroxene, sa; micritic carbonate, sr; amphibole, sr; biotite, sr; quartz, sa	700˚C	
Geo 57	SGF 014	Daydadli/ Naxcivan chay	clay	riverbed	light brown (PPL/XPL), optically active	unimodal/ very well sorted/ <0.56, mode 0.15 mm	micritic carbonate, sr; chert, sr; quartz, sr	micritic carbonate, sr; chert, sr; quartz, sr	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 58	n/a	Milakh	silty sand	Stream-bed			Rhyolite, sr; calcareous arkose, sr; micritic carbonate, r; k-feldspar, sa-sr; quartz, sa-sr; plagioclase, sa-sr; pyroxene, sr			
Geo 59	n/a	Milakh	silty sand	outcrop			Volcanic comglomerate composed of acidic volcanic, k-feldspar, plagioclase, quartz, carbonate, and fibrous silicate, sa-sr			grain suspension
Geo 60	SGF 015	Alincr Chay/ Milakh	silty loam	riverbed	brown (PPL/XPL), optically active	unimodal/ poorly sorted/ <3.92, mode 0.56 mm	siltstone with quartz, micro-fossil, and carbonate inclusions, sr; felsic to intermediate volcanic, sr; volcanic conglomerate, sr; k-feldspar, sa-sr; plagioclase, sa-sr; pyroxene, sa-sr;micritic carbonate, sr; biotite, sr; quartz, sa	k-feldspar, sa-sr; plagioclase, sa-sr; pyroxene, sa-sr; micritic carbonate, sr; volcanic, sr; biotite, sr; quartz, sa	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 61	SGF 016	Alincr Chay/ Milakh	silty loam	riverbed	brown (PPL/XPL), optically active	unimodal/ very poorly sorted/ <3.18 mm, mode 0.84 mm	Volcanic comglomerate composed of acidic volcanic, k-feldspar, plagioclase, quartz, and carbonate, sa-sr; siltstone, sa-sr; sparitic carbonate, sa-sr;micritic carbonate, sa-sr; chert, sa; volcanic, sr; k-feldspar, sa-sr; quartz, sa-sr	siltstone, sa-sr; sparitic carbonate, sa-sr; micritic carbonate, sa-sr; chert, sa; volcanic, sr; k-feldspar, sa-sr; quartz, sa-sr	700˚C	
Geo 63	n/a	Elinceqala	silty sand	ground			balsalt with pyroxenes almost completely replaced by biotite (uralization), plagioclase, and rare olivine phenocrysts; possible some actual rhyolite present, sa-sr; plagioclase, sa; quartz, sa-sr; siliceous carbonate, sr; volcanoclastic greywacke, sa			grain suspension
Geo 66	SGF 017	Nehram	silty clay	bulldozer cut	Red brown (PPL/XPL)/ optically active	unimodal/ very poorly sorted/ <4.08 mm, mode 1.08 mm	Highly sparitic altered volcanic, sr; andesite, sr; chert, sr; pyroxene, sr; polycrystalline quartz, sr; quartz, sr, plagioclase, sr	Highly sparitic altered volcanic, sr; volcanic, sr; chert, sr; pyroxene, sr; quartz, sr, plagioclase, sr	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 68	n/a	Nehram	silty clay	Stream-bed	light brown (PPL/XPL), optically active	unimodal/ poorly sorted/ <3.44 mm, mode 0.48 mm	foraminifera, r; micritic carbonate, sa-sr; sparitic carbonate w/polycrystalline quartz and feldspar inclusions, sa-sr; highly sericite altered polycrytalline k-feldpar, sa-sr; sandstone, sr; quartz, sa; k-feldspar, sa	micritic carbonate, sa-sr; sparitic carbonate, sa-sr; quartz, sa; k-feldspar, sa	700˚C	
Geo 69	n/a	Paraga	silty sand	hillside			tuff conglomerate with andesite, pyroxene, carbonate, and feldspar inclusions, sa-sr; andesite (with rare serpenitinization), sa-sr; micrtic carbonate, sr; plagioclase, sa; k-feldspar, sa; quartz, sa			grain suspension

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 70	n/a	Paraga	sand	hillside flood channel			basaltic andesite (predominant) with some mafics showing evidence of sperpentinization, sr; metamorposed sparitic carbonate sr-r; micritic carbonate, r; pyroxene, sa; plagioclase, sa; serpentinite, r			grain suspension
Geo 72	SGF 018	Paraga	clayey loam	road cut	brown (PPL/XPL), optically active	unimodal/ very poorly sorted/ <			700˚C	
Geo 72	n/a	Paraga	clayey loam	road cut	brown (PPL/XPL), optically active	unimodal/ poorly sorted/ <3.28 mm, mode 0.56 mm	felsic to intermediate volcanics, often highly sericite altered, primarily composed of k-feldspar with rare pyroxene phenocrysts, sa-sr; k-feldspar, sa-sr; pyroxene, sr; plagioclase, sa-sr; quartz, sa	k-feldspar, sa-sr; volcanics, sr; pyroxene, sr; plagioclase, sa-sr; quartz, sa	700˚C	
Geo 73	n/a	Paraga	silty sand	hillside			rhyolite (predominant) with k-feldspar, quartz, and rare carbonate phenocrysts, sa-sr; k-feldspar, sa-sr; quartz, sa-sr			grain suspension

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 74	n/a	Paraga	silty sand	dried stream-bed			sandstone with quartz inclusions in carbonate cement, sr; andesite, sr; basalt, sr; diorite, sr; quartz, sa; micritic carbonate, sr; plagioclase, sa-sr; k-feldspar, sa-sr			grain suspension
Geo 75	n/a	Kotom	silty sand	hillside			Sandstone conglomerate with quartz, feldspar, volcanic, carbonate, microfossils, and chert inclusions in carbonate cement, in varying proportions, sr; muddy, siliceous carbonate, sr; quartz, sa; orthoclase, sa			grain suspension
Geo 76	SGF 019	Kotom	clayey loam	dried stream-bed	light brown (PPL), yellow brown (XPL), optically active	unimodal/ poorly sorted/ 3.68 mm, mode 0.8 mm	micritic carbonate, sr; sparitic carbonate, sr; felsic volcanic, sa-sr; chert, sa-sr; quartz, sa-sr; k-feldspar, sa-sr; glass, sr	quartz, sa-sr; k-feldspar, sa-sr; micritic carbonate, sr; sparitic carbonate, sr; felsic volcanic, sa-sr; chert, sa-sr; glass, sr		

Geo ID	**NAA ID**	**Location**	**Field soil test**	**Context**	**Ground mass**	**modality/ sorting/ grain size**	**Coarse fraction (most -> least prevelent)**	**Fine fraction (most->least prevelent)**	**Firing temp. (C°)**	**Comments**
Geo 78	n/a	Kotom	silty sand	hillside			siltstone conclomerate with quartz, feldspar, volcanic, carbonate, chert, and muscovite inclusions, sr; sandy tuff, sr; sparitic carbonate with contact metamorphism, sr; micritic carbonate with silt sized quartz, sr; rhyolite, sa-sr			grain suspension
Geo 79	n/a	Kotom	silty sand	stream bed			micritic carbonate, sr-r; sparitic carbonate, sr; quartz, sa; k-feldspar, sa-sr; coarse, equigranular andesite with pyroxene, sa-sr; pyroxene, sr; amphibole, sr; biotite, sr; epidote, sr			grain suspension

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 80	n/a	Genze	sandy gravel	mountain side			siltstone, some laminated (slate) with high carbonate content in groundmass, micritic carbonate, foraminifera microfossil, quartz, and feldspar, sa-sr; k-feldspar and quartz granite, carbonate altered, sr			grain suspension
Geo 82	SGF 020	Diza/ Ovucular tepe	silty loam	road cut	orange brown (PPL/XPL), optically active	unimodal/ very poorly sorted/ <4.6 mm, mode 0.64 mm	andesite with pyroxene and and plagioclase phenocryts; sr; micritic carbonate, sr; sparitic carbonate, sr; sand-stone with clay cement, sr; pyroxene, sa-sr; felsic volcanic, sr; plagioclase, sa-sr; ortho-clase, sa-sr; quartz, sr; siliceous carbonate, sr	quartz, sa; carbonate, sr; volcanic, sr; plagioclase, sa-sr; pyroxene, sa-sr; orthoclase, sa-sr	700˚C	

Geo ID	NAA ID	Location	Field soil test	Context	Ground mass	modality/ sorting/ grain size	Coarse fraction (most -> least prevelent)	Fine fraction (most->least prevelent)	Firing temp. (C°)	Comments
Geo 83	n/a	Oglanqala	sand	base of qara tepe			siltstone, some laminated (slate) with high carbonate content in groundmass, quartz, and feldspar inclusions, sa-sr; micritic carbonate with sparite and microfossil inclusions, sr; felsic volcanic, sr; chert, sr; pyroxene, sr; polycrystalline quartz, sr			

APPENDIX D: Petrographic Long Form Descriptions

Petrofabrics description are listed in the same order as they appear in Chapter 5.

Early Iron Age/Period 5

Andesite Calcareous Group

Calcareous clay with andesite, micritic carbonate, and mixed volcanic sand inclusions
n=169

The microstructure, groundmass, and inclusions will be described separately for each subgroup, with the mineral descriptions of the entire Andesite Calcareous group described together.

Subgroup A- Coarse

n=80; samples: 2, 4, 10, 15, 17, 21, 29, 31, 37, 38, 42, 48, 49, 54, 60, 63, 69, 74, 75, 80, 86, 98, 101, 102, 109, 112, 116, 121, 122, 126, 132, 138, 153, 155, 160-162, 164, 165, 168, 173, 185, 192, 194, 208, 209, 213, 217, 223, 224, 225, 230, 234, 237, 251, 252, 254, 258, 259, 262-264, 270-272, 274, 278, 282, 289-291, 294, 296, 300, 303, 306, 309, 310

Microstructure

Frequent-rare meso vughs, frequent-rare micro vughs, frequent-very rare meso-planar, common-absent macro-planar, rare-absent macro vughs, very rare-absent chamber. PRD is close to double spaced (more single than double, but some areas with fewer inclusions). Inclusions are not oriented for most samples, though a few samples contain inclusions that are oriented parallel with the vessel walls (74, 234, 282). The planar voids display mostly some orientation parallel with the vessel walls (except for 10, planar voids perpendicular to vessel walls).

Groundmass

Very heterogenous between samples and within single samples. This group displays some low optical activity (samples 2, 17, 29, 60, 63, 98, 109, 121, 155, 161, 252, 272, 278, 284 highly oxidized, samples 74, 75, 138, 263, 270 highly reducing) but mostly moderate to high optical activity. In PPL the clay matrix is brown, red brown, yellow brown and/or dark brown and in XPL it is orange brown, red brown, yellow brown, brown and/or dark brown (40x). B-fabrics can include: cystallitic, mosaic speckled, granostriated, porostriated, and random striated.

Inclusions

$c:f:v_{0.125mm}$ 15:80:5 - 20:72:8

The inclusions are mostly poorly sorted, though some are moderately sorted or moderately well sorted. Inclusions are mostly unevenly distributed throughout the fabric. <1.6 mm, mode, 0.37 mm, sa-r.

Subgroup B- Open Space

n=56; samples: 3, 39, 53, 70, 79, 82, 88, 89, 91, 99, 103, 114, 118, 145-149, 159, 163, 171, 172, 180, 183, 193, 203, 205, 207, 210, 214, 239, 240, 243, 244, 248-250, 253, 255, 256, 260, 261, 266, 267, 273, 277, 279-281, 283, 285, 301, 302, 304, 308, 311

Microstructure

Dominant-frequent micro vughs, frequent- rare meso vughs, common-very rare meso-planar voids, common-absent macro vughs, common-absent macro-planar, rare-absent chamber. PRD is double to open. Inclusions are not oriented for most samples. The planar voids usually display some orientation parallel with the vessel walls (except for 273, planar voids perpendicular to vessel walls).

Groundmass

This is a heterogenous group, both between and within samples. Mostly high optical activity, though some have moderate to low optical activity (3, 39, 114, 118, 273, 279, 281). In PPL the clay matrix is light brown, brown and in XPL it is yellow brown, red brown, brown (40x). B-fabrics can include: mosaic speckled, crystallitic, porostriated, granotriated, and random striated

Inclusions

$c:f:v_{0.125mm}$ 5:91:4 - 14:79:7

The inclusions are equally likely to be poorly sorted, moderately sorted, or moderately well sorted. Inclusions are mostly unevenly distributed throughout the fabric. <2.35mm, mode 0.55mm, a-r.

Subgroup C- Bimodal

n=33; samples:18, 72, 73, 76, 81, 83-85, 87, 90, 92-94, 105, 125, 139, 151, 166, 167, 169, 202, 204, 211, 241, 242, 245, 246, 257, 265, 269, 275, 286, 287

Microstructure

Predominant-common macro planar, frequent-few micro vugh, common-few meso vugh, common-few meso planar, very rare-absent chamber. Double to open spaced PRD. Inclusions do not display orientation (exceptions: 93, 166, 275). Planar voids are generally oriented parallel to vessel walls.

Groundmass

Very heterogenous, both within and between samples. In PPL, the groundmass is light brown, brown, and dark brown (40x). In XPL the groundmass can be yellow brown, orange brown (rare), brown, and dark brown. Most of these samples are optically active, though there are a few with moderate to low optical activity (211, 242, 269, 275, 287). Several varieties of b-fabrics are present: crystallitic, mosaic speckled, unistriated, random striated, granostriated, and porostriated.

Inclusions

c:f:v $_{0.125mm}$ 5:93:2 - 16:75:9

The inclusions in this subgroup are bimodal, with a fine, well sorted fine fraction and moderately sorted to well sorted coarse fraction, and are often evenly distributed throughout the sample <1.6 mm, mode 0.86 mm, mainly sa-sr.

Fine fraction

Fine fraction<0.125 mm

Common-frequent	**Micritic carbonate**, sr-r
Common-few	**Quartz/orthoclase**, sa-sr
Very few-absent	**Volcanics** (too small to identify), sr-r
	Othopyroxene, sa-sr
	Clinopyroxene, sa-sr
	Plagioclase, sa-sr
	Opaques, sr
Very rare-absent	**Biotite**, sr
	Amphibole, sa
	Microfossils, wr
	Radiolaria, wr
	Muscovite, sr

Coarse fraction>0.125mm

Dominant-few	**Andesite**,[11] mainly equant, some oblong with a range of crystal sizes in the groundmass, <.24 mm, and most much finer than that. Mostly hypocrystalline, though some holocryalline or holohyline. Often acicular groundmass with trachytic texture, though equant crystal groundmass present. Phenocrysts can include: tabular euhedral plagioclase with albite twinning and some oscillatory zoning, tabular euhedral orthoclase with some zoning, both elongated and equant subhedral clinopyroxene, equant subhedral orthopyroxene, equant anhedral opaques, rare amphibole and very rare biotite. Very rare epidote and chloritization. Rarely vesicular. Most rock fragments are partially devitrified and/or carbonate altered. <3.38 mm, mode 0.41 mm, sa-sr
Frequent-rare	**Micritic carbonate**, some pelitomorphic, some shaley, many with fine quartz, carbonate crystal and opaque inclusions, as well as some cherty/chalcedony limestone. Some muddy areas. Occasionally barely visible microfossil fragments, one piece with replaced microfissil (foraminifera?) with a trochoid test morphology and microgranular walls that have been completely replaced by calcite. The precise number of chambers in the cross-section is difficult to discern, but it is at least twelve (81). Another very muddy, sandy piece has a microfossil of two spherical chambers with carbonate walls (0.18 mm)- (foraminifera?) (94). In 23, carbonate clusters of spherical microfossils. Occasional evidence of bedding, or interfaces between different levels of micritic limestone (94). In sample 83, there is a roughly oval shaped microfossil (0.78 mm), with three rectangular chambers along the inside of about half of the external walls, as well as the beginning of another wall below this row. Below this is a layer of what appears to be silica, and a third of the microfossil is micritic carbonate material. In 89, regularly distributed brown pellets in a circular pattern suggest a holothurian sclerite skeleton with a table morphology <1.06 mm, mode 0.31 mm, sr-r
Frequent-absent	**Rhyodacite,** mostly a groundmass of equant, anhedral crystals (<0.13mm), though some glassy fragments present. Rare trachytic texture. Phenocrysts can include anhedral and rare subhedral to euhedral plagioclase,

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[11] This rock category probably includes some andesitic basalt and andesitic dacite, although it was not recognizable as such.

	quartz, and orthoclase (sometimes sieve textured), some anhedral opaque, and euhedral tablets of muscovite, biotite and amphibole. Very rare micritic carbonate phenocrysts. Sericitization present on some fragment as well as rare chloritization. Most rock fragments are partially devitrified and/or carbonate altered. <0.8 mm, mode 0.37 mm, sa-r
Few-absent	**Orthoclase**, mainly equant, straight extinction, subhedral, some zoning, rare embayments, very rare sieve texture, sometimes sericite or carbonate altered <0.53mm, mode 0.21 mm, sa-sr
	Argillaceous rock fragment, (e.g shale, siltstone), dark brown to light brown in PPL, yellow brown, orange brown, dark brown and brown in XPL, mostly prolate, some equant, mostly clear boundaries though some diffuse, mostly neutral density, though high and low density present, silt sized quartz inclusions and lamimnate texture, <1.47 mm, mode 0.96 mm, sa-r
	Clinopyroxene, equant and oblong, subhedral, rare twinning, rare embayments, rare polycrystalline fragments, straight extinction. <1.26 mm, mode 0.18 mm, sr
	Orthopyroxene, subhedral, oblong, rare lamellae (pigeonite?), some twinning, straight extinction, rare anhedral opaques, rare polycrystalline fragments, <0.52 mm, mode 0.22 mm, sa-sr
Very few-absent	**Polycrystalline quartz**, anhedral, mainly equant with some elongated crystals in a polygonal intergrain relationship. Mostly straight extinction, though some undulose. Some clay particles around edges from weathering. Often appears to be detrital from igneous rock <0.63 mm, mode 0.46 mm, sr-r
	Fine granodiorite, medium grained (1-2mm) anhedral quartz, orthoclase and plagioclase, sometimes with embayments, some with sieve texture, with rare fibrous muscovite inclusions, rare amphibole, pyroxene inclusions, rare opaques, mostly straight but some rare undulose extinction, rare sericite alteration <1.14 mm, mode 0.58 mm, sr
	Plagioclase, subhedral-anhedral, equant or tabular, albite and/or pericline twinning and/or oscillatory zoning. Some with embayments, vesicles, as well as some are carbonate alteration and seritization. One very large piece (2.02) is anhedral, extensively embayed and

	embedded in a glassy matrix, but still a plagioclase mineral that is shaped as a wr oval (83) <0.96 mm, mode 0.23 mm, sa-sr
	Monocrystalline quartz, mostly equant, straight extinction, some embayments, rare glassy and micaceous and/or amphibole inclusions <0.36 mm, mode 0.2 mm, sa
	Sparitic carbonate, anhedral, sa-sr coarse crystals, many with twinning. Some shell fragments, <2.42 mm, mode 0.39 mm, sa-sr
	Sandstone, moderately well sorted within fragments, though inter-fragments can range from fine-coarse sand, anhedral, equant and oblong quartz and feldspar grains, sometimes opaque, carbonate crystals and/or carbonate altered crystals, with a clay and/or carbonate cement, straight extinction with fragment equant <1.66 mm, mode 0.64 mm, sr
	Biotite, subhedral, brown, green and sometimes red in PPL, pleochroic, tabular, weathering <0.48mm, mode 0.23 mm, sr
	Amphibole, euhedral, pale brown-colorless, sometimes red-orange in PPL, some zoning or alteration (orange XPL) around the edge. Some fragments highly altered by iron oxide/iron hydroxide, gives mineral red (PPL/XPL), fibrous appearance, usually in samples fired in an oxidizing atmosphere <0.8mm, mode 0.23 mm, sr
Rare-absent	**Tuff**, glassy mix of silica and clay particles, some with porphyritic quartz, plagioclase, carbonates, lithic and glassy fragments. Some partially devitrified and carbonate altered. Anhedral, both equant and oblong <1.08 mm, mode 0.89 mm, sa-sr.
	Chert, mostly equant, some with fine quartz inclusions, much of it with clear radiolarian tests, some altered by carbonates, and some pieces muddy <1.14 mm, mode 1.0 mm, a-r
	Diabase, medium grained, subhedral and anhedral plagioclase surrounded by larger <1.04 mm, euhedral grains of clinopyroxene. Mainly equant, some oblong anhedral opaques <1.72 mm, sr
	Microfossils, three aligned carbonate spheres, two partial, one complete, with opaque centers (Foraminifera?), 0.3 mm, wr, adjacent to a hook shaped microfossil with

	carbonate walls, with a crenulated shaped tip on the longer end, and a spherical tip on the shorter end, with a bump on the exterior side of the corner (Brachiopod?), 1.28 mm.
Very rare-absent	**Muscovite,** subhedral, tabular, <0.36, mode 0.28 mm, sr
	Radiolarian mudstone, some with subhedral tabular embayed plagioclase phenocrysts and/or chert fragments. Fragments equant, <1.16 mm, sr
	Staurolite, equant, anhedral, straight extinction, sericitization along fractures, highly weathered, <0.75mm, sr
	Chalcedony, equant, radial extinction, some weathering, <0.48 mm, mode 0.4 mm, sr-r
	Conglomerate, equant fragment with anhedral rhyolite, orthoclase, calcite constituents, clay minerals from weathering along edges of fragments, <0.83mm, sr
	Epidote, oblong, anhedral conglomerate, <0.48mm, mode 0.36mm, sa

Textural concentration features

- Common to absent pellets, equant with sharp to clear boundaries and high optical density. Dark brown (PPL and XPL). <0.36 mm, mode 0.08 mm, sr-r.
- Very rare-absent dark red, semi translucent concentrations with clear boundaries, present in the fine fraction, and in the coarse fraction they are equant with some fine quartz inclusions, <0.38 mm, mode 0.26 mm, sr

Amorphous concentration features

- Rare to absent hypocoating of planar voids

Crystalline concentration features

- Common to absent carbonate hypocoatings and segregregations

Glassy Andesite Loner

Naturally coarse glassy andesite inclusions in a dark red groundmass
n=1, sample 142

Microstructure

Frequent meso planar voids, common micro planar voids, few macro planar voids, few micro vughs, very few meso vughs, very few macro vughs. Single to double spaced PRD. The planar voids and oblong inclusions show moderate orientation parallel to the vessel walls.

Groundmass

Heterogenous, inclusions and voids unevenly distributed. Dark brown core and orange brown margins in both PPL and XPL (x40). Low optical activity in core, higher optical activity along margins. B-fabrics include: mosaic speckled, granostriated, porostriated.

Inclusions

$\text{c:f:v}_{0.125\text{mm}}$	21:71:8

The inclusions are poorly sorted. <1.62, mode 0.47 mm, sr-a

Fine fraction

Dominant	**Andesite**, sr-sa
Common	**Quartz/orthoclase**, sr-sa
	Pyroxene, sa
Few	**Plagioclase**, sa-sr
	Iddingsite, sa-sr
Rare	**Amphibole**, sa
Very rare	**Muscovite**, sa

Coarse Fraction

Predominant	**Andesite**, equant and oblong fragments, acicular feldspar groundmass with anhedral and subhedral pyroxene phenocrysts, anhedral, equant opaques, and few subhedral feldspar (plagioclase and quartz) phenocrysts. One large fragment has a glassy groundmass with coarser andesite, orthoclase, plagioclase, and pyroxene phenocrysts <1.50 mm, mode 0.40 mm, sr
Few	**Volcanic**, equant and oblong fragments, fine to glassy equigranular groundmass, possibly acidic to intermediate based on light color/first order interference colors (PPL and XPL, x40) and parallels to known acidic rock fragments, but no identifying mafic inclusions. <0.27 mm, mode 0.18 mm, sa-sr
	Orthoclase, equant and oblong, subhedral and anhedral, some simple twinning, some sieve texture and

	vesicles, sericitization common, rare undulous exitinction. <0.23 mm, mode 0.18 mm, sa-sr
	Monocrystalline quartz, equant, anhedral, rare polycrystalline fragments <0.30, mode 0.18 mm, sa-sr
Very rare	**Clinopyroxene**, equant and oblong, subhedral, rare polycrystalline fragments, <0.22 mm, mode 0.18 mm, sr
	Sandstone, fine sand sized, equant, sa-sr volcanics, quartz, and feldspar, with clay cement, sometimes very thick cement,weathered fragments. <1.63 mm, mode 1.31 mm, sr
	Muscovite, oblong, anhedral, <0.28 mm, sr

Textural concentration features

- Common pellets, equant and elongated with sharp to diffuse boundaries and neutral to high optical density. Dark brown (PPL and XPL), with rare silt size quartz/feldspar inclusions. <1.34 mm, mode 0.35 mm, sr-r.

Amorphous concentration features

- Few hypocoating of planar voids

Glassy Welded Tuff Loner

Glassy welded tuff sand in brown groundmass
n=1, sample 77

Microstructure

Dominant macro planar voids, common meso planar, few micro vughs, few meso vughs, rare mega planar voids. Mainly double space PRD, with some areas more single spaced and some areas open spaced. Planar voids are oriented parallel to the vessel walls, and the inclusions are primarily equant and thus lack orientation.

Groundmass

Moderately heterogenous with inclusions unevenly distributed and a slightly darker core. Light brown margins and brown core, with some dark brown patches where the two areas meet (PPL x40). The margins are light yellow brown and the core is brown in XPL (x40). Optically active with b-fabrics including: moasic striated, random striated, granostriated, and porostriated.

Inclusions

c:f:v $_{0.125mm}$ 15:78:7

Bimodal with moderately sorted coarse fraction and well sorted fine fraction. <1.03mm, mode 0.59 mm, sa-sr.

Fine fraction

Frequent	**Glassy welded tuff**, sa-sr
	Quartz/orthoclase, sa-sr
Few	**Pyroxene**, sa-sr
	Micritic carbonate, sr
Rare	**Plagioclase**, sa
Very rare	**Biotite**, sa

Coarse fraction

Predominant	**Glassy welded tuff**, equant and oblong, very fine (<medium silt sized) quartz and/or feldspar inclusions, equant and acicular. Rare second order birefringent inclusions, possibly pyroxene or amphibole but too small for identification. Vesicles common, rare flow pattern and rare devitrification. <1.03 mm, mode 0.61 mm, sr
Rare	**Glassy volcanic**, (likely andesite), equant, glassy groundmass with tabular, subhedral feldpar (mostly orthoclase but some possible plagioclase) phenocrysts, rare equant anhedral pyroxene and equant opaques. Some fragments have trachytic flow pattern. <0.71 mm, mode 0.36 mm, sr
	Intermediate volcanic, equant rock fragments composed of anhedral, equant feldspar (orthoclase and rare plagioclase) with rare twinning, rare anhedral, equant pyroxene and opaques. One fragment with fibrous silicate mineral, pleochroic, that may be in tremolite-actinolite series. < 0.48, mode 0.36 mm, sr
	Micritic carbonate, equant, partially diffuse boundaries, <0.19 mm, mode 0.16 mm, r
	Orthoclase, anhedral to subhedral, mostly equant, some oscillatory zoning and simple twinning, <0.31 mm, mode 0.20 mm, sa-sr
	Clinopyroxene, subhedral, equant, <0.14 mm, mode 0.13 mm, sr
	Orthopyroxene, subhedral, elongated, <0.13 mm, mode 0.13 mm, sa

Mafic Volcanic Loner

Very coarse fabric with high density of basalt and andesitic basalt in dark brown groundmass
n=1, sample 247

Microstructure

Dominant micro-vughs, common meso-vughs, common macro-vughs. Single spaced PRD. Inclusions and voids are equant, show no orientation.

Groundmass

Homogenous. Dark brown with light brown margins in PPL and XPL (x40). Low optical activity, though higher optical activity along margins. B-fabrics not discernible because of high density of aplastics in fine fraction.

Inclusions

c:f:v $_{0.063\text{mm}}$	30:65:5

Inclusions very poorly sorted. <2.35 mm, mode 0.43 mm, sa-a

Fine fraction

Frequent	**Plagioclase**, sr-sa
Common	**Pyroxene**, sr-sa
	Quartz/feldspar, sr-sa
Very few	**Olivine**, r
	Amphibole, sr-sa
	Biotite, sr
	Muscovite, sr

Coarse fraction

Frequent	**Basalt**, equant and oblong, acicular groundmass with phenocrysts that include: euhedral to subhedral olivine, subhdral pyroxene, subhedral pyroxene, and anhedral opaques. <2.35, mode 0.72 mm, sr
Common	**Plagioclase**, equant and oblong, euhedral to subhedral, oscillatory zoning and albite twinning, some seritization present. <1.12 mm, mode 0.42 mm, sr-sa
	Pyroxene, equant and oblong, subhedral, <0.94 mm, mode 0.38 mm, sr-sa

	Diabase, oblong, medium grained, tabular subhedral plagioclase with interstitial, anhedral pyroxene and subhedral pyroxene phenocrysts, equant anhedral opaques, and rare anhedral muscovite. <1.03 mm, mode 0.55 mm, sr
Few	**Olivine**, equant, euhedral to subhedral, <0.44 mm, mode 0.28 mm, sr-r
	Rhyodacite, equant and oblong, acicular to glassy groundmass with euhedral to subhdral amphibole, euhedral biotite, and subhedral orthoclase phenocrysts. <1.2 mm, mode 0.85 mm, sa-sr
Rare	**Amphibole**, oblong, subhedral, <0.2 mm, mode 0.11 mm, sr
	Biotite, oblong, subhedral, <0.48 mm, mode 0.27 mm, sr
	Quartz, equant and oblong, anhedral, <0.33, mode 0.12 mm, sr-sa

Siliceous Sedimentary Loner

Bimodal with coarse sand to fine gravel sized siliceous carbonate temper.
n=1; sample 78

Microstructure

Frequent macro-planar voids, common meso vughs, common micro vughs, few meso planar vughs, rare macro vughs. Open spaced PRD. Voids and inclusions oriented parallel to vessel walls.

Groundmass

Homogenous fabric. Brown groundmass with light brown margins in PPL and XPL (x40). Moderate optical activity. B-fabrics include: mosaic speckled, granostriated, porostriated.

Inclusions

c:f:v$_{0.125mm}$	15:78:7

Inclusions bimodal, with coarse fraction moderately sorted. <3.7 mm, mode 1.90 mm, sr

Fine fraction

Frequent	Quartz/orthoclase, sa-sr

Common	Volcanic, sr Plagioclase, sa-sr Pyroxene, sr
Few	Micritic carbonate, sr-r
Very few	Muscovite, sr

Coarse fraction

Dominant	**Siliceous carbonaceous siltstone**- oblong rock fragments composed of carbonaceous clay groundmass, light brown in PPL, yellow-orange-brown in XPL (x40), optically active with unistrial and speckled mosaic b-fabrics. Inclusions include: silt to medium sand sized quartz/k-feldspar, opaque pellets, and rare muscovite. <3.7 mm, mode 2.49 mm, sr-r
Common	**Micritic Carbonate**, equant fragments with rare silt sized quartz/feldspar inclusions. <1.55 mm, 0.9 mm, sr-r
Few	**Intermediate volcanics**, equant and oblong rock fragments, trachy to glassy textured groundmass with anhedral to subhedral orthoclase (dominant) and plagioclase phenocrysts (rare). One fragment has subhedral pyroxene phenocrysts, but no other identifying mafics present in rock fragments. Some carbonate altered. <1.3 mm, mode 0.48 mm, sa-sr **Orthoclase**, equant and oblong, subhedral, simple twinning common, <0.20 mm, mode 0.14 mm, sa-sr
Very few	**Quartz**, equant, anhedral, <0.19, mode 0.13 mm, sa-sr **Plagioclase**, equant and oblong, subhedral, albite twinning, <0.25, mode 0.15 mm, sr **Clinopyroxene**, mostly oblong, subhebral, <0.58 mm, mode 0.25 mm, sr

Middle Iron Age/Period 4

Rhyolite Group

Coarse rhyolite inclusions with a narrow mineralogical range in a variety of groundmasses
n=10, samples 24, 120, 175, 176, 191, 196, 197, 199, 200, 206

Microstructure

Dominant-common meso-macro planar, dominant-common micro-meso vughs, common-rare micro planar vughs, few-rare macro vughs, and very rare-absent chamber. Single to double spaced PRD. Voids show a moderate preferred orientation parallel to the vessel walls but the inclusions are randomly oriented. Sample 130 has a relic coil.

Groundmass

Heterogenous clay matrix both within and between samples, with samples red brown, light brown to dark brown, and almost black from carbon residue in PPL (x25) and light brown to dark brown or red brown in XPL (x25). Carbon residue present in core as well as on vessel walls seemingly from use. Some samples have high optical activity (24, 175, 176, 191, 196, 199), while some have low optical activity (130,197, 200, 206), though this appears to be due to carbon residue rather than high firing temperatures. B-fabrics for the optically active samples include: granostriated, random striated, mosaic speckled, and porostriated.

Inclusions

c:f:v$_{0.125\text{mm}}$ 15:80:5 - 30:60:10

The inclusions are poorly sorted and show a unimodal grain-size distribution. The voids and the inclusions are evenly distributed in most samples, but the inclusions are more clustered in some. The inclusions are <2.3 mm, mode 0.65 mm, a-sr

fine fraction <0.125 mm

Frequent	**Monocrystalline quartz/orthoclase**, sa-sr
Common	**Plagioclase**, sr
	Rhyolite, sr-r
Common-rare	**Biotite**, sr
	Opaques, sa-sr
Few-absent	**Micritic carbonate,** r
Very rare-absent	**Glass**, sa
	Radiolaria, r
	Muscovite, sr
	Clinopyroxene, sa
	Orthopyroxene, sr
	Zoisite, sr

coarse fraction >0.125 mm

Predominant	**Rhyolite**, equant and oblong, groundmass includes crystals in a range of equant, aphanitic sizes <0.12 mm, becoming glassy in some areas though mostly retaining

	crystal boundaries. Sometimes different portions of the groundmass of same rock fragment will have different crystal sizes. Very rare trachyte texture. Phenocrysts can include: subedral-euheral orthoclase with oscillatory zoning some simple twining, subhedral-euhedral plagioclase with albite and/or pericline twinning and/or oscillatory zoning, equant anhedral opaques, subhedral biotite, very few anhedral monocrystalline quartz, and rare micritic carbonate. Inclusion boundaries are clear, though the rock fragments are altered to clay in some (occasionally quite large) areas, especially at crystal margins. Some pieces altered by carbonates and/or sericite, rarely devitrified. <2.3 mm, mode 0.61 mm, sa-sr
Common-very few	**Biotite**, subhedral, elongated plate/flake. Many pieces partially altered to clay, and very rare pieces altered to chlorite. <0.3 mm, mode 0.2 mm, sa-sr
Few	**Orthoclase**, anhedral, mostly equant, many pieces partially altered to clay. Simple twinning and oscillatory zoning common. Some pieces have undulous extinction. <0.37 mm, mode 0.21 mm, sa-sr
Very Few	**Plagioclase**, subhedral-anhedral, mostly equant though some elongated. Pieces have albite and/or pericline twinning and/or oscillatory zoning. Many pieces altered to clay in fractures and at crystal margins. <0.46 mm, mode 0.22 mm, sa-sr.
	Monocrystalline quartz, anhedral, mostly equant. Rare pieces have undulous extinction. <0.24 mm, mode 0.17 mm, sa-sr.
	Opaques, anhedral, mainly equant, probably detrital from rhyodacite <0.3 mm, mode 0.19 mm, sa-sr
Very rare-absent	**Micritic carbonate**, mainly elongated with some equant, clear boundaries, some areas being altered to clay. <0.7 mm, mode 0.25 mm, sr
	Sparitic carbonate, equant, consisting of anhedral, sr-sa crystals <0.1 mm. Likely shell fragments. Rare anhedral quartz inclusions. Decomposing into clay around edges. <0.53 mm, 0.3, sr
	Muscovite, subhedral, elongated. Micaceous "birds-eye" extinction. <0.28 mm, sr
	Clinopyroxene, oblong, subhedral, green-brown weakly pleochroic in PPL, 3rd order birefringence, <0.14, mode 0.13 mm, sa

Orthopyroxene, equant, subhedral, 1st order birefringence <0.32 mm, 0.21 mm, sr
Glass, elongated, <0.46 mm, 0.36 mm, sa
Radiolaria, spherical <0.21 mm, r

Textural concentration features

- Rare, equant and elongated dark red brown inclusions with low to absent optical activity and some quartz/feldspar inclusions (clay pellets), only visible in the samples with a lighter groundmass, <0.98 mm, mode 0.25 mm, r.
- Very rare-absent, equant red orange translucent inclusions (iron-oxide?), clear boundaries, <0.21 mm.

Crystalline concentration features

- Rare carbonate hypocoatings in some samples

Carbonate Group

n=11
Subgroup A (n=7): 11, 13, 36, 52, 100, 129, 177
Subgroup B (n=4): 30, 115, 135, 154

Microstructure

Predominant to dominant micro vughs, common few meso vughs, common to very few macro vughs, very few to absent chamber, very rare to absent mega planar voids. Sample 36 has darker brown depletions surrounding mega planar voids, possibly indicating burnt out vegetal material. Open spaced PRD. Inclusions are mostly equant and thus not oriented. All of samples in subgroup B (30, 115, 135, 154) have planar voids oriented parallel to the vessel walls. Samples 11 and 36 have planer voids parallel to the vessel walls as well, and sample 13 has planer voids perpendicular to vessel walls, the latter probably indicating coils or a join. All three of the latter samples (11, 13, and 36) are period 2 trays. The rest of the samples in this petrogroup show no void orientation.

Groundmass

This is a relatively homogenous group in that nearly all of the inclusions are carbonate, sandstone, quartz, feldspar, and rare volcanics, seriate grain size with an open space PRD. However, there is heterogeneity in the grain size and density of the inclusions, which is only partially captured by the subgroups. The groundmass is light brown, orange brown, and brown in PPL and XPL (40x). Optically active fabric. B-fabrics include: crystallitic, mosaic speckled, random striated, porostriated, granostriated, parallel striated (154), and strial (30, 115).

Inclusions

Subgroup A:

$\text{c:f:v}_{0.063\text{ mm}}$ 4:91:5 - 8:84:8

Inclusions are poorly sorted. <1.02 mm, mode 0.23 mm, sa-sr
Subgroup B:

$\text{c:f:v}_{0.063\text{ mm}}$ 1:96:3 - 3:91:6

Inclusions are well sorted, primarily because there is very little coarse fraction. <0.79 mm, mode 0.13 mm, sa-sr

fine fraction <0.063

Dominant-frequent	**Quartz/feldspar**, sa-sr
Dominant-few	**Carbonate**, sa-sr
Common-few	**Volcanic**, sa-sr
Few-rare	**Clinopyroxene**, sa-sr
	Orthopyroxene, sa-sr
Few-absent	**Glass**, sa-sr
Rare-absent	**Plagioclase**, sa-sr
	Amphibole, sa-sr
	Biotite, sa-sr

Dominant to common	**Sparitic Carbonate**, equant, polycrystalline rock fragments with anhedral crystals <0.24 mm, which may have clay rich, brown, negative optical density, "muddy" margins, especially around the fragment edges. Rare euhedral or subhedral fragments present, usually monocrystalline. Rare microfossils, generally not identifiable. Very rare quartz/feldspar and muscovite inclusions. <1.3 mm, mode 0.34 mm, sr
	Quartz, equant, anhedral, straight extinction, <0.26 mm, mode 0.13 mm, sa-sr
	Orthoclase, equant, equant, anhedral, straight extinction, rare simple twinning and oscillatory zoning, <0.34 mm, mode 0.15 mm, sa-sr
Common to few	**Micritic Carbonate**, equant, often muddy with sharp to diffuse boundaries. Rare microfossils (not identifiable), ooids, quartz/feldspar, and chert. One fragment (36) microfossil supported <0.56 mm, mode 0.22 mm, sr-r

	Rhyolite, equant and oblong, range of textures including: groundmass of equant subhedral to anhedral crystals <0.25 mm to glassy groundmass with unclear crystal boundaries. Rare fragments with trachytic texture, often smaller. Phenocrysts can include include subhedral and anhedral quartz and feldspar, subhedral biotite, equant anhedral opaques, and rare fibrous amphibole. Highly weathered, some devitrification and carbonate alteration. < 1.0 mm, mode 0.35 mm, sa-sr
Few to rare	**Plagioclase**, equant, subhedral, straight extinction, simple and albite twinning, rare epidotization <0.15 mm, mode 0.11 mm, sa-sr
Rare to absent	**Microfossils**, radiolaria= 0.15mm (100) and long, straight fragment= 0.46 mm (100)
	Glass, oblong and equant, isotropic, rare quartz/feldspar inclusions, <0.40 mm, mode 0.25 mm, sr
	Sandstone, equant, subhedral and anhedral equant quartz, orthoclase, and opaques, in either clay or carbonate cement. <0.70 mm, mode 0.55 mm, sr
	Volcanogenic conglomerate, oblong and equant, fragments of rhyolite, quartz, feldspar, and rare biotite lathes (<0.42 mm) in a clay cement <1.36, mode 0.84 mm, sr
	Argillaceous rock fragment, oblong, (siltstone) clay particles, silt sized quartz/feldspar inclusions, biotite, and possibly some rare fibrous amphibole, brown (PPL and XPL), optically active with first order interference colors. One fragment shows evidence of low grade metamorphism (fibrous/foliated, higher birefringence- still first order). One fragment has flat edge with layer of oxidation that is visibly similar to slip, possibly grog, but unlikely as this is the only example in entire assemblage. <0.54 mm, mode 0.45 mm, sa-sr
	Orthopyroxene, equant, anhedral, <0.16 mm, mode 0.12 mm, sa
	Clinopyroxene, oblong and equant, subhedral and anhedral, <0.17, mode 0.11 mm, sa-sr
Very rare to absent	**Amphibole**, oblong, subhedral, <0.14 mm, sa
	Biotite, oblong, subhedral, <0.35 mm, mode 0.29 mm, sr
	Chalcedony, oblong, fibrous, first order interference colors, pale brown in PPL (x40), <0.23 mm, sr

Andesite, oblong, fine feldspar lathes (<0.08 mm) in trachytic texture with fine sand sized clinopyroxene inclusions or equant, subhedral feldspar (<0.18 mm) with equant, subhedral clinopyroxene. <0.83 mm, mode, sr

Textural concentration feature

- Rare to absent argillaceous pellets, equant and oblong with sharp to clear boundaries dark red brown (PPL and XPL) with low optical density, nearly opaque, probably high iron content, with rare silt sized quartz/feldspar inclusions. <0.55 mm, mode 0.21 mm, sr-r

Amorphous concentration feature

- Moderately impregnated, dark brown depletions quasicoating some voids in sample 36.

<u>Coarse Andesite Group</u>

Very coarse andesite inclusions in a reducing groundmass
n=11; samples 104, 108, 110, 117, 127, 131, 136, 143, 144, 186, 221

Microstructure

Frequent-common meso planar voids, frequent-common micro planar voids, frequent-rare meso vughs, common micro vughs, common-absent macro planar voids, very rare chamber. Single to close spaced PRD. Neither the voids nor the inclusions show evidence of orientation, except sample 110 and 136, which has voids that lie parallel to the vessel walls.

Groundmass

Heterogenous group within samples as result of uneven PRD and grain size. However, each sample is characterized by a narrow range of andesite inclusions. This group is heterogenous between samples as a result of slightly different andesite types present in different samples. The groundmass is dark brown to black, while some samples (108, 127, 131, 143, 144) brown edges in PPL (50x), with red brown edges in XPL (50x). Optically inactive core and some (108, 127, 131, 143, 144) optically active margins. B-fabrics include: granostriated, random striated, and mosaic speckled.

Inclusions

c:f:v $_{0.125mm}$	28-35:57-66:6-8

Very poorly sorted. <2.13mm, mode 0.77 mm, sa-sr

fine fraction

Frequent-common	**Quartz/orthoclase**, sa-sr
Common-few	**Plagioclase**, sa-sr
	Pyroxene, sr
Few-absent	**Biotite**, sr
	Muscovite, sr
	Volcanic, sr
	Micritic carbonate, r

coarse fraction

Dominant	**Andesite**, oblong and equant fragments, groundmass can include subhedral elongated, equant, or acicular feldspar and quartz ranging to a more glassy groundmass. Phenocrysts most commonly include subhedral plagioclase, as well as subhedral orthoclase, clinopyroxene, orthopyroxene, amphibole, biotite, and anhedral opaques. Some weathering around crystal and fragment edges and even visibly decomposing, some devitrifed, rare carbonate altered. <2.13 mm, mode 0.89 mm, sa-sr
Few-rare	**Clinopyroxene**, oblong and equant, subhedral, rare polycrystalline fragments and twinning. <0.58mm, mode 0.32 mm, sa-sr
	Orthoclase, equant and elongated, subhedral to anhedral, straight extinction, simple twinning and oscillatory zoning can be present. <0.88 mm, mode 0.31 mm, sa-sr
	Plagioclase, equant and elongated, subhedral, albite and/or pericline twinning and/or oscillatory zoning often present. <0.48 mm, mode 0.20 mm, sa-sr
Few-absent	**Biotite**, oblong, tabular, euhedral to subhedral, often weathered. <0.42 mm, mode 0.31 mm, sr
Very few-rare	**Orthopyroxene**, equant, subhedral, <0.44 mm, mode 0.30 mm, sa-sr,
	Monocrystalline quartz, mostly equant, anhedral, straight extinction, <0.21 mm, mode 0.15 mm, sa-sr
	Micritic carbonate, equant and oblong, often muddy with sharp to diffuse boundaries. < 0.38 mm, mode 0.28 mm, sr-r

	Amphibole, oblong, subhedral. <0.15 mm, mode 0.14mm, sa
Very rare-absent	**Sandstone**, oblong fragment with oblong and equant quartz grains, rare feldspar (0.08 mm) in a clay matrix <0.50 mm, mode 0.50 mm, sr

Textural concentration feature

- Very few to absent argillaceous rock fragments, equant and oblong with sharp to clear boundaries and varied optical density (high, low and neutral can be present in a single fragment). Dark brown and light brown in PPL, and dark brown, brown, and red brown in XPL (50x). Fine sand sized quartz and feldspar present in larger fragments. <0.90 mm, mode 0.43 mm, sa-r

Fine Glassy Andesite Group

High density of fine glassy andesite inclusions in varied groundmasses
n=7; samples: 178, 179, 184, 187, 188, 198, 212

Microstructure

Predominant to frequent micro-planar voids, frequent to few micro vughs, common to absent meso vughs, few to absent macro vughs, few to absent meso planar voids, very rare to absent macro planar, very rare to absent chamber. Single to close spaced PRD. There is no orientation of either voids or inclusions, though the latter are mostly equant.

Groundmass

Moderately heterogenous both within and between samples. Some samples are highly reduced with low to absent optical activity (88, 184), some are optically active (79, 187, 198, 212), and some have a dark core with optically active edges (173, 188). The groundmass is brown, dark brown, and red brown in PPL (40x) and brown, light brown, red brown, and dark brown/black in XPL (40x). B-fabrics include: mosaic speckled and random striated.

Inclusions

c:f:v $_{0.063\text{ mm}}$ 20:77:3 - 30:64:6

The inclusions are moderately sorted to moderately well sorted and show a unimodal grain size distribution. <1.32 mm, 0.23 mm, a-sr

fine fraction <0.063

Frequent-common	**Andesite**, a-sr
	Quartz/orthoclase, sa-sr
Common-few	**Orthopyroxene**, sr
	Clinopyroxene, sr
Few	**Plagioclase**, sa-sr
Very few-very rare	**Glass**, a-sr
	Amphibole, sr
	Biotite, sr
Very rare-absent	**Muscovite**, sr

Dominant	**Andesite**, mostly equant rock fragments with acicular to glassy groundmass, usually trachytic texture. Rare equant crystals in groundmass with unclear boundaries. The majority of the inclusions are fine sand sized or smaller, glassy and/or devitrified. Larger andesite fragments may have coarser groundmass with crystals <0.17 mm, and are often oblong fragments. Phenocrysts include subhedral tabular orthoclase, subhedral tabular plagioclase, anhedral equant opaques, anhedral equant clinopyroxene, anhedral equant clinopyroxene, equant glass, rare equant micritic carbonate. Phenocryst boundaries sometimes merge with groundmass. Relatively"fresh" (i.e. lacks extensive weathering with the exception of devitrification), though rare examples of high degrees of weathering/devitrification, <1.32 mm, mode 0.29 mm, a-sr
Few-very few	**Orthopyroxene**, equant and oblong, subhedral and anhedral, some sieve texture <0.32 mm, mode 0.17 mm, sa-sr
	Clinopyroxene, equant and oblong, subhedral and anhedral, rare twinning, very rare polycrystalline <0.29 mm, mode 0.16, sa-sr
	Orthoclase, equant and oblong, anhedral, straight extinction, rare simple twinning, <0.4 mm, mode 0.25 mm, sa-sr
	Monocrystalline quartz, equant and oblong, anhedral, straight extinction, some sieve texture <0.5 mm, 0.24 mm, sa-sr
	Plagioclase, equant and oblong, subhedral and anhedral, albite and simple twinning, oscillatory zoning, straight extinction, rare sericitization, some weathering, <0.49mm, 0.25 mm, sa-sr

	Glass, some perlitic, some partially devitrified, rare quartz/feldspar inclusions, appears to be part of same andesitic flows that characterize this fabric, but cooled extremely rapidly. <0.38 mm, mode 0.18mm, a-sr
Rare-absent	**Polycrystalline quartz/feldspar**, equant, groundmass of equant crystals <0.12 mm, mostly much smaller, straight extinction, rare sericitization, <0.67 mm, mode 0.27 mm, sr
	Rhyolite, equant, with a groudmass of equant, anhedral quartz and feldspar, rare equant opaques <0.02 mm, some weathering, <0.35, mode 0.32, sa-sr
	Biotite, oblong, subhedral and anhedral, "birds-eye" extinction, <0.33 mm, mode 0.2 mm, sr
	Amphibole, oblong, subhedral and anhedral, common weathering, <0.1 mm, mode 0.09 mm, sr
	Volcanic conglomerate, equant with equant, anhedral constituents including glass, andesite, k-feldspar, and quartz in a brown to dark brown (PPL and XPL) clay matrix, <1.33 mm, sa

Textural concentration features

- Rare to absent argillaceous pellets, equant with sharp to clear boundaries and high to neutral optical density, rare silt sized quartz inclusions. Dark brown and brown (PPL and XPL). <0.5 mm, mode 0.26 mm, sr-r

<u>Dacite Group</u>

Coarse dacite inclusions with a narrow mineralogical range in a variety of groundmasses n=6; samples: 16, 134, 182, 189, 195, 232

Microstructure

Dominant to common meso vughs, frequent to few macro vughs, frequent to few micro planar, frequent to few meso planar, common to rare macro planar, few micro vughs, very rare chamber. Single to close spaced PRD. Weak to no orientation of voids and inclusions parallel to vessel walls.

Groundmass

Homogenous minerallogy, consistent between samples, though color of groundmass and inclusion spacing varied within samples. Main different between samples is optical activity. Dark brown, brown and red brown in PPL and XPL (x25). Most samples optically active, but 134 and 189 optically inactive. B-fabrics includes: crystallitic speckled, mosaic speckled, porostriated and granostriated.

Inclusions

$\text{c:f:v}_{0.125\text{mm}}$	25:79:6 - 35:55:10

The inclusions are poorly sorted and show a unimodal grain-size distribution. The voids and the inclusions are evenly distributed in most samples, but the inclusions are more clustered in some. <5.25 mm, 0.89 mm, a-sr

fine fraction <0.125 mm

Frequent	**Monocrystalline quartz/orthoclase**, sa-sr
Common	**Dacite**, sr
Few-very rare	**Amphibole**, sa-sr
	Clinopyroxene, sr
	Orthopyroxene, sr
	Plagioclase, sr
Very rare-absent	**Biotite**, sr

coarse fraction >0.125 mm

Predominant	**Dacite**, equant and oblong with a primarily feldspar groundmass of equant crystals with unclear boundaries, <0.08 mm, sometimes glassy. Very rare trachyte texture. Phenocrysts can include subhedral orthoclase, sometimes merging with the groundmass, subhedral amphibole, and equant, subhedral opaques. Rare alpha to beta transition, trapezoidal quartz. Very rare anhedral clinopyroxene and biotite. Rock fragments are often highly weathered with clay forming at crystal boundaries and sometimes seeming to disintegrate into the groundmass of the surrounding clay. Rare saussiterization. <5.25 mm, mode 1.44 mm, sa-sr
Few-very rare	**Orthoclase**, equant, anhedral, straight extinction, rare oscillatory zoning, rare sieve texture and anhedral pyroxene inclusions, 0.53, mode 0.3 mm, sr
	Amphibole, elongated, subhedral to anhedral, highly weathered and often disintegrating into the groundmass, 0.5 mm, 0.8 mm, sr
	Clinoyroxene, equant and elongated, subhedral to anhedral, often weathered, <0.3 mm, mode 0.25 mm, sr-sa
	Orthopyroxene, equant, subhedral to anhedral, often weathered, <0.38 mm, mode 0.23 mm, sr

Very few-very rare	**Plagioclase**, equant, subhedral, albite and pericline twinning, rare oscillatory zoning, <0.5 mm, mode 0.36 mm, sa
Rare	**Quartz**, equant, nearly always monocyrstalline, though polycrysalline present, subhedral to anhedral, straight extinction, <0.36 mm, 0.22 mm, sa-sr
Very rare-absent	**Argillaceous rock fragment (claystone?)**, laminated, blocky sedimentary rock fragment primarily composed of clay and muscovite, with rare silt sized quartz and opaque inclusions.<2.45 mm, mode 2.21 mm, a-sa

Textural concentration features

- Rare to absent argillaceous pellets, equant with sharp to clear boundaries and high optical density, rare silt sized quartz inclusions. Dark brown (PPL and XPL). <0.48 mm, mode 0.24 mm, sr-r

Trachyandesite Group

Andesite tempered, open spaced inclusions in an orange brown groundmass
n=4; samples 50, 58, 157, 158

Microstructure

Dominant to frequent macro planar voids, common to few meso planar voids, common to few meso vughs, common to few macro vughs, few to rare micro vughs, rare chamber. Open to double space PRD. Sample 50 has a macro planar void with dark brown (PPL and XPL) hypocoating that suggests an anomalous piece of burned out vegetal material. Two samples' (58, 157) voids are moderately oriented parallel to the vessel walls, while the other two (50, 158) each have a relic coil. The inclusions are generally equant and thus not oriented.

Groundmass

Very homogenous both within and between samples. Strongly optically active along edges and moderately optically active core, except for sample 50, which shows the reverse pattern. The strongly optically active areas are light brown to brown and the moderately active areas are orange brown to dark brown in PPL and XPL (40x) . B-fabrics include: mosaic speckled and grano-striated.

Inclusions

$c:f:v_{0.125mm}$	15:79:8 - 20:69:11

Bimodal, with a poorly sorted coarse fraction and a well sorted, very fine fine fraction. <3.45 mm, mode 0.65 mm, a-sr

fine fraction <0.125 mm

Frequent	**Andesite**, a-sr
	Quartz/feldspar, a-sa
Common to few	**Clinopyroxene**, a-sa
	Orthopyroxene, a-sa
Rare	**Plagioclase**, sr
Very rare to absent	**Amphibole**, sr
	Micritic carbonate, r

coarse fraction >0.125 mm

Predominant	**Andesite**, equant, fine acicular groundmass (<0.1 mm) with trachytic texture and phenocrysts, including euhedral to subhedral tabular orthoclase with simple twinning and oscillatory zoning, subhedral orthopyroxene (rarely polycrystalline) and subhedral clinopyroxene (rarely polycrystalline), equant anhdreal opaques and rare subhedral plagioglase. <3.45 mm, mode 1.08 mm, a-sr
Few	**Orthoclase**, equant and oblong, straight extinction, simple twinning and oscillatory zoning, subhedral, <0.75 mm, mode 0.40 mm, a-sr
	Clinopyroxene, equant, subhedral, some polycrystalline, some anhedral opaques, <0.80 mm, mode 0.39 mm, a-sr
Very few-rare	**Orthopyroxene**, equant, subhedral, some polycrystalline, some anhedral opaques, <0.50 mm, mode 0.29 mm, a-sr
	Plagioclase, equant, straight extinction, subhedral, albite twinning and rare oscillatory zoning, <0.60 mm, mode 0.38 mm, a-sr
	Quartz, equant and oblong, straight extinction, subhedral, <0.45 mm, mode .28 mm, a-sr
Very rare-absent	**Fibrous mineral**, (serpentinite?), equant, pale yellow to red in PPL, first order birefringence, grey to yellow in XPL, *machen* texture, undulous extinction, <0.19 mm, mode 0.17 mm, sr

Metamorphic Pair

Meta-igneous and meta-sedimentary inclusions coarse fabric with red groundmass.
n=2; samples: 62, 120

Microstructure

Common meso-planar voids, common meso-vughs, common micro-vughs, common meso-vughs, common macro-planar vughs. Single to double spaced PRD. Voids and inclusions oriented parallel to vessel walls.

Groundmass

Heterogenous with uneven size and distribution of inclusions. Groundmass is orange, brown, and dark brown in PPL and XPL (x40). Optically active, though sample 62 has a low optical activity core. B-fabrics can include: mosaic speckled.

Inclusions

c:f:v$_{0.125\text{mm}}$	20:73:7

Inclusions very poorly sorted. <4.36 mm, mode 0.98 mm, sr-sa

Fine fraction

Frequent	**Quartz/orthoclase**, sr-sa
	Amphibole, sr
Common-few	**Epidote**, sr
	Pyroxene, sr
	Metamorphics, sr
	Volcanic, sr

Coarse fraction

Frequent	**Medium grade intermediate meta-igneous** (phyllite to schist), mostly oblong rock fragments, fine to medium grained (<0.30 mm) quartz and feldspar, often remelted with sutured grain boundaries. Accessory minerals can include: fibrous amphibole in the tremolite-actinolite series (can be present in veins that account for half of certain fragments, or barely be present), subhedral amphibole, subhedral to anhedral pyroxene, anhedral epidote, seritization common.

	Some pieces highly weathered and visibly decomposing into the groundmass. <1.95 mm, mode 0.99 mm, sr-sa
Frequent to common	**Low to medium grade meta-sedimentary** (slate to schist), oblong rock fragments, fine grained clay minerals with brown and orange-brown (PPL and XPL) streaks parallel to foliation. Birefringent specks suggest mica and/or amphibole present but too small to identify. Some fragments contain accessory silt to medium sand sized sized quartz/feldspar and fibrous amphibole, generally associated with higher grade metamorphosed fragments. Some pieces highly weathered and visibly decomposing into the groundmass. <4.36 mm, mode 2.13 mm, sr
Few to very few	**Rhyodacite**, oblong and equant rock fragments, acicular to glassy groundmass with phenocrysts that include: subhedral to anhedral orthoclase with oscillatory zoning and simple twinning, anhedral quartz, and very rare, tabular subhedral plagioclase. <2.75 mm, mode 1.11 mm, sr
	Orthoclase, equant, subhedral, some oscillatory zoning and simple twinning, mostly straight extinction, some remelted portions, <0.75 mm, mode 0.41 mm, sa-sr
Rare to very rare	**Quartz**, equant, anhedral, <0.26, mode 0.19 mm, sa-sr
	Amphibole, oblong, subhedral, <0.14, mode 0.13, sr
	Epidote, oblong, anhedral, <0.14 mm, mode 0.13 mm, sr

Carbonate Andesite Loner

Micritic, sparitic, and fossiliferous carbonate and andesite temper in a red brown groundmass
n=1; sample: 47

Microstructure

Common meso planar voids, common macro planer voids, common meso vughs, common macro vughs, few micro vughs. Single to double spaced PRD. Voids and inclusions oriented parallel to vessel walls.

Groundmass

Mostly homogenous, but heterogenous aplastic distribution. Red brown in both PPL and XPL (x40). Moderately optically active, with crystallitic b-fabric.

Inclusions

c:f:v$_{0.125\text{mm}}$	20:72:8

Very poorly sorted. <3.18 mm, mode 0.73 mm, r-sa

Fine fraction

Frequent	**Carbonate**, r
Common	**Quartz/orthoclase**, sr-sa
	Chert, sr-r
	Volcanic, sr-sa
Few	**Plagioclase**, sr-sa
	Pyroxene, sr-sa
	Amphibole, sr
Very few	**Biotite**, sr
Very rare	**Epidote** sr-r

Coarse fraction

Frequent	**Micritic Carbonate**, equant and oblong fragments. Some fragments fossilerferous (calcareous algae or undentifiablefragments), some fragments silliceous will sand sized quartz/feldspar inclusions or cherty, one fragment has sparite crystals. <3.18 mm, mode 1.14 mm, sr-r
	Andesite, equant and oblong fragments. Acicular to glassy groundmass, rarely equigranular, with a phenocrysts including: subhedral plagioclase, anhedral to subhedral pyroxene, subhedral orthoclase, subhedral amphibole. <1.75 mm, mode 0.79 mm, sr-sa
Few	**Chert**, equant and oblong, some weathered and/or carbonate altered. <2.45 mm, mode 0.71 mm, sr
	Plagioclase, equant and oblong, subhedral, albite twinning, some polycrytalline fragments, <0.75, mode 0.26 mm, sr-sa
	Quartz, equant, anhedral, straight extinction, <0.38 mm, mode 0.17 mm, sr-sa
Very few	**Orthoclase**, equant, subhedral, some simple twinning and oscillatory zoning, <0.52 mm, mode 0.18 mm, sr-sa
Rare	**Quartzite**, equant, sutured grain boundaries, undulating extinction, <0.88 mm, mode 0.42, r

Very rare	**Clinopyroxene**, equant, anhedral to subhedral, <0.40 mm, mode 0.23 mm, sr-sa

Glassy Welded Tuff Feldspar Loner

Naturally coarse, glassy welded tuff and k-feldspar inclusions in a light brown groundmass
n=1; sample: 23

Microstructure

Predominant micro vughs, few meso vughs, very rare macro vugh. Single to double spaced PRD. Neither voids nor inclusions display any orientation.

Groundmass

Heterogenous, light brown with dark brown interior wall in both PPL and XPL (x40). Optically active, with b-fabrics including: granostriated, mosaic speckled, random striated.

Inclusions

$\text{c:f:v}_{0.125\text{mm}}$	15:78:7

Inclusions are poorly sorted. <1.25 mm, mode 0.45 mm, sa-sr

Fine fraction

Frequent	**Glassy welded tuff**, sa
	Quartz/orthoclase, sa-sr
Few	**Micritic carbonate**, sr
	Pyroxene, sa
Very rare	**Amphibole**, sr

Coarse fraction

Frequent	**Glassy welded tuff,** (possible that some fragments are glassy lava flow), equant and oblong fragments with common anhedral, equant orthoclase and quartz phenocrysts, and rare subhedral, equant pyroxene and amphibole phenocrysts. <1.25 mm, mode 0.38 mm, sa-sr
Common	**Orthoclase**, mostly equant, rare oblong, anhedral to subhedral with some simple twins and oscillatory

	zoning. Some fragments with areas melted into glass. <0.64 mm, mode 0.29 mm, sa
	Quartz, equant, anhedral. <0.50 mm, mode 0.22 mm, sr
Few	**Argillaceous rock fragment**, (e.g. siltstone), oblong, brown in PPL, yellow brown, orange brown, and brown in XPL, mostly clear boundaries though some diffuse, neutral to positive density, silt sized quartz inclusions. <1.10 mm, mode 0.50 mm, sr-r
Very few	**Clinopyroxene**, subhedral, oblong, some fragments being replaced by amphibole, <0.39 mm, 0.22 mm, sa-sr
	Orthopyroxene, subhedral, oblong, <0.38 mm, mode 0.24 mm, sa-sr
	Glassy volcanic, oblong and equant with anhedral equant and acicular quartz and feldspar phenocrysts. <0.45 mm, mode 0.34 mm, sr
Rare	**Amphibole**, subhedral, oblong, <0.26 mm, mode 0.20 mm, sr
	Plagioclase, subhedral, equant, albite twinning, 0.37 mm, mode 0.29 mm, sa
	Sparitic carbonate, anhedral, oblong, sa-sr coarse crystals (<0.01 mm), <0.48 mm, sr

Textural concentration features

- Few pellets, equant with sharp to clear boundaries and high optical density. Dark brown (PPL and XPL). Rare silt sized quartz inclusions <0.44 mm, 0.16 mm, sr-r

Micritic Carbonate Loner

Coarse sand to gravel sized micritic carbonate temper in light brown groundmass
n=1, sample 170

Microstructure

Predominant micro vughs, few meso vughs, few meso planar voids, very rare macro planar voids. Open spaced PRD. No orientation.

Groundmass

Homogenous. Light brown in PPL and XPL (x40). Optically active with crystallitic b-fabric.

Inclusions

c:f:v $_{0.125\text{mm}}$	8:88:4

Inclusions moderately well sorted. <1.93 mm, mode 1.09 mm, sr-r

Fine fraction

Dominant	**Carbonates**, sr-r
Common	**Quartz/orthoclase**, sr-sa
Very few	**Chert**, sr **Volcanics,** sr
Very rare	**Biotite**, sr

Coarse fraction

Dominant	**Micritic Carbonate**, equant and oblong, some fragments have muddy or cherty areas. <1.93 mm, mode 1.11 mm, sr-r
Common	**Andesite**, equant fragments, mostly acicular, some equigranular to glassy groundmass, anhedral feldspar phenocrysts. One fragment has anhedral pyroxene insterstitial to the feldspar groundmass. <1.58 mm, mode 0.63 mm, sr
Few	**Chert**, equant and oblong, some weathered and/or cabonate altered. <0.55 mm, mode 0.26 mm, sr-r
Very few	**Quartz**, equant and oblong, anhedral, straight extinction, <0.30 mm, mode 0.13, sr-sa
Very rare	**Biotite**, oblong, subhedral, <0.33 mm, mode 0.22 mm, sr

Sandstone Rhyolite Loner

Naturally coarse sandstone and rhyolite inclusions in a dark brown to black groundmass
n=1; sample: 305

Microstructure

Common micro vughs, common meso vughs, common meso planar voids, few macro vughs, few macro planar voids. Single spaced PRD. No orientation, though there is some evidence for a coil.

Groundmass

Heterogenous in terms of inclusion type and size. Black in PPL and XPL(x40). Optically inactive.

Inclusions

c:f:v $_{0.063\text{mm}}$	25:69:6

Inclusions are poorly sorted. <2.18 mm, mode 0.42 mm, sr-a

Fine fraction

Frequent	**Quartz/orthoclase**, sr-sa
Common	**Volcanic**, sr **Biotite**, sr
Few	**Pyroxene**, sr-sa **Plagioclase**, sr-sa

Coarse fraction

Frequent	**Sandstone**, equant and oblong fragments, component minerals moderately well sorted (<0.30 mm) equant and oblong quartz grains with straight extinction and rare muscovite in clay cement. <2.18 mm, mode 0.70 mm, sr-a
Common	**Rhyolite**, equant and oblong fragments, acicular to glassy groundmass with subhedral orthoclase and subhedral biotite phenocrysts. Highly weathered <1.43 mm, mode 0.45 mm, sr **Quartz**, equant and oblong, anhedral, straight extinction, rare polycrytalline fragments, <1.25, mode 0.32 mm, sa-a
Few	**Orthoclase**, equant and oblong, subhedral, oscillatory zoning and simple twinning common, <0.95 mm, mode 0.38 mm, sr-sa **Siltstone**, equant, clay to silt sized brown (PPL and XPL, x40) matrix with sand sized quartz and rare muscovite inclusions. <2.1 mm, mode 0.75 mm, sr **Plagioclase**, equant and oblong, subhedral, albite twinning, <0.55 mm, mode 0.23 mm, sr-sa
Very few	**Biotite**, oblong, subhedral, <0.30 mm, mode 0.25 mm, sr

Rare	**Andesite**, equant, acicular groundmass, anhedral clinopyroxene phenocrysts, <0.85 mm, mode 0.58 mm, sr
Very rare	**Clinopyroxene**, equant, anhedral, <0.2 mm, mode 0.16 mm, sa

Volcanic Conglomerate Loner

Volcanic conglomerate with detrital acidic volcanic and feldsper inclusions in a red brown groundmass
n=1; sample: 190

Microstructure

Frequent micro vughs, common micro planar voids, common meso planar voids, common meso vughs, rare mega vughs, very rare chamber. Single to double spaced PRD. Inclusions and voids are moderately orienated parallel to vessel walls.

Groundmass

Heterogenous. Brown in PPL and reddish brown in XPL (40x). Optically active. B-fabrics include: mosaic speckled and stipple speckled.

Inclusions

c:f:v $_{0.063\text{mm}}$	20:73:7

Inclusions are poorly sorted. <1.18 mm, mode 0.38 mm, sr-sa

Fine fraction

Common	**Quartz/orthoclase**, sr-sa
	Volcanic, sr
	Micritic carbonate, sr
Few	**Biotite**, sr
	Plagioclase, sr-sa

Coarse fraction

Frequent	**Rhyodacite**, equant and oblong fragments, acicular and equigranular to glassy groundmass with subhedral to anhedral biotite, amphibole, quartz, and orthoclase phenocrysts. <1.05 mm, mode 0.42 mm, sr

Common	**Volcanic conglomerate**, equant fragments, moderately well sorted (<0.65 mm) components include rhyodacite (as described above), subhedral orthoclase with oscillatory zoning, subhedral plagioclase with albite twinning, anhedral amphibole in clay cement. Carbonate alternation common. <1.18 mm, mode 0.91 mm, sr
	Quartz, equant and oblong, anhedral, straight extinction, 1.02 mm, mode 0.32 mm, sr-sa
	Orthoclase, equant and oblong, anhedraal to subhedral, oscillatory zoning and simple twinning common. Rare sieve texture. Sericitization common, with some fragments almost completely replaced. <0.80 mm, mode 0.28 mm, sr-sa
Few	**Plagioclase**, equant and oblong, subhedral, albite twinning, common, with some fragments almost completely replaced. <0.74 mm, mode 0.25 mm, sr-sa
	Micritic carbonate, equant and oblong, some fragments cherty, have silt sized quartz inclusions, or have muddy, undentifiable microfossils. One fragment with laminated bedding. <0.75 mm, mode 0.24 mm, sr-r
Rare	**Biotite**, oblong, subhedral, often weathered <0.70 mm, mode 0.47 mm, sr
	Amphibole, oblong, anhedral to subhedral, <0.35 mm, mode 0.33 mm, sr

Crystalline concentration features

- Strongly impregnated hypocoatings. Micritic carbonates coat and often fill voids, apparently a post-depositional alteration, but not found on any other sherds in same context.

Late Iron Age/Period 3

Sandstone Gabbro Loner

Very coarse gabbro, sandstone, and detrital narturally coarse inclusions in a brown groundmass
n=1; sample: 128

Microstructure

Common meso vughs, common macro vughs, common meso planar voids, common macro planar voids. Single spaced PRD. Voids and inclusions are moderately oriented at an oblique angle to vessel walls.

Groundmass

Heterogenous in terms of inclusion composition and size. Brown with dark brown margins in PPL and red brown margins in XPL (x40). Optically active. B-fabrics include: mosaic speckled and granostraiated.

Inclusions

c:f:v $_{0.063\text{mm}}$	25:68:7

Inclusions are poorly sorted. <2.5 mm, mode 0.56 mm, a-r

Fine fraction

Frequent	**Quartz**, sa-sr **Plagioclase**, sa-sr **Carbonate**, sr
Few	**Pyroxene**, sa-sr

Coarse fraction

Common	**Sandstone**, equant and oblong fragments, component minerals moderately well sorted (<0.31 mm) equant and oblong anhedral quartz grains with straight extinction in clay cement. <1.4 mm, mode 0.52 mm, sr-r **Sparitic carbonate**, equant and oblong, component minerals poorly sorted (<1.66 mm), subhedral with rare twinning. <2.5 mm, mode 0.73 mm, a-sr **Gabbro**, equant and oblong rock fragments, component minerals include subhedral plagioclase with seritization, subhedral clinopyroxene, and subhedral to anhedral olivine. Extensive weathering and seritization. <1.33 mm, mode 0.7 mm, a-sa **Quartz**, equant, anhedral, straight extinction, <0.32 mm, mode 0.11 mm, a-sr **Plagioclase**, equant and oblong, subhedral, albite twinning, heavy sericitization common. <0.94 mm, mode 0.54 mm, sa-sr

Few	**Argillaceous rock fragment**, oblong, highly optically active clay groundmass, clear to diffuse boundaries, l ight brown in PPL, yellow brown in XPL (x40) with fine silt sized quartz/feldspar inclusions. <1.05 mm, mode 0.65 mm, r
Very rare	**Muscovite**, oblong, subhedral, 0.09mm, mode 0.09, sa

Roman-Parthian Period/Period 2

Serpentinite Group

Mix of volcanic, sedimentary, and metamorphic sand sized inclusions with rare serpentinite in red groundmass
n=39, samples: 7, 35, 43, 59, 65, 96, 97 106, 107, 111, 113, 119, 123, 124, 137, 140, 141, 150, 152, 201, 215, 216, 218, 220, 222, 226-229, 231, 233, 235, 236, 238, 292, 293, 295, 297-299

Microstructure

Frequent to few meso planar voids, frequent to few micro planar voids, frequent to few meso vughs, frequent to few micro vughs, common to rare macro planar voids, common to very rare macro vughs. Single to double space PRD, though single is more common. The planar voids are generally oriented parallel to the vessel walls, but the inclusions have no orientation.

Goundmass

Moderately heterogenous with two main groups: an optically active group (7, 35, 43, 59, 65, 97, 106, 113, 140, 215, 222, 226, 233, 235) and a low optical activity group (96, 107, 111, 119, 123, 126, 137, 216, 218, 227, 228, 229, 231, 236), with just a few samples having a low optical activity core and high optical activity margins (124, 141, 150, 152, 201). The optically active samples are orange brown with darker brown depletions around some of the voids and inclusions in both PPL and XPL (x40). Though inclusions are usually evenly distributed, some samples samples (43, 218, 226, 235) have clear areas without coarse inclusions. The samples with low optical activity are brown to dark brown in PPL and red brown to dark brown in XPL (x40). The more optically active samples have several b-fabrics, including: granostriated, porostriated, mosaic speckled, unistrial, and random striated.

Inclusions

c:f:v $_{0.063\text{mm}}$	15:82:3 -22:69:7

The inclusions are moderately sorted. Most of the inclusions are medium sand sized, and nearly all of the inclusions fall into the range of fine-coarse sand, with very few inclusions represented in the fine fraction. <0.9, mode 0.22 mm, sa-r, some sa.

Fine Fraction

Frequent to common	**Quartz/orthoclase**, sa
Common to few	**Clinopyroxene**, sr
	Orthopyroxene, sr
Common to rare	**Volcanics**, r
	Plagioclase, sr
	Carbonate, sr
Few to absent	**Serpentinite**, sr
	Glass, sr
	Biotite, sr
	Amphibole, sr
Very rare to absent	**Epidote**, r

Coarse Fraction

Few	**Andesite**, oblong and equant, tabular subhedral feldspar (probably plagioclase and some orthoclase) and quartz, with some simple twinning (<0.1 mm), ranging to a more glassy groundmass. Also, tabular subhedral and equant anhedral clinopyroxene, equant anhedral orthopyroxene, rare euhedral to anhedral, sometimes fibrous amphibole, rare saussuritization. Some weathering around crystal and fragment edges, some devitrifed, rare carbonate altered <0.42 mm, mode 0.35 mm, sr
	Glassy volcanic, (probably detrital andesite and/or dacite, but lacks identifying inclusions) oblong and equant, some with acicular groundmass with trachytic texture, some with more equant groundmass with unclear crystal boundaries, rare tabular feldspar phenocryst, but most lacking identifiable conclusions. <0.69 mm, mode 0.34 mm, sa-sr
	Orthoclase, equant and oblong, straight extinction, some simple twining and oscillatory zoning, rare sieve texture, often weathered <0.28 mm, mode 0.22 mm, sa-sr

	Clinopyroxene, equant and oblong, euhedral to anhedral, rare twinning, some altering to biotite, some uralization <0.35 mm, mode 0.20 mm, sa-sr
	Sparitic Carbonate, equant and elongated, anhedral, sa-sr coarse crystals, rare twinning. Some shell fragments, <0.55 mm, mode 0.29 mm,
	Polycrystalline quartz/feldspar, (probably detrital diabase, but lacks identifying inclusions), quartz/feldspar all untwinned (<0.53 mm), mostly straight extinction but some undulous extinction, clay particles around some mineral margins, re-melted crystal boundaries around some margins, rare anhedral muscovite, rare equant anhedral opaques, very rare zoisite, <0.54 mm, mode 0.41 mm, sa-sr
	Diabase, oblong, groundmass has anhedral feldspar (probably plagioclase, though mostly untwinned or simple twinned, <0.55 mm), euhedral to subhedral amphibole (possibly hornblende), fibrous and/or acicular amphibole (possibly tremolite-actinolite), anhedral pyroxene, anhedral epidote-zoisite, rare chlorite lathes, rare subhedral biotite. mostly polygonal intergrain relationship but some grain boundaries remelted, and rare decussate texture present. Possible rare evidence for low grade metamorphism (phyllite?) as observed through possible foliation and deformation, but fragments too small for certain identification <0.71 mm, mode 0.42 mm, sr
Few to rare	**Glass**, oblong and equant, some perlitic, some devitrification, <0.52 mm, mode 0.28 mm, sa-sr
	Quartz, equant and oblong, straight extinction, <0.50 mm, mode 0.26 mm, sa-sr
	Micritic Carbonate, equant and elongated, with clear to diffuse boundaries, some siliceous and/or muddy, <0.64 mm, mode 0.21 mm, sr-r
	Serpentinite, equant and oblong, pale yellow to red in PPL, grey to red in XPL (x40), darker red in less optically active samples, sometimes also isotropic, fibrous *machen* texture, undulous extinction, some fragments still serpentinizing and pyroxene remains visible, <0.46 mm, mode 0.24 mm, sa-sr
	Orthopyroxene, equant and oblong, subhedral, <0.24 mm, mode 0.16 mm, sa-sr
	Dacite, oblong and equant, groundmass of equant anhedral or acicular quartz/feldspar often grading into

	glass, with some anhedral amphibole and anhedral quartz and feldspar phenocrysts, <0.48 mm, sr
	Amphibole, euhedral to anhedral, often highly weathered, rare polycrystalline <0.53 mm, mode 0.23 mm, sr
	Biotite, subhedral to anhedral, highly weathered, <0.48 mm, mode 0.25 mm, sr-r
	Plagioclase, equant and oblong, subhedral, straight extinction, albite twinning and rare oscillatory zoning, <0.31 mm, mode 0.21 mm, sa-sr
Rare to absent	**Iddingsite**, equant and oblong, orange to red in PPL, dark red in XPL (x40), darker red in less optically active samples, sometimes also isotropic, fractured cleavage, <0.14 mm, mode 0.12 mm, sa-sr
	Polycrystalline pyroxene, (probably peridotite) oblong and equant, anhedral to subhedral minerals, mostly clinopyroxene but some othropyroxene may be present, also rare fragments of anhedral quartz/feldspar <0.30 mm, weathering to clay around mineral edges, some partially altered to biotite, rare evidence of low grade metamorphism, rare red around margins evidence of uralization and/or serpentinization <0.65 mm, 0.45 mm, sr
	Polycrystalline epidote, (possibly epidotite), equant, anhedral (<0.05 mm), <0.20 mm, sr
	Zoisite, equant, anhedral, anomalous blue interference colors, <0.16 mm, mode 0.09 mm, sr-r
	Muscovite, oblong, subhedral, rare polycrystalline fragments that show some evidence of low grade metamorphism (possible foliation), <0.47 mm, mode 0.25 mm, sr
	Argillaceous rock fragment (e.g. siltstone), equant and oblong, dark brown to light brown in PPL, yellow brown, orange brown, dark brown and brown in XPL, clear to diffuse boundaries, neutral density, silt sized quartz/feldspar inclusions, 1.32, 0.45, .67 mm

Textural concentration feature

- Few to very rare argillaceous pellets, equant and oblong with sharp to diffuse boundaries and high to neutral optical density, rare silt sized quartz inclusions, very rare clusters of epidote, anhedral pyroxene, and/or fibrous amphibole. Dark brown, red brown and brown (PPL and XPL). <0.60 mm, mode 0.26 mm, sr

Amorphous concentration feature

- Moderately impregnated segregations dispersed irregularly throughout samples

Feldspar Andesite Loner

Sand sized k-feldspar and andesite inclusions in red groundmass
n=1; sample: 133

Microstructure

Dominant micro vughs, common meso planar voids, few meso vughs, rare macro vughs. Double spaced PRD. Voids and inclusions oriented parallel to vessel walls.

Groundmass

Homogenous. Orange brown groundmass in PPL and XPL (x40). Highly optically active with unistrial b-fabric.

Inclusions

c:f:v $_{0.063\text{mm}}$	14:81:5

Inclusions moderately sorted. <1.2 mm, mode 0.36 mm, sr-a

Fine fraction

Dominant	**Quartz/feldspar**, sr-a
Common	**Plagioclase**,sr-sa
Very few	**Pyroxene**, sr-sa
	Volcanic, sr
Very rare	**Muscovite**, sr

Coarse fraction

Frequent	**Orthoclase**, equant and oblong, oscillatory zoning and simple twinning common, subhedral, some fragments polycrystalline, <0.85 mm, mode 0.33 mm, sr-a **Plagioclase**, equant and oblong, albite twinning, subhedral, <0.42 mm, mode 0.21 mm, sr-a **Andesite**, acicular to glassy groundmass with subhdral to anhedral orthoclase and plagioclase phenocrysts, often melting into the groundmass. Devitrification and weathering common. <1.2 mm, mode 0.31 mm, sr

Very few	**Pyroxene**, equant, subhedral to anhedral, <0.23 mm, mode 0.14 mm, sr **Quartz**, equant and oblong, anhedral, <0.20, mode 0.13 mm, a-sr

Textural concentration features

- Common pellets, equant with sharp to clear boundaries and high optical density. Dark brown (PPL and XPL). <0.85 mm, mode 0.23 mm, r-sa

<u>Perlitic Glass Loner</u>

Perlitic glass inclusions in a dark red groundmass
n=1; sample:28

Microstructure

Dominant meso-vughs, few micro-vughs, few meso planar voids, few micro planar voids, very rare macro planar, very rare macro vugh. Single spaced PRD. Planar voids show orientation parallel to the vessel walls; inclusions are equant and do not have orientation.

Goundmass

Homogenous groundmass. Optically inactive except for thin strip along exterior edge. Dark brown to black with thin strip of red brown along exterior edge in both PPL and XPL (x40). B-fabrics include: mosaic speckled along exterior edge.

Inclusions

c:f:v $_{0.125mm}$	25:68:7

Inclusions are poorly sorted. <2.0mm, mode 0.49 mm, sr-r

Fine Fraction

Frequent	**Quartz/orthoclase**, sr **Glass**, sa
Very few	**Pyroxene**, sa-sr
Very rare	**Biotite**, sa

Coarse Fraction

Predominant	**Perlitic glass**, equant, isotropic with flow pattern and spheroids. Rare inclusions include subhedral equant and elongated orthoclase with simple twinning, anhedral equant quartz, acicular quartz/orthoclase too

small to identify (<0.02mm), very rare subhedral elongated pyroxene, very rare elongated anhedral mafic mineral too deteriorated to clearly identify (possibly biotite?). <1.58 mm, mode 0.41 mm, sr-r

Orthoclase, subangular, subhedral, equant and elongated, <0.49 mm, mode 0.27 mm, sa-sr

Plagioclase, one very large (fine gravel sized) equant, anhedral, polycrystalline fragment with simple twinning, sieve texture, and tabular epidote group accessory mineral. <2.00, r

Amphibole, subhedral, elongated, <0.26 mm, mode 0.19 mm, a-sr

Clinopyroxene, anhedral, elongated, <0.26 mm, sa

Argillaceous rock fragment (siltstone), equant fragment, brown in PPL and yellow brown in PPL (x40) with non-oriented, oblong, rounded medium sand sized glass inclusions and silt sized equant and oblong, anhedral quartz and feldspar inclusions. <1.45 mm, sa

APPENDIX E: NAA Data

ANID	As	La	Lu	Nd	Sm	U	Yb	Ce
SGF001	19.3017	32.7714	0.3699	25.1283	5.5765	2.6532	2.3839	63.4345
SGF002	24.0210	14.9571	0.1679	12.1274	2.9449	6.1901	1.1121	32.4112
SGF003	23.7552	25.9824	0.3246	21.2251	4.6829	3.0191	2.0525	51.3453
SGF004	205.9631	95.1316	1.7385	114.6437	29.3810	13.3160	13.1396	274.5340
SGF005	29.2668	21.1297	0.2560	18.5627	3.8183	1.9778	1.8967	42.2395
SGF006	8.5017	14.8471	0.1553	11.4523	2.5289	1.5492	0.9653	29.0748
SGF007	19.0799	10.4140	0.1725	8.4034	1.7303	2.7609	0.6825	18.9937
SGF008	207.6102	27.9103	0.2793	21.9944	4.5528	3.2921	1.8104	54.0255
SGF009	32.1295	19.2327	0.2528	16.0098	3.5142	2.2927	1.7259	37.6379
SGF010	13.2189	20.8623	0.2672	15.1503	3.3776	3.0570	1.4236	39.2831
SGF011	6.1251	25.7818	0.3086	20.6108	4.8411	2.5486	2.1960	50.5654
SGF012	15.8310	47.2946	0.4247	35.2395	6.8324	2.4446	3.3979	92.3438
SGF013	10.2114	14.9404	0.2867	12.0028	3.5249	1.3355	2.0359	29.9817
SGF014	15.6299	22.4948	0.3190	18.9801	4.3875	2.1484	2.3054	43.8684
SGF015	17.3824	22.1107	0.3323	18.3749	4.5922	1.8459	2.2495	43.2893
SGF016	34.2414	22.9679	0.3386	20.6040	4.6185	2.3938	2.3502	46.2114
SGF017	9.2314	17.8390	0.2185	13.7936	2.8253	3.3299	1.1981	33.0981
SGF018	18.1912	26.9549	0.3166	22.1629	5.0478	3.0349	2.0096	54.1404
SGF019	14.9202	20.8396	0.2310	18.5617	3.7244	1.5198	1.6548	41.2126
SGF020	21.8080	23.1924	0.2954	18.2429	3.9608	2.4278	1.6824	44.3229
SGF021	12.6428	28.4674	0.3163	21.5172	4.6702	2.1855	1.9807	54.9179
SGF022	25.6217	24.8479	0.2655	17.8403	4.1014	1.8701	1.6220	47.7232
SGF023	12.0159	45.4763	0.7057	40.4465	8.8930	1.7465	5.1932	85.7154
SGF024	13.9514	63.7940	0.3375	44.0286	9.5192	9.2200	2.7175	120.8490
SGF025	7.9855	31.9542	0.3012	24.7624	5.2059	2.6670	2.0992	60.5071
SGF026	14.3884	31.3060	0.2897	24.1901	5.0070	2.6328	1.9984	59.0431
SGF027	6.3820	58.3054	0.3046	38.8239	7.1534	6.7507	2.2428	102.0160
SGF028	10.5391	28.8427	0.2927	25.0045	4.7911	2.8178	2.1960	54.4202
SGF029	6.2352	57.0299	0.3223	41.0827	7.9329	6.1818	2.3165	106.8751
SGF030	11.1183	47.2583	0.5834	38.5492	7.9930	3.0181	4.0880	94.5483
SGF031	10.7106	26.8811	0.2800	21.8056	4.5664	2.3534	1.8663	53.7283
SGF032	15.2560	49.0276	0.7289	42.4016	9.3742	2.3654	5.2392	94.5166
SGF033	12.6766	19.3278	0.3232	15.4832	3.9900	1.6076	2.3940	38.0155
SGF034	14.6705	19.2423	0.3293	14.8926	4.0060	1.7664	2.4164	38.3043
SGF035	14.5775	27.9007	0.3029	21.1006	4.7468	2.7081	2.0216	53.3238
SGF036	18.3575	23.8220	0.2787	17.9726	3.9759	2.1950	1.7967	45.0593
SGF037	11.4851	29.7332	0.3590	22.6233	5.2871	1.8517	2.4964	57.3961
SGF038	16.9695	27.0970	0.3155	21.5891	4.6201	2.3704	2.0069	56.3157
SGF039	13.2564	33.8558	0.3686	25.3693	5.2755	2.7277	2.3678	67.9595
SGF040	10.2188	32.4318	0.3416	28.3177	5.8968	2.1440	2.3765	63.9717
SGF041	12.8295	29.0946	0.3214	19.7464	4.8198	2.3991	2.0024	58.8596
SGF042	10.8082	30.7330	0.3578	23.5937	5.4653	1.9450	2.9007	61.5369
SGF043	25.9417	41.6395	0.3461	28.2434	5.4779	2.7942	2.4898	74.7741
SGF044	7.4972	81.0792	0.5814	49.9656	9.2665	8.5833	2.5812	148.6402
SGF045	11.4053	33.0507	0.3632	27.3153	6.0881	2.5496	2.3556	64.0778
SGF046	9.1727	36.2838	0.3955	27.1381	5.7960	2.3141	3.0992	71.4813
SGF047	16.7700	47.8533	0.3257	32.3901	5.9288	3.2545	2.2619	83.9729
SGF048	11.6870	28.7153	0.2706	21.2353	4.5220	2.8565	1.5719	58.0734

ANID	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb
SGF001	21.2589	73.0612	6.7409	1.3606	49451.9	4.3416	66.06	83.55
SGF002	9.2836	134.7289	2.4130	0.5873	25067.3	2.4562	43.23	29.15
SGF003	17.5270	166.1713	3.4883	1.0702	36732.6	4.8682	51.38	57.84
SGF004	131.4902	87.8838	5.9419	8.9742	132451.1	5.7793	141.75	43.84
SGF005	11.1591	230.6166	17.9753	0.8865	32767.7	3.5767	62.86	60.69
SGF006	11.6948	74.8602	4.4968	0.5455	19287.8	1.9534	37.82	42.33
SGF007	6.5570	64.4325	1.5715	0.3771	13794.2	1.4768	21.89	18.30
SGF008	8.3086	91.5480	47.7401	1.1299	43713.0	3.3568	45.90	79.66
SGF009	18.2789	167.4264	4.2962	0.8771	36309.6	2.8966	71.74	53.52
SGF010	15.3526	166.2850	1.6971	0.9168	35293.4	3.7106	66.32	35.75
SGF011	29.1214	268.4450	4.4231	1.1053	52494.0	3.3333	219.68	78.18
SGF012	23.3150	155.4880	6.2722	1.4918	52112.8	6.6706	78.79	103.27
SGF013	22.7793	28.6684	1.9172	1.0698	58305.4	2.6862	0.00	45.24
SGF014	20.3328	38.5991	3.9197	1.1559	51444.5	3.3785	50.68	66.82
SGF015	23.3516	55.8860	2.3335	1.2993	63331.7	3.8131	0.00	55.20
SGF016	18.5455	78.7351	4.7002	1.1646	46651.0	3.9557	46.33	65.91
SGF017	13.2990	102.9772	2.5919	0.6220	28082.4	1.9815	96.13	42.93
SGF018	20.3874	26.4670	2.9814	1.3960	57505.9	3.5213	0.00	68.03
SGF019	18.4920	219.3652	2.0656	0.9402	39439.4	3.4204	53.30	52.94
SGF020	16.0963	101.5358	2.9859	0.9594	37807.1	3.9450	87.15	56.28
SGF021	20.3034	124.9214	3.3139	1.1343	41421.2	3.7762	78.29	66.99
SGF022	12.6340	89.6277	11.1692	0.9971	36181.3	3.7369	0.00	54.02
SGF023	11.0282	112.7391	3.9395	2.0757	55062.8	10.0673	44.51	63.57
SGF024	25.3836	53.6480	13.4404	2.1189	47049.1	7.8935	23.65	210.16
SGF025	20.1921	133.2688	4.1455	1.2859	46210.2	4.3781	48.15	75.13
SGF026	19.8764	106.0331	4.1374	1.2453	46025.6	4.0093	43.27	73.74
SGF027	15.2738	78.1520	9.3329	1.6100	40691.3	6.9449	30.78	114.48
SGF028	19.0932	113.8227	4.0118	1.1495	43401.8	3.8800	46.60	70.97
SGF029	20.9558	89.1792	8.2455	1.7945	47140.4	6.6446	0.00	120.20
SGF030	21.5456	178.8890	5.5539	1.5774	53308.4	8.7366	63.37	112.19
SGF031	18.3465	115.0314	3.1130	1.1062	41275.2	3.8092	62.49	57.63
SGF032	10.6543	113.2435	4.0341	2.0612	53333.7	9.7970	43.06	66.07
SGF033	32.7047	230.1867	2.4462	1.0691	54095.12	3.8157	146.23	47.15
SGF034	34.4113	235.5078	2.8643	1.0757	56025.52	3.7132	172.98	52.05
SGF035	21.4942	147.7089	3.7936	1.1451	43970.10	3.7539	81.24	64.50
SGF036	18.9837	136.0436	3.2763	0.9594	37544.21	3.0712	87.50	57.71
SGF037	22.9698	127.0117	4.0894	1.2873	54090.84	4.5222	47.84	62.49
SGF038	14.4404	105.9308	8.1206	1.0339	39119.34	4.3871	38.53	57.10
SGF039	20.4900	146.3016	3.3106	1.2279	45205.46	5.2342	46.88	73.60
SGF040	22.1307	131.6424	2.5785	1.5116	51444.67	4.4615	85.57	78.02
SGF041	18.4030	69.1410	4.1978	1.1687	43307.13	4.1052	35.93	67.03
SGF042	24.9194	131.1318	3.9823	1.2977	55443.69	4.4528	52.25	57.52
SGF043	16.7900	103.9807	3.4415	1.3049	42735.07	5.7137	71.69	67.35
SGF044	22.2968	38.1186	9.5538	1.8599	47933.40	6.7042	0.00	133.78
SGF045	22.4615	139.7799	2.5453	1.5464	51809.82	4.5109	53.95	78.51
SGF046	20.8079	158.9641	4.1138	1.3493	46906.05	5.7061	64.55	84.11
SGF047	17.3256	90.0398	3.3144	1.3566	41511.72	5.7324	44.67	78.40
SGF048	14.8300	51.3721	2.0485	1.2239	36152.73	3.4042	0.00	58.75

ANID	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
SGF001	1.2960	19.0309	423.71	0.8787	0.7129	10.4746	119.69	128.04
SGF002	1.0318	7.6504	459.25	0.7460	0.2806	4.3111	44.85	81.91
SGF003	2.1033	12.3855	404.85	0.8863	0.6097	8.0871	107.75	131.51
SGF004	0.8736	42.0176	125.15	1.6022	4.4047	4.5565	172.09	301.13
SGF005	0.6296	11.5210	222.04	0.6967	0.4980	6.2046	51.06	102.54
SGF006	0.3144	6.9278	914.63	0.5984	0.2745	4.1175	48.19	42.16
SGF007	0.4016	4.4864	479.94	0.3007	0.1761	2.5443	29.92	50.72
SGF008	1.0028	14.8230	432.34	0.5756	0.4740	7.9498	109.59	90.51
SGF009	0.4928	13.1001	388.57	0.8102	0.3899	5.0953	64.82	71.42
SGF010	0.5662	10.1957	449.29	0.6529	0.3973	5.2556	58.03	104.99
SGF011	0.7506	18.5759	419.63	0.8489	0.5690	8.0925	98.63	77.98
SGF012	0.9698	16.4310	254.10	1.4120	0.8787	15.3676	109.04	213.85
SGF013	0.4306	23.0328	392.29	0.2957	0.9593	4.0910	100.27	78.55
SGF014	0.6532	19.7299	449.03	0.5144	0.5650	6.7718	106.93	109.89
SGF015	0.5535	20.1516	501.17	0.5096	0.5971	5.7938	114.06	102.24
SGF016	1.9125	17.2947	396.77	0.6780	0.5261	6.1132	106.46	106.40
SGF017	0.4346	9.2088	3024.23	0.4484	0.2743	5.1867	56.28	62.95
SGF018	0.8782	17.5654	483.78	0.6116	0.5607	6.6435	100.99	93.04
SGF019	1.5046	13.0610	918.35	0.8615	0.4435	5.0591	78.64	93.65
SGF020	0.7002	11.9111	554.12	0.6579	0.4869	6.7854	86.25	111.45
SGF021	0.7102	14.8116	460.08	0.7575	0.5483	8.9319	78.47	97.15
SGF022	0.6518	11.5884	550.32	0.7651	0.6582	7.5174	69.06	91.77
SGF023	0.6678	14.4621	215.84	1.9428	1.2945	13.8363	116.50	284.60
SGF024	0.8337	11.0899	916.75	1.8123	0.9856	27.8315	117.64	259.26
SGF025	0.7339	16.2197	512.29	0.8223	0.5759	9.8762	91.23	111.95
SGF026	0.8050	16.1288	550.44	0.8021	0.6719	9.6661	86.70	102.68
SGF027	0.7517	10.2802	663.80	1.6104	0.6654	26.0808	82.55	222.52
SGF028	0.6714	15.4881	635.47	0.7329	0.5974	9.1976	79.50	82.87
SGF029	0.5557	12.5801	826.35	1.6227	0.7195	27.6328	89.24	189.05
SGF030	0.7831	15.2627	217.87	1.8277	1.1328	15.1234	105.87	235.47
SGF031	0.6834	14.8452	397.78	0.7284	0.5410	8.9892	85.43	97.82
SGF032	0.6404	13.6051	272.41	1.9365	1.3676	13.7607	123.76	248.42
SGF033	0.4944	21.1026	281.15	0.6932	0.5698	5.7691	87.35	97.93
SGF034	0.5169	21.9570	276.55	0.6236	0.6253	5.5827	107.39	91.96
SGF035	0.6441	15.9123	408.60	0.7825	0.5706	8.8276	83.81	84.31
SGF036	0.6518	13.5177	598.45	0.6146	0.5255	7.2140	88.60	92.76
SGF037	0.7257	20.2678	277.03	0.7764	0.6520	8.3461	102.49	120.41
SGF038	0.6091	12.2711	318.88	0.9121	0.5484	8.8579	84.12	127.23
SGF039	0.5758	15.1066	377.69	1.0827	0.6696	10.4899	98.40	131.31
SGF040	0.5489	16.9801	343.25	0.7880	0.6514	9.4672	117.41	110.11
SGF041	0.8842	15.5092	474.42	0.8001	0.5587	10.2136	89.77	124.14
SGF042	0.7070	20.3250	335.52	0.7938	0.7933	8.5421	96.01	122.13
SGF043	0.9767	14.0198	576.78	1.0148	0.7398	12.8626	91.59	157.11
SGF044	0.3086	11.4050	870.27	1.8777	0.8152	31.1523	95.90	227.93
SGF045	0.5233	16.8796	362.12	0.7733	0.7860	9.5323	104.67	150.69
SGF046	0.6477	15.6116	291.93	1.1609	0.8662	10.7767	91.74	148.77
SGF047	1.3238	14.3605	615.27	0.9425	0.5435	14.9833	91.50	189.68
SGF048	0.6482	11.6970	628.89	0.6509	0.4481	9.7267	63.70	91.71

ANID	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
SGF001	88233.7	529.6	71567.8	4.1227	17891.1	1076.25	8661.5	4528.7	156.30
SGF002	36775.4	163.6	248268.1	2.0379	7097.2	267.01	3361.7	2859.2	133.32
SGF003	58906.9	378.4	137316.6	3.3445	14425.4	725.22	10015.7	3473.9	100.66
SGF004	93245.4	395.3	21103.5	27.4239	13880.7	507.29	3629.5	15437.7	504.37
SGF005	47929.0	248.4	175499.4	3.2181	9574.2	498.62	2440.6	2947.6	115.15
SGF006	35109.4	151.3	279044.0	1.8077	10921.0	333.65	2490.4	2039.3	44.85
SGF007	20181.3	123.5	218535.0	1.1822	5213.1	314.62	2144.9	1255.7	78.45
SGF008	67379.2	590.0	136946.2	3.1782	14422.0	367.55	6260.2	3256.9	179.19
SGF009	48905.2	233.6	166789.8	2.8315	15380.2	712.67	5655.5	3594.7	104.59
SGF010	47279.0	402.5	140258.5	1.7540	10936.0	677.71	10708.4	3953.7	139.38
SGF011	63247.8	341.6	72436.3	2.7675	23676.8	968.94	21381.2	3487.1	145.01
SGF012	92845.6	727.2	23815.2	4.0256	21572.2	1264.32	12481.4	4535.3	142.86
SGF013	87976.8	523.7	44618.4	2.7355	14050.7	1211.60	21396.1	3001.0	218.78
SGF014	81982.8	543.1	54789.1	2.7056	17794.2	1055.32	12158.0	3373.6	171.97
SGF015	80484.5	613.6	60095.8	3.1381	19093.1	1074.28	18031.4	3523.1	235.24
SGF016	76800.5	377.4	72139.1	3.3492	17281.7	746.20	4501.4	4393.9	161.66
SGF017	40938.2	310.6	164869.6	2.0253	13034.6	535.38	7630.8	2172.7	88.16
SGF018	88505.7	795.6	20634.4	2.3271	20629.2	1409.58	21275.8	2585.2	208.10
SGF019	52719.5	307.5	169194.0	2.8011	13525.1	722.14	8440.4	3851.3	99.30
SGF020	51342.0	399.3	143277.0	3.0958	19658.0	774.89	10172.8	3177.1	120.85
SGF021	70342.9	680.7	79721.5	3.1512	26444.5	767.70	11285.9	3292.4	123.51
SGF022	56205.6	593.8	135545.1	2.3738	26180.2	800.43	8553.4	3561.6	103.19
SGF023	93170.5	827.4	13251.2	6.9473	22391.4	700.82	15424.5	4827.5	75.32
SGF024	91168.8	1941.3	12518.2	4.4443	39799.5	1440.19	17774.6	3637.0	111.31
SGF025	69470.4	626.5	66556.5	3.2034	22323.2	854.16	12565.6	3114.6	132.33
SGF026	69330.8	799.6	74928.2	2.8742	21285.5	865.28	12137.0	3179.3	132.78
SGF027	81802.7	848.1	26771.8	3.0879	33860.0	672.21	22763.2	4362.6	113.98
SGF028	70477.9	907.9	87417.3	3.0078	21878.4	851.93	10446.2	3959.0	123.62
SGF029	89305.3	1159.2	26806.4	3.9074	37372.2	965.59	21337.5	4718.2	128.01
SGF030	91805.2	653.6	16690.8	6.3468	33414.8	1026.02	15252.9	5164.7	122.05
SGF031	71601.5	587.8	75686.8	3.4149	24106.8	814.01	11015.8	3890.6	123.41
SGF032	100104.0	398.6	16511.4	8.8011	25759.5	927.74	19538.3	5478.6	75.77
SGF033	77839.0	313.2	51415.0	4.2917	21451.9	1017.27	17076.9	4850.4	142.55
SGF034	79145.9	264.1	52808.2	3.8592	14982.7	1058.81	15751.9	4667.7	148.79
SGF035	71573.1	443.5	89246.9	3.9417	22254.6	814.70	11688.4	4318.4	151.59
SGF036	58645.0	448.8	133999.8	2.8774	24398.9	736.80	9019.5	3226.4	110.41
SGF037	90050.1	452.4	23883.4	4.3107	29126.3	852.79	16306.2	4429.5	177.90
SGF038	61852.4	338.4	126676.3	3.6591	23490.3	508.51	6163.5	4246.8	114.07
SGF039	88254.5	450.8	27912.5	3.8727	27680.4	985.18	18394.8	4612.1	119.16
SGF040	92558.2	683.5	10430.3	4.4610	30034.2	1098.93	22819.4	4067.9	182.66
SGF041	86231.8	517.3	51249.5	3.8266	25779.3	1007.37	14710.5	4480.6	129.72
SGF042	91233.1	488.7	22589.0	4.7390	24789.2	1228.76	15650.7	4616.0	183.33
SGF043	90718.9	733.0	21041.5	3.9800	26500.9	568.93	20523.9	4681.9	136.86
SGF044	92034.8	853.8	31848.6	4.9750	25100.0	1385.47	23803.9	5152.1	182.93
SGF045	93773.5	694.8	12339.7	4.5624	31990.5	1157.85	21421.7	4193.8	176.12
SGF046	93187.6	503.5	24627.8	5.0622	20068.8	1078.68	17372.4	5156.8	126.98
SGF047	88579.6	950.4	18588.3	3.4178	27669.9	798.50	19968.7	4363.8	157.87
SGF048	81130.3	812.2	63070.9	2.7972	28301.0	741.48	14330.9	3291.2	126.19

ANID	**As**	**La**	**Lu**	**Nd**	**Sm**	**U**	**Yb**	**Ce**
SGF049	12.8875	29.3390	0.3376	24.0377	5.1128	2.1195	2.7028	60.0955
SGF050	5.2824	47.5249	0.3682	35.0452	6.5737	4.6119	2.1398	88.2150
SGF051	8.3635	27.1585	0.2854	21.5485	4.5483	2.3932	1.8634	52.4613
SGF052	8.5589	32.3768	0.3239	24.2690	5.1359	2.6665	2.2787	61.4028
SGF053	24.9678	47.2390	0.3343	31.9833	6.0024	3.5335	2.6265	85.8781
SGF054	17.8527	38.0267	0.3386	26.6726	5.5302	3.0633	2.5340	65.6127
SGF055	11.5490	36.3285	0.3215	24.5213	5.0794	3.1498	2.0882	65.4161
SGF056	8.3347	32.6667	0.3200	25.0732	5.2460	2.4081	2.2995	65.2408
SGF057	13.8179	37.2782	0.3349	27.8451	5.3357	2.8185	2.2928	65.0606
SGF058	9.4458	33.8643	0.3720	26.4025	5.8777	2.2949	3.0257	61.4458
SGF059	7.2784	36.7278	0.2828	26.0604	5.4258	3.6679	1.7507	73.3767
SGF060	13.3906	28.6639	0.3105	20.0771	4.7015	2.0333	2.0456	55.3162
SGF061	61.1361	42.8455	0.3611	37.1953	6.5017	4.7116	2.4843	82.9182
SGF062	11.1178	27.5139	0.3166	22.8557	4.5596	3.0183	1.8863	51.5503
SGF063	9.3529	27.0813	0.2909	24.5776	4.5433	2.8361	1.7940	55.2437
SGF064	13.2236	29.6836	0.3364	23.1717	4.8019	2.6216	2.1264	56.1683
SGF065	11.3585	28.4185	0.3087	20.5370	4.7221	2.3754	1.9118	56.6442
SGF066	14.2059	30.4314	0.2823	23.1465	5.0449	2.3301	2.1408	59.1456
SGF067	11.2798	28.1833	0.2783	20.8871	4.6435	2.1415	1.8085	53.5218
SGF068	12.2779	28.7360	0.2756	23.8017	4.7070	2.7275	2.1703	54.7809
SGF069	10.7911	44.1069	0.4586	32.5832	6.4387	5.4319	2.4824	81.6408
SGF070	10.5450	35.4620	0.3296	25.3038	5.4502	3.8830	2.2173	66.2184
SGF071	81.8602	41.7695	0.3836	31.0467	6.5255	5.1241	2.7981	82.4706
SGF072	14.7854	33.0060	0.3167	24.5302	5.0485	2.5509	2.0042	61.9407
SGF073	11.6713	33.1387	0.3034	25.7965	5.2780	2.4457	2.0691	62.4700
SGF074	7.9857	41.6145	0.3436	29.7131	6.1097	4.3381	2.2976	77.2945
SGF075	8.6749	45.0835	0.4010	34.9042	6.8339	5.1883	2.3272	87.7030
SGF076	22.5937	41.4545	0.3571	31.4744	6.3311	4.8090	2.4029	79.2456
SGF077	10.4895	31.2265	0.3144	25.4370	4.9839	2.5423	1.8949	57.6875
SGF078	10.7569	17.0875	0.2444	16.5825	3.5951	1.7052	2.0951	34.3158
SGF079	10.3069	32.8293	0.3370	26.2466	5.2952	2.5711	2.4077	61.8414
SGF080	9.7485	17.4191	0.2524	16.8717	3.5850	1.6781	1.9775	34.4711

ANID	Co	Cr	Cs	Eu	Fe	Hf	Ni	Rb
SGF049	18.8038	104.0241	2.5770	1.2366	40988.12	4.8249	58.44	59.50
SGF050	19.6613	56.2595	6.0717	1.5981	49321.63	5.2135	33.03	102.31
SGF051	18.2953	102.5365	3.8380	1.0867	41225.61	3.5854	60.80	62.37
SGF052	19.9028	64.8956	4.6367	1.2893	46238.04	4.2049	34.35	78.70
SGF053	18.5975	102.9080	3.0737	1.3289	42336.24	5.3859	33.08	81.48
SGF054	14.8325	78.1944	2.7805	1.2737	36078.15	4.7301	40.64	72.15
SGF055	17.4363	134.8304	3.0269	1.2262	38518.97	4.5994	57.28	71.81
SGF056	20.5192	142.6912	3.3409	1.2017	43015.07	4.9575	37.07	64.86
SGF057	14.7640	78.6355	2.3739	1.2203	34369.69	4.4535	49.26	68.10
SGF058	24.0919	214.1113	3.6990	1.3942	45704.33	5.4492	82.94	68.17
SGF059	14.3905	35.2691	3.8157	1.3202	37786.55	4.1731	0.00	71.18
SGF060	18.6186	87.3685	3.3479	1.1446	41893.54	3.6829	54.07	63.00
SGF061	17.5101	94.5978	8.6245	1.3922	43803.47	5.5465	63.12	93.44
SGF062	18.4943	110.6163	4.0650	1.0819	40363.69	3.5902	54.98	62.04
SGF063	17.9490	86.8721	3.3027	1.1117	40993.52	3.6347	42.74	58.42
SGF064	18.3541	93.6192	3.3047	1.1210	43801.40	3.6085	46.24	60.73
SGF065	17.4612	84.6859	3.2427	1.1450	40686.09	4.0371	0.00	58.79
SGF066	20.8463	154.4124	5.2802	1.2377	47725.75	4.0346	34.17	75.95
SGF067	18.3781	79.1445	3.2143	1.1437	44497.57	3.7911	61.30	56.28
SGF068	17.2811	78.4421	3.5491	1.1253	40375.21	3.7837	0.00	63.20
SGF069	14.5553	67.3407	7.9023	1.4736	40314.08	5.5155	20.59	118.40
SGF070	21.8159	128.1805	6.8910	1.2595	45663.20	4.4098	82.12	93.86
SGF071	15.2346	119.7426	13.3344	1.4275	43903.81	5.4879	50.73	110.73
SGF072	18.4907	60.0465	5.1476	1.2571	46094.79	4.0213	0.00	83.01
SGF073	17.3278	69.6134	4.5896	1.2551	43601.55	4.3141	48.72	79.71
SGF074	14.0126	73.3805	6.2774	1.3899	35517.91	5.0298	0.00	101.58
SGF075	15.9104	62.7009	7.9863	1.4630	42502.04	6.0303	0.00	107.75
SGF076	15.3519	106.0514	9.0333	1.3495	39583.49	5.2032	29.43	154.50
SGF077	16.6838	79.3290	4.0291	1.2321	40136.00	4.0494	0.00	71.81
SGF078	33.3193	280.8705	2.4028	0.9138	53794.82	2.8744	175.75	38.20
SGF079	19.5718	64.4804	4.6439	1.3210	47237.49	4.0209	50.24	70.64
SGF080	32.8076	282.6273	2.4672	0.9080	53830.45	2.7678	168.04	43.50

ANID	Sb	Sc	Sr	Ta	Tb	Th	Zn	Zr
SGF049	0.7050	13.3413	247.20	0.8079	0.6622	9.6139	76.96	122.50
SGF050	0.6613	13.6819	730.92	1.1111	0.6497	17.2158	94.88	168.76
SGF051	0.7587	14.5926	425.65	0.7035	0.5889	8.6129	89.11	93.26
SGF052	0.9761	16.6452	483.77	0.7563	0.6589	10.1017	100.31	110.68
SGF053	0.9357	13.6363	664.68	0.9607	0.6941	13.9408	85.19	159.51
SGF054	0.5413	10.6176	297.38	0.8268	0.6543	12.2520	79.06	130.70
SGF055	0.5564	12.5633	243.54	0.8763	0.6214	11.5302	73.83	131.58
SGF056	0.6248	14.4142	304.83	1.0568	0.7301	10.7628	98.46	134.20
SGF057	0.5070	10.1219	268.18	0.7832	0.6422	12.1730	75.79	149.56
SGF058	0.5621	16.3814	217.85	1.1269	0.8120	9.5323	106.58	138.81
SGF059	0.4729	12.2060	730.88	0.7980	0.5542	13.1388	77.23	129.13
SGF060	0.6697	14.8239	421.75	0.7546	0.5751	9.4498	99.60	104.78
SGF061	0.9342	13.7097	656.01	1.1748	0.7862	17.3736	98.84	154.00
SGF062	0.6397	14.1322	410.86	0.7192	0.4783	8.6234	84.15	121.59
SGF063	0.6903	14.5941	378.42	0.7471	0.7600	9.3940	92.94	73.70
SGF064	0.7644	14.8558	562.61	0.7335	0.5996	9.5853	100.78	109.17
SGF065	0.7992	14.5343	511.50	0.7751	0.6000	9.4804	83.23	113.91
SGF066	1.0542	18.4871	462.72	0.7807	0.7267	9.8005	104.42	122.19
SGF067	0.7351	14.8965	476.98	0.6824	0.6213	8.8297	97.33	105.72
SGF068	0.8469	14.4036	384.66	0.7075	0.5744	9.6112	87.84	125.45
SGF069	0.5929	12.7900	725.26	1.2168	0.7928	17.9880	89.01	164.80
SGF070	0.6764	16.6608	504.66	1.0291	0.7795	14.6076	98.55	130.61
SGF071	0.8090	14.0254	596.73	1.2127	0.8008	16.1771	108.55	162.10
SGF072	0.9503	16.8710	535.79	0.7585	0.6325	10.5587	102.92	110.28
SGF073	0.8304	15.5965	492.48	0.8094	0.6483	10.6835	107.10	134.68
SGF074	1.5482	12.1880	758.04	1.1469	0.6184	17.2657	87.46	168.93
SGF075	0.6561	12.6679	588.14	1.3232	0.7643	20.0186	94.70	176.96
SGF076	0.3270	12.3498	625.16	1.1898	0.7110	16.9031	71.04	188.95
SGF077	0.7809	14.5072	543.91	0.8275	0.7203	10.4805	87.95	95.86
SGF078	0.3383	21.8545	201.45	0.6506	0.4386	5.3413	109.42	50.43
SGF079	1.0644	16.0326	533.38	0.7806	0.7062	10.0940	96.12	113.24
SGF080	0.4004	21.7557	193.38	0.6152	0.5577	5.3135	112.07	78.92

ANID	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
SGF049	85298.4	684.6	15105.0	4.2430	19092.4	1047.56	11228.4	3990.1	122.55
SGF050	84322.5	793.2	53436.5	3.9237	27068.0	1034.71	17601.1	5096.1	176.83
SGF051	68795.2	457.6	78558.9	3.3998	23648.0	779.53	11153.3	3375.9	136.87
SGF052	87731.2	789.1	47735.3	3.9947	21165.9	1032.38	14246.5	4028.3	153.76
SGF053	91270.6	969.6	15783.7	3.5231	30597.7	1378.90	19948.8	3717.9	137.60
SGF054	85982.3	651.3	10503.0	3.7924	26855.1	791.85	14181.3	3030.6	112.63
SGF055	79125.4	672.0	13280.5	3.5713	27848.7	818.45	13787.1	3801.3	108.61
SGF056	84445.7	429.6	23658.5	4.1876	28141.9	866.32	17415.1	4384.5	123.38
SGF057	88156.8	633.8	11194.7	4.0095	26768.1	856.34	15013.9	3698.5	113.60
SGF058	82618.2	397.3	23234.6	5.4311	20583.4	991.73	11855.9	4675.2	121.63
SGF059	77051.5	367.9	102991.3	3.4201	32843.4	636.28	9872.7	3419.8	111.93
SGF060	75784.4	728.2	58080.6	3.7669	28743.8	1067.26	12173.0	3634.5	138.43
SGF061	77916.8	711.9	103535.6	4.4730	34936.4	942.55	12386.6	4435.4	111.98
SGF062	65320.8	442.4	81493.4	3.3999	25311.4	805.16	10222.4	3091.0	116.86
SGF063	75217.3	447.7	63085.3	2.6402	25844.8	901.34	11761.9	3788.9	132.29
SGF064	77763.4	504.0	64923.5	2.6301	27060.4	890.68	11159.4	3447.6	146.06
SGF065	78617.1	553.4	57290.3	3.5218	29744.4	989.93	14050.1	2770.5	121.52
SGF066	90586.6	538.9	47903.2	3.6428	21840.4	1083.18	12387.6	3383.7	143.63
SGF067	69679.7	494.8	65235.8	2.6411	24694.4	901.99	13647.3	3709.0	139.95
SGF068	72761.3	546.1	58899.9	2.7960	24549.8	872.49	12141.0	3226.8	123.28
SGF069	78707.0	659.5	78575.8	3.6216	30075.1	787.79	12351.5	3452.7	106.77
SGF070	71196.8	569.6	66006.9	3.1212	30212.9	926.52	14821.7	3071.3	142.02
SGF071	80008.8	531.3	71293.8	4.2225	30398.4	654.15	9445.5	4390.9	117.72
SGF072	81643.4	654.6	45678.8	3.6878	26511.3	966.51	12914.9	3598.6	144.09
SGF073	77010.2	663.7	60251.7	3.0602	23016.0	849.42	12780.4	3729.2	117.60
SGF074	84352.0	850.7	48701.1	3.5087	36444.5	706.73	15319.2	3975.1	120.98
SGF075	74306.8	604.7	68416.8	3.7722	34467.2	876.65	11976.6	3915.0	116.92
SGF076	71202.2	666.7	85409.9	3.5737	33135.1	763.47	18591.0	3161.3	97.20
SGF077	74470.2	548.2	70775.0	2.6206	34665.6	817.17	12724.3	3246.3	113.04
SGF078	71067.8	200.0	52148.5	3.1002	26904.0	974.33	10210.5	3596.4	143.91
SGF079	80851.9	1476.7	54906.5	3.5187	23597.6	1008.19	13560.1	4410.2	131.07
SGF080	69823.5	227.3	59527.6	2.1390	22653.7	1041.05	9645.3	3349.4	125.65

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