Spring 5-15-2018

Earthen Monuments and Social Movements in Eastern North America: Adena-Hopewell Enclosures on Kentucky's Bluegrass Landscape

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Recommended Citation

Henry, Edward Ross, "Earthen Monuments and Social Movements in Eastern North America: Adena-Hopewell Enclosures on Kentucky's Bluegrass Landscape" (2018). *Arts & Sciences Electronic Theses and Dissertations*. 1534.
https://openscholarship.wustl.edu/art_sci_etds/1534

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Department of Anthropology

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Earthen Monuments and Social Movements in Eastern North America: Adena-Hopewell Enclosures on Kentucky's Bluegrass Landscape

by
Edward Ross Henry

A dissertation presented to
The Graduate School
of Washington University in
partial fulfillment of the
requirements for the degree
of Doctor of Philosophy

May 2018
St. Louis, Missouri

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Acknowledgments

Although a Ph.D. is awarded to an individual, completing the requirements to earn the degree demands assistance and encouragement from numerous people and organizations. I would like to thank some of these here. During my tenure at Washington University in St. Louis I have been fortunate to work alongside brilliant peer and senior colleagues who have endlessly supported me and my work. However, my dissertation advisor T. R. Kidder stands at the forefront of this list. T. R. gave me a chance to enroll in a top-tier academic institution and conduct research that would otherwise not be possible. In doing so, he helped me refine ideas pertaining to the organization of small-scale societies broadly, in particular ancient Native American communities of the Eastern United States. T. R. also supported my research strengths in geophysical survey and guided me toward new concentrations in geoarchaeology and Bayesian chronological modeling. He served as an amazing role model for professionalism in academia. T. R. is a mentor and friend that I look forward to working alongside for years to come.

The other members of my dissertation committee also played crucial roles in my intellectual and professional development. Michael Frachetti entertained countless conversations on the interplay between mobile societies and the development of social institutions, in addition to providing me with the opportunity for international fieldwork experiences in Central Asia. Gayle Fritz always challenged me to clarify ideas and support them with archaeological data. She also forced me to consider the intricacies of agricultural systems unlike those of contemporary farmers and the effects those systems had on the ways ancient societies organized themselves. Sarah Sherwood helped cultivate my interests in the ways people intentionally and unintentionally modified their surroundings. She entertained my ideas as they developed and always insisted I look to the dirt for answers to the ways people and environments changed.

Sarah Baitzel challenged me to clarify my assumptions and look to cross-cultural comparisons to support my arguments. David Fike served an important role as the outside member of my committee and he did so at the last minute. He had very important comments on details of my research that I may have overlooked. For all these contributions I sincerely thank my committee.

Apart from my committee, numerous colleagues and organizations have supported me in conversation, research, fieldwork, and in most cases all three. Archaeologists at the University of Kentucky's (UK) Department of Anthropology, William S. Webb Museum of Anthropology, Kentucky Archaeological Survey, and Program for Archaeological Research have donated thoughts, equipment, and labor since I was first beginning to explore archaeology as a career. Their continued assistance during my dissertation research in Kentucky was no exception. They include: David Pollack and Gwynn Henderson, George Crothers, Richard Jefferies, Steve and Kim McBride, Greg Maggard, Phil Mink, Justin Carlson, Nancy O'Malley, and Steven Ahler. All the staff archaeologists at UK who were exploring archaeology as a career (as I once did there) during my fieldwork helped me immensely during excavations. They are too numerous to mention here but I thank them nonetheless. The Natural Resources Conservation Service provided a coring truck during my research. Bill Sharp, Scott Aldridge, Steve Blanford, and Karen Woodrich helped facilitate this aspect of my work. I thank them for their time and efforts.

My research in Kentucky greatly benefited from local residents who helped me negotiate access to private land and/or granted me access to lands that held archaeological sites I was interested in. They include: Bill Sharp and Tere Tune, John and Donna Ward, Oscar Penn, Naoya and Marie Yoshida, Robert Tillyer, Tony and Kathy Lacy, Nancy Polk, Craig and Holly Bandoroff, Patria Fielding, Greg McCord, Ernie and Lila Cruse, Wayne Long, the late Rev.

James Clark, Bob Mahan, and Martha Exline. The Archaeological Conservancy allowed access to their Bogie Circle preserve.

Over the years I have benefitted from discussions and collaborations with colleagues I worked alongside while finishing my Ph.D. In St. Louis this includes: David Mixter, Steven Goldstein, BrieAnna Langlie, Michael Storozum, Lynne Rouse, Carla Khlem, Robert Spengler, Aaron Hames, Natalie Mueller, Mica Jones, Maggie Spivey, John Willman, Elissa Bullion, Juan Carlos Melendez, Guillermo Martín-Saiz, Alex Rivas, Kelsey Nordine, Caitlin Rankin, and Andrew Flachs. Outside of St. Louis this includes: Casey Barrier, Alice Wright, Meg Kassabaum, Erin Stevens Nelson, Sarah Baires, Parker VanValkenburgh, Jera Davis, Tim Horsley, Logan Kistler, Colin Quinn, Brent Lansdell, Bryan Haley, Matthew Sanger, Justin Carlson, Stephen Carmody, Brett Giles, Chris Moore, Lewis Borck, and David Cranford. Thank you all for the conversation and inspiration!

Organizations that helped fund my research at Washington University in St. Louis include: The National Science Foundation, The National Geographic Society, The American Philosophical Society, The Graduate School of Arts and Sciences at Washington University in St. Louis, The Throop Endowment, The Kentucky Organization of Professional Archaeologists, in addition to T. R. Kidder, and Bill Sharp and Tere Tune. Kathleen Cook, Kirsten Jacobsen, Elaine Beffa, Jen Masterson, Calin Sterling, and Karlee Kreienkamp—the staff in the Department of Anthropology—helped negotiate and manage these funds, in addition to providing constant support during my time at Washington University in St. Louis. Thank you!

Family often get listed toward the end of acknowledgements even though their degree of contributions and support often outweigh those that precede them. I lost my last two living grandparents while completing this degree and became a father to a beautiful daughter. When investing in a piece of research of this magnitude it is easy to get lost in the minutiae and selfishness of one’s work. However, family is always there to pull you out of dark holes and to provide constant reminders of what *always* remains important in life and who is there to break your fall. I thank my father and step-mother Michael and Debbie Henry; my mother Dina Perry; and my in-laws Denny and Carole Schuhmann, as well as all my brothers and sisters, nieces and nephews, for their advice, encouragement, assistance, and friendship. I love you all.

Finally, I must thank the people who keep me going every day. My wife Andrea Schuhmann and my daughter Sylvia Wren Henry are always my largest sources of inspiration. They pick me up when I am down, cheer me on when I succeed, and are constantly my motivation to keep going. I look forward to our next big adventure and promise to always return every bit of support you have given me. I love you both dearly.

Edward R. Henry

Washington University in St. Louis
May 2018

Dedicated to:

Andrea Nichole Schuhmann & Sylvia Wren Henry

ABSTRACT OF THE DISSERTATION

Earthen Monuments and Social Movements in Eastern North America: Adena-Hopewell Enclosures on Kentucky’s Bluegrass Landscape

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Professor Tristram R. Kidder, Chair

Geometric earthen enclosures are some of the best known pre-Columbian monuments in North America. Across the Eastern Woodlands, many have been preserved as state and national parks. However, their chronological placement is poorly understood as they relate to the rise of complex social behaviors associated with the Adena-Hopewell florescence (500 BC–AD 500) in the Middle Ohio Valley. This is especially true for communities who built smaller enclosures referred to by archaeologists as ‘scared circles’. To better understand the timing, tempo, and nature of their construction I examined the Bluegrass Region in Central Kentucky using aerial and terrestrial remote sensing methods to learn if more enclosures were built than previously known. My results indicate the remnants of many sites exist but have been greatly damaged by modern agricultural activities and development. I then excavated a series of seven sites, examining their embankments, ditches, and internal use-areas. I found the communities who built these monuments did so in ways unique to their local histories of participation in the Adena-Hopewell social movement. Chronological modeling suggests the construction of all earthen enclosures in the Bluegrass region likely occurred in 170 years or less and the spread came from the north, possibly Central Ohio. Burial mounds, however, were built as early as 400 BC and the switch to building enclosures signals a major social change in the need for ritual

space. From the sum of these results I argue that the traditional definition of Adena is indeed earlier than the major Hopewell climax in Ohio. However, I argue that this may indicate the material evidence for Hopewell ritual cycles, of which local populations in Kentucky were likely active participants in, do not represent a separate culture but instead a different context and situation for interregional integration.

Chapter 1:
Adena, Hopewell, and the Awkward Past and Present of Archaeology in the Eastern Woodlands of North America

1.1 Introduction

When European settlers began colonizing the interior portions of eastern North America they encountered a diverse range of earthen monuments, some of which were constructed more than two millennia before their arrival. These landscape features promoted a sense of awe among those participating in the migratory wave of colonial expansion into the Ohio and Mississippi River drainages that was so great, many could not accept that they were built by the ancestors of the same American Indian tribes they were killing and displacing. From this Euro-American fascination with the various mounds, enclosures, and animal effigies shaped from earth and spread across the Eastern Woodlands came a thesis that they were built by a lost race of people that had been killed and replaced by the American Indians settler communities were clashing with as the American Republic's territorial expansion moved west. The historical effects of the 'myth of the mound builder' narrative explicitly helped legitimize the forced removal of American Indian groups from their ancestral lands and erase any historical connection they had to these monumental places in eastern North America (Howey 2012; Silverberg 1986).

With the elaboration of colonial 'origin stories' for mounds in the eastern U.S., nineteenth-century hypotheses appeared that proposed 'lost tribes of Israel', Vikings, and other white European-based populations had once lived on the North American continent and created the mounds and enclosures. These hypotheses created an alternate narrative that effectively rewrote the history of pre-Columbian North America, a history that endured much after research conducted by the Smithsonian Institution (Thomas 1894) demonstrated that earthen monuments were erected by the ancient ancestors to then-modern American Indian nations. In fact, this counter-narrative is being reprised today amidst the rise in White nationalism across the United States. While archaeologists have long emphasized the indigenous nature of these monuments and worked to broadly understand the long and varied history of pre-Columbian human occupation in eastern North America.

Less attention has been directed toward detailing local participation in regional-scale social movements that influenced how communities began constructing and using certain kinds of earthen monuments. In addition, rarely does research on or at earthen monuments allow archaeologists to trace how pre-Columbian societies who lived centuries after their construction interacted with these sites. As America's own history involving the myth of the mound builder shows, monuments have the potential to outlast numerous social movements and migrations, and these social changes often come with different meanings, memories, and myths associated with monuments—even their modification (Bradley 1998; Connerton 1989; Dillehay 2007; Henry 2017; Sherwood and Kidder 2011; Osborne, ed. 2014; Parker Pearson 2013; Pauketat 2014; Pauketat and Alt 2003; Pollard 2012).

Perhaps part of the reason why historical contingencies underlying the creation and use of earthen monuments in the eastern Woodlands can be lost in the focus of archaeological research comes from the origins of archaeology as a discipline. Pre-dating chronometric dating methods, the development of archaeology first relied on stratigraphy and ceramic chronologies to understand the order of cultural and material change through time. Modern scientific methods now allow archaeologists to chronometrically date ancient social phenomena in a highly precise manner and model chronological information in ways that allow histories of people in the past to be examined at the scale of a human generation (cf. Barrier 2017; Bayliss et al. 2007; Bronk Ramsey 1995, 2009; Buck et al. 1994; Kennett et al. 2014; Kennett et al. 2017; Kidder 2006;

Pluckhahn and Thompson 2017; Randall 2013). Yet, the results of these interpretations can be hindered by the intellectual remnants of the pre-chronometric age in archaeology. The persistence of early twentieth-century culture histories and typologies can create situations in which archaeologists do not critically engage with their results, instead opting to situate ill-fitting or divergent data within the boundaries of familiar typological boxes (cf. Henry et al. 2017). The Adena-Hopewell social movement that arose during the Middle Woodland period (ca. 200 BC–AD 500) in eastern North America, and built the geometric earthen enclosures in this region, is a great example of this issue and the focus of this dissertation.

In many ways typologies are good. They provide a starting point for research questions and a vocabulary that allows archaeologists across regions to converse with one another. However, when their boundaries grow blurry and gray areas between typologies continue to increase, the focus of archaeological analyses should turn to "useful distinctions that help us understand variability and dynamics in the past" (Henry et al. 2017:30). Adena and Hopewell encompass two cultural typologies that have grown increasingly unstable over the last 40 years, yet little research has been focused on what 'Adena' represents within the context of 'Hopewell'. Background information for this problem should begin in the late-nineteenth and early-twentieth century.

1.2 Adena, Hopewell, Adena-Hopewell, or Adena Hopewell?

The term *Adena* was originally developed to describe Early Woodland (1000–200 BC) social complexity in the Middle Ohio Valley (Clay 1998; Dragoo 1963; Greenman 1932; Hays 2010; Railey 1996; Seeman 1986; Webb and Snow 1945; Figure 1.1). Early archaeologists generally characterized this time period by the adoption and spread of ceramic technology, an increasing reliance on low-level food production, and the appearance of new ritual practices that include

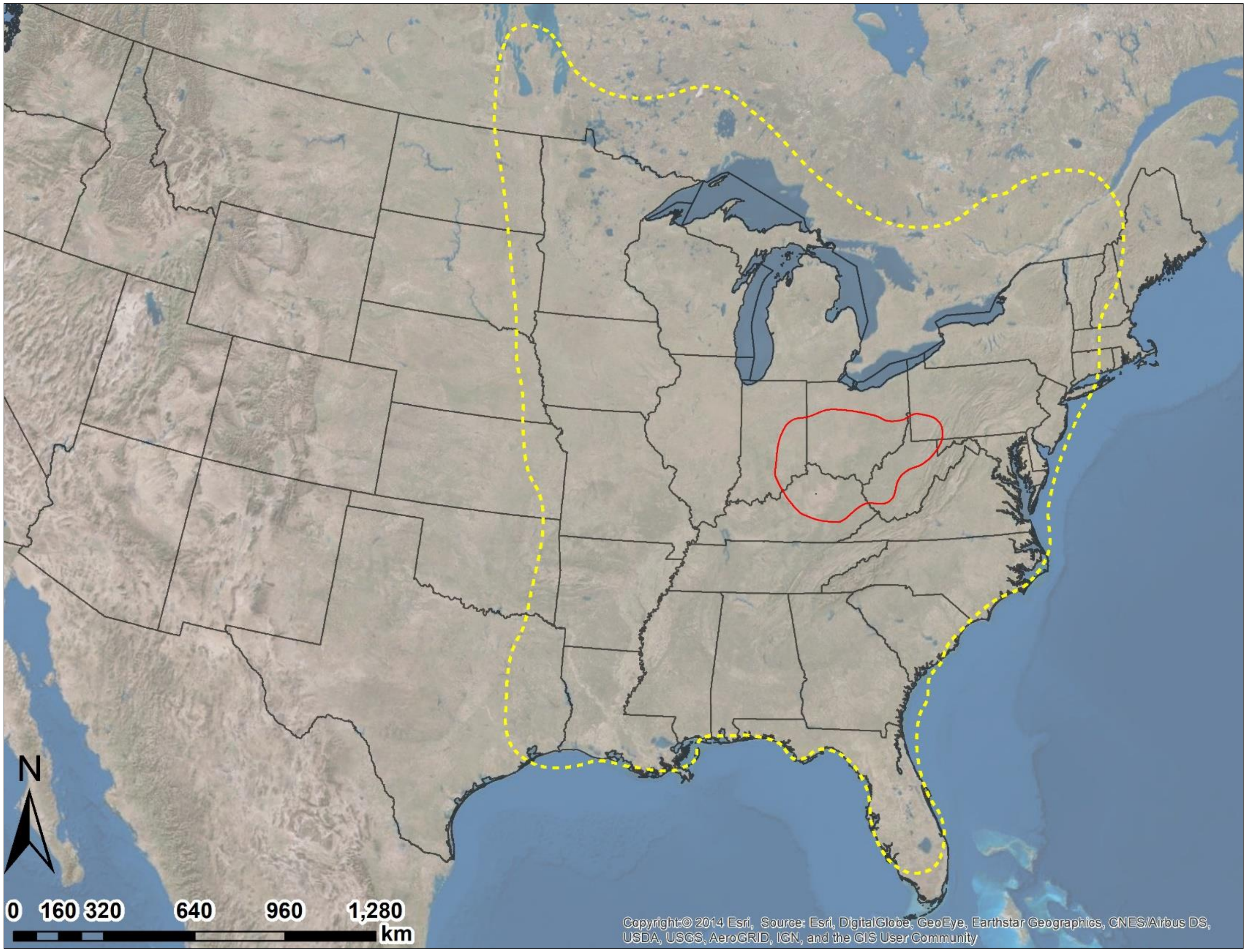

Figure 1.1. Map of North America showing the geographic extent of traditionally-defined Adena (500 BC–AD 250) societies (red polygon) and Hopewell (200 BC–AD 500) societies (yellow polygon).

small geometric enclosures and burial mound construction (Abrams and Freter, eds. 2005; Farnsworth and Emerson, eds. 1986; Milner 2004:54-96; Otto and Redmond, eds. 2008; Smith 2001, 2006). Elaboration on Early Woodland ritual practices are generally considered to have intensified and spread across eastern North America during the Middle Woodland (200 BC–AD 500) period. In the Middle Ohio Valley, archaeologists often use the term *Hopewell* to refer to this increase in social complexity—indicated by escalations in the scale and intricacy of enclosure and burial mound constructions (Brose and Greber, eds. 1979; Charles and Buikstra, eds. 2006; Carr and Case, eds. 2005; Dancey and Pacheco, eds. 1997; Prufer 1964; Shetrone 1920).

The excavation of the 'Adena Mound' outside Chillicothe, Ohio (named by a former governor who once owned the land it was on) in the early 1900s led to the creation of the cultural category, which was first based on mortuary practices like cremation and inhumation, and their associated artifacts (Mills 1902, 1917; Shetrone 1920). This Adena 'culture' was considered a precursor to the then already defined 'Hopewell culture', an archaeological taxon also based on mortuary traits, albeit from larger burial mounds and large multi-shape geometric earthen enclosures, as well as artifacts recovered from these sites like stone platform pipes, carved marine shell, iconography of animal, geometric, and human forms cut from mica and copper, as well as and large caches of obsidian bifaces (Mills 1906; Shetrone 1920; see also Applegate 2005 and Lynott 2015 for excellent histories of these developments). Archaeologists once considered Adena to originate as early as 1000 BC in the Middle Ohio Valley, however researchers have narrowed this time span to 500 BC–AD 250 (Applegate 2008; Hays 2010; Otto and Redmond, eds. 2008; Railey 1996). Nevertheless, because Adena (as a cultural concept) was based on material remains from a few burial sites and developed before the advent of ^{14}C dating, an agreed upon chronology and definition for Adena is lacking. The recent AMS radiocarbon dating of materials curated from the lower portions of the original Adena mound in Ohio returned dates that straddle the BC/AD transition (Lepper et al. 2014), placing it at least 200 years into the 'Hopewell' timeframe at the geographic center for Hopewell material culture. This reiterates that Early and Middle Woodland chronologies need redefining, something scholars have recently been vocal about (see contributions to Applegate and Mainfort, eds. 2005).

The division between Adena and Hopewell was fortified when Greenman (1932) published a list of traits defining Adena after the excavation of 70 burial mounds in the Ohio Valley. When William S. Webb and colleagues (who founded the Anthropology Department at the University of Kentucky) began excavating mounds and small circular earthen enclosures referred to as 'sacred circles' across Kentucky with the funding from Depression-era relief agencies like the Works Progress Administration (WPA), the Adena trait lists grew in number and detail (Webb and Snow 1945; Webb and Baby 1956). Webb's work in Kentucky strengthened the notion in Americanist archaeology that Adena cultures were predecessors to Hopewell, and the main occupants of areas of the Middle Ohio Valley south of the Ohio River, despite the evidence that a few large Hopewellian enclosure complexes and other material culture, such as sites with tetrapodal ceramic vessels, existed in the state (Henderson et al. 1988; Fenton and Jefferies 1991; Lewis 1887). Contemporary archaeologists working in the Middle Ohio Valley continue to define Adena as a more regionally-contained cultural expression (cf. Abrams and Le Rouge 2008; Burks and Cook 2011; Pollack and Schlarb 2013). Outside of the Ohio Valley, material evidence for late-Early and Middle Woodland-era ceremonialism (i.e., Adena and Hopewell) are more often referred to as Hopewell (Hermann et al. 2014; Kimball et al. 2011, 2013; Perri et al. 2015; Wright 2014, 2017). More recently, archaeologists have used the term Adena-Hopewell (Henry 2017; Henry and Barrier 2016; Mueller 2018; Wright 2017) or talked broadly of Middle Woodland ceremonialism that begins earlier in the Middle Ohio Valley than elsewhere in the Eastern Woodlands (Clay 2014).

This begs the question of what archaeologists refer to when they use terms like Adena, Hopewell, or Adena-Hopewell. Most notions of Adena and Hopewell are largely built on mortuary data from burial mounds and understandings of large and small geometric enclosures. Therefore, some archaeologists refer to their associated material remains more as evidence for mortuary and ritual systems, or broad religious beliefs or religious movements rather than ethnic or cultural divisions (Beck, Jr. and Brown 2011; Brown 1997, 2006; Carr 2005, 2008; Dragoo 1963; Prufer 1964). This view bears importance to the study of Adena-Hopewell mounds and enclosures. Both are considered monumental ritual contexts; their construction alone likely served to locally reproduce social and religious needs (Kidder and Sherwood 2017). At the same time, their continued use and modification signaled cosmological principles that maintained and renewed the organization and conceptualization of what archaeologists consider a general three-tiered Eastern Amerind worldview (Upper World, Middle World that humans inhabit, and a watery Underworld) that cross-cut language groups in the Eastern U.S. and is informed by Native American ethnology and archaeoastronomy (Brown 1997; Hall 1997; Hudson 1976; Lankford 1987; Reilly, III and Garber, eds. 2010; Romain 2000, 2009, 2015).

Evidence for a common Adena-Hopewell cosmology comes from widespread animistic and shamanic themes present in non-quotidian artifacts recovered from ritual architecture such as burial mounds and enclosures (Brown 1997, 2006; Carr and McCord 2013, 2014; Romain 2009), the construction of common enclosure and burial mound types (Byers 2011; Burks 2014; Burks and Cook 2011; Carr and Case, eds. 2005; Clay 1998; Lynott, ed. 2009; Mainfort and Sullivan

1998), and the alignment of these architectural forms to astronomical phenomena (Romain 2000). Participatory engagement in such a common worldview has been identified as one mechanism that helps propel economic structures among small-scale societies (Caldwell 1964; Spielmann 2002; Struever and Houart 1972; Wright and Loveland 2015). In Adena-Hopewell societies this is evidenced through exotic material exchanges that draw upon resources and networks encompassing eastern North America and reaching as far west as the Rocky Mountains (Brose and Greber, eds. 1979; Charles and Buikstra, eds. 2006; Carr and Case, eds. 2005; Dancey and Pacheco, eds. 1997). Caldwell (1964) named this institutionalized system of trade and exchange the *Hopewell Interaction Sphere*, whereby religious regalia and symbols—constructed from regionally specific exotic materials—served as markers for ritual performance.

If what archaeologists refer to as Adena-Hopewell may be better conceived of as the material evidence for a larger system of cosmological or religious understandings common among diverse ethnic and language groups in pre-Columbian North America (the extent of Hopewell material culture denoted in Figure 1.1 covers more than four million square kilometers), then societies in present-day Kentucky who participated in this belief system might better be considered Adena Hopewell in the same manner that archaeologists refer to Ohio Hopewell or Illinois Valley Hopewell. As Railey (1996:100) put it, “Adena should be viewed as an early regional expression of Hopewell rather than its predecessor.” However, very little modern research has been conducted in Kentucky to understand exactly how and when localized communities engaged in this sphere of religious interaction. Situating Adena societies that once inhabited the Kentucky landscape in this interpretive framework allows the archaeological study of ritual earthen monuments to focus on the ways separate communities adopted general ideas about worldview and made it work on a local scale. Moreover, this perspective allows archaeologists to test ideas about the spread of religious institutions insofar that they can trace the histories of ritual infrastructure like mounds and enclosures as they spread across the landscape—learning what directions ideas about them come from, where they go, and the rate at which they spread.

1.3 Geometric enclosures as ritual infrastructure and material expression of religious institutions.

Geometric Enclosures have long been considered locales of ritual practice. Ritual behaviors documented by other archaeologists working on enclosures in the Middle Ohio Valley include their initial construction and periodic modification. This is seen in the selection and manipulation of specific colors and textures of sediments during the process of construction (Charles 2012; Kidder and Sherwood 2017; Lynott and Mandel 2009; Sherwood and Kidder 2011), in addition to the building, burning, and renovation of non-domestic wooden structures within them (Byers 2011; Lynott and Mandel 2009; Webb 1941), feasting (Carr 2005; Clay 1985; Ruby et al. 2005), burying the dead within their spaces (Clay 1998:10; Hardesty 1965; Henry et al. 2014), the association of enclosures with natural features (e.g., springs) interpreted as possible world renewal features (Byers 2011; Henry 2011; Sunderhaus and Blosser 2006), and the disposal of exotic goods—some iconographic in nature (Spielmann 2009). They are also commonly oriented to astronomical phenomena like solstices, equinoxes, and lunar maximums and minimums (Romain 2000; Hively and Horn; 2013; Turner 2011). Moreover, there is no evidence for domestic structures or dense midden accumulation inside enclosures that might suggest anyone ever lived within them. Therefore, I follow the many scholars who view these sites as spaces for ritual gatherings and locales for regional pilgrimage journeys (Byers 2011; Lepper 2004, 2006; Wright 1990; Wright and Loveland).

Catherine Bell (1992, 1997) has approached the study of ritual through avenues of structured social practices apart from the broader context of religion. She considers ritual a practice-based integration of thought and action that is prescribed and repetitive, serving to construct symbols that can be communicated across society. Her notion that ritual can be set aside from quotidian spaces and times is applicable here since the astronomical alignments of many enclosures point to their temporary but cyclical uses within a situational context for world renewal ceremonies (Byers 2011; Sunderhaus and Blosser 2006). However ritual practice can penetrate many more aspects of society, serving to contest sociopolitical structures and consolidate social consensus (DeMarrais 2016; DeMarrais et al. 1996). Swenson (2015) emphasizes the practical and material nature of ritual practices and performance that creates the possibility for situational shifts in agency, providing the space for different people and things to contribute to the creation of social influence and change. To this end, Kidder and Sherwood (2017:1078) suggest questions pertaining to ritual should focus on the ways ritual provides a framework for social practice. In their view, the ritual construction of earthen monuments, "is presumed to be both a functional way of bringing people together to undertake these tasks as well as a participatory process to perpetuate social systems" (Kidder and Sherwood 2017:1080).

In the context of geometric enclosures, the ritual production of sacred space through the construction of enclosures served to provide a form of religious or cosmological *infrastructure* that pilgrims and travelers would be familiar with, understanding the prescriptions required to interact with them. Brian Larkin (2013:328) refers to infrastructure as material networks that facilitate the exchange of people, goods, and ideas over space. In short, they are "matter that enable the movement of other matter" and also the ambient environment of everyday life (Larkin 2013:328-9). This serves as an excellent descriptor for earthen enclosures of the Middle Ohio

Valley because these places were where exotic, highly crafted, material goods were brought during long distance travel (i.e., pilgrimages) from as far as the Gulf Coast, Great Lakes, and Rocky Mountains of the present-day United States. However, participation in large cyclical ritual gatherings that unfolded in Central Ohio (where many of the most complex multi-form enclosures are located and integrated to one another by earthen-walled roadways) would have required local communities spread throughout eastern North America to have their own forms of ritual infrastructure that served to perpetuate larger cosmological notions on a regular basis, and these can be seen in the construction of smaller sacred circles and burial mounds spread throughout this area. This highlights the very effective nature of burial monuments and enclosures to be that ambient environment of everyday life that served to encode notions of cosmological knowledge and provide an arena for ritual performance to occur on a more regular basis so that social structures could be maintained and changed apart from the ritual cycles occurring within Central Ohio.

Fowles' (2013) concept of "doings" resonates with local participation in broader non-western religious forms and provides a response to scholars of religion who are shying away from comprehensive definitions of the concept and its application in a sacred-secular divide (e.g., Asad 2003; Bowen 2012; Keane 2008; Latour 1993). His work among Puebloan societies and the material remnants of their ancestors opts to examine how humans interact with ideas, objects, and one another—working to maintain and recreate their worlds in ways that transcend a sacred-secular divide. "Doings," as he regards them, are a way to circumvent an opaque category and focus instead on assemblages of places, practices, and histories that are associated with the ways humans activate their origins and orientations through social action. The fact that archaeologists have identified contemporary forms of monumental earthen architecture used in similar ways across more than four million square kilometers of eastern North America suggests that larger underlying systems of belief were present that transcended language and ethnic boundaries. Therefore, we might regard these ritual infrastructure as the material evidence for other social institutions (e.g., cosmologies).

Institutions can be defined as the normative rules of society, the mechanisms that maintain cooperation and consensus by providing permanent platforms though which individuals can participate in society (Bowen et al. 2013; Mantzavinos 2011). However, as Bowen et al. (2013:12) note of institutions where multi-ethnic participation is common, "[i]nstitutions are not simple receptacles of existing ideas about what [people] must do, or the passive sponges of…identity principles. [People] participate in the production of these principles as well." While institutions can help remove uncertainty from the decision-making processes of individuals and how they should act, they also provide individuals the space for social creativity. Sometimes it is within the dissonance of competing ideas about what is valued within institutions that novel social forms emerge (Henry and Barrier 2016; Stark 2009). In this sense, a study of institutions should pay particular attention to the interplay between the individual and group, or in this case the local and what Wright (2017) calls the 'Global' (i.e., the Hopewellian world of eastern North America) nature of Middle Woodland interaction as it applies to institutions like cosmology as it becomes materialized through the construction and use of ritual earthen enclosures. For instance, how do local communities adopt ideas underlying the practice of constructing and using earthen enclosures? Do local reinterpretations of cosmology in turn alter how other Adena-Hopewell communities perceive of these ideas and transform their practices? Can archaeologists trace these forms of stability and change through time and across space? In addition, if Adena-Hopewell can be considered a social (or religious) movement (*sensu* Beck, Jr. and Brown 2011) how quickly does this movement take hold in the Eastern Woodlands and from where does it originate and spread?

1.4 The structure of the dissertation

In this dissertation I examine small geometric enclosures referred to as 'scared circles' (Webb 1941; Webb and Snow 1945) in the Bluegrass Region of Central Kentucky to learn how and when local communities began participating in the institution of Middle Woodland ceremonialism through the construction of ritual infrastructure. In doing so, I structure my research questions around three themes:

1. What was the magnitude of participation in Adena-Hopewell among late-Early and Middle Woodland period societies who lived in Central Kentucky?
2. How did local communities participate in Adena-Hopewell through the construction and use of earthen enclosures, and how were local practices of construction and use unique?
3. What was the timing and tempo of enclosure construction and use across the Bluegrass Region of Central Kentucky?
4. How did late prehistoric populations (post–AD 1000) in Central Kentucky interact with earthen enclosures?

Chapter 2: *Mapping the Adena-Hopewell Landscape in the Middle Ohio Valley, USA: A Landscape-scale Analysis of LiDAR Data from Central Kentucky* addresses question one. Specifically, my co-author (Carl Shields) and I use high-tech aerial remote sensing methods (e.g., LiDAR, aerial photography) to explore the Central Kentucky landscape for remnants of earthen enclosures that are unknown to modern archaeologists. When potentially unknown enclosures were located, we negotiated access to private properties to examine these topographic anomalies with geophysical remote sensing methods (e.g., magnetometry, electromagnetic induction, ground-penetrating radar). In some cases, geoarchaeological coring was also employed to understand subsurface variation identified using geophysical methods. This article highlights the benefit of integrating multiple approaches to the examination of lost landscapes. Carl Shields' contributions to this article included providing early access to Kentucky's State LiDAR data and assistance with portions of the LiDAR survey. I conducted additional LiDAR processing and analyses, analyses of aerial photographs, and all on-ground data collection. As director of the Geoarchaeology Laboratory at Washington University in St. Louis, Tristram R. Kidder oversaw fieldwork and data analyses relating to geophysical surveys and geoarchaeological analyses. I am solely responsible for the text in Chapter Two.

Chapter 3: *Ritual Dispositions, Adena-Hopewell Enclosures, and the Passing of Time: A Monumental Itinerary for the Winchester Farm Enclosure in Central Kentucky, USA* addresses questions 2-4. Drawing on a very detailed excavation regime, geoarchaeology, paleoethnobotany, zooarchaeology, and artifact analyses my co-authors (Natalie G. Mueller and Mica B. Jones) and I provide a 'thick description' of how one enclosure in Central Kentucky was built, used, and treated after it was abandoned. We employ Bayesian statistical analyses that incorporated 16 radiocarbon assays into a chronological model that provides context for the reason the enclosure was built in its specific location and identifies an abnormally long period of site-maintenance prior to being intentionally deconstructed. The contributions of my co-authors included Natalie Mueller's analysis of the archaeobotanical assemblage, and Mica Jones' analysis of the faunal assemblage, recovered during excavations. I am responsible for all other data collection and analyses. Mueller and Jones wrote short reports of their results that I edited and incorporated into the text of Chapter Three. The rest of the text was authored by myself.

Chapter 4: *The Temporality of Adena-Hopewell Monuments: Bayesian Perspectives on the Chronology of Mounds and Enclosures in the Bluegrass Region of Central Kentucky* addresses questions 3 and 4. Utilizing over 60 chronometric measurements from earthen monuments across Central Kentucky, I draw on Bayesian chronological modeling to place the practice of monumentalizing the Bluegrass landscape within a historical framework. This research speaks to the unique histories of individual monuments and the durability of Adena-Hopewell monuments in the region for late prehistoric populations (post–AD 1000). I am solely responsible for all the data collection, analyses, and writing of this chapter.

Data collected and produced as a result of the researched discussed in this dissertation will be curated in two places. All images and digital data will be curated in the digital repository of the Washington University in St. Louis Library system. All artifacts, original notes and maps, as well as copies of all digital data will be curated at the William S. Webb museum of Anthropology at the University of Kentucky.

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Chapter 2

Mapping the Adena-Hopewell Landscape in the Middle Ohio Valley, USA: A Landscape-scale Analysis of LiDAR Data from Central Kentucky

Edward R. Henry, Carl Shields, and Tristram R. Kidder

2.1 Introduction

Light-detection and ranging (LiDAR; also known as airborne laser scanning or ALS) is a popular tool for the exploration and interpretation of topography associated with archaeology (Crutchley and Crow 2013; Hesse 2010; Opitz 2013; Opitz and Cowley 2013; Schindling and Gibbes 2014). The success of this method has led some archaeologists to declare that it has triggered a scientific revolution (Chase et al. 2012). Recently published examples of LiDAR survey data integrated into archaeological research around the world have shown that this technique can unambiguously depict the remains of both monumental and non-monumental architecture across a range of cultural contexts (Baires 2014; Bewley et al. 2005; Chase et al. 2011; Chase et al. 2012; Evans et al. 2013; Evans 2016; Fisher et al. 2016; Howey et al. 2016; Johnson and Ouimet 2014; Pluckhahn and Thompson 2012; Randall 2014; Rosenwig et al. 2013). In archaeological contexts where architecture is constructed from stone, results can be impressive (Chase et al. 2011; Chase et al. 2012; Evans et al. 2013; Evans 2016; Harmon et al. 2006). However, archaeologists using LiDAR in the Eastern United States have had to confront various challenges related to examining ancient architecture that include dense vegetation, destructive modern land-use practices (e.g., agriculture), in addition to urban and rural development (e.g., home and business construction, barns, roads) (Baires 2014; Howey et al. 2016; Pluckhahn and Thompson 2012; Randall 2014; Riley and Tiffany 2014; Rochelo et al. 2015). Because most topographically visible archaeological constructions in the Eastern U.S. were constructed from some form of earth, agricultural practices and modern development significantly constrain the utility of LiDAR to investigate ancient architecture. These historic impacts have altered the size and shapes of earthworks, making them appear obscure in LiDAR datasets, or rendering them invisible (Baires 2014; Burks and Cook 2011; Pluckhahn and Thompson 2012; Randall 2014; Riley and Tiffany 2014). Thus, exclusively relying on LiDAR to identify and explore the architectural remains of pre-Contact societies in this portion of the U.S. can be problematic.

With these issues in mind, we initiated the first landscape-scale analysis of LiDAR from Central Kentucky, a portion of the larger Middle Ohio River Valley (Figure 2.1). Our research objectives included identifying burial mound and enclosure sites not currently known to archaeologists, with the broader goals of learning where these forms of ritual infrastructure are spatially situated across Central Kentucky. The research presented here includes qualitative assessments of topographic anomalies that resemble burial mounds and enclosures. These monuments correspond to Early and Middle Woodland-era Adena-Hopewell societies (500 BC-AD 500). Our LiDAR survey identified over 200 potential archaeological sites unknown to present-day researchers. However, geophysical surveys, geoarchaeological coring, and test excavations conducted at a sample of the potential sites demonstrate that relying on LiDAR data to rediscover the Early and Middle Woodland-period landscape in this region is problematic. Our investigations show that, for interior portions of the Eastern U.S., the use of LiDAR alone may not be a reliable method for identifying ancient earthen architecture. Instead, we suggest that landscape-scale examinations of LiDAR data in these regions are best incorporated into research strategies that combine diverse aerial and terrestrial remote sensing methods. Our use of this approach led to the rediscovery of four Adena-Hopewell earthen enclosures.

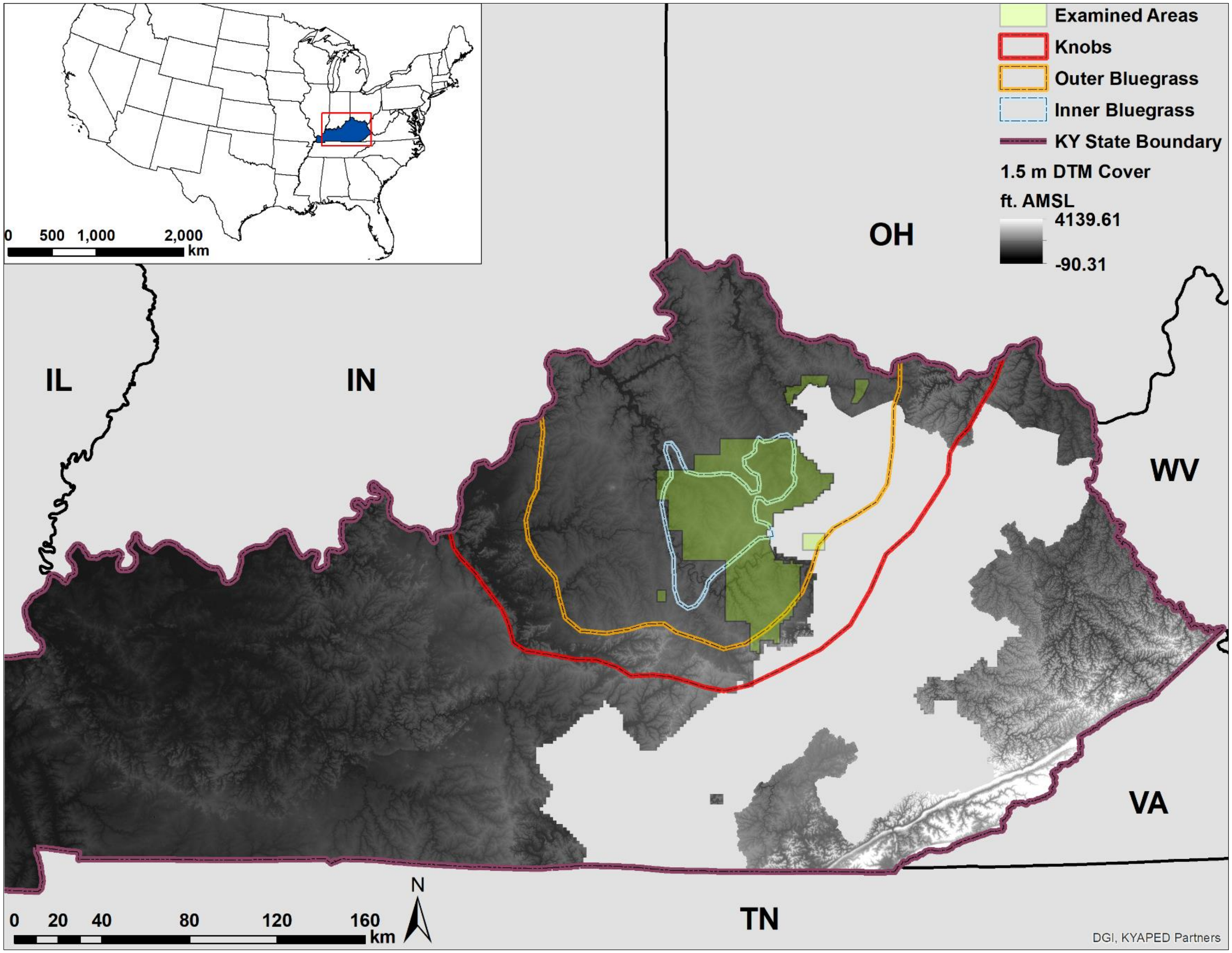

Figure 2.1. Location of physiographic regions in Kentucky and LiDAR examinations carried out in this study.

2.2 Study Area: Ritual Infrastructure on the Early and Middle Woodland Landscape in the Middle Ohio Valley

Between ca. 500 BC and AD 500 in the Eastern U.S. a near continental-scale trade network in exotic and ritually-charged craft items emerged alongside the shift from hunting and gathering to forms of low-level food production (Anderson and Mainfort, eds. 2002; Caldwell 1964; Milner 2004:54-96; Mueller et al. 2017; Smith 2001; Struever and Hoart 1972; Wright and Loveland 2015). In the Middle Ohio Valley, considered the center for these social trends, these changes coincide with the appearance of ceramic technologies, as well as new forms of ritual infrastructure seen in the construction of Adena-Hopewell burial mounds and geometric enclosures (Brose and Greber, eds. 1979; Abrams and Freter, eds. 2005; Farnsworth and Emerson, eds. 1986; Charles and Buikstra, eds. 2006; Clay 1998; Carr and Case, eds. 2005; Dancey and Pacheco, eds. 1997; Lynott 2015; Webb and Baby 1957; Webb and Snow 1945). Archaeologists have drawn upon the distribution and similarities in these changes to propose a religious vernacular existed—evidenced by common iconographic themes materialized in exotic artifacts recovered from Adena-Hopewell mounds and enclosures, in addition to the alignment of some sites to astronomical phenomena (e.g., solstices, equinoxes, and lunar maximums) (Beck and Brown 2011; Brown 1997, 2005, 2006; Carr 2008; Carr and Case, eds. 2005; Carr and McCord 2013, 2015; Romain 2000, 2009).

A great amount of contemporary Early and Middle Woodland archaeology in the Middle Ohio Valley has focused on investigating ritual-religious symbolism and settlement practices in modern-day Central Ohio, considered the Adena-Hopewell Core (Byers 2011; Charles and Buikstra, eds. 2006; Carr and Case, eds. 2005; Case and Carr, eds. 2008; Lynott 2015; Otto and Redmond, eds. 2008). Traditionally, much less Adena-Hopewell archaeology has occurred to the south in present-day Central Kentucky, but this trend is changing (see Applegate 2013; Henry

2011, 2013, 2017; Henry et al. 2014; Jefferies et al. 2013; Pollack et al. 2005; Pollack and Schlarb 2013; Richmond and Kerr 2005; Schlarb 2005). Our examination of Kentucky's LiDAR data follows the rediscovery of earthen monuments in Ohio through intensive aerial and terrestrial remote sensing (Burks 2010, 2013a, 2013b, 2014; Burks and Cook 2014; Romain and Burks 2008; Hermann et al. 2014) to explore where in Kentucky participation in social movements and institutions contemporary with Ohio Hopewell took place at local scales.

New perspectives on past and present social movements, institutions, and infrastructure (e.g., Beck, Jr. and Brown 2011; Bowen et al., eds. 2014; Frachetti 2012; Klandermans and Stekelenburg 2013; Larkin 2013; Maeckelbergh 2016; Mantzavinos 2011) offer innovative ways to frame the spread of Adena-Hopewell ideas and practices through the construction of mound and enclosure infrastructure. For the purposes of this paper, we follow Larkin (2013:328) to emphasize the notion of infrastructure as "built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space" and through time. Although Larkin's theoretical review of infrastructure references modern day constructions like roads, power grids, and buildings, we contend that similar perspectives on the physical forms and materialities of constructed networks can be applied to our study of Adena-Hopewell earthen architecture. This is primarily because studies of mound building as a process have established ways that these built features served symbolic roles that incorporated diverse notions of world renewal through ritual practices (Byers 2004; Charles 2012; Charles et al. 2004; Howey 2012; Kidder and Sherwood 2017; Sherwood and Kidder 2011; Wright and Henry, eds. 2013). Moreover, the literature on Adena-Hopewell interaction has long proposed that events occurring at mounds and enclosures offered diverse interpersonal experiences the moved objects, practices, and ideas across space and through time (Caldwell 1964; Carr and Case, eds. 2005; Charles and Buikstra, eds. 2006; Charles and Buikstra 2002; Henry 2017; Henry and Barrier 2016; Mueller 2013; Streuver and Hoart 1972; Wright 2014, 2017; Wright and Loveland 2015). From this perspective, we consider Early and Middle Woodland burial mounds and earthworks *ritual infrastructure* insofar that they encoded social information pertaining to the past and present, and passed on such information to the participants building and interacting at them (Henry 2017; Howey 2012). Drawing on these notions, our survey of Kentucky's LiDAR data seeks to reassess the scale of participation in Adena-Hopewell institutions by seeking to better understand the density and distribution of ritual infrastructure across the Central Kentucky landscape.

2.2.1 Physiographic Setting of the Study Area: The Bluegrass and Knobs Regions of Kentucky

Kentucky's high-resolution LiDAR data covers most of the state. However, we confined our analyses to two physiographic regions where known Adena-Hopewell earthworks have been identified: The Bluegrass and Knobs Regions (see Figure 1). The Bluegrass Region covers the north-central portion of the state and is separated into Inner and Outer zones. Both sit atop a geology that spans the Ordovician, Silurian, and Devonian periods (McGrain 1983). The Inner Bluegrass is characterized by the uplift of the Cincinnati Arch, which contains thick-bedded limestones. As a result, is contains a gently rolling terrain with deep fertile soils and some karst development in the form of sinkholes, sinking streams, and springs (McGrain 1983:38; McGrain and Currens 1978). Alternatively, the Outer Bluegrass is distinguished by an inter-bedded limestone and shale geology that is less resistant to erosion, creating a more dissected upland geography with steep slopes and little flat land (McGrain 1983:42). This dissected topography continues into the Knobs where isolated conical hills (monadnocks) comprised of erosion-resistant rock are common (McGrain 1983:46). The majority of currently known Early and Middle Woodland monuments are situated within the Bluegrass Region; however, some lie in the

Knobs. For this reason, we focused most of our efforts in the Bluegrass, supplementing our research with small sections of the Knobs.

2.3 Methods

Archaeologists have argued that the discipline is currently undergoing a geospatial revolution where LiDAR is transforming how landscape-scale research is being conducted (Bewley et al. 2005; Chase et al. 2011; Chase et al. 2012). However, some of the most successful LiDAR applications in archaeology occur within research on state-level societies where stone architecture is common and produces a high-contrast in light reflectance between buildings, foundations, and the surrounding landscape (see Chase et al. 2011; Chase et al. 2012; Evans 2016; Evans et al. 2013; Fernández-Lozano et al. 2015; Harmon et al. 2006; Johnson and Ouimet 2014; Rosenswig et al. 2013). Successfully applying LiDAR to find, delineate, and study earthen architecture and other material remnants of small-scale societies is much more challenging, but still achievable (see Bewley et al. 2005; Fisher et al. 2016; Howey et al. 2016; Pluckhahn and Thompson 2012; Riley and Tiffany 2014; Rochelo et al. 2015; Romain and Burks 2008). In the case of small-scale societies, on-the-ground examinations if often required to test interpretations made from LiDAR data, particularly when they involve assessing partially destroyed and/or eroded earthen monuments. Incorporating aerial photographs, terrestrial geophysics (e.g., magnetometry, ground-penetrating radar (GPR), earthen resistance, electromagnetic induction), in addition to geoarchaeological methods (e.g., coring and sediment analyses) helps inform archaeological understandings of past human activities originating from LiDAR-based exploration of modern-day landscapes.

2.3.1 LiDAR Collection, DTM creation, and Analyses

Aerial LiDAR methods typically incorporate a laser scanner mounted in some way to an airborne device (e.g., airplane, helicopter, or unmanned aerial vehicle), geospatial positioning and referencing equipment (e.g., survey-grade GPS), and a data recorder to collect information accumulated during flight (Crutchley and Crow 2009; Opitz 2013). As Opitz (2013:15) has summarized, LiDAR systems typically come in two varieties: discrete return and full waveform. Discrete return LiDAR devices measure the position of a pre-selected number of waveform returns that fall between defined thresholds. Alternatively, full wave devices record the entire returned waveform. Full waveform systems allow users to more easily separate returns from tree canopy, scrub brush, and final ground returns used to create digital terrain models (DTMs).

LiDAR data analyzed for this project were collected for the State of Kentucky. The data were collected in full waveform and divided into multiple discrete returns comprised of at least three returns per pulse, whereby the intensity values were recorded for each return. Collection strategies were such that a highly accurate bare-earth model could be generated from the data. For instance, flights occurred during leaf-off seasonal conditions with cloud-free and fog-free atmosphere between the aircraft and the ground to maximize ground returns and minimize spectral interference. In addition, ground conditions were snow-free with no unusual flooding. Nominal Pulse Spacing (NPS) was no greater than a meter and the collection angle was no greater than 40-degrees. Flight lines overlapped by at least 20-percent to ensure no gaps in coverage. Vertical accuracy of the resulting data is ±12 cm.

Raw LiDAR data were delivered as classified point clouds, a bare earth surface (raster DTM), breaklines, and ground control points. The point cloud data were coded as follows: 1-processed, but unclassified; 2-bare-earth ground; 7-noise (low or high, manually identified, if needed); 9-water; 10-ignored ground (breakline proximity). These data were processed to create bare-earth surface DTMs whereby buildings were removed, and water bodies were hydro-flattened. The result was a raster-based image server delivered to the Kentucky's Aerial

Photography and Elevation Data Program (KYAPED). Data are projected in Kentucky Single Zone State Plane coordinates under NAD83 FIPS 1600 and U.S. Survey Feet.

Analytical procedures that we could apply to the LiDAR data were constrained by modern land-use and development in the region. Although buildings in urban and rural areas were removed (i.e., flattened) during data processing, patterned shapes that resemble ancient monuments like mounds and enclosures (e.g., circles and squares) remained (Figure 2.2). Therefore, it was not practical to begin our analyses with automated unsupervised classification of the LiDAR data with remote sensing software. Moreover, modern agricultural practices (e.g., plowing, mowing, and tilling) and horse racing farms common to the region also leave patterned remnants of those practices on the landscape similar in form and topographic relief to extant Adena-Hopewell monuments. Therefore, we conducted qualitative examinations of the LiDAR data to maintain control over what topographic anomalies we considered important.

Qualitative inspection of the LiDAR data included viewing DTMs in ESRI's ArcMap (v. 10.1-10.3) at a 1:4000 ft. scale with display properties manipulated to enhance bare-surface variability. Manipulation of display properties included utilizing cubic convolution raster resampling to create sharper visualization for the continuous DTM offered as an image server through KYAPED. Contrast of the DTM raster was set between 20 and 35-percent depending on the amount of slope present within the viewable area. When slope was greater, less contrast was applied. Additional enhancements to the DTM's visual properties were made within the symbology window. The hillshade effect was always implemented and Z factors between three and 35 were selected. These factors were applied because higher vertical relief within the DTM rendered slopes invisible if the Z factor was not adjusted. As with contrast, Z factor values varied

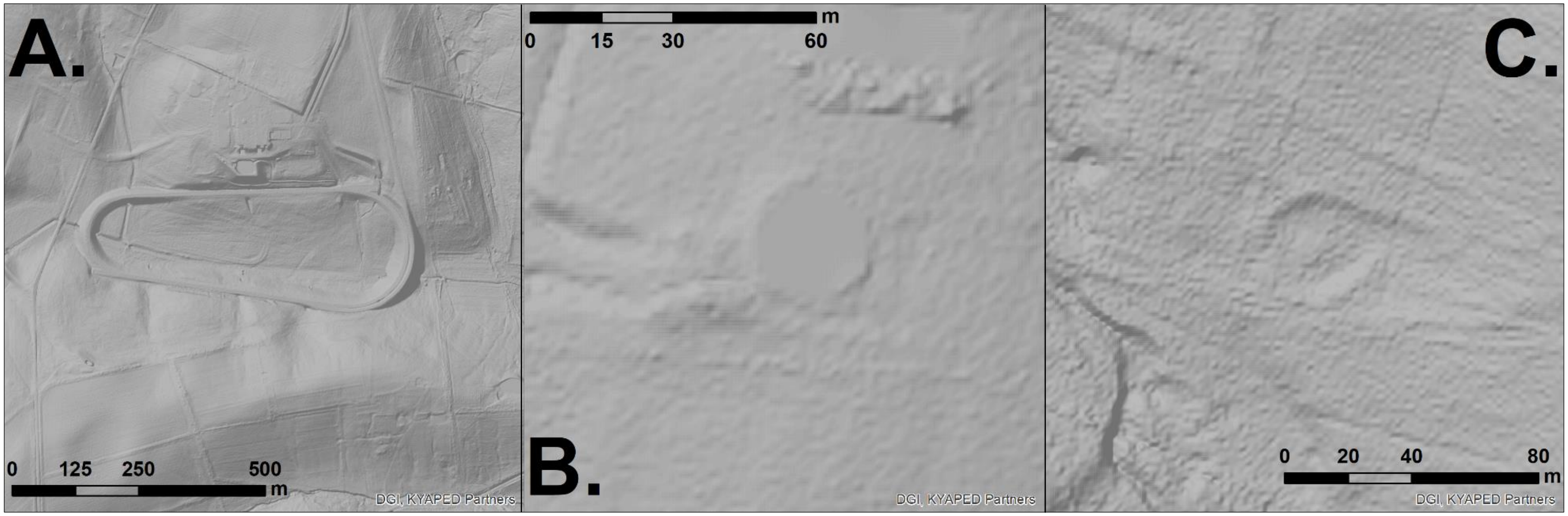

Figure 2.2. Examples of geometric features on the Central Kentucky Landscape that compare to Adena-Hopewell enclosures: A.) Horse racing track; B.) Flattened water tower; C.) Subtle topography of Winchester Farm Enclosure (15Fa153), an Adena-Hopewell enclosure site.

depending on the amount of slope present on the landform being viewed. When the percentage of slope was higher, smaller Z factors were applied to enhance the LiDAR imagery.

DTMs were visualized using a gray-scale color ramp. Depending on the nature of the topography, either no stretch (None) was applied, or Standard Deviations were selected. If Standard Deviations were utilized, it was typically set to two. However, some experimentation did take place, with 2.5 or 3 standard deviations selected to clarify visualization. No gamma stretch was applied, and the statistics from the image server were always accepted. Depending on the topography and modern disturbances (i.e., farms, roads, and buildings), each area was systematically examined between 30 seconds and two minutes. Visual scans assessed the viewing area for topographic anomalies comparable to three types of Woodland-era monuments: irregular enclosures, geometric enclosures, or burial mounds (Figure 2.3). After an area was scanned, the viewing area was moved to provide approximately 20-percent overlap with the previous area.

Our viewing pattern generally shifted vertically, following the boundaries of the Kentucky Quad Index Grid. For quality control, shapefile markers (points) were placed along the upper and lower edges of the index lines to ensure proper alignment and overlap of viewing areas. If a point did not appear along the grid line within the viewing area, the entire section was reexamined. When anomalies of interest were identified, they were marked with polygons and cross-examined using available aerial photographs to rule out correlations with historic or recent activities (Table 2.1). If no topographic anomalies were identified, the viewing area was briefly reexamined using recent aerial photographs. We initiated these cursory reexaminations to

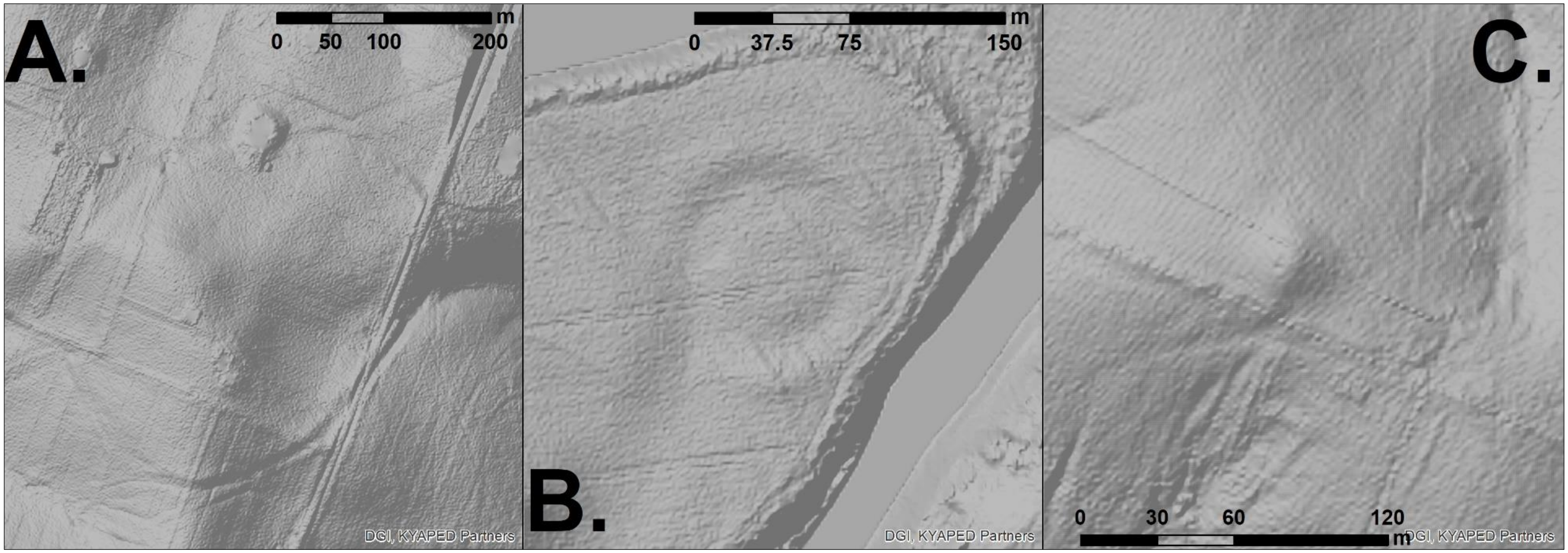

Figure 2.3. Topographic signatures in LiDAR data from: A.) Irregular Enclosure, Peter Village (15Fa166); B.) Circular enclosure, LeBus Circle (15Bb01); and C.) Burial mound, Elam Mound (15Fa12).

Table 2.1. Sources of aerial imagery used to cross-check LiDAR anomalies for historic disturbance.

Source of Aerial Imagery	**Year**	**Resolution**	**Colour or Black & White**
USGS EarthExplorer	1950s & 1960s	varied	B&W
USGS	1990s	1 m	B&W
KY NAIP	2004	1 m	Colour
KY NAIP	2006	60 cm	Colour
Fayette County Aerial Photography	2006	15 cm	Colour
KY NAIP	2008	1 m	Colour
Fayette County Aerial Photography	2010	30 cm	Colour
KY NAIP	2010	1 m	Colour
KY NAIP	2012	2 m	Colour

quickly determine if topographically invisible sites (e.g., plowed-down) might be visible in aerial photography as crop marks. Aerial photographs we often used for this aspect of our analyses were taken during drought conditions in the summer of 2012, which turned out to be an ideal environmental condition for detecting flattened enclosures.

Our assessment of Kentucky's LiDAR data identified 244 potential anomalies that may represent currently unknown constructions of Adena-Hopewell ritual infrastructure, including burial mounds (n=206), enclosures (n=28), and mound/enclosure combinations (n=10) (Figure 2.4). Burial mounds represent the greatest number of LiDAR anomalies in our study, but they contain the ancestors of present-day American Indians. To avoid disturbing these culturally sensitive ancestors and sites, we concentrated on enclosures. Due to the long history of Euro-American occupation in the region, however, as well as the likelihood for some potential enclosure sites to be the result of modern activities, we decided to more intensively examine a sample of LiDAR anomalies using a multi-staged ground-based approach (*sensu* Henry 2011). As we discuss below, this included using various geophysical methods, in addition to geoarchaeological studies of soil cores, before we considered confirming an anomaly was likely an archaeological site. During ground-based investigations at a one potential enclosure site we did encounter a probable burial mound that our LiDAR surveys had not identified. However, this was not part of our research strategy.

2.3.2 Geophysical Methods

Geophysical surveys focus on detecting and documenting a range of subsurface phenomena (Aspinall et al. 2008; Conyers 2004; Gaffney and Gater 2003; Johnson, ed. 2006; Schmidt 2013). Because geophysical methods provide a way to quickly assess subsurface variation tied to various types and quantities of buried archaeological features, they make an excellent tool for archaeologists working with the multi-scalar nature of landscapes (Campana

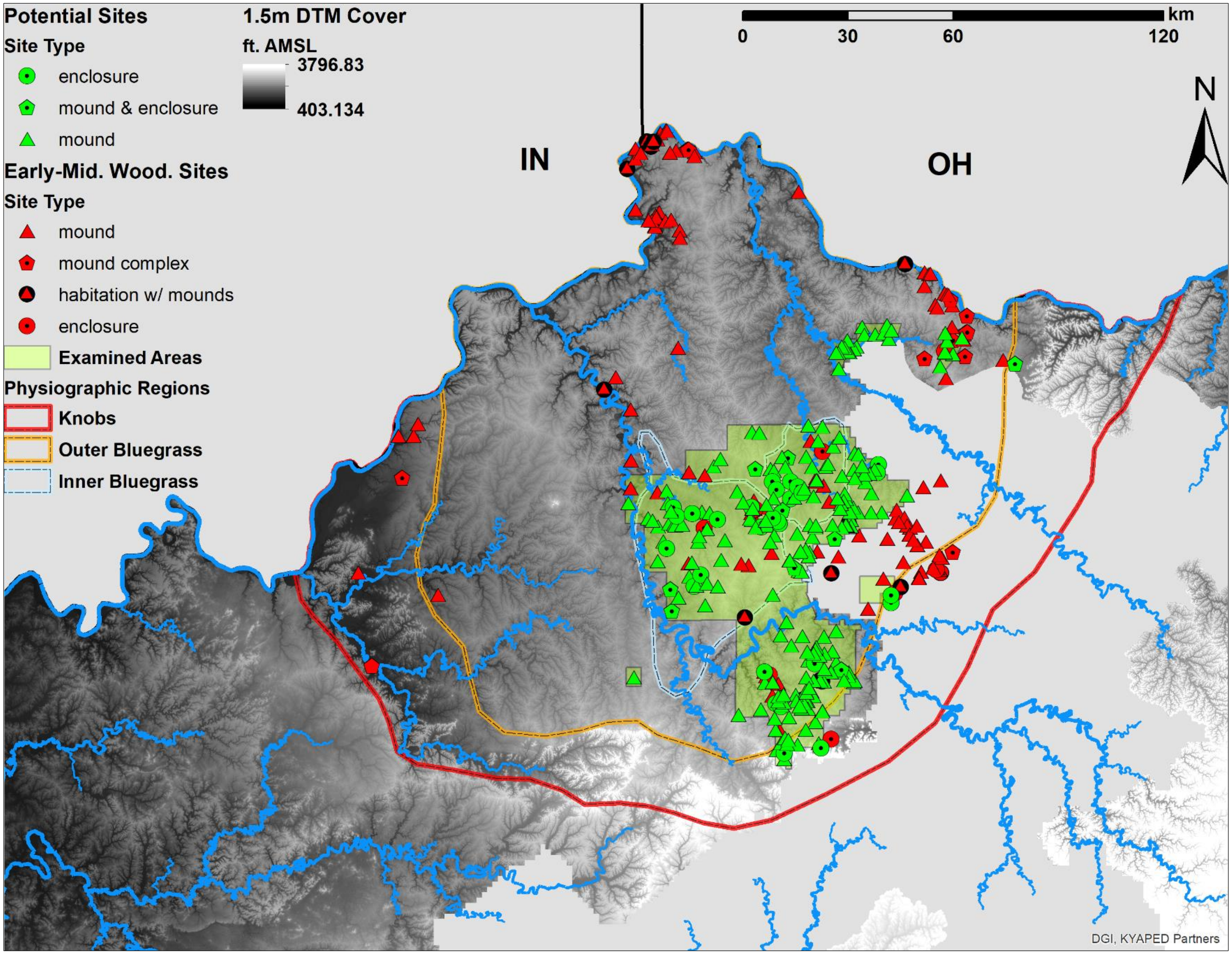

Figure 2.4. Location of known and potentially unknown sites of Early to Middle Woodland ritual infrastructure.

and Piro 2008; Kvamme 2003; Wright and Henry, eds. 2013). This includes surveys over extensive amounts of contiguous space (Gaffney et al. 2000; Gaffney et al. 2012; Field et al. 2014) or surveys of smaller to moderate amounts of space across a given cultural landscape (Barrier and Horsley 2014; Burks 2013a, 2013b; Burks and Cook 2011; Horsley et al. 2014; McKinnon 2009; VanValkenburgh et al. 2015). Our work falls within the latter category because we implemented geophysical surveys over enough space to assess a given LiDAR anomaly, and these surveys all fall within the Adena-Hopewell landscape of Central Kentucky.

Our geophysical approach to examining LiDAR anomalies began with magnetometry surveys. Magnetometry has proven extremely useful in identifying and mapping Adena-Hopewell ritual infrastructure (Burks 2014, 2015; Burks and Cook 2011; Henry 2011; Henry et al. 2014; Herrmann et al. 2014; Horsley et al. 2014). The ability to rapidly collect dense datasets over large survey areas, as well as the ability of local magnetic variation to be associated with diverse human behaviors, makes magnetometry an ideal method to initiate a geophysical survey (Kvamme 2003, 2006). However, it was possible that the history of modern anthropogenic alteration in Central Kentucky impacted the success of a magnetic survey and their ability to accurately distinguish discrete features. Given this possibility, magnetic data were referenced during decisions to integrate different geophysical methods (e.g., electromagnetic induction and GPR) to better identify subsurface archaeological remnants. This has been referred to as a multi-staged approach (Henry 2011), where use of one instrument informs the decision to utilize another that measures different subsurface properties. The use of multiple instruments provides a better understanding of subsurface variation (Clay 2001). Our surveys employed three instruments, including a Foerster Ferex 4-sensor fluxgate gradiometer to collect magnetic data. A Geonics Ltd. EM38-MK2 electromagnetic induction meter (EMI) was used to collect conductivity and magnetic susceptibility from two coil separations, 50-cm and 1-meter. The 50-cm coil collects conductivity data from roughly 75-cm below ground surface (cmbs) and magnetic susceptibility data from 30-cmbs. The 1-meter coil targets variations in earthen conductivity approximately 1.5 meters below surface and magnetic susceptibility around 60-cmbs. Finally, we utilized a GSSI, Inc. SIR-3000 GPR unit with a 400 MHz antenna capable of penetrating approximately 1.5-1.75 meters below surface in the clayey upland soils of the Bluegrass and Knobs Regions.

Geophysical surveys over the last 15 years have provided clear expectations for how various instrumentation should respond to enclosures in various states of preservation. For instance, ditches often refill with magnetically enhanced topsoil or culturally modified sediments, presenting the ditch as an enhanced magnetic feature. Alternatively, embankments can appear as negative magnetic features because the magnetic orientation of ferrous minerals in their sediment fills has been altered. Finally, a ‘ring’ of enhanced magnetism from erosion accumulations is often mapped at the exterior of embankments and can denote the boundaries of embankments long since destroyed (Burks 2014; Burks and Cook 2011; Henry 2011; Henry et al. 2014; Horsley et al. 2014; Jefferies et al. 2013). EMI surveys typically exhibit high earthen conductivity associated with embankments due to the clay-rich sediments that comprise them retaining moisture. Low conductivity is typically recorded over ditches, possibly due to the higher porosity of eroded fills impeding the EMI signal (Clay 2006; Henry 2011; Jefferies et al. 2013). However, the inverse of these responses has been identified, presumably relating to the density of embankment materials and their ability to repel moisture, thus lowering conductivity values (Henry et al. 2014). In these cases, a high conductivity response to ditches may corresponds to shallow ditches or ditch fills with less porosity, both of which would retain more moisture. GPR is not typically used to locate buried enclosures, but ditch fills have produced clear high-amplitude reflections where it has been applied (Horsley et al. 2014). One might expect the fills of surviving embankments to produce similar results.

2.3.3 Coring

Coring was implemented during this project when understanding differences between LiDAR and geophysical data required an examination of soils and sediments underlying the ground surface. In some cases, this involved using cores to elucidate the spatial boundaries of some sites. In other cases, cores were used to explore the subsurface sedimentology of probable sites if LiDAR and geophysical data demonstrated the presence of subsurface archaeological features. Coring involved the use of two methods. The first, and most expedient, was the use of a 3-cm diameter Oakfield split-spoon soil sampler. The second method involved removing 6.3-cm diameter solid soil cores with a truck-mounted hydraulic bull auger. This latter method allowed us to examine and characterize subsurface soil profiles with more detail in the field. When necessary, solid cores were packaged and transported to the Geoarchaeology Laboratory at Washington University in St. Louis for further analysis.

2.4 Survey Results

In this section, we present our ground-based examinations of LiDAR anomalies that potentially represented unknown enclosures (Figure 2.5). Anomalies we could negotiate access to were given name-based identifications that correspond to landowners or farms that granted us permission to conduct research on their properties. We refer to these anomalies as ‘features’ below. We examined eight topographic features identified in our LiDAR analyses using a combination of methods described above. Our sample represented two forms of ritual infrastructure that Clay (1998) has considered essential to Adena-Hopewell societies in the region: small geometric enclosures (i.e., sacred or ceremonial circles) and larger irregular enclosures often regarded as temporary villages (see Figure 2.3a and b; Table 1). These types of enclosures were constructed by excavating a ditch and mounding the sediments inside or outside of the ditch, which accentuated an interior platform for ritual activities (Clay 1985; Webb and Snow 1945:30-31). An unexcavated portion of the ditch served as a causeway to enter and exit the interior space.

2.4.1 The Mahan Feature

The Mahan Feature is located in the Outer Bluegrass Region in an upland geographical context comprised of residual soils. It is characterized by a ditch-like topographic depression approximately five meters wide, enclosing 1.82 ha. We considered it a potential irregular enclosure because it encloses more area than any small geometric enclosure in the region and has a non-uniform shape, (Figure 2.6). Magnetic survey over the southern half of the feature revealed numerous linear dipolar anomalies trending with the natural slope of the survey area. These may represent shallow erosion scars or other natural phenomena, such as subsurface concentrations of ferrous minerals known to exist in areas surrounding this location. A Y-shaped drainage scar extends through the southeastern portion of the survey area. However, the magnetic signature of the ditch does not compare with other Adena-Hopewell ditches from the Middle Ohio Valley. Instead of exhibiting enhanced magnetism from refilling sediments, we recorded areas of slightly negative magnetism. Moreover, the magnetic signature we did record was not consistent with the position of the ditch in all areas of our survey.

EMI data collected over a sample of our survey area further indicates this feature may not be a ditched enclosure (Figure 2.7). Conductivity data from the 50-cm coil reveals a pattern of high conductivity over the depression, as well as other isolated clusters of high and low conductivity; the 1-meter coil exhibits linear noise and non-continuous areas of high conductivity

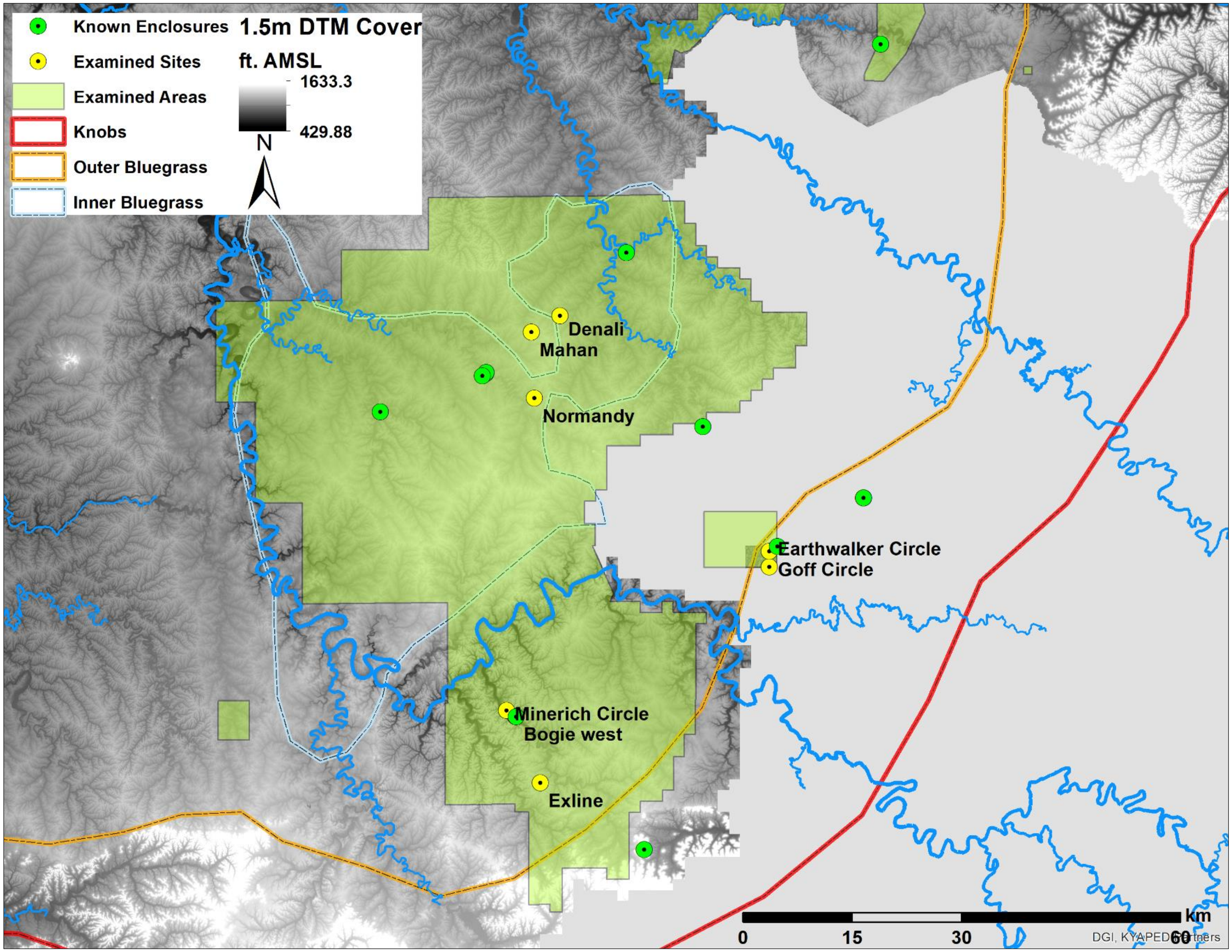

Figure 2.5. Location of features examined during this study with reference to adjacent known enclosures.

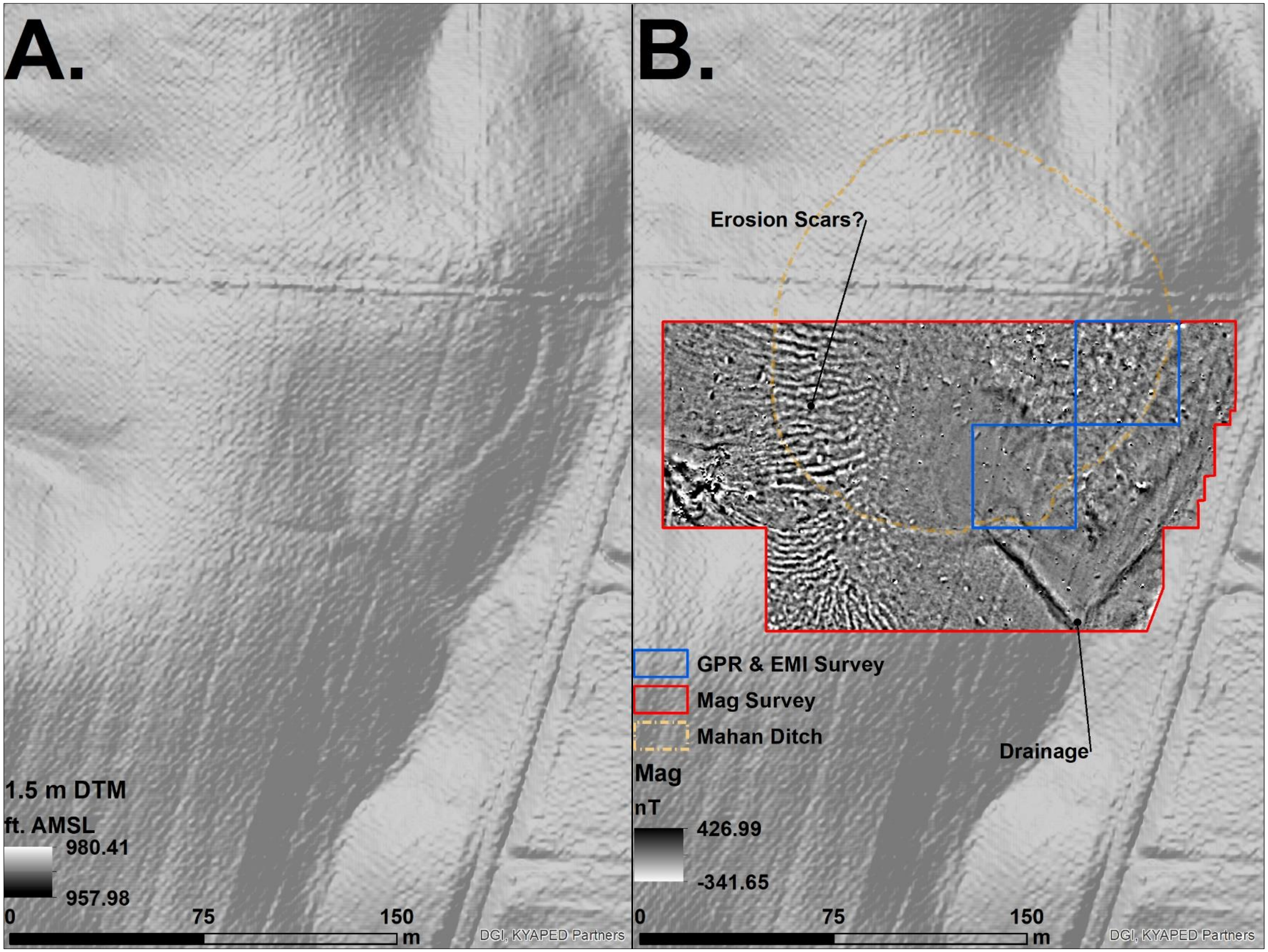

Figure 2.6. A.) LiDAR imagery depicting the Mahan Feature. B.) Magnetic data from the Mahan Feature displayed at two standard deviations with additional geophysical survey areas depicted.

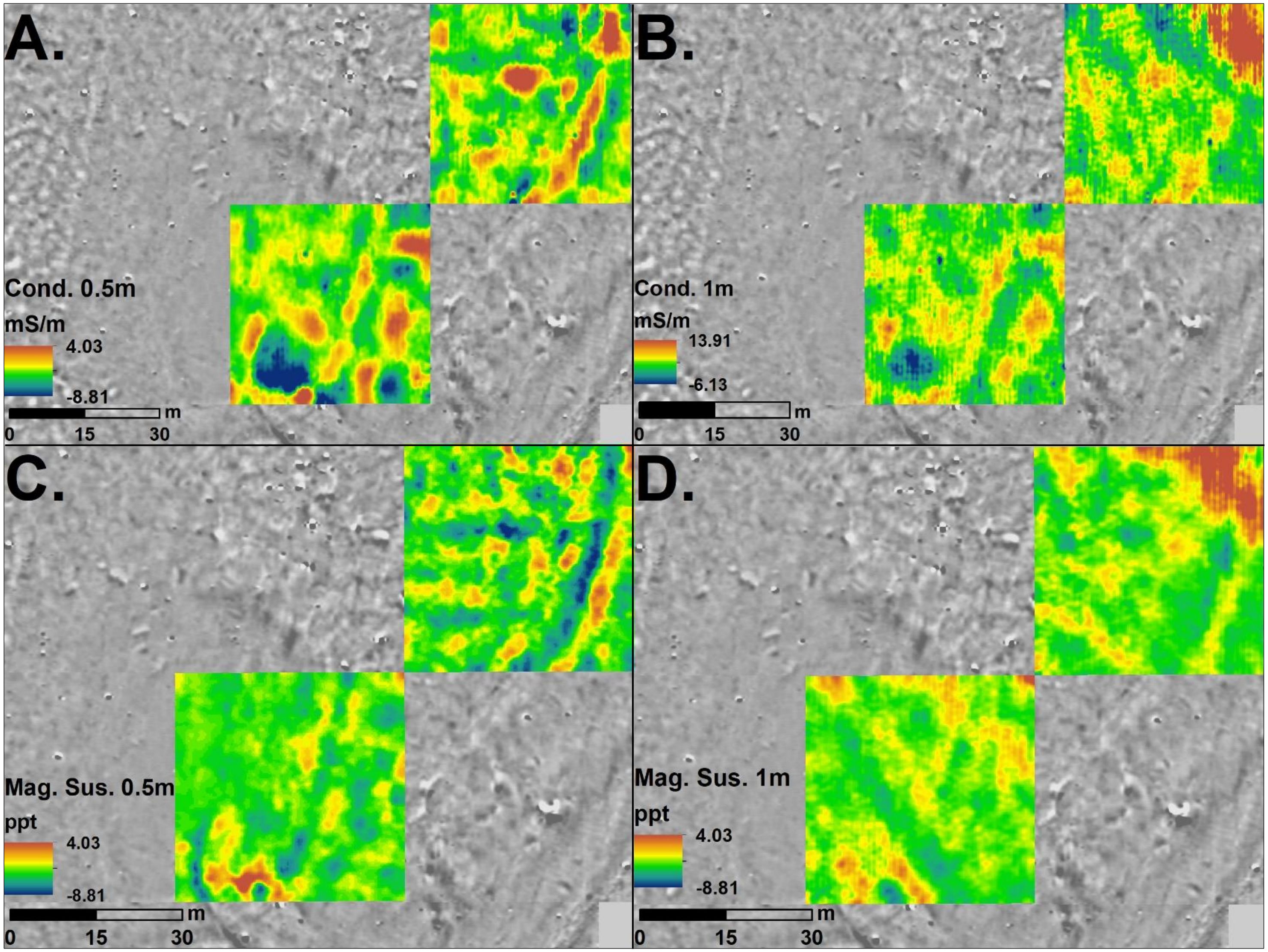

Figure 2.7 EMI data from the Mahan Feature overlaid onto magnetic data with 50-percent transparency. A.) Conductivity data from 0.5m coil; B.) Conductivity data from 1m coil; C.) Magnetic susceptibility data from 0.5m coil; D.) Magnetic susceptibility data from 1m coil.

that have little relation to the location of the potential ditch. The shallow depth of the high conductivity signature over the ditch is unusual because Adena-Hopewell ditches in this region often extend roughly 2-meters in depth (Clay 1985; Henry 2011; Webb 1941). The magnetic susceptibility component of our EMI survey recorded parallel but discontinuous bands of low and high susceptibility over one area of the ditch in the 50-cm coil data. However, the 1-meter coil data did not reveal a similar signature over the ditch, suggesting the source of the topographic depression we documented in the LiDAR data was not originally very deep. GPR survey covering the same areas as the EMI meter corroborated this hypothesis by revealing high amplitude reflections over the "ditch" no deeper than 50 cm below ground surface (Figure 2.8).

Drawing on data derived from our multi-instrument geophysical surveys, we propose that the Mahan Feature is the result of currently unknown historic activities. It is possible that this feature relates to horse training or other agricultural practices such as driving farm machinery in circular patterns to unroll large circular hay bales for livestock.

2.4.2 The Denali Feature

The Denali Feature is situated in the Inner Bluegrass region and is also located in an upland context dominated by residual soil development. This LiDAR anomaly represents another potential irregular enclosure characterized by an oval ditch-like depression approximately six-meters wide enclosing 3.12 ha of space and numerous topographic depressions (Figure 2.9). Magnetic survey at Denali identified numerous variations associated with drainage scars and lightning strikes, as well as faint evidence for historic plow scars trending generally east-west (Figure 2.10). However, the magnetic signature from what we considered to be a ditch at Denali does not conform to the published magnetic responses to ditches at other Adena-Hopewell enclosures. Instead of appearing as a solid band of enhanced magnetism, the data exhibits

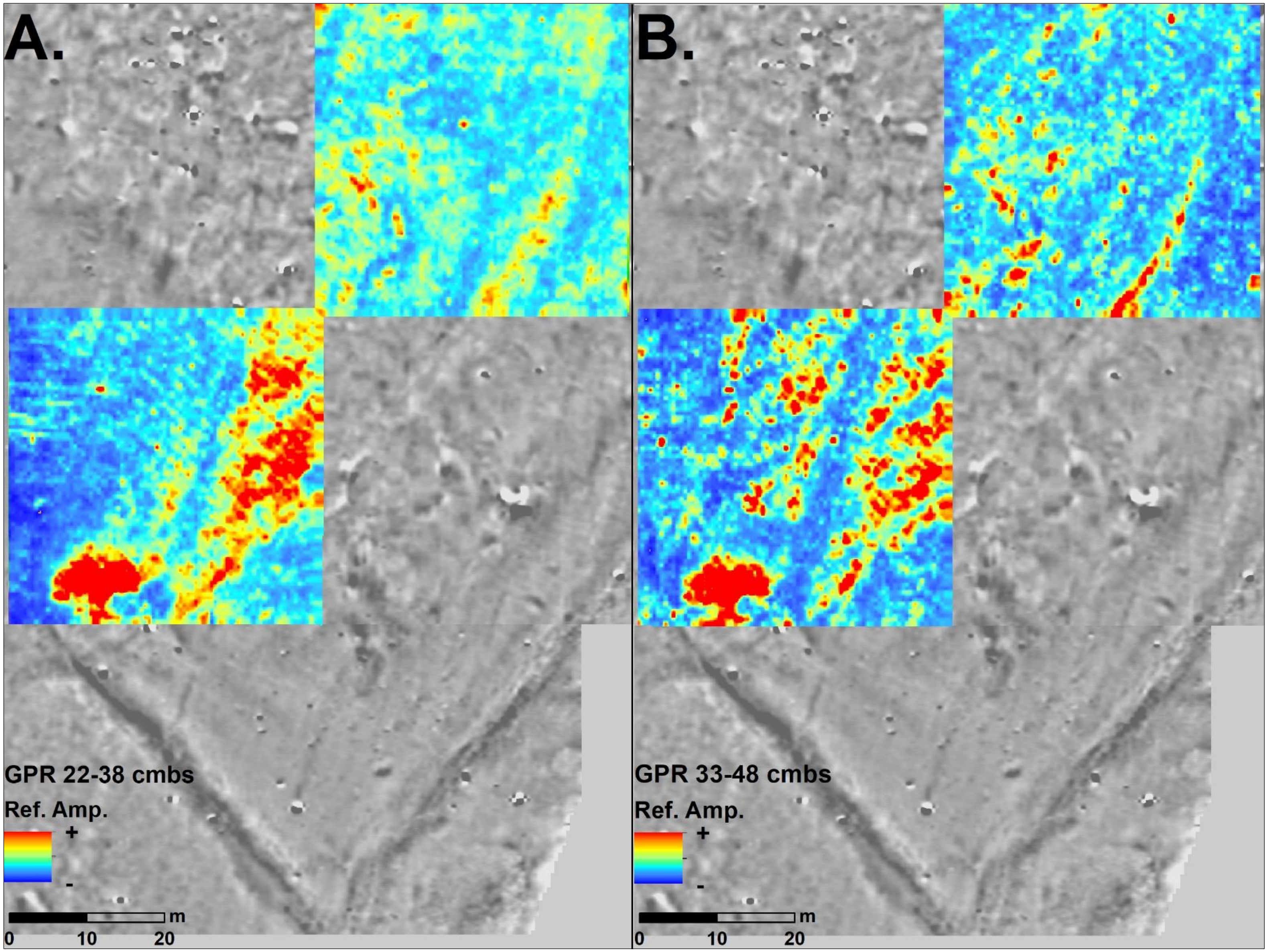

Figure 2.8. GPR amplitude slice maps from the Mahan Feature. A.) 22-38cm below surface; B.) 33-48cm below surface.

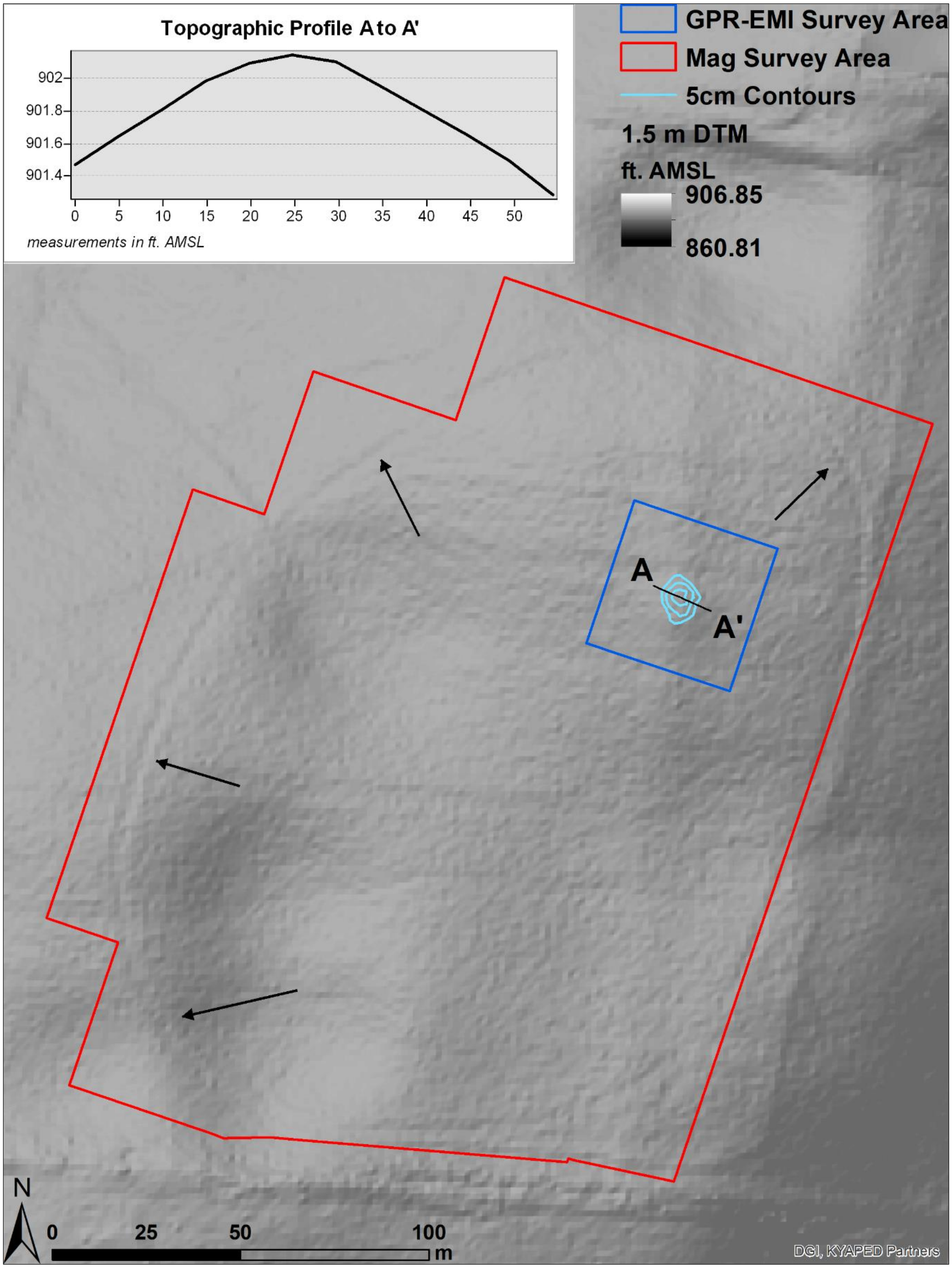

Figure 2.9. LiDAR data depicting the Denali Feature. Arrows point to the potential ditch. Geophysical survey areas denoted and contours of small topographic rise discussed in text are highlighted.

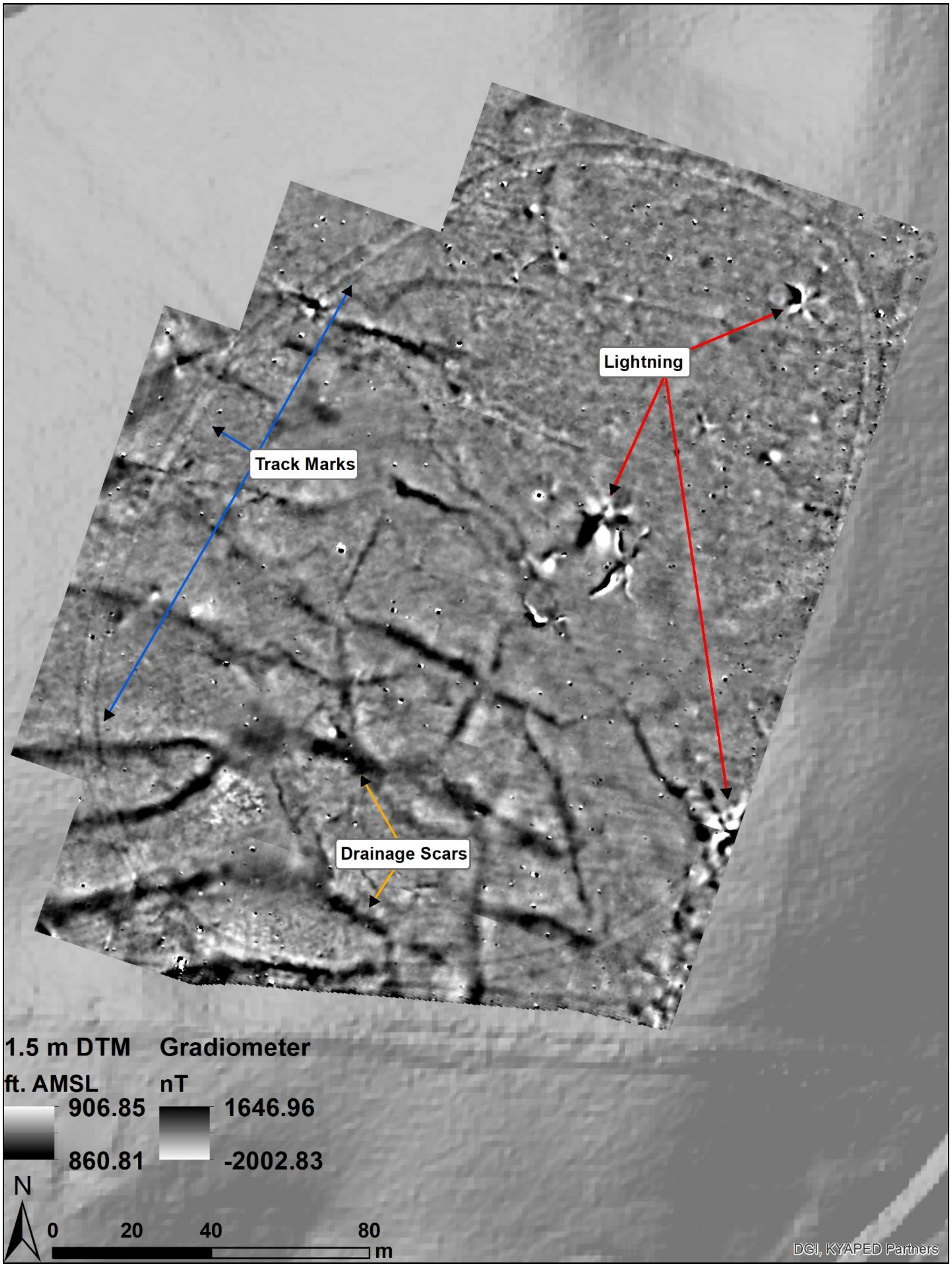

Figure 2.10. Magnetic data from the Denali Feature displayed at 2 standard deviations.

parallel lines of positive and negative magnetism. The cause of these anomalies became clear during the end of data collection when farm machinery entered the field and began tossing manure and hay from the stalls of a nearby horse barn. At this point we knew the Denali Feature was not a prehistoric enclosure, instead a result of tire impressions from farm machinery. Prior to abandoning the feature, however, we identified a small conical rise (~30 cm tall) (see Figure 2.9). Upon reviewing the magnetic data in this location, we found the rise was associated with multiple magnetically-enhanced isolated anomalies beneath and around it. Because this rise exhibits a similar morphology to small burial mounds (see Clay 1983; Pollack et al. 2005), we decided to survey the feature with EMI and GPR.

The 50-cm coil dataset from the EMI survey depicted extensive areas of moderately low conductivity associated with the rise, as well as isolated areas of high magnetic susceptibility under and around it (Figure 2.11). Alternatively, data from the 1-meter coil revealed low conductivity and high magnetic susceptibility around the rise. Variations in EMI data from both coils likely represent sediment differences inside the rise, as well as underlying it. If this feature is indeed a small burial mound, the magnetic susceptibility data may reflect differences within and just under the rise, especially considering the rise may have been taller before historic plowing occurred in the area. These factors led us to hypothesize that the high susceptibility values we documented correlated with different sediment fills or zoned fills like those identified at the Walker-Noe Mound (Pollack et al. 2005). GPR survey over this area at Denali exhibits high amplitude reflections associated with, and around, the rise ranging from 9 to 46 cmbs (Figure 2.12). Some correspond with the location of magnetic anomalies (Figure 2.12d).

Correlations between the magnetic, EMI, and GPR datasets led us to examine the sediments along the flanks of the rise to search for sediment fills and buried A soil horizons

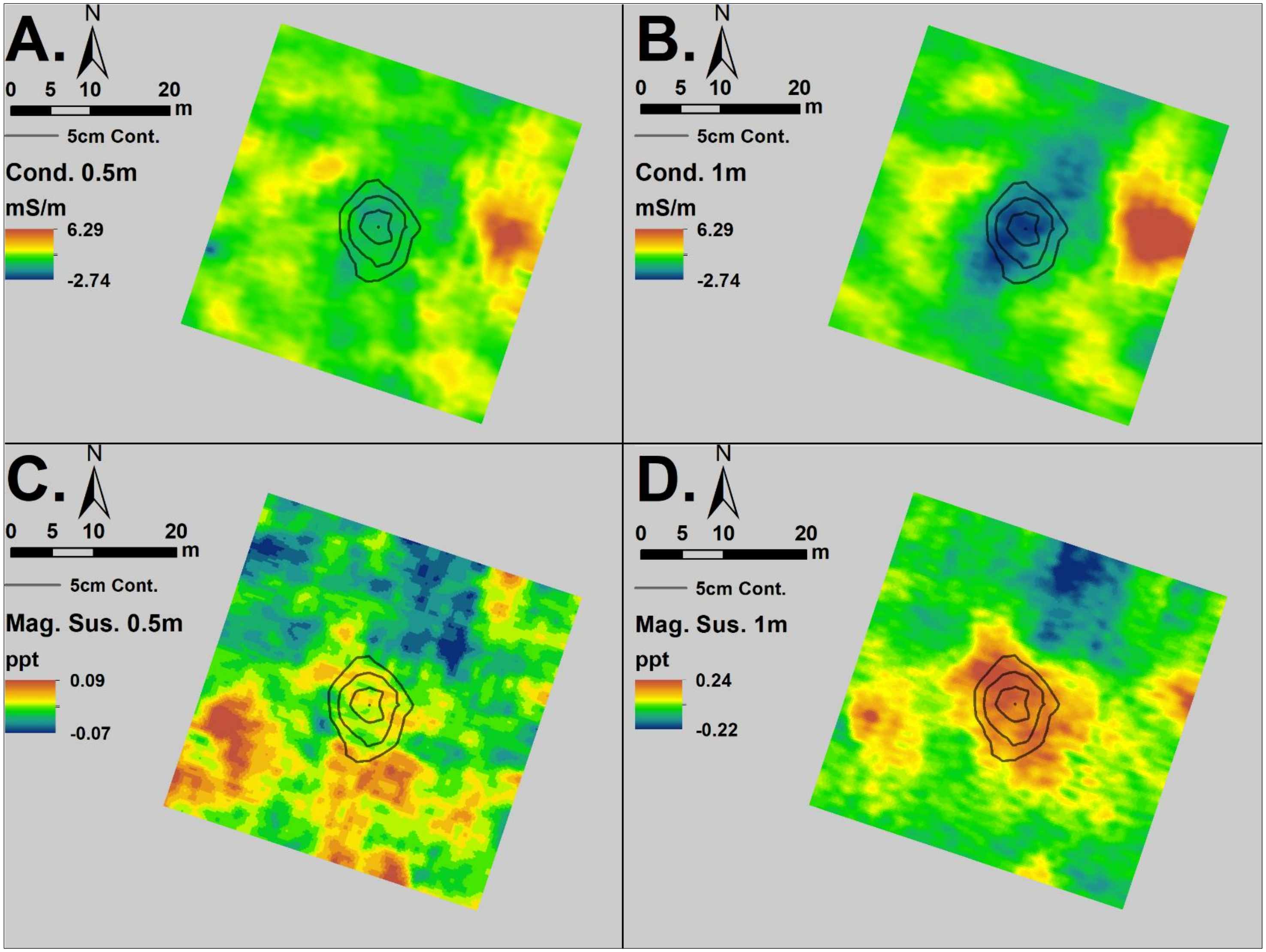

Figure 2.11. EMI data from the topographic rise at the Denali Feature. A.) Conductivity data from 0.5m coil; B.) Conductivity data from 1m coil; C.) Magnetic susceptibility data from 0.5m coil; D.) Magnetic susceptibility data from 1m coil.

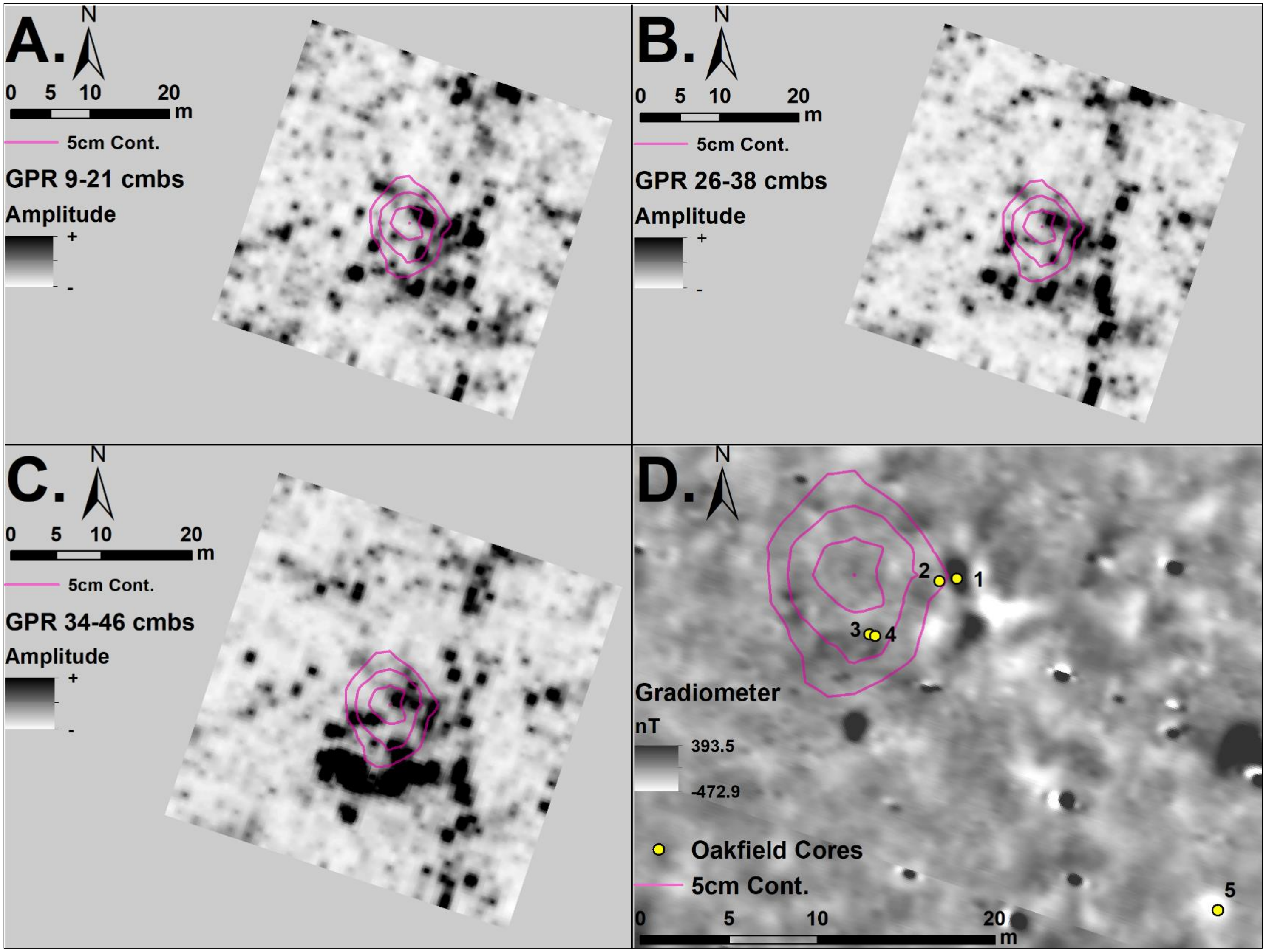

Figure 2.12. GPR amplitude slice maps from the topographic rise at the Denali Feature. A.) Reflections from 9-21cm below surface; B.) Reflections from 26-38cm below surface; C.) Reflections from 34-46cm below surface; D.) Location of Oakfield soil cores in proximity to the topographic rise.

common to mound architecture in Eastern North America (Sherwood and Kidder 2011). To examine the sediments in the least invasive manner possible, we used an Oakfield soil core. Four cores were placed on the eastern and southern flanks of the rise, over magnetic and GPR anomalies (Figure 2.12d). We also examined the natural soil profile through one core placed 22 meters southeast of the rise. All cores were compared to NRCS surveys of the local soil series (Table 2). Core One exhibited a natural soil profile in the upper 38cm, progressing through Ap, and Bt soil horizons natural to the Bluegrass-Maury silt loam soil series on this landform (Soil Survey Staff 2017). However, between 38 and 51 cmbs, sediments exhibited clear yellow clay mottles trending into a buried A horizon (Ab) before transitioning back into a Bt horizon that exhibited a natural profile (e.g., culturally sterile) to a depth of 83 cmbs. Core Two, placed slightly higher on the flank of the topographic rise, exhibited a natural soil profile in the upper 45 cm. However, from 45 and 53 cmbs an Ab soil horizon was encountered. This buried horizon exhibited a burned reddish hue and ferrous concretions. Core Three exhibited an Ab horizon with fragments of burned earth between 44 and 52 cmbs. Core Four exhibited an Ab horizon overlaying a deep reddish-orange soil zone like the layer identified in Core Two. Core Five, positioned away from the rise, exhibited a natural soil sequence that fits the NRCS soil series description for this landform. The irregularities observed in sediments underlying this subtle topographic feature suggests culturally-altered sediment fills are covering an ancient land surface. Thus, we conclude that our research at Denali could indicate a small burial mound exists there.

Table 2.2. Sediment descriptions from Oakfield cores removed near the topographic rise at the Denali Feature.

Core No.	Depth (cm) Below Surface	Physical Characterization	Horizon Designation	Sediment Colour	Inclusions
1	0-19	Silt Loam	Ap	10YR 3/3: Dark Brown	N/A
	19-38	Silty Clay Loam	Bt	10YR 4/4: Dark Yellowish Brown	N/A
	38-47	Silt Loam/Clay Loam Mix	Bt/C	10YR 4/4: Dark Yellowish Brown 10YR 5/6: Yellowish Brown	Yellow Clay Mottles
	47-51	Silt Loam	2Ab	10YR 4/3: Brown	N/A
	51-83	Clay Loam	2Bt	10YR 5/6: Yellowish Brown	N/A
2	0-16	Silt Loam	Ap	10 YR 4/2: Brown	N/A
	16-45	Silty Clay Loam	Bt	10YR 3/4: Dark Yellowish Brown	N/A
	45-53	Silt Loam	2Ab	7.5YR 3/3: Dark Brown	Numerous Ferrous Concretions; Burned?
	53-76	Clay Loam	2Bt	10YR 5/8: Yellowish Brown	N/A
3	0-15	Silt Loam	Ap	10YR 4/3: Brown	N/A
	15-44	Silty Clay Loam	Bt	10YR 4/6: Dark Yellowish Brown	N/A
	44-52	Silt Loam	2Ab?	10YR 4/3: Brown	Fragments of Burned Earth
	52-96	Clay Loam	2Bt	10YR 5/8: Yellowish Brown	N/A
4	0-17	Silt Loam	Ap	10YR 4/3: Brown	N/A
	17-58	Silty Clay Loam	Bt	10YR 4/4: Dark Yellowish Brown	N/A
	58-66	Silt Loam	2Ab	7.5YR 4/6: Strong Brown	Numerous Ferrous Concretions; Burned?
	66-88	Clay Loam	2Bt	10YR 5/6: Yellowish Brown	N/A
5	0-12	Silt Loam	Ap	10YR 4/3: Brown	N/A
	12-64	Clay Loam	Bt	10YR 5/6: Yellowish Brown	N/A

2.4.3 The Normandy Feature

After investigating two possible irregular enclosures that we concluded were historic and modern disturbances, we began examining potential small geometric enclosures. The first we examined was the Normandy Feature, located in the Inner Bluegrass Region atop residual soil development. Normandy is characterized by a potential circular ditch-and-embankment enclosing 2,306.6 m^2 (Figure 2.13). A modern farm road bisects the feature. Consultation with the landowners indicated no modern buildings were located there in recent history. Results of our magnetic survey suggests much historic disturbance has occurred in this area (Figure 2.14). Numerous metallic pipes are buried under the survey area, some of which extend to the center of the circle where a large monopolar anomaly is present. The outer portion of the internal platform is marked by numerous dipolar and monopolar anomalies consistent with a response to ferrous materials. Areas outside the circle exhibit a network of linear magnetic highs, possibly relating to compacted horse paths or subsurface disturbances. No clear magnetic anomalies were associated with the potential ditch or embankment at this feature. The magnetic characteristics of Normandy indicated it was not a Woodland enclosure. However, additional landowner consultations suggested no known historic architecture was buried in this area, leading us to conduct abbreviated EMI and GPR surveys over a sample of the magnetic survey.

Data from both the 50-cm and 1-meter coils of the EMI survey showed little subsurface variation apart from responses to metal debris and metal pipes (Figure 2.15). However, data from our GPR survey offered an entirely different subsurface view of the Normandy Feature (Figure 2.16). Amplitude slice maps between 8 and 89 cmbs exhibit a 5.5-meter wide band of high amplitude reflections. This anomaly is situated outside the internal platform identified in the LiDAR data, leaving a possibility that the anomaly could represent a refilled ditch. However,

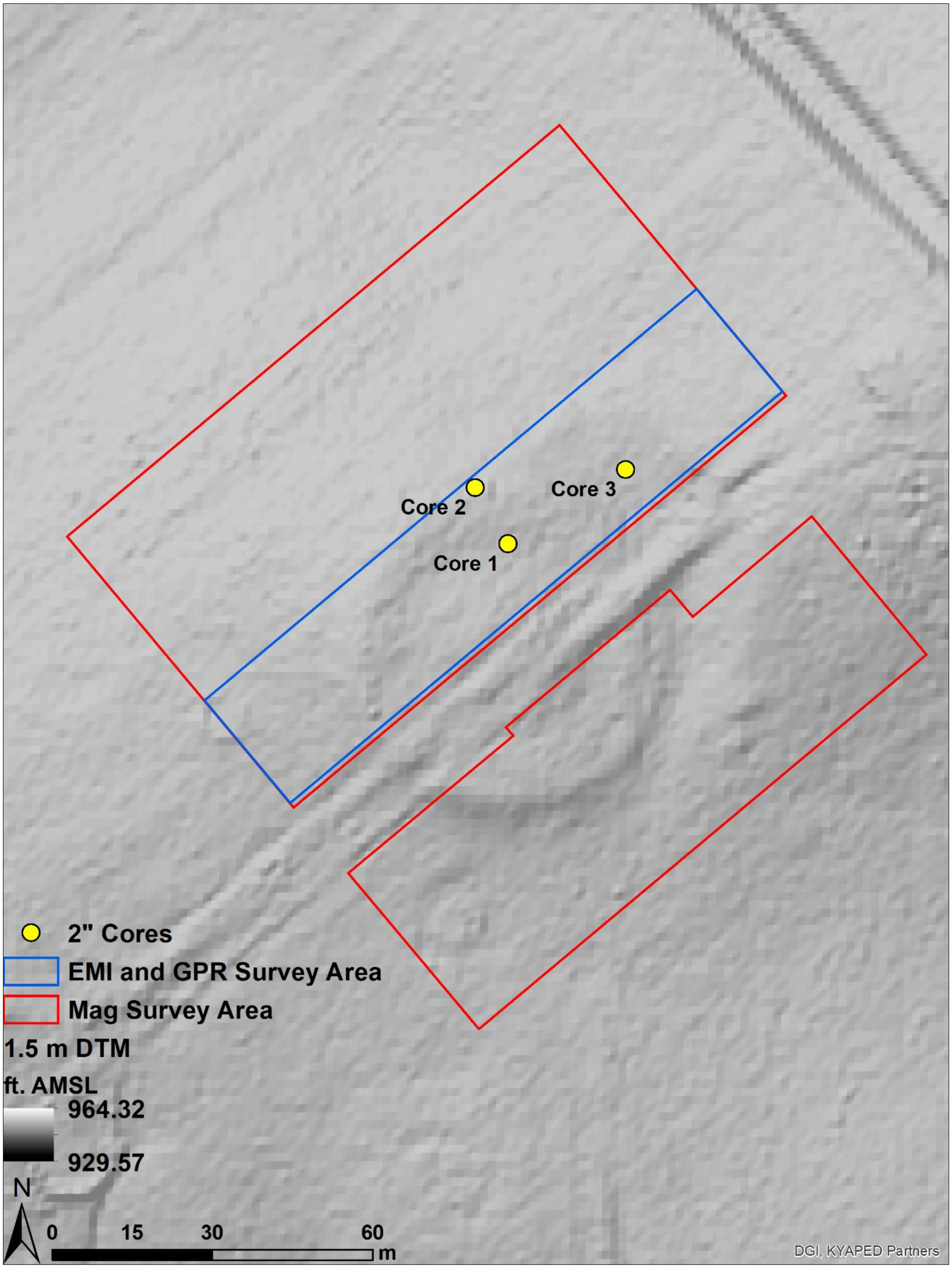

Figure 2.13. LiDAR data depicting the Normandy Feature. Geophysical survey areas and placement of 2” solid soil cores are denoted.

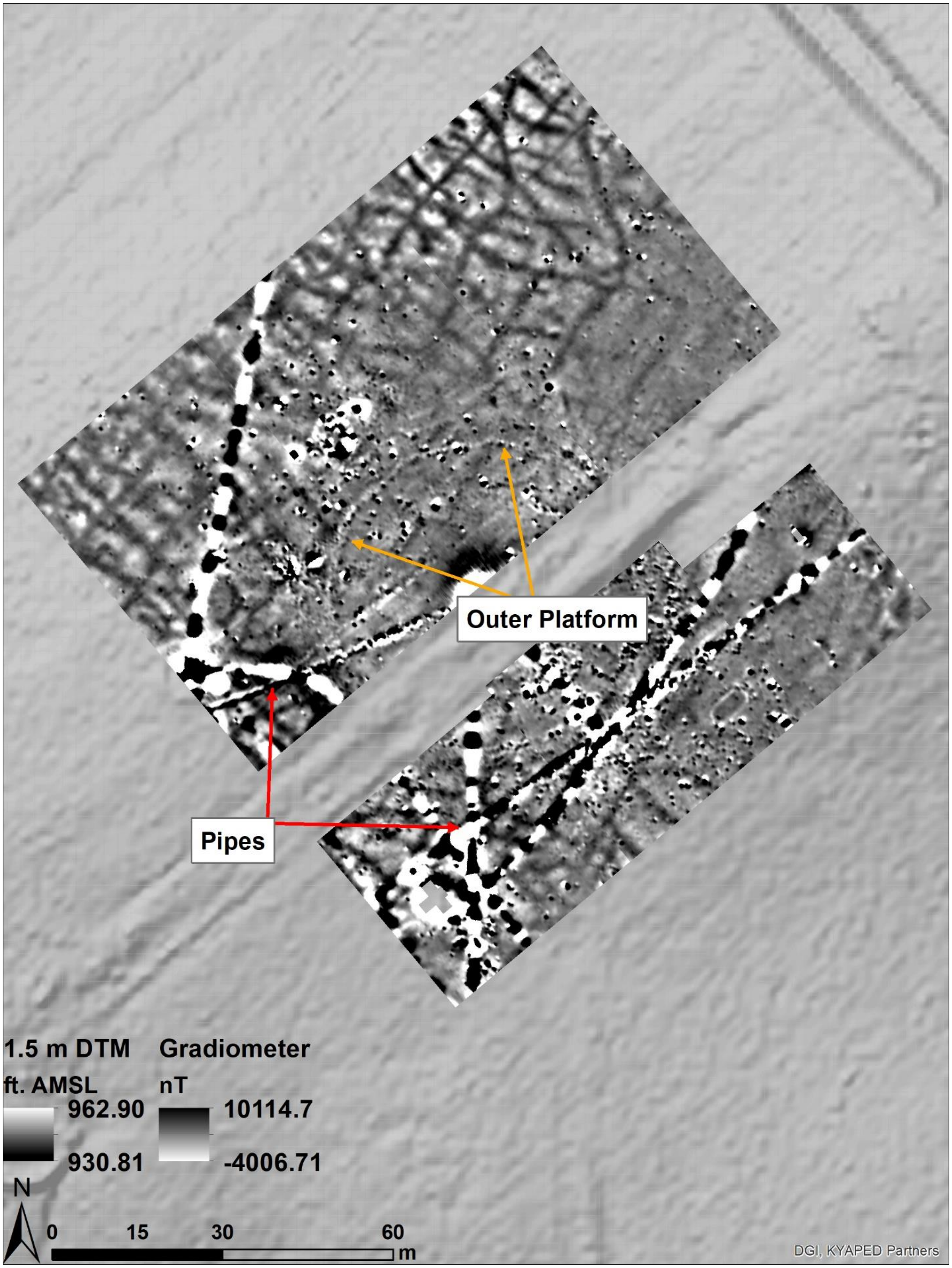

Figure 2.14. Magnetic data from the Normandy Feature displayed at 0.2 standard deviations.

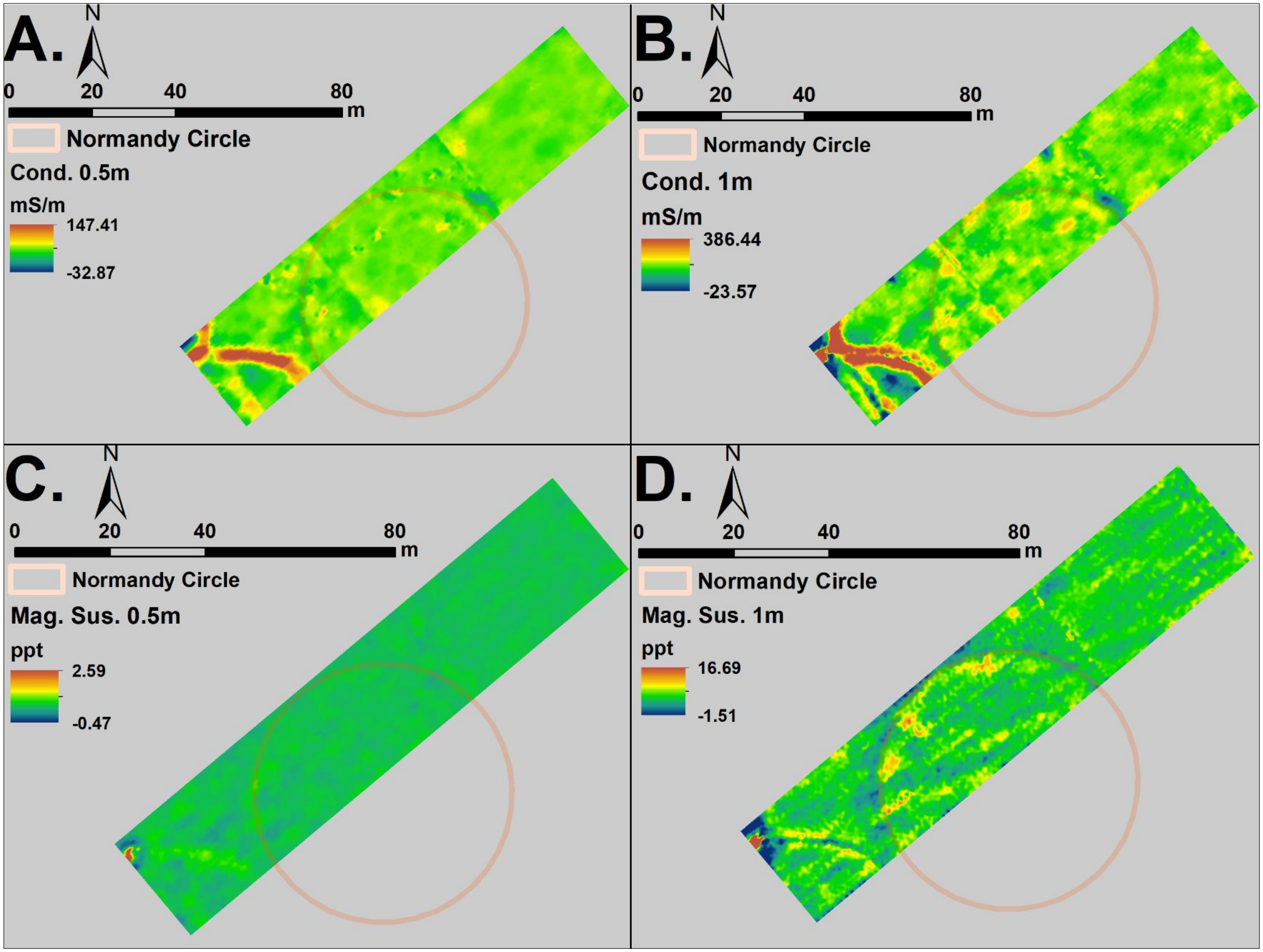

Figure 2.15. EMI data from the Normandy Feature. A.) Conductivity data from 0.5m coil; B.) Conductivity data from 1m coil; C.) Magnetic susceptibility data from 0.5m coil; D.) Magnetic susceptibility data from 1m coil.

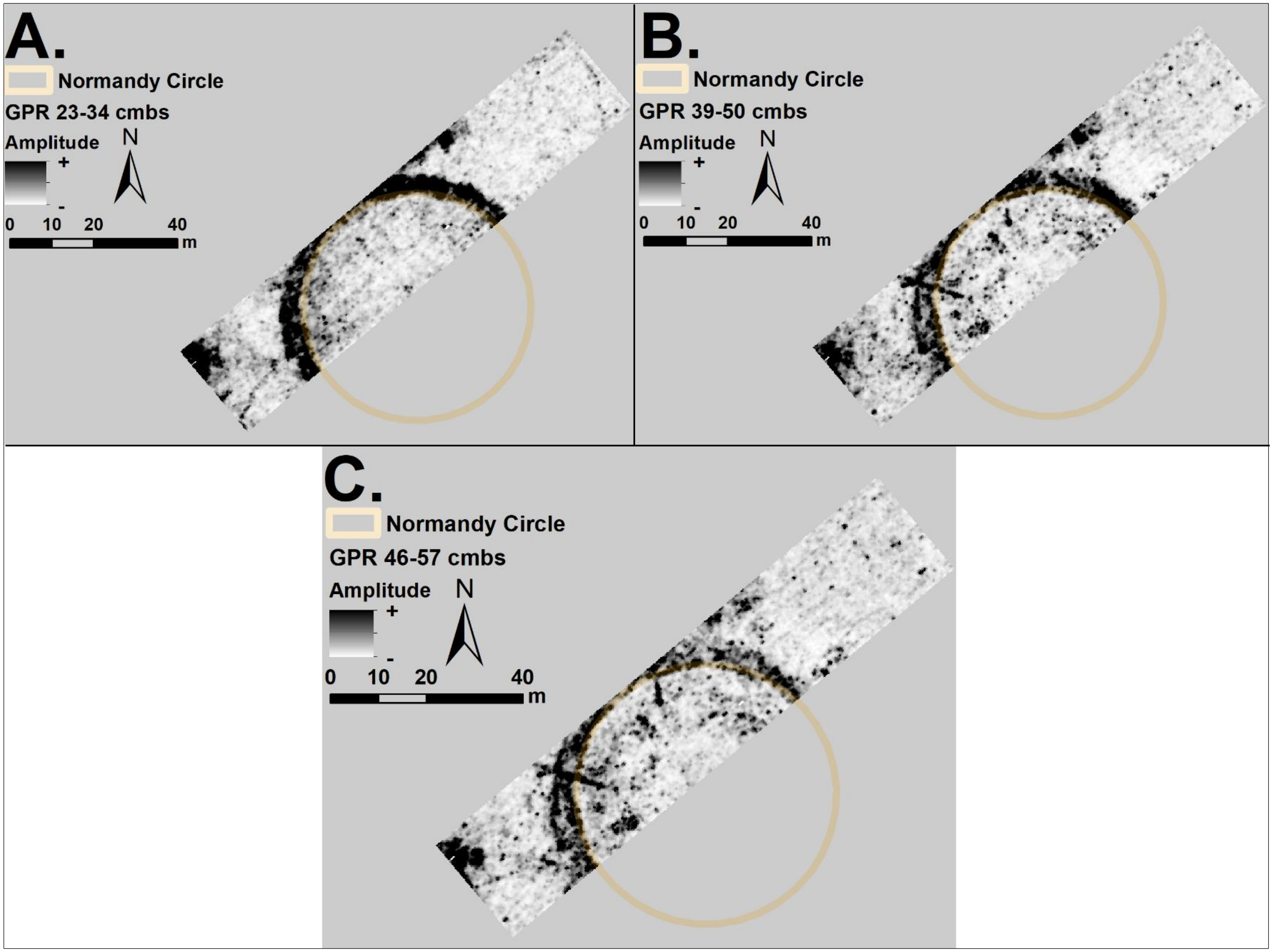

Figure 2.16. GPR amplitude slice maps from the Normandy Feature. A.) Reflections from 23-34cm below surface; B.) Reflections from 39-50cm below surface; C.) Reflections from 46-57cm below surface.

beyond 42 cmbs the GPR data depicts linear features running toward the center of the circle that are not present in the EMI or gradiometer data. Thus, the question remained whether the GPR was depicting a ditch or deeper historic features.

We extracted three bull auger soil cores across different portions of the feature to examine the soil profile at Normandy (see Figure 2.13). Cores One and Two extended only 43 and 12 cmbs before terminating at a concrete surface. Core Three extended 94 centimeters below surface and exhibited a natural soil profile for the landform (Table 2.3). Therefore, we can only assume that the circular feature at Normandy is a concrete structure possibly associated with an early historic horse farm. The circular pattern of high amplitude reflections in the GPR data likely represents the outer boundary of this structure. The circular pattern of magnetic monopoles and dipoles may be iron rebar associated with the concrete structure.

2.4.4 The Exline Feature

After confirming that three of our LiDAR anomalies situated in the Inner Bluegrass Region—where most horse farms are located—were non-enclosures, we shifted focus to examine a topographic anomaly on the southern boundaries of the Outer Bluegrass Region. The Exline Feature can be characterized as a circular ditch-like depression with an exterior embankment-like rise enclosing 1,432.4 m^2 (Figure 2.17a). Like other previously discussed LiDAR anomalies, Exline is situated on residual upland soils. Magnetic data from the area depicts faint inner and outer circular patterns. A natural gas pipeline runs through the southwest portion of the survey area (Figure 2.17b). EMI data from the 1-meter coil shows enhanced susceptibility along the exterior of the circle and low susceptibility in the ditch (Figure 2.18). Conductivity data from the two coil separations show low conductivity values over the potential embankment and elevated conductivity in the ditch. In both the conductivity and susceptibility data, we mapped inverse responses to what is generally observed for enclosures in the region.

Table 2.3. Sediment descriptions from 2” bull auger cores removed at the Normandy Feature.

Core No.	Depth (cm) Below Surface	Physical Characterization	Horizon Designation	Sediment Colour	Inclusions
1	0-19	Silt Loam	Ap	10YR 3/3: Dark Brown	N/A
	19-43	Clay Loam	B	10YR 3/3: Dark Brown	Core Terminates in Concrete
2	0-12	Silt Loam	Ap	10YR 3/3: Dark Brown	Core Terminates in Concrete
3	0-18	Silt Loam	Ap	10YR 3/3: Dark Brown	N/A
	18-49	Silty Clay Loam	Bt1	10YR 3/6: Dark Yellowish Brown	N/A
	49-94	Clay Loam	Bt2	10YR 4/4: Dark Yellowish Brown	N/A

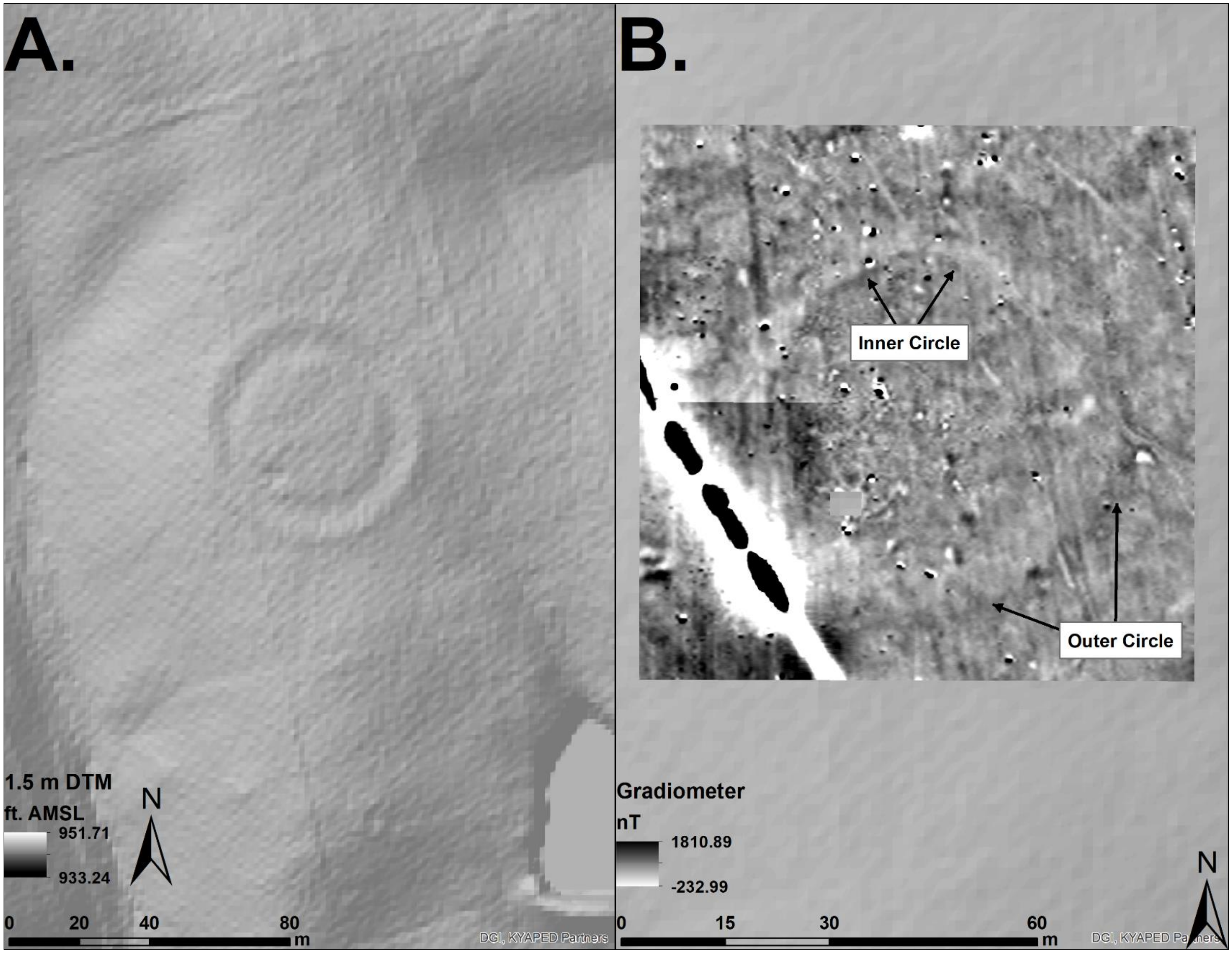

Figure 2.17. A). The Exline Feature depicted in the LiDAR data. B.) Magnetic data from the Exline Feature displayed at 0.25 standard deviations.

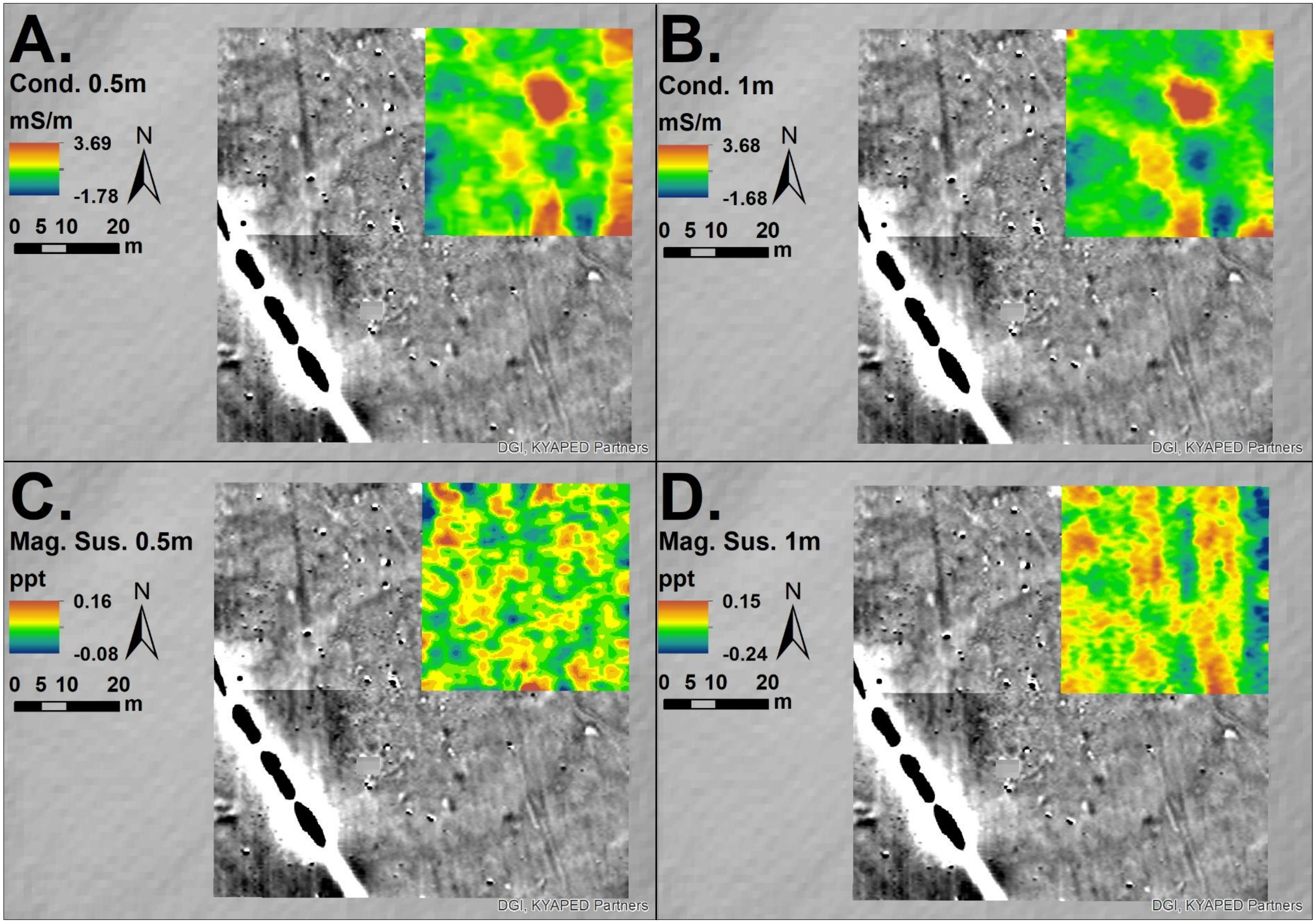

Figure 2.18. EMI data from the Exline Feature. A.) Conductivity data from 0.5m coil; B.) Conductivity data from 1m coil; C.) Magnetic susceptibility data from 0.5m coil; D.) Magnetic susceptibility data from 1m coil.

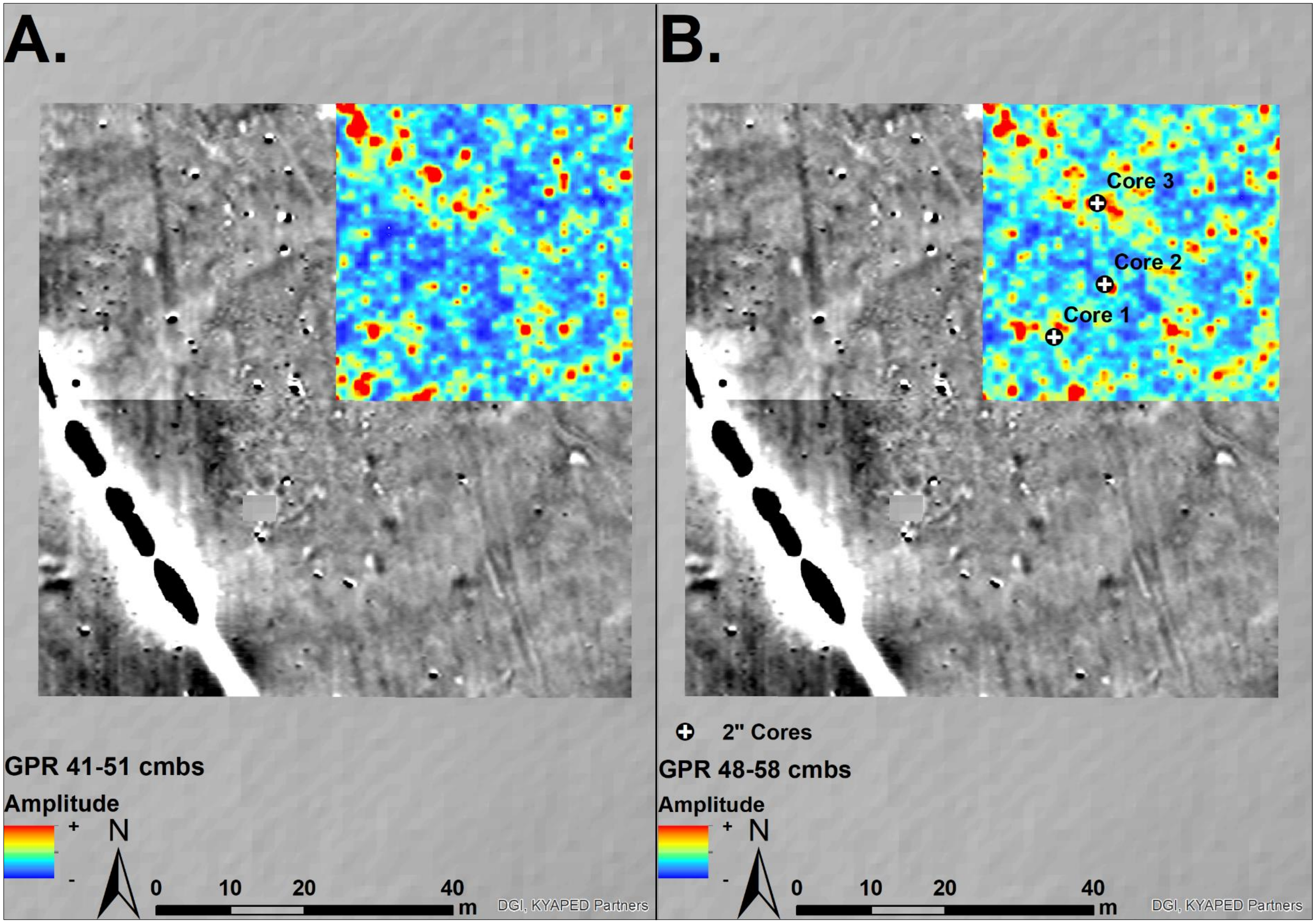

Figure 2.19. GPR amplitude slice maps from the Exline Feature. A.) Reflections from 41-51cm below surface; B.) Reflections from 48-58cm below surface with locations of bull auger soil cores.

GPR data from survey over the ditch and embankment exhibits a faint patterning in high amplitude reflections along the potential embankment. This pattern is most evident between depths of 41 and 58 cmbs (Figure 2.19).

Although geophysical survey documented subsurface variation associated with the Exline Feature, no clear evidence for an enclosure was detected. To be sure this was not an enclosure, we extracted three bull auger soil cores (Figure 2.19b). Core One was located inside the enclosure to examine what should be a natural soil profile that could be compared to Core Two (located in the potential ditch) and Core Three (situated over the potential embankment). All three cores exhibited soil profiles consistent with the natural profile reported by the NRCS for the landform (Table 2.4). None of these cores exhibited evidence for buried A horizons or any irregular sediment fills that could relate to ancient human alteration. Like the potential enclosures discussed above, our geophysical surveys and coring regime at Exline confirmed the feature was not an Adena-Hopewell enclosure. We currently have no suitable explanation for this topographic anomaly.

2.4.5 The Bogie West Feature

The Bogie West Feature was identified as a ditch-like anomaly in aerial photography during the examination of LiDAR data adjacent to the well-preserved Bogie Circle (15Ma44). Situated 140-meters west of this known enclosure on a residual terrace, the potential Bogie West Feature is not topographically visible in LiDAR data or on the ground. However, the feature’s ditch-like appearance is visible in 2012 NAIP aerial photographs because of differences in vegetation growth (Figure 2.20). Magnetic survey of the feature revealed an enhanced magnetic response common at other enclosure sites in the Middle Ohio Valley. These data suggest an internal area measuring 1,917.2 m^2 represents the internal platform where a faint circular

Table 2.4. Sediment descriptions from 2” bull auger cores removed at the Exline Feature.

Core No.	**Depth (cm) Below Surface**	**Physical Characterization**	**Horizon Designation**	**Sediment Colour**
1	0-15	Silt Loam	Ap	10YR 3/3: Dark Brown
	15-67	Silty Clay	Bt1	10YR 3/6: Dark Yellowish Brown
	67-89	Silty Clay	Bt2	10YR 4/4: Dark Yellowish Brown
2	0-17	Silt Loam	Ap	10YR 3/3: Dark Brown
	17-58	Silty Clay	Bt1	10YR 3/6: Dark Yellowish Brown
	58-93	Silty Clay	Bt2	10YR 4/4: Dark Yellowish Brown
3	0-18	Silt Loam	Ap	10YR 3/3: Dark Brown
	18-63	Silty Clay	Bt1	10YR 3/6: Dark Yellowish Brown
	63-94	Silty Clay	Bt2	10YR 4/4: Dark Yellowish Brown

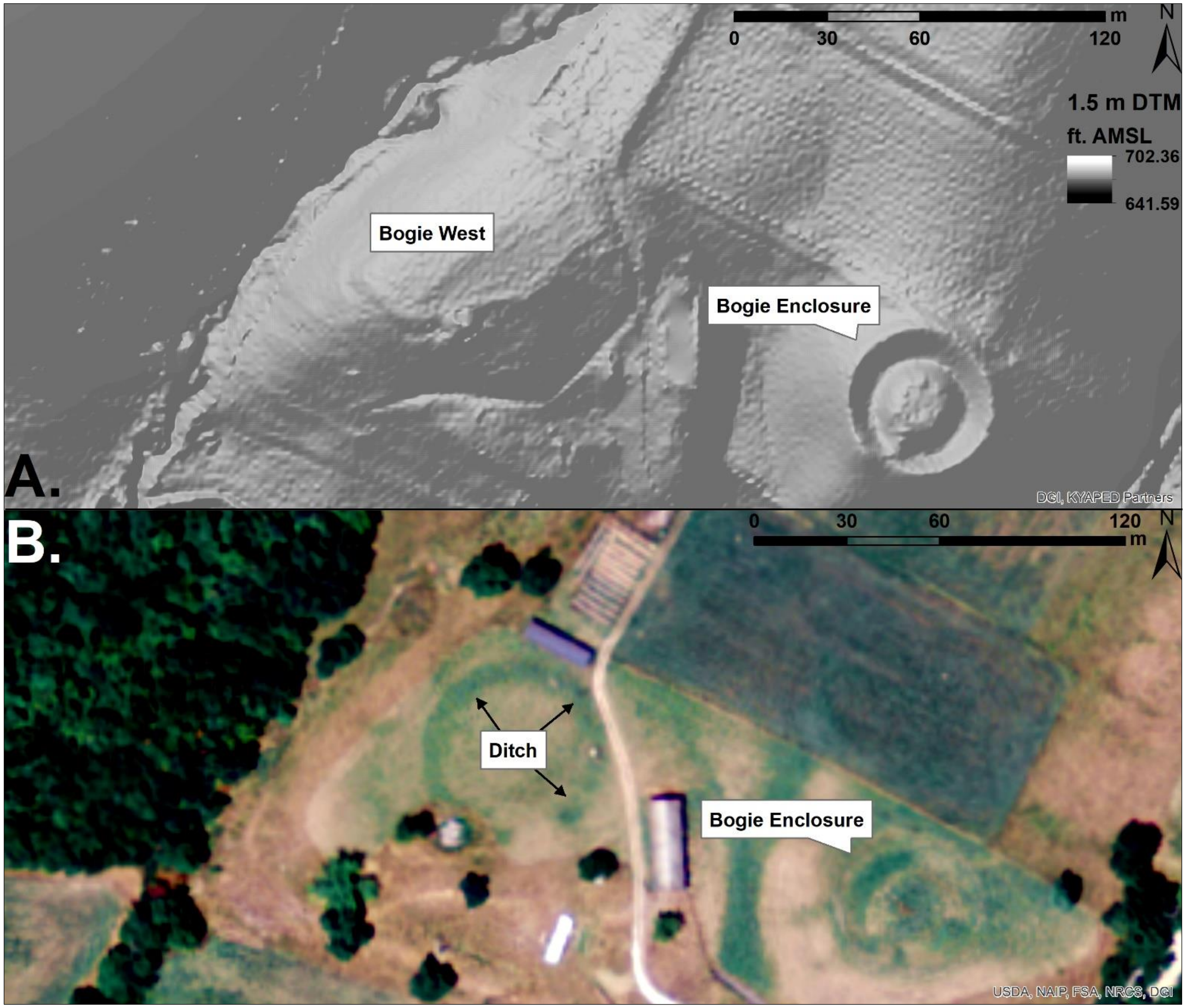

Figure 2.20. A.) LiDAR data from the area around the Bogie Enclosure (15Ma44). B.) 2012 NAIP aerial photography from the area around the Bogie Enclosure (15Ma44). Note the dark green vegetation growing in a circle west of the Bogie Enclosure.

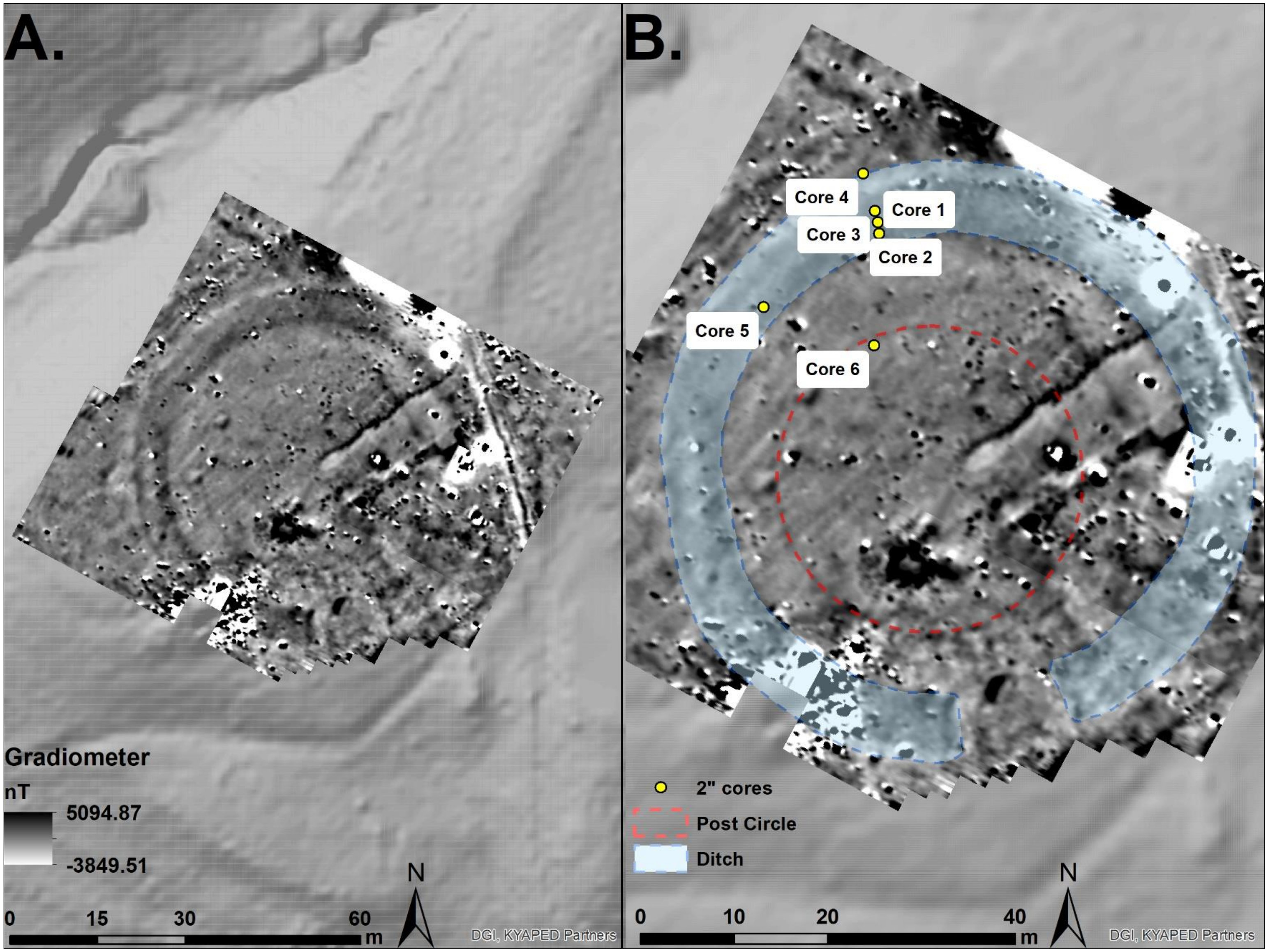

Figure 2.21. A.) Magnetic data from the Bogie West Feature displayed at 0.2 standard deviations. B.) Magnetic data with ditch, internal post-circle, and location of bull auger cores denoted.

magnetic anomaly 32.7-meter in diameter is present. This may indicate the presence of a post-enclosure (Figure 2.21). Magnetic evidence for the refilled ditch suggests the causeway opens to the south-southwest. No additional geophysical surveys were conducted due to the amount of historic alteration to this area and amount of metal debris that would limit the ability of EMI to detect enclosure features like embankment remnants. Furthermore, the magnetic signature of the ditch was clear and replicated what we observed in aerial imagery. However, we did remove a series of bull auger cores to examine how the ditch refilled, in addition to searching for buried sediment fills used in embankment construction (Figure 2.21b). Another core placed inside the enclosure was removed to examine the natural soil profile for the landform. Cores in the ditch extended roughly 1.7m below surface and exhibited alternating clay and silt loam strata. Ongoing sediment analyses should help inform our understandings of how the ditch refilled through time. In this case, magnetic survey confirmed the presence of a buried ditch first seen in aerial imagery and geoarchaeological coring revealed how deep the ditch was initially excavated.

2.4.6 The Goff Feature

The Goff Feature represents another case where 2012 NAIP aerial photography revealed the presence of a possible enclosure during the examination of LiDAR data near a known burial mound (i.e., Goff Mound). Like the Bogie West Feature, Goff Feature is not visible in LiDAR data, but differences in the color of vegetation growth indicated the presence of a ditch enclosing 1,470.5m^2 (Figure 2.22). Goff is located within the heavily dissected upland residual soils of the Knobs Region of Central Kentucky. Results of our magnetic survey at Goff revealed a faint circular band of enhanced magnetism amidst evidence for intensive plowing (Figure 2.23), confirming the presence of a site. The prominence of plow scars in the magnetic data, paired with the width of the ditch made us question whether intact embankment fills would exist below the surface, so we collected EMI data over a sample of the magnetic survey. Results of our EMI

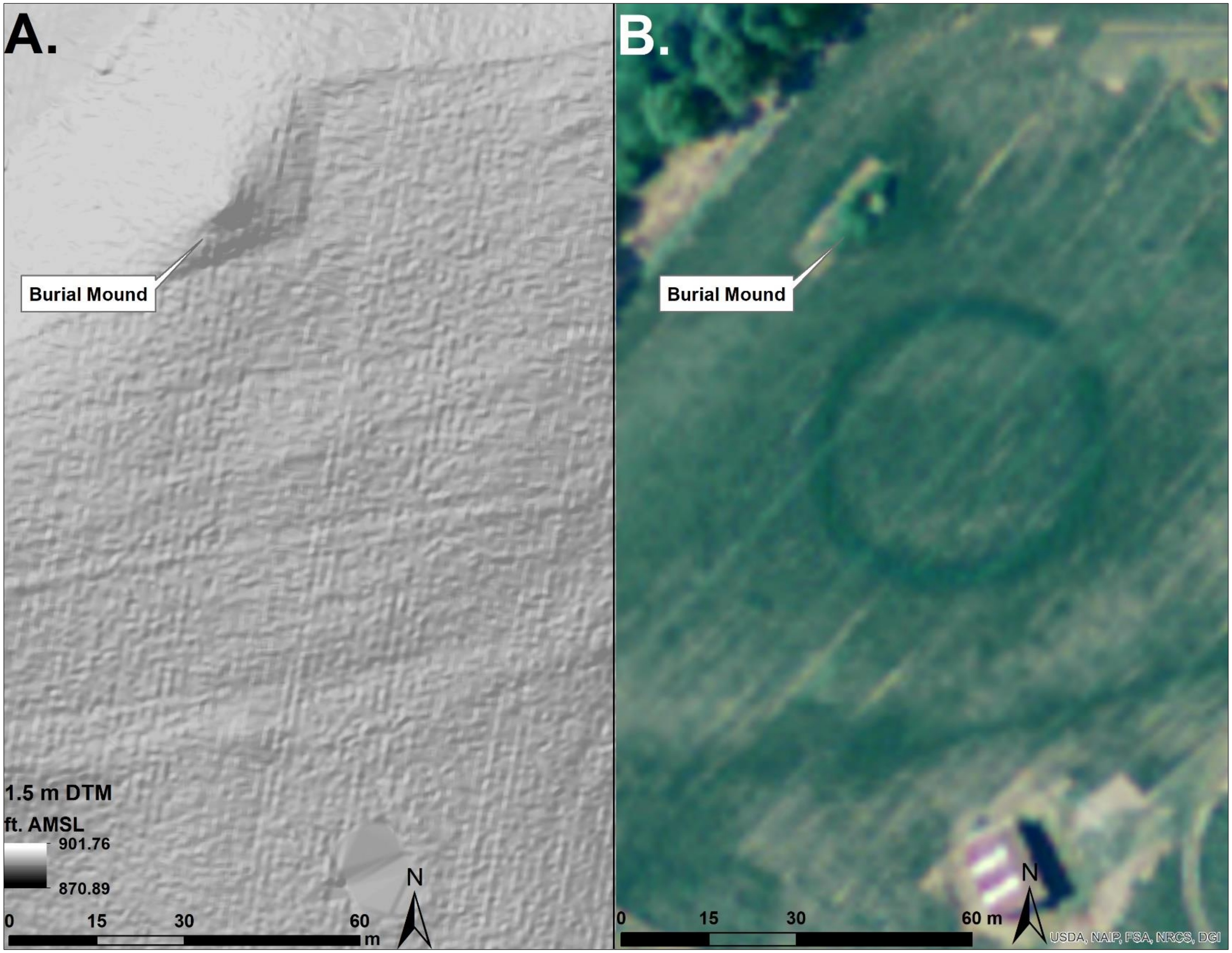

Figure 2.22. A.) LiDAR data encompassing the Goff Mound. B.) 2012 NAIP aerial photography from the area around the Goff Mound. Note the circular dark green vegetation growing south of the mound.

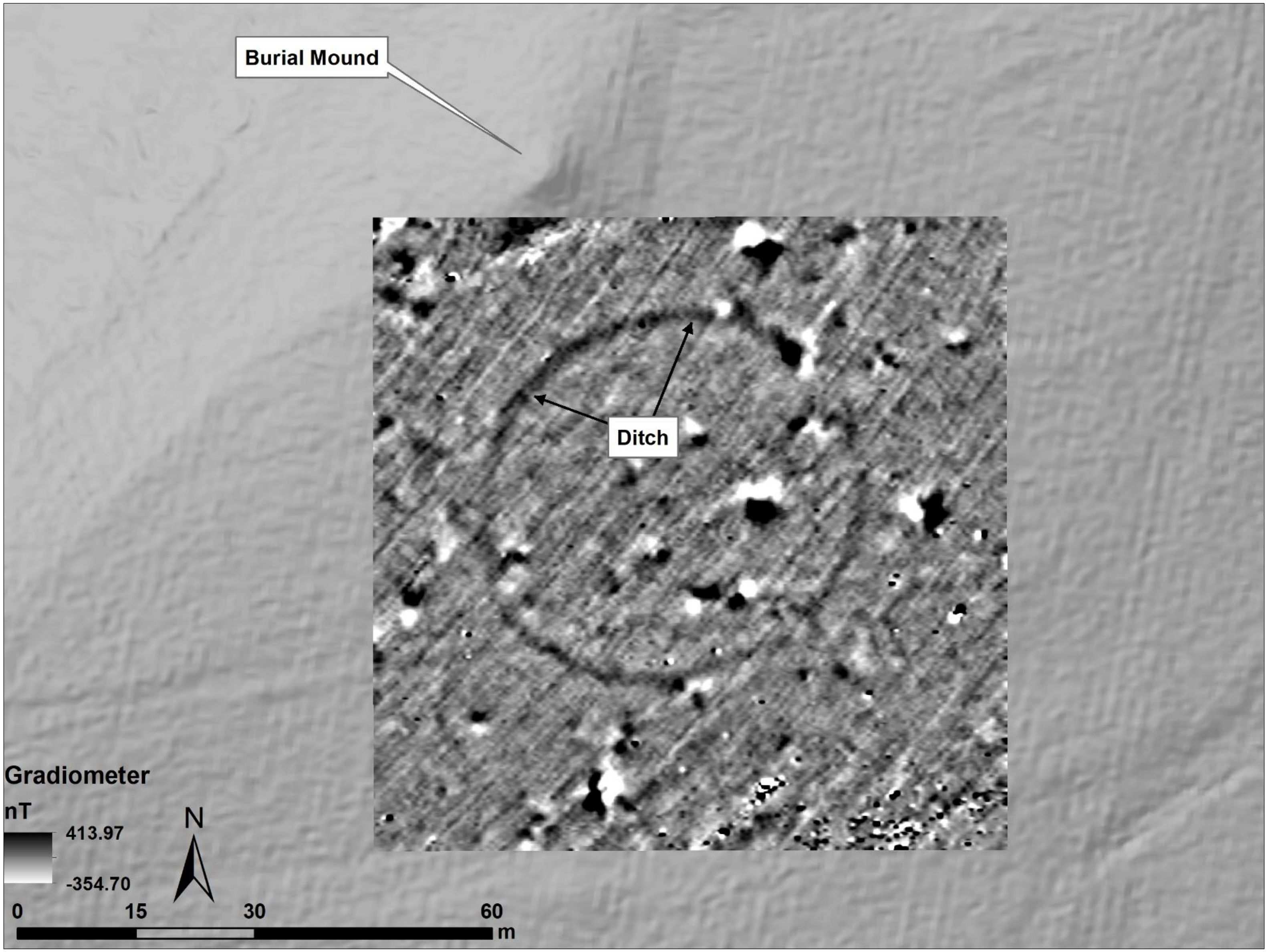

Figure 2.23. Magnetic data from the Goff Feature displayed at 2 standard deviations.

survey exhibits no clear evidence for an embankment exterior to the ditch, suggesting that plowing has significantly impacted the site (Figure 2.24). However, enhanced magnetic susceptibility recorded near the center of the enclosure in the susceptibility data from the 1-meter coil may provide evidence for an activity area not visible in the magnetic data. Trench and block excavations conducted after our surveys revealed the ditch had a maximum depth of 2.1-meters below surface, terminating in unconsolidated bedrock. Refilling events associated with the ditch are distinct and include the deposition of sediments with dense amounts of charcoal and unconsolidated bedrock fragments, in addition to intact charred logs. Future analyses of these deposits will provide information on the timing and nature of abandonment at the Goff Circle.

2.4.7 The Earthwalker Feature

The Earthwalker Feature is another potential enclosure site we identified in the 2012 NAIP aerial photographs during our LiDAR examinations (Figure 2.25). It is positioned in the Knobs Region on residual upland soils. Like the Goff and Bogie West enclosures, Earthwalker is topographically invisible in LiDAR data but the ditch is visible in aerial imagery as dark green vegetation growing in a circular pattern. Results of our magnetic survey show an enhanced response to a ditch, confirming the presence of a site that encloses 269.85 m^2 with a causeway opening to the northeast (Figure 2.26). Ferrous magnetic dipoles located south of the enclosure are likely associated with a nearby historic farmstead. EMI data collected over the enclosure indicates the ditch fills are low in magnetic susceptibility, but the conductivity data exhibit no evidence for buried intact embankment fills (Figure 2.27). Subsequent trench and block excavations revealed the ditch extended a maximum of 1.5-meters deep, and that the ancient

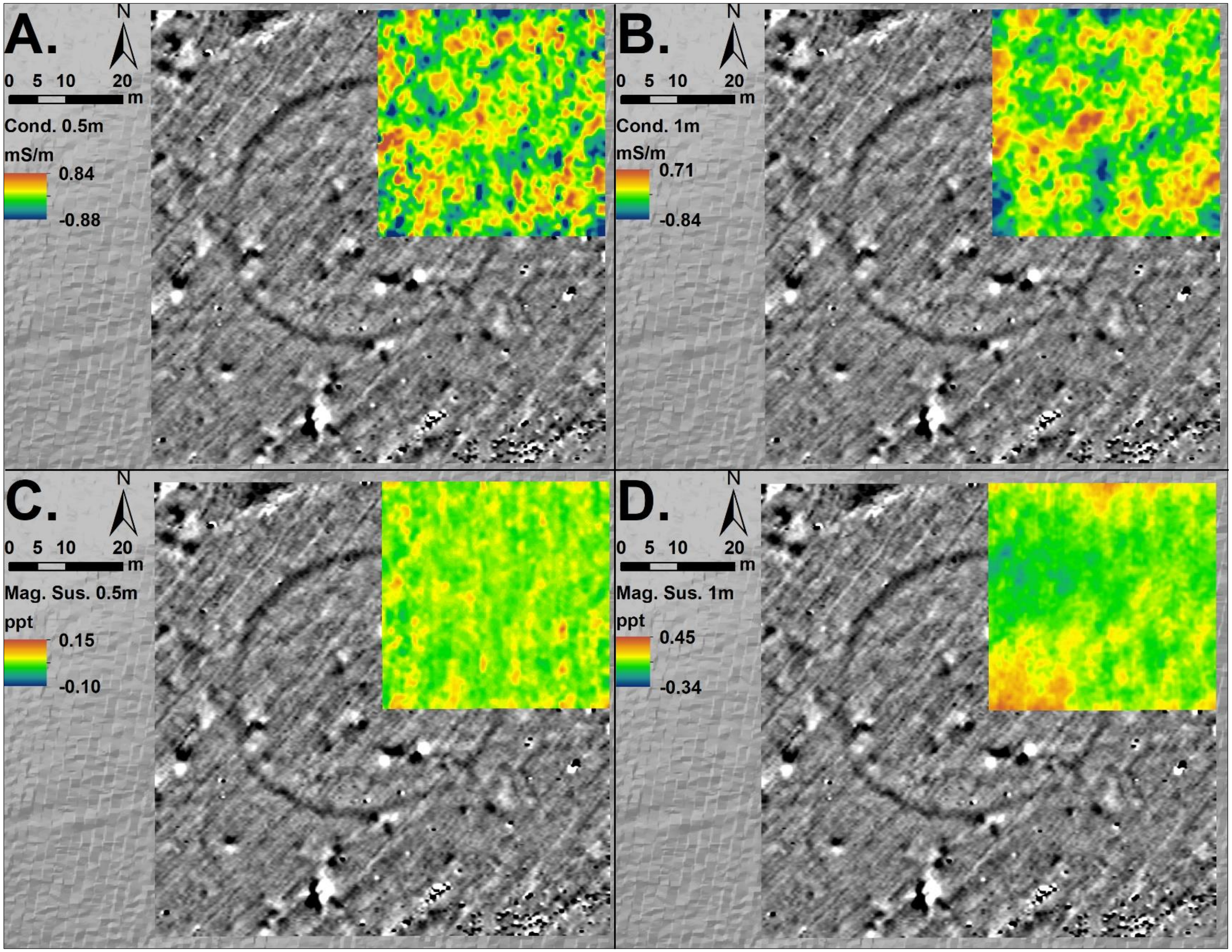

Figure 2.24. EMI data from the Goff Feature. A.) Conductivity data from 0.5m coil; B.) Conductivity data from 1m coil; C.) Magnetic susceptibility data from 0.5m coil; D.) Magnetic susceptibility data from 1m coil.

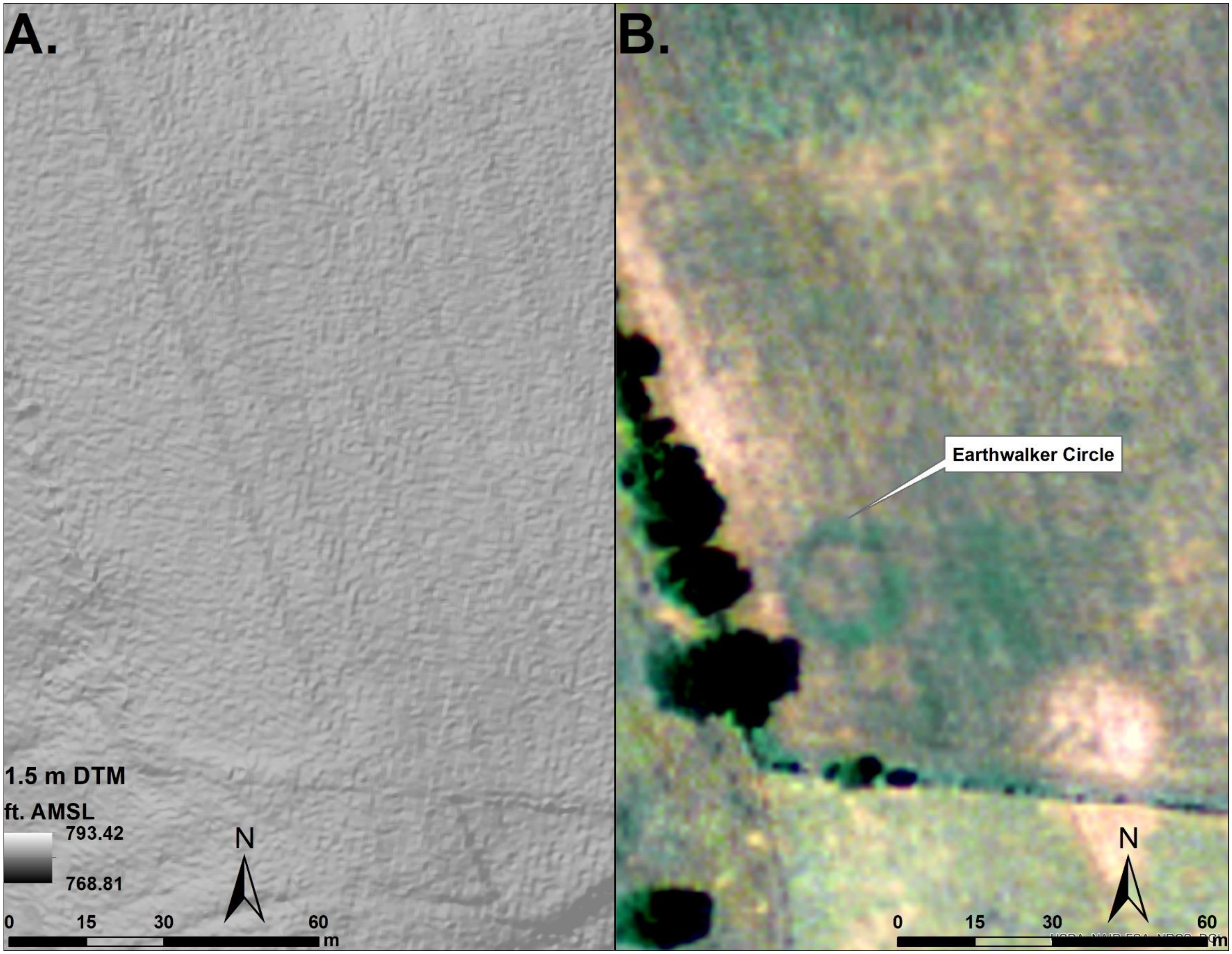

Figure 2.25. A.) LiDAR data around the Earthwalker Feature. B.) 2012 NAIP aerial photography from the Earthwalker Feature.

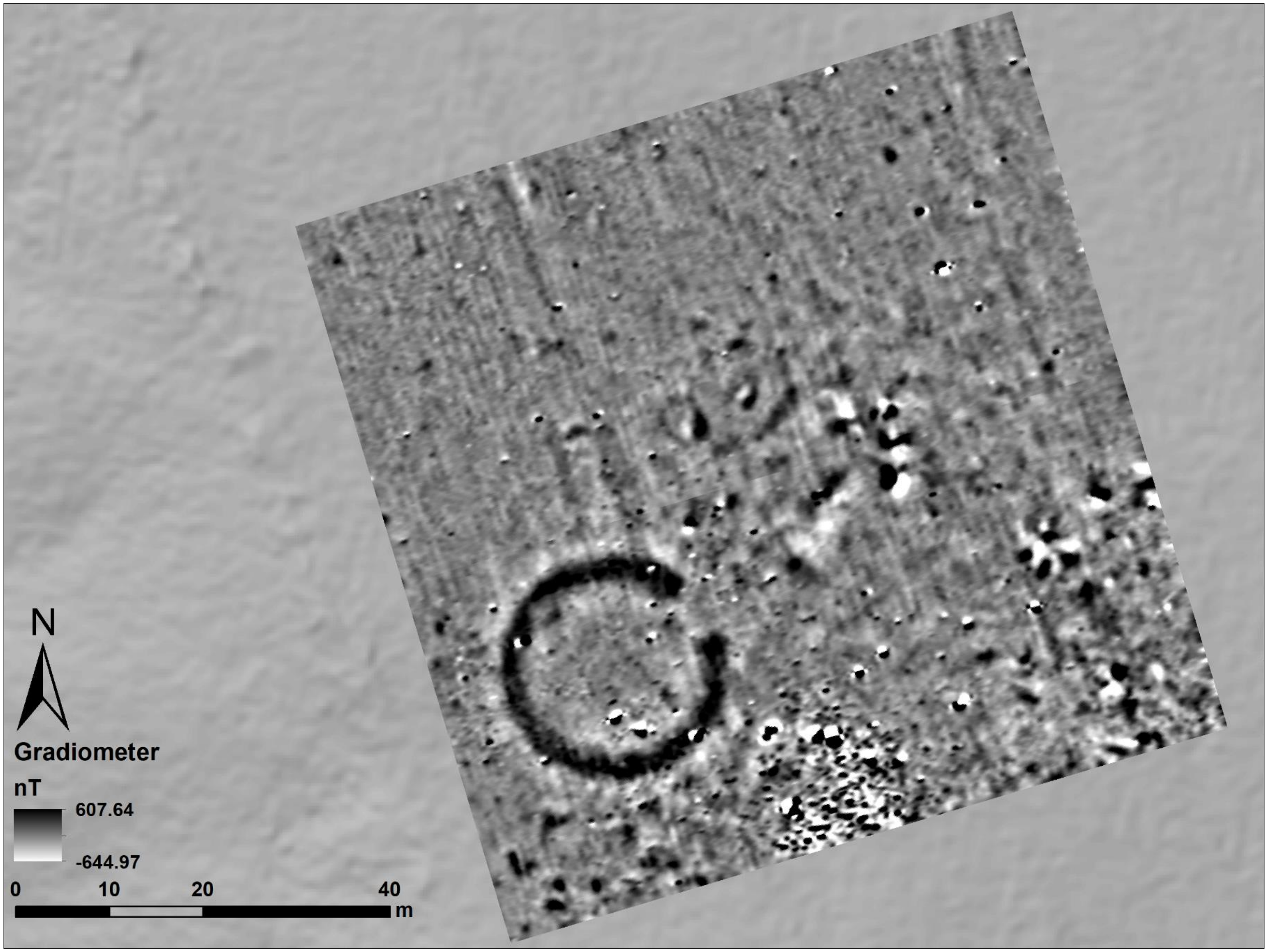

Figure 2.26. Magnetic data from the Earthwalker Feature displayed at 1.5 standard deviations.

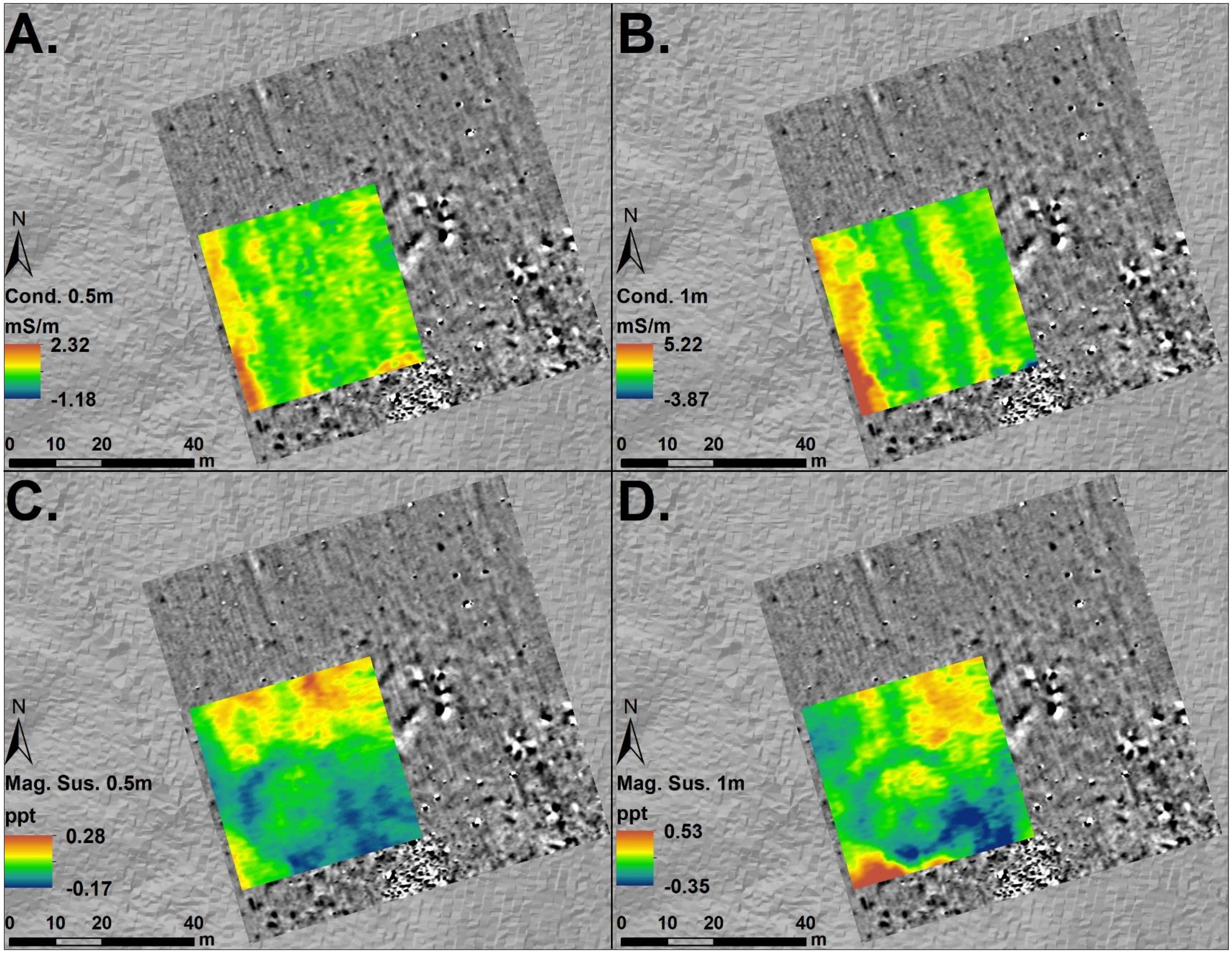

Figure 2.27. EMI data from the Earthwalker Feature. A.) Conductivity data from 0.5m coil; B.) Conductivity data from 1m coil; C.) Magnetic susceptibility data from 0.5m coil; D.) Magnetic susceptibility data from 1m coil.

builders of Earthwalker site excavated through multiple layers of residual shale before stopping. Irregular refilling sequences comprised of diverse sediment fills were identified in the ditch profiles. Some of these strata held large pieces of displaced shale, others contained dense concentrations of charcoal. Like the Goff site, the ditch deposits at Earthwalker will provide important information for future geoarchaeological research that examines how ditches refill at enclosure sites. Block excavations identified numerous post-features that extended around the opening of the enclosure. Some of these were set with large pieces of non-local sandstone. Ongoing research at Earthwalker site will focus on identifying when these posts were placed at the site and whether they once served as markers of the site after it was abandoned (*sensu* Wright 2014).

2.4.8 The Minerich Feature

The Minerich Feature is located approximately 1.5-kilometers northwest of the Bogie enclosures in an alluvial floodplain (Figure 2.28). We identified this circular topographic anomaly in the LiDAR data but were unable to gain permission to conduct geophysical survey or coring from the landowner. Nevertheless, the feature is 150 meters from a known burial mound (site 15Ma112) and exhibits a clear ditch signature in the 2012 NAIP aerial photography. The placement of enclosures near burial mounds is common. We identified the close placement of Goff Circle to Goff Mound in this research, and spatial relatedness between burial mounds and enclosures has been noted elsewhere in Kentucky, including the well-known Mount Horeb earthwork complex (Henry et al. 2014; Jefferies et al. 2013; Webb and Snow 1945:29-30). In addition, the rediscovery of enclosures in our current work has identified the association between buried enclosures and ditch patterns visible in aerial photographs from 2012 as vegetation differences. The correlation between the 2012 NAIP aerial photography and LiDAR-based

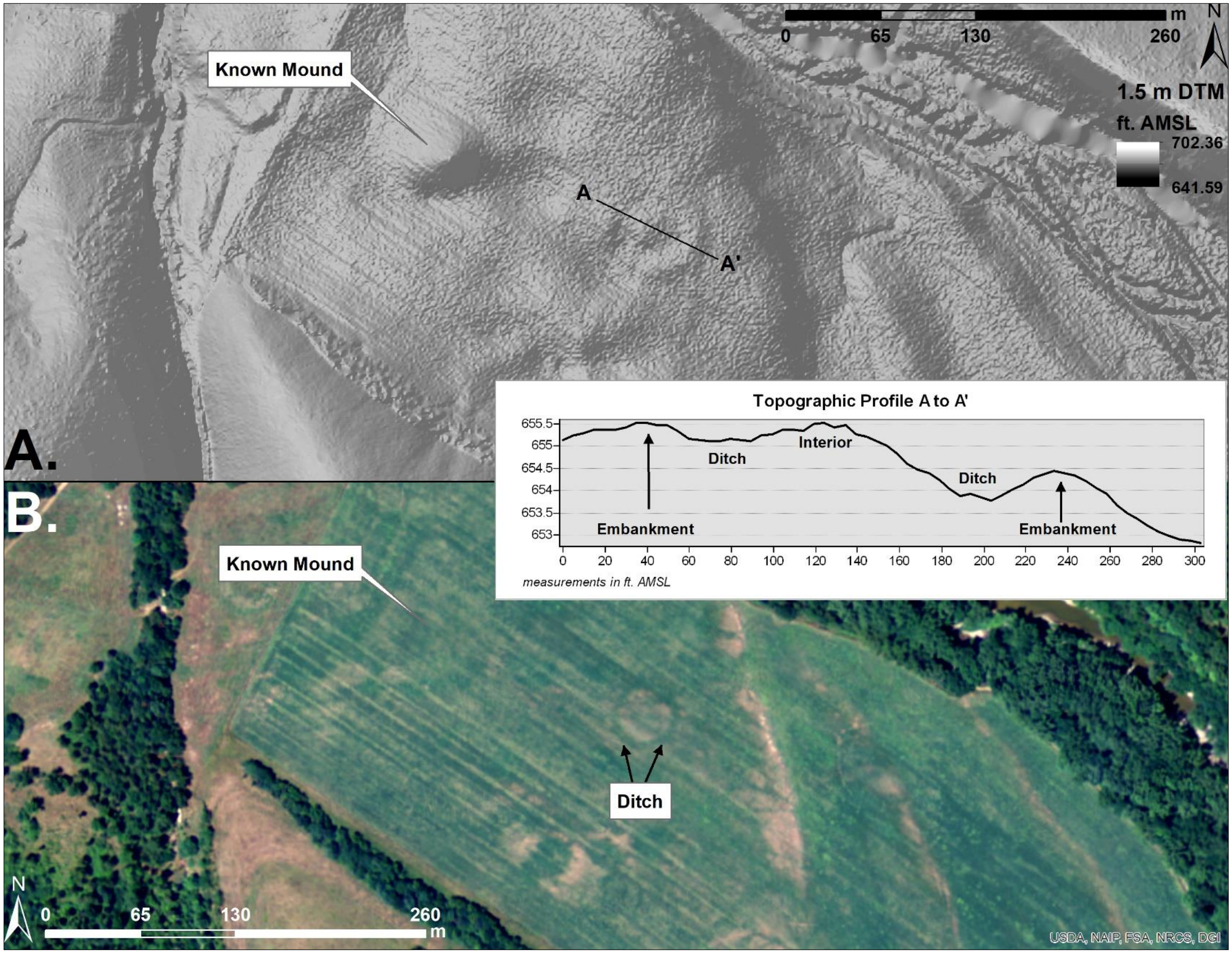

Figure 2.28. A.) LiDAR data encompassing burial mound 15Ma112 and a potential adjacent enclosure. B.) 2012 NAIP aerial photography encompassing burial mound 15Ma112. Note the circular pattern of dark vegetation growth.

topography at the Minerich Feature provides strong evidence that the topographic anomaly adjacent to mound site 15Ma112 is an Adena-Hopewell enclosure. Based on the 2012 aerial photographs, the site encloses approximately 1,656.2 m^2.

2.5 Discussion

Our geophysical and geoarchaeological evaluations of new possible Adena-Hopewell enclosure sites found during LiDAR examinations highlights the problem with relying on LiDAR alone to uncover and interpret archaeological landscapes in the Eastern U.S. LiDAR has been repeatedly demonstrated to be a powerful tool for archaeological survey, capable of providing otherwise inaccessible topographic data at the landscape-scale. However, using multi-scalar approaches to consider the cultural and historical subtleties of landscapes should be fundamental to integrating LiDAR into any archaeological research program. As we have shown in our case study from Central Kentucky, LiDAR data only provides one temporal aspect of surface variation.

The synchronistic perspective LiDAR provides requires archaeologists to use other methods that can corroborate what is being observed topographically. This is especially true in areas subject to a long history of diverse landscape modifications that have not been well documented, and where archaeological sites being investigated include monumental architecture made from earth. As we move forward with our investigations of the Adena-Hopewell landscape it is becoming clear that Historical-era ground surface modifications are requiring us to use more, not less, methods to reassess the density of ritual infrastructure in Central Kentucky.

Considerable landscape modification has occurred across urban and rural areas of the U.S. during the nineteenth and early twentieth centuries. While the construction and modification of urban spaces in the Eastern U.S. is well documented historically, landscape modification in rural areas is seldom documented through media such as aerial photographs or other accessible historical records that archaeologists can use to corroborate LiDAR data. As our research shows, this creates numerous possibilities for LiDAR anomalies to exist that are morphologically similar to Adena-Hopewell mounds and enclosures but originate from relatively recent agrarian practices.

Potential sites we examined within the Inner Bluegrass region (i.e., Mahan, Denali, and Normandy) were likely remnants of activities related to raising and training horses. We know this to be true at Denali, where we observed the farm machinery that made the topographic signature we were investigating. The Normandy Feature is located on a property that has been a horse farm since the mid-nineteenth century. The buried pipelines and concrete structure we encountered indicate that this LiDAR anomaly may predate aerial photographs of the area. Since the Mahan Feature is presently part of a horse farm, it too may be the result of the historical horse industry, and thus aerial photographs that document when or how it was created may not exist. Given how clearly these anomalies appeared in LiDAR, in the future we should pause to consider why other unknown potential sites were not mentioned or documented by early antiquarians (e.g., Constantine Rafinesque) who mapped so many enclosures and mounds in Central Kentucky. Nevertheless, features like Exline in the Outer Bluegrass prove that historical landscape features resembling Adena-Hopewell enclosures can exist away from areas with historical ties to the horse racing industry. This reinforces the need to conduct multi-scalar investigations of LiDAR data using multiple aerial and terrestrial approaches before assuming any topographic anomaly represents an archaeological site.

Because the ritual enclosures built by Adena-Hopewell societies were made from earthen fills and not stone, their heights and shapes have been dramatically reshaped by Euro-Americans occupying Central Kentucky since the late-1700s. However, even heavily altered earthen monuments can leave visible signatures in aerial and terrestrial remote sensing methods. For instance, our re-examinations of LiDAR data using aerial photographs allowed us to identify three enclosures (i.e., Earthwalker, Goff, and Bogie West) that exhibited no topographic relief because the ditches retained significantly more moisture during a heavy drought year (2012) and produced darker vegetation. In the case of the Minerich enclosure, which exhibited very little topographic relief, we could draw on multiple lines of evidence to propose it was an Adena-Hopewell enclosure. For instance, it was situated near a known burial mound (15Ma112), exhibited a ditch and embankment topography visible in LiDAR, and its ditch appeared in the 2012 NAIP aerial imagery.

Although our work to date has only confirmed the location of four new enclosure sites, they correlate well with spatial attributes of known enclosures. For instance, our ongoing efforts to rediscover ritual infrastructure built and used by Adena-Hopewell societies indicate that all known enclosures in our study area are situated within a very close proximity to annually-flowing waterways. This could indicate that waterways served as another form of infrastructure relating to the distribution of enclosure sites, movement across the Central Kentucky landscape, and transmission of ritual ideas and practices (*sensu* Baires 2015; Hall 1976; Sunderhaus and Blosser 2006; Figure 2.29). Using spatial analyses to verify our observations about the proximity of enclosures to water, we identified rivers and streams in Central Kentucky that flow annually[1] and measured the Euclidean distance of enclosures to those streams (Table 2.5). The furthest

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[1] We selected this flow rate based on stream gages with continuous measurement systems reported on the United States Geological Survey's (USGS) stream stats website (https://streamstats.usgs.gov/ss/). Our assumption (based on the USGS data) is that small narrow streams in the upper sections of the Kentucky and Licking River basins—the two drainages in our study area where enclosures are found—will flow throughout the year if their average annual flow is greater than 30 cubic feet per second (cfs). Thus, any river or stream with an annual flow rate greater than 30 cfs was selected as an annual stream to ensure both large and small annually-flowing rivers and streams in the Ohio River basin would be included in our measurements of Euclidean distance. All spatial calculations were performed in ESRI's ArcGIS 10.5.

distance a known enclosure was built from an annually flowing stream is roughly 4 km; for enclosures identified in this study the furthest distance is 3.4 km. These distances could easily be covered on foot in less than half a day, which indicates that proximity to water was a crucial aspect to the placement of enclosures. While we acknowledge the functional benefits of proximity to water during laborious construction projects like building earthen monuments, Hudson's (1976) compilation of perspectives on rivers and streams among indigenous societies in the Southeast highlight their association with ritual ideas and practices. They include: personhood, purification, human longevity, underworld entities common to Amerind myths and cosmologies, as well as general access to underworlds (see also Carr 2008). Therefore, we should recognize the combined and multivalent importance of waterways and enclosures to facilitate the movement of people, materials, and ideas across space and time. This is especially true if we consider enclosures as sites of, and for, indigenous pilgrimages during the Middle Woodland period (Carr 2006; Lepper 2004, 2006; Wright and Loveland 2015). From this perspective, positioning enclosures near waterways may imply they served as stopping points on travel routes to larger pilgrimage centers (e.g., those in the Scioto Valley of Ohio). However, future research focused on whether enclosures were all constructed within a small amount of time will be needed to support this interpretation. Nevertheless, the enclosures we have identified provide a series of sites to begin exploring and testing such questions at a landscape scale.

2.6 Conclusions

There is no doubt LiDAR is a powerful tool capable of providing incredible topographic data that can be integrated into landscape-scale research in archaeology. We agree with others (e.g., Chase et al. 2012) that having access to these compelling geospatial tools has triggered a revolution in how we think about issues of space and scale in archaeology. However, as archaeological practitioners and consumers of geospatial tools like LiDAR we must remain

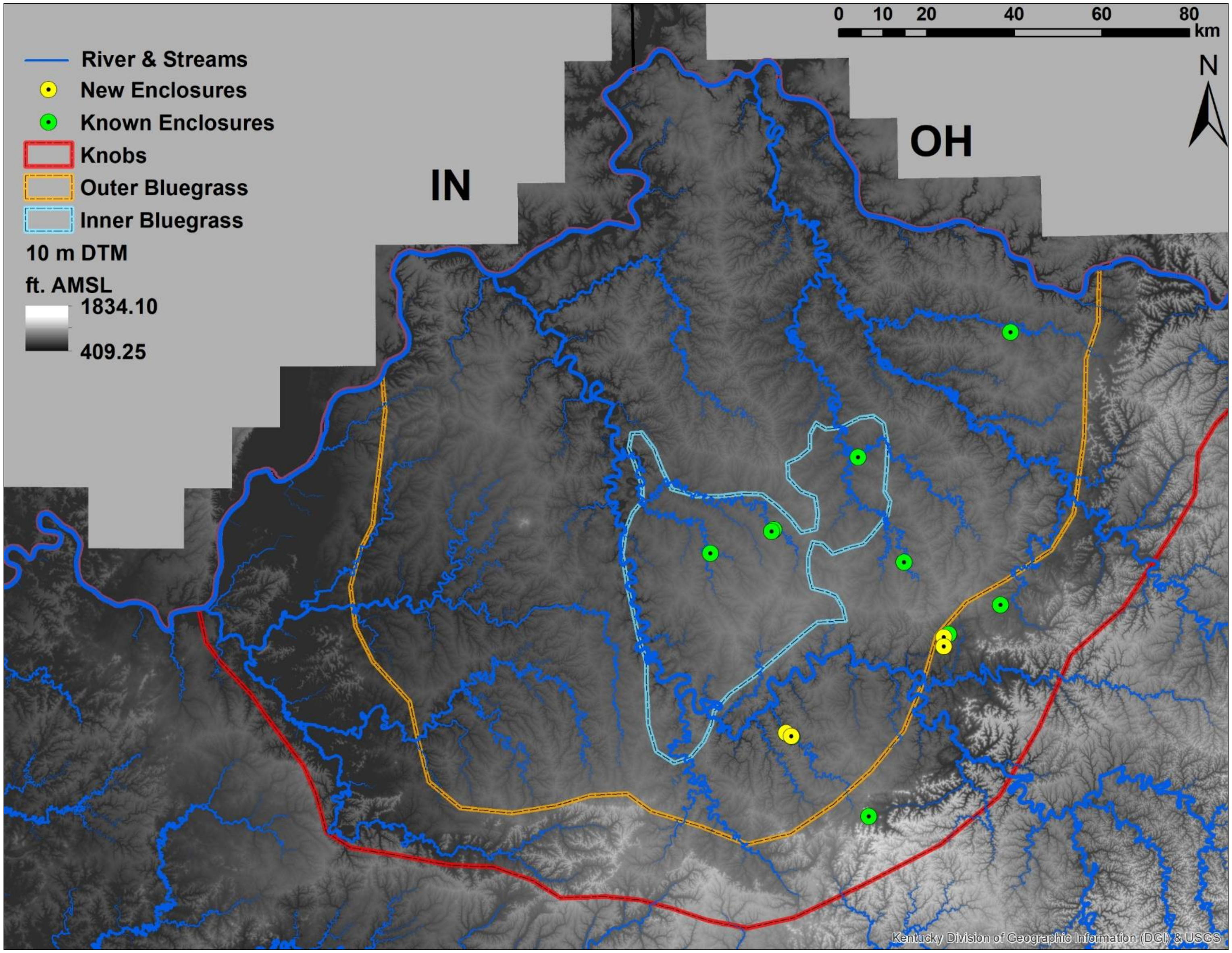

Figure 2.29. Location of known enclosures and newly identified enclosures related to annual flowing waterways in Central Kentucky.

Table 2.5. Euclidean distance of known and newly identified enclosures to annual-flowing waterways in Central Kentucky.

	Site	Distance to Annual Waterway (km)	Minimum (km)	Maximum (km)	Mean (km)
New Enclosures	Bogie West Circle	0.285	0.146	3.420	1.728
	Minerich Circle	0.146			
	Earthwalker Circle	3.059			
	Goff Cricle	3.420			
Known Enclosures	LeBus Circle	0.075	0.075	4.062	1.265
	Winchester Farm	0.300			
	Peter Village	0.601			
	Mount Horeb Circle	0.100			
	Bogie Circle	0.293			
	15Ma25	4.062			
	15Ck363	2.460			
	Nelson-Gay Mound & Circle	0.351			
	15Mm30a	2.674			
	15Mm30b	2.674			
	15Wd2	0.090			
	15Ms4	1.498			

vigilant in maintaining a responsibility to critically examine these datasets before building interpretations from them. Using multi-scalar approaches to consider the cultural and historical subtleties of landscapes being studied should be fundamental to integrating LiDAR into any archaeological research program. As we have shown in our case study from Central Kentucky, LiDAR data only provides one temporal aspect of surface variation.

The synchronistic perspective LiDAR provides requires archaeologists to use other methods that can corroborate what is being observed topographically. This is especially true in areas subject to a long history of diverse landscape modifications that have not been well documented, and where archaeological sites being investigated include monumental architecture made from earth. Our ongoing efforts to rediscover ritual infrastructure built and used by Adena-Hopewell societies indicate that enclosures are built within a very close proximity to annually-flowing waterways. Further GIS-based spatial analyses will be crucial to further interrogating Kentucky's LiDAR data and our continued assessment of potential Adena-Hopewell monuments. Integrating these sorts of spatial data into our examinations of LiDAR data should help restrict the number of sites we have identified as potential enclosures. In fact, the application of spatial modelling presents another methodology that could help frame multi-method analyses of LiDAR datasets. As we move forward with our investigations of the Adena-Hopewell landscape it is becoming clear that historic-era ground surface modifications are requiring us to use more, not less, methods to reassess the density of ritual infrastructure in Central Kentucky.

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Chapter 3

Ritual Dispositions, Adena-Hopewell Enclosures, and the Passing of Time: A Monumental Itinerary for the Winchester Farm Enclosure in Central Kentucky, USA

Edward R. Henry, Natalie G. Mueller, and Mica B. Jones

3.1 Introduction

The essential foundations of archaeology include a focus on understanding change among landscapes, sites, people, and artifacts. As Roberta Gilchrist (2000) remarked, the advantage archaeology holds over history lies in our ability to work with and understand great depths of time. Yet, in contrast with history, archaeology has a harder time tacking back and forth between short and long timescales in a manner that allows us to create constructive understandings of the past (Pauketat and Alt 2005; Wylie 1989, 2002:161-7). In fact, apart from our understandings of individuals derived from bioarchaeology, we have only recently begun to explore scales of time that individual humans would have experienced through methods such as Bayesian chronological modeling (Bayliss 2009; Bronk Ramsey 1995, 2009; Buck and Meson 2015; Litton and Buck 1995). Archaeologists cannot afford to ignore the importance of understanding the thick and thin of time as it relates to social change, because it is at the intersection of these intervals that we can identify the impacts history and cultural process have within society. Recent research suggests that, in conjunction with American Indian community outreach, working toward these forms of archaeological understanding can potentially serve a therapeutic role (Schaepe et al. 2017). That said, the degree to which we can use material culture to identify change in the ways humans orient themselves socially with respect to cultural norms and rules is often limited to the data available from the diverse scales at which archaeology takes place. This becomes problematic when research centers on very durable archaeological remnants that exist for centuries or millennia, such as monuments, heirlooms, or socially-important natural places on a landscape. In these cases, only identifying when monuments are constructed, natural locales become socially significant, or objects become heirlooms neglects the long-term changes in social dispositions (e.g., values, meaning, attitudes) attached to these things as new cultural contexts develop through interactions with diverse people and other things.

When archaeologists *can* trace changes in the ways socially-situated objects and places are regarded over long periods of time, it is possible to situate our analyses within the realm of life histories or biographies (*sensu* Gosden and Lock 1998; Gosden and Marshall 1999; Holtorf 1998; Kolen et al., eds. 2015; Kopytoff 1986; Meskell 2004; Walker 1999, 2002; Zedeño 1997). It is not easy for archaeologists to successfully establish biographical understandings of places, people, and objects. Nevertheless, doing so facilitates the ability to create thick levels of description about the past that Geertz (1977) advocated for many years ago, and archaeologists are now achieving (Baires and Baltus 2017; Pearson and Meskell 2014; Weismantel and Meskell 2014; Wright 2014a). These detail-rich understandings of the past provide an opportunity to go beyond describing what transpired in the past, and instead begin examining causal effects of human-thing and thing-thing entanglements (Hodder 2011, 2012). As Mills and Walker (2008:10-13) have noted, the genealogy of the biographical approach is diverse. Archaeologists have used a variety of terms and approaches to highlight the ways social attachments to places and things emerge and shift through time, sometimes becoming ways to remember or forget resolved understandings of the past through various kinds of memory work (Mills and Walker, eds. 2008; Mixter and Henry 2017). They include: ‘life histories’ (Holtorf 1998, 2002; LaMotta and Schiffer 2001; Schiffer 2002; Walker 1999, 2002), speak of various kinds of ‘deposition’ (Baires and Baltus 2017; Kassabaum and Nelson 2016; Nelson and Kassabaum 2014; Pollard 2001, 2008; Richards and Thomas 1984), and trace historical changes in the social attitudes toward objects and places to create ‘biographies’ or ‘itineraries’ (Bayliss et al. 2016; Hamilakis

1999; Joyce 2012; Joyce and Gillespie 2015; Kolen et al., eds. 2015; Lillos 1999; Meskell 2004). These approaches are not exactly congruent with one another, but they seek to delineate changes in what Ashmore (2002) refers to as social "decisions and dispositions" across time and space.

In this paper, we work toward a biographical approach to earthen monuments that historicizes the actions of pre-Columbian American Indian societies in eastern North America. We borrow from many of the diverse concepts on biographies and itineraries in archaeology that complement relational perspectives and worldviews held by American Indians whereby people, places, and things work in concert to arrange and transform societies through time (Deloria, Jr. 1992; Norton-Smith 2010; TallBear 2015; C. Watts 2013; V. Watts 2013). Our approach employs a socially-centered geoarchaeology that seeks to understand how earth was manipulated during the construction of, and interactions with, monuments (Contreras 2014; Jusseret 2010; McAnany and Hodder 2009; Kidder and Sherwood 2017; Roos and Wells 2017; Sherwood and Kidder 2011), and explores the temporality of these interactions by using highly precise understandings of time derived from the Bayesian chronological modeling of radiocarbon dates (Bayliss 2009, 2015; Bronk Ramsey 1995, 2009a; Buck 1999; Buck and Meson 2015; Littleton and Buck 1995).

We apply this approach to examine—in detail—one of the most prevalent institutions of the Adena-Hopewell world (cal 500 BC–AD 500): the geometric earthen enclosure. Data obtained during our work at the Winchester Farm enclosure in Central Kentucky, USA (Figure 3. 1) allows us to identify changes in social activities that occurred at the site before, during, and after its construction. Furthermore, we can situate these activities within a precise temporal sequence that shows how the monument, and past behaviors associated with it, influence late

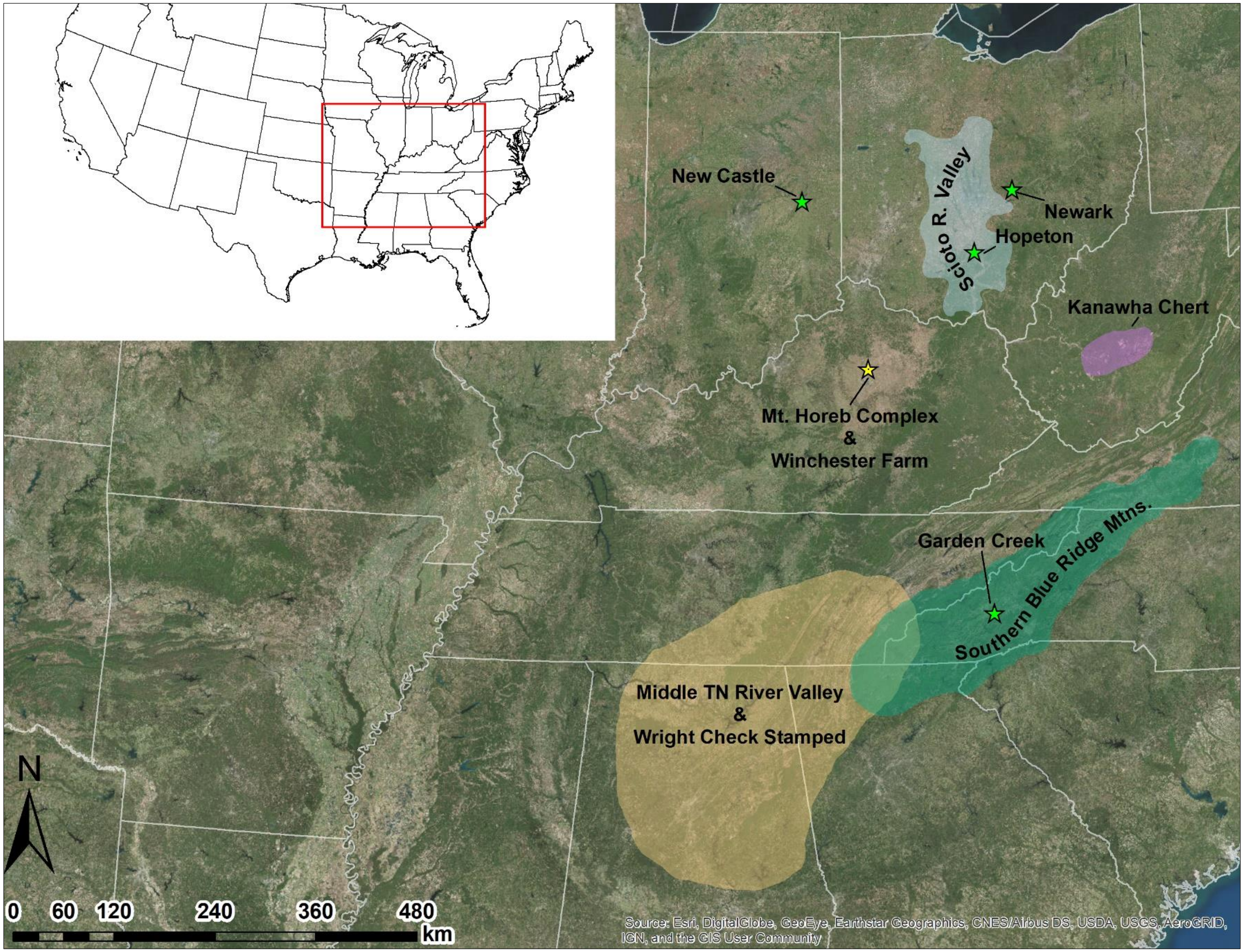

Figure 3.1. Sites and regions discussed in Chapter 3.

behavior and have identified clear evidence that the site was ritually closed through an intentional deconstruction event. Drawing upon analyses of geoarchaeological data, artifacts, and Bayesian chronological models, we outline an itinerary for Winchester Farm enclosure that highlights how social groups and objects became entangled within changing forms of cooperative ritual action at the site for roughly a millennium. Our work reveals what influence the enclosure, and objects bounded within it, had on these gatherings through time.

3.2 Archaeological Circuits: Multiple Approaches to a Detailed Past

3.2.1 Approaching Biographies and Itineraries of the Past

Creating biographical understandings of the different ways humans valued and interacted with durable things and places over long periods of time is challenging. Perhaps due to the intricacies of identifying and understanding shifts in the cultural contexts and relationships between humans and things through time, many approaches to the long-term studies, or life histories, of materials and materiality have emerged in archaeology. Many of these approaches cite the work of Kopytoff (1986) who was among the early sociocultural anthropologists interested in the roles things played in the creation and maintenance of social relationships (cf. Appadurai, ed. 1986). His emphasis on the different ways meaning and value are attributed to things through time and space underscored the importance of recognizing different statuses attached to objects, commodities, and people throughout their life history. Being able to identify and understand these changes can expose the ways society is constructed on notions of people and objects simultaneously (Kopytoff 1986:90). An emphasis on examining the life history of material culture to trace changes in social attitudes toward objects and places has influenced many branches of archaeology, including the Behavioral approaches (cf. LaMotta and Schiffer 2001; Schiffer [1976] 2002) that seek to examine links between sequences of material acquisition, artifact production, use, recycling, and deposition, as well as the recovery of artifacts by archaeologists (LaMotta and Schiffer 2001; Schiffer [1976] 2002; Walker 1999, 2002; Walker and Lucero 2000; Walker and Schiffer 2006). These entire ‘life histories’ of artifacts (spanning their systemic and archaeological contexts) elucidate ‘behavioral chains’—what one can use to infer past human activity and the formation of the archaeological record (Walker and Schiffer 2006:71).

Archaeologists such as Walker (1999, 2002) use this approach to study ritual practices in the American Southwest, focusing on how everyday objects were transformed into powerful ritually-charged items. He argues that ritual objects even take on after-lives when they are deposited in meaningful places like the floors and walls of kivas during ritual closing (i.e., deconstruction) activities. From this perspective, the life history of an object can be traced from its production, to use, and later deposition in a sacred place, with the assumption being that during this process the object (e.g., a ceramic pot or projectile point) becomes a different, potentially more powerful, object in society. Another important aspect of the behavioral life history approach is the notion of *cadenas*. Cadenas reference the diverse social spheres that interact with an object throughout its life history (Walker and Schiffer 2006:71-3). This includes various people, other objects, and different places and seeks to place equal social and analytical significance on people and things, following perspectives from the ontological turn (e.g., Barad 2003, 2007; Gell 1998; Latour 1993, 2005).

The emphasis on symmetry underlying the social roles and life histories of humans and things (*sensu* Olsen 2010), adds another viewpoint on biographical understandings of the past. What archaeologists refer to as *object biographies* involves ascertaining information such as the social context within an object originated and how it was used (Gosden 2005; Gosden and Marshall 1999). These pieces of information become jumping off points to explore the movement of objects from their origins and serve to inform archaeologists what social changes an object endures and how it influences specific cultural and historical contexts (Holtorf 2002). In this sense, Gosden (2005:193) reminds us to consider, “the obligations objects place upon us when they are operating as a group.” Thus, object biographies provide archaeologists insight to the important and influential roles objects such as heirlooms, figurines, or repurposed stone carvings had in society (Joyce 2012; Lillos 1999; Meskell 2004; Meskell et al. 2008). Most recently, archaeologists have pushed this idea in two different directions. The first emphasizes *itineraries* rather than biographies of objects. Itineraries focus on the paths of movement and stasis objects encounter as they influence social fields and actions in the past, as well as in the present, when they become the center of archaeological inquiry (Joyce and Gillespie, eds. 2015; Joyce 2012, 2015). This avoids the need to focus on the ‘birth’, ‘life’, and ‘death’ cycles of objects since it is challenging to access these stages archaeologically. Furthermore, object itineraries realize death and life metaphors are counterproductive. Instead, more attention can be given to the association of *spatial* and *temporal* relationships objects help produce (Joyce and Gillespie 2015:11-12). The second direction archaeologists are taking with combined notions of materiality and temporality situates objects within the framework of multiplicity coming from science studies (e.g., Mol 2002, 2006). For Merion Jones et al. (2016:126-7), objects are always in a state of instability and becoming, which creates multiple meanings and contexts, leading to multiple social productions of the object itself. This notion is akin to the ways some researchers describe personhood on ‘dividual’ terms (e.g., Fowler 2004). Citing commonalities with actor-network concepts, Merion Jones et al. (2016:127) states that their approach seeks to, “emphasize that objects are composed of multiple relations, and to emphasize the symmetry between subjects and objects.”

Of course, understanding how or why objects were deposited helps support broader claims to their biographies or itineraries. Depositional perspectives can be traced to the work of Richards and Thomas (1984) who argued that ritual deposition was structured differently than everyday refuse deposits (i.e., an ‘everyday’ midden). Deposition is also important to Behavioral archaeologists through a pursuit to examine the formation process of the archaeological record (e.g., LaMotta and Schiffer 2001:40-7; Walker 2002; Walker and Lucero 2000). The importance of understanding deposition when considering the itinerary of an object or place centers on identifying human intentionality over natural post-deposition processes, as Richards and Thomas (1984:214-15) emphasized. However, as Pollard (2001, 2008) notes, any act of disposal or deposition requires a negotiation between the body, materials being engaged, and the physical and cultural environmental contexts in which deposition occurs. Following Brück (1999), Pollard (2008) argues against placing depositional practices in a sacred/secular dichotomy. Instead, he notes that all depositional practices fall within a functional domain that is meant to explore and negotiate the complex and constantly shifting obligatory relationships between people, animals, and things (Pollard 2001:328-30; 2008:58-9)—a point made by Meskell et al. (2008) in their study of figurines recovered from communal depositional contexts at Çatalhöyük.

These diverse views offer multiple lenses through which one can situate the study of deposition, behaviors, and place-based object itineraries as they relate to earthen monuments. Moreover, they complement common themes in American Indian relational philosophies on places and time (Basso 1996; Deloria, Jr. 1992; Hunt 2014; Norton-Smith 2010; Tallbear 2015). Among the place-time notions advocated for by American Indian scholars is an emphasis on the unified importance of objects, places and people in the creation of society and the impetus for social change. The creation histories of American Indian Nations underline these important connections and archaeology that integrates oral histories and traditions into their interpretations can create what Echo-Hawk (2000) calls *ancient American history*. Watts (2013:26) argues that oral histories reside in *place-thought*, or the integration of particular places and events that were the result of actions made by humans and non-humans. By centering our work within a Bayesian chronological framework supported by a socially-focused geoarchaeology, we seek to identify and explore how objects, places, and humans become influential to the arrangement and transformation of social contexts over long periods of time.

3.2.2 Social Geoarchaeology, Bayesian Chronologies, and the Biographical Approach

As a set of methodological tools in archaeology, geoarchaeologists typically focus on delimiting site stratigraphy and formation processes, as well as environmental and climatic changes that societies responded to through time (Dalan and Bevan 2002; Goldberg and Macphail 2006; Kidder et al. 2018; Shahack-Gross 2017; Tolksdorf et al. 2013; Wegman et al. 2013; Woodson et al. 2015). This is indeed crucial information for understanding how social fields are arranged and transformed, in addition to how depositional activities were organized and carried out. However, geoarchaeologists are increasingly calling attention to the ways the discipline can explicitly address issues of social organization and change at multiple scales of analysis (Contreras 2017; Kidder and Sherwood 2017; Jusseret 2010; McAnany and Hodder 2009; Milek and Roberts 2013; Roos and Wells 2017; Sherwood and Kidder 2011; Van Keuren and Roos 2013). In these studies, the analysis of formation processes, sediments, and soils are used to illuminate larger patterns of human behavior that can be linked back to broader anthropological and social questions. Roos and Wells (2017:1002) use the term *behavioral geoarchaeology* to align their geoarchaeological approach with the emphasis on life histories from Behavioral Archaeology. However, following Roddick (2015) we employ the term *social geoarchaeology* to accentuate the ways soils, sediments, and geologies themselves help constitute and rearrange social fields. This approach aligns with notions of social stratigraphy as defined by McAnany and Hodder (2009), and like Conneller (2011), seeks to show how materials (in this case geological materials like rocks, clays, and minerals) matter to the formation of social fields.

Kidder and Sherwood (2017; see also Sherwood and Kidder 2011) have emphasized the importance of understanding the construction of earthen monuments as more than ritual practices that communicate social relationships, and instead considering their construction as the actual production and innovative recombinations of social relationships. Therefore, thorough geoarchaeological examinations of depositional practices in mounds, including how they may have been used differently through time, are paramount to studying the itineraries of earthen monuments in the eastern U.S. Soils and sediments used to construct these landscape features were routinely mined for their color and texture, in addition to being manipulated to create unique combinations of loads and fills during the ongoing processes of construction and refurbishment (Charles et al. 2004; DeBoer 2005; Sherwood and Kidder 2011; Pursell 2013; Van Nest et al. 2001). The performative acts required to build ritual infrastructure like earthen monuments bundled together the social roles of humans and substances in ways that initiated networks of action. Extending beyond the initial act of construction, such networks of action became resolved understandings of the past and were drawn upon at later times to negotiate the continuation, or rearrangement, of social fields (Henry 2017). Thus, the complex itineraries of sediments used to build earthen monuments affect more than the functional placement and persistence of mounds on the landscape (Kidder and Sherwood 2017:1095) they manipulated social and ritual dispositions through time.

The tempos and rhythms of change in social practices associated with earthen monuments can be used to identify stasis and shifts in social dispositions. However, it is important to understand time as precisely as possible when tracing itineraries in the past. Therefore, we apply Bayesian statistical methods to model different phases of social activity that are evident archaeologically. We use our case study of Winchester Farm, an Adena-Hopewell geometric earthen enclosure, to operationalize this approach. Our work at the site has identified how this place existed as a nexus for multiple overlapping social groups for roughly a millennium. During this time, the landform where Winchester Farm was built was first a locale where people from diverse distances shared experiences tied to small-scale feasting and pilgrimage journeys. Later, a shift in monumentality and ritual action took place, followed by a long period of durable attitudes toward site preservation. Finally, the site was ritually closed through a period of intentional deconstruction. We outline evidence for these changes by situating the Winchester Farm enclosure within its cultural context and describing our recent work at the site. We then present our methodological approach to the site and explain our understandings of the archaeological contexts identified through our excavations. The subsequent presentation of our Bayesian models for the enclosure allow us to outline the temporality of shifting ritual dispositions at the site. We end by discussing the monumental itinerary for Winchester Farm, showing how the history of human and non-human interactions at the site influenced each phase of use.

3.3 The Winchester Farm Enclosure: An Adena-Hopewell Monument

Toward the end of the Early (cal 1000–200 BC) and beginning of the Middle Woodland (cal 200 BC–AD 500) periods in the Middle Ohio Valley of eastern North America, a major surge in social and religious elaboration occurred. Novel ritual practices, including the first appearance of burial mounds and earthen enclosures, materialized alongside the intensification of ceramic technologies and the domestication of starchy-seed food crops (Abrams and Freter, eds.

2005; Applegate and Mainfort, eds. 2005; Charles and Buikstra, eds. 2006; Carr and Case, eds. 2005; Dancey and Pacheco, eds. 1997; Fritz 1990; Gremillion 2004; Milner 2004:54-96; Mueller 2018; Smith 2001; Webb and Snow 1945). Archaeologists traditionally separated this cultural florescence into two phases: *Adena* (cal 500 BC-AD 250) groups, defined by smaller less complex material culture, were once considered to be a precursor to the more complex *Hopewell* (cal 200 BC-AD 500) societies of central Ohio. However, modern chronological considerations have noted that the timing of Adena significantly overlaps with traditional Hopewell sites, making the boundaries of these typological constraints blurry (Hays 2010; Lepper et al. 2014; Railey 1996). For these reasons we use the term Adena-Hopewell to recognize the likelihood that differences in material culture may relate to temporal differences but were almost certainly related to different situationally-based social contexts and historical contingencies archaeologists have yet to identify. The tension between time and Adena-Hopewell material culture is especially evident in our understandings of earthen enclosures.

Alongside burial mounds, geometric earthen enclosures (large and small) are the most prevalent landscape features of Adena-Hopewell societies in the Middle Ohio Valley. However, partially due to their scale—they can be multiple hectares in size—and the general absence of internal features, they remain somewhat enigmatic; usually only the details of their construction are left to be examined (Mainfort and Sullivan 1998:1). Enclosures vary in size and shape, with small to moderate-sized sites usually built like henges in western Europe (Burks 2014; Burks and Cook 2011; Gibson, ed. 2012). This included excavating a ditch in a near-complete geometric shape and mounding the sediments outward to create an embankment. This construction technique isolated an internal platform for ritual activities that was accessible via a causeway left from an unexcavated portion of the ditch. The embankments of the largest enclosures were constructed from various sediments without the excavation of adjacent ditches (see Lynott 2015).

Often, the interior spaces of geometric enclosures are virtually devoid of material culture (see Henry 2011; Webb 1941). However, sometimes burial mounds and wooden post-enclosures were constructed inside the embankments, and archaeologists have identified a scant number of deposits where exotic craft items, presumably used in ritual practices and offerings, were recovered (Brown 2012; Lynott 2015; Wright and Loveland 2015). Many enclosures have alignments with astronomical events like solstices and equinoxes or lunar maximums and minimums (Hivley and Horn 2013; Romain 2000; Turner 2011). Together, these lines of evidence have led archaeologists to interpret these places as the delineation of sacred space—possibly pilgrimage centers (Lepper 2004, 2006)—where periodic ritual gatherings probably emphasized world renewal (Byers 2011; Carr 2005; Clay 1998; Lynott 2015; Sunderhaus and Blosser 2006). Small enclosures were integrated into the planning principles of larger enclosure complexes (see Plate XXV from Squire and Davis [1848]1998 for examples from the Newark earthworks) but also situated apart from larger social centers. This indicates large and small enclosures may have served different ritual purposes and were used for diverse social situations.

However, these kinds of interpretations are hard to support; very few enclosures have been securely dated in a way that allows archaeologists to contemplate their historical trajectories with respect to their Adena-Hopewell builders and later inhabitants of the landscape. However, Burks and Cook (2011) have compiled available chronometric information on enclosures and suggest that small circles were the first enclosure forms to appear, followed by more intricate forms and clusters of small enclosures before the largest multi-form enclosures were built. The significance of Adena-Hopewell monuments to later inhabitants of the landscape is even more ambiguous. While the ‘intrusive’ reuse of burial mounds by pre-Columbian Late Woodland (cal AD 500-1000) societies, as well as Historic-era American Indian Nations, has been documented in the eastern U.S. (Seeman 1992; Mann 2005), very little information exists on how enclosures were regarded by social groups after roughly cal AD 500. Because of this temporal ambiguity our work at the Winchester Farm site specifically focused on seeking evidence for the long-term historical significance of the site.

3.3.1 The History of Research at Winchester Farm

Winchester Farm is one of six earthen monuments that antiquarian Constantine Rafinesque ([1821]1949, 1820) mapped north of present-day Lexington, Kentucky (Figure 3.2). Known today as the Mount Horeb Complex, this landscape includes small burial mounds (Webb and Haag 1947), a large irregular enclosure (9.2 ha) known as Peter Village (Clay 1985), and the well-known Mount Horeb enclosure that was excavated in the early twentieth century (Webb 1941). These mounds and enclosures have become foundational to understanding Adena-Hopewell societies, and especially enclosures, south of the Ohio River (Clay 1987, 1991, 1998; Webb and Snow 1945). However, much of what archaeologists now know of this complex originated before chronometric dating techniques. Therefore, the historical understanding of monument construction is poorly understood. For example, despite the near total excavation of the Mount Horeb enclosure (Webb 1941), only 11 artifacts were recovered. Information obtained from excavations proved that this site was probably built in one phase and a post-enclosure roughly 30 m in diameter once lined the interior space. One unique aspect of the post-enclosure was that it was a complete circle with no clear gap for entrance or exit (Webb 1941:154-55). This point will become important to our discussion at the end of this article.

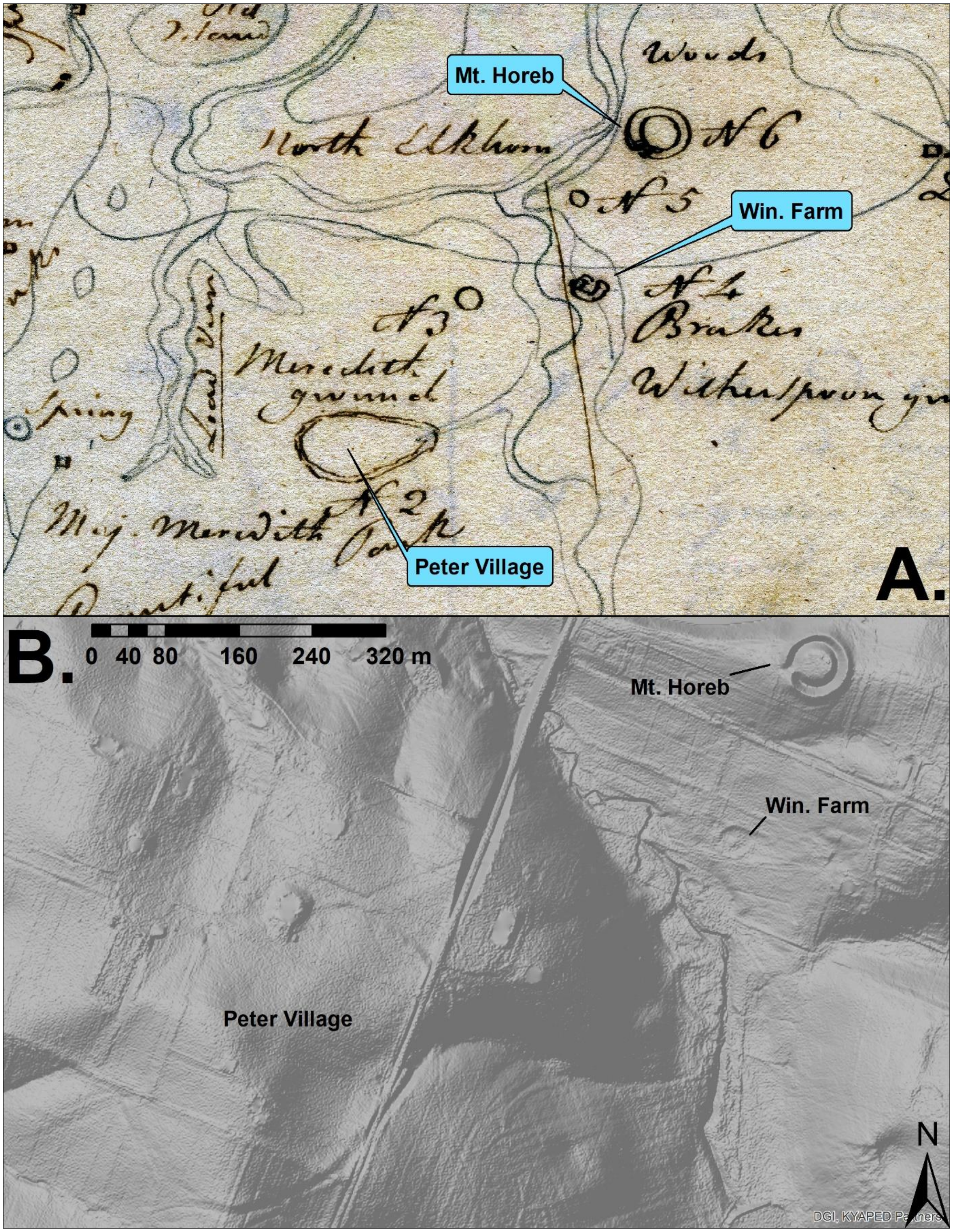

Figure 3.2. A.) Portion of Rafinesque's 1820 map of the Mount Horeb area. Enclosures denoted. Image courtesy of University of Kentucky Special Collections Library B.) 1.5 m LiDAR imagery showing present-day topographic variation from enclosure sites.

After Rafinesque's cartographic exploration of the Mount Horeb landscape, no archaeological research was carried out at Winchester Farm until 1985 when the site was mapped by George Milner and Richard Jefferies to identify micro-topographic changes (Jefferies et al. 2013:97-8). Their work revealed the subtle ditch-and-embankment topography first described by Rafinesque, but also identified a small 15 cm rise at the center of the enclosure's interior space. This feature is slight but visible in modern LiDAR data (Figure 3.3d) and corresponds to elevated levels of magnetic susceptibility mapped during recent geophysical surveys of the site (Jefferies et al. 2013) (Figure 3.3c). Geophysical data clearly show the site, enclosing ca. 317 m^2, is a 'squircle' (square with rounded corners) as defined by Burks (2015, 2017). This earthwork form is ubiquitous across central Ohio (Burks 2017, 2015, 2017; Burks and Cook 2011) but has only been found outside of Ohio at the Garden Creek site in western North Carolina (Horsley et al. 2014; Wright 2014), near present-day New Castle in east-central Indiana (Cochran and McCord 2001; McCord and Cochran 2008), and Winchester Farm (see Fig. 1). Our excavations at Winchester Farm built on the geophysical and mapping work of Jefferies et al. (2013) with the explicit goals of understanding the site biographically—when it was constructed, how and for how long the site was used, and finally, to learn when the site was abandoned.

3.4 Methodologically Considering the Itinerary of an Enclosure

Our approach to understanding the itinerary of the Winchester Farm site required us to obtain many lines of evidence from diverse excavation contexts at the enclosure. Excavations were conducted by hand and all excavated materials were passed through 0.635 cm mesh. This included a 1 m x 16 m trench across the ditch and embankment of the enclosure (Figure 3.4). Inside the enclosure, two 1x2 m units were excavated at a right angle to our trench to examine the outer boundary of the interior platform. Lastly, a 14 m^2 excavation block overlying the

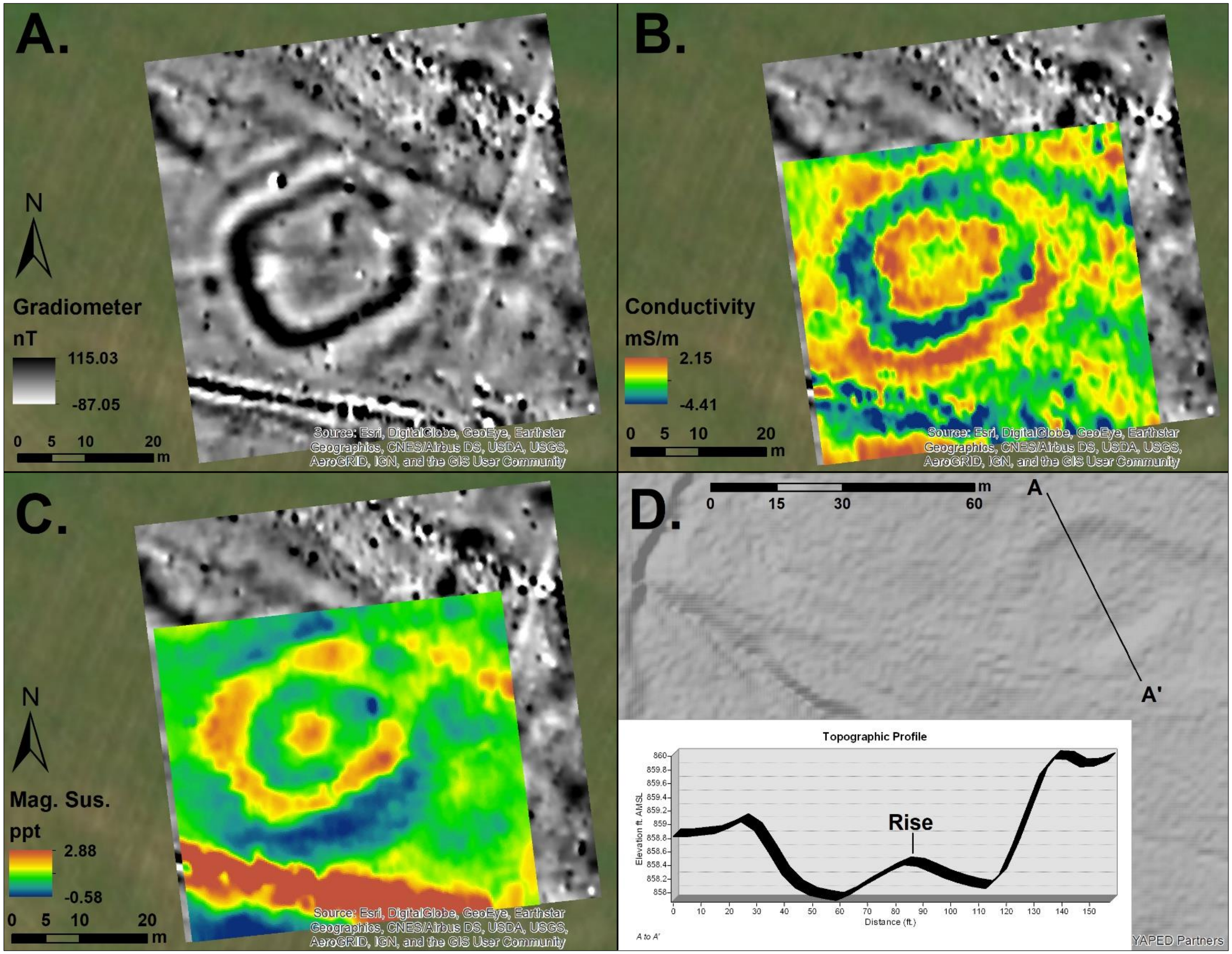

Figure 3.3. Geophysical data from Winchester Farm A.) Magnetic gradiometer B.) Conductivity C.) Magnetic Susceptibility D.) Topographic profile of the enclosure from LiDAR imagery.

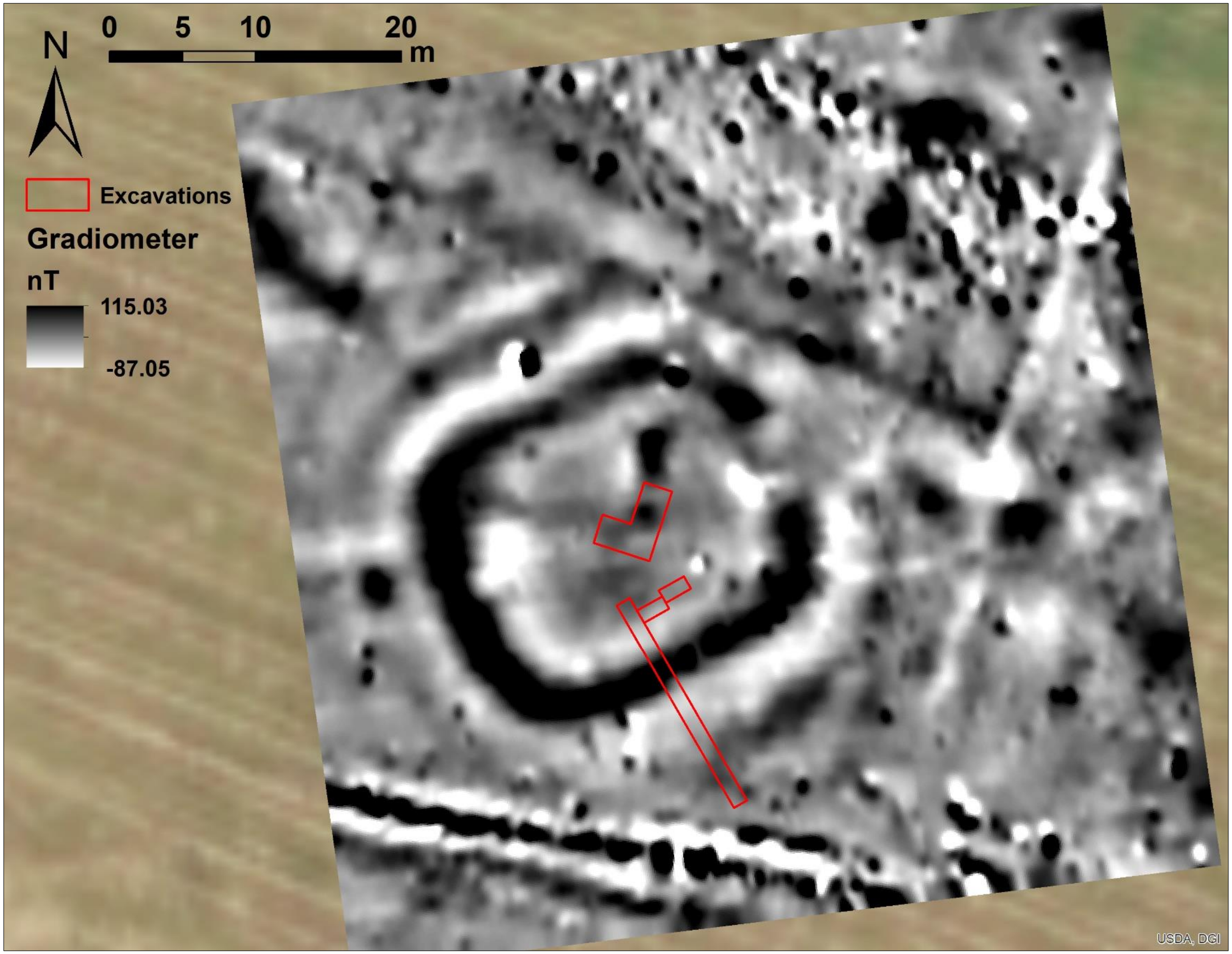

Figure 3.4. Excavation areas (red) overlaid onto magnetic gradiometer data.

topographic rise was situated at the center of the enclosure. We recovered artifacts, archaeobotanical, and zooarchaeological data from the enclosure, in addition to geoarchaeological data from the embankment and ditch. These datasets allow us to explore how the site was constructed, used, and what happen after the initial use of the enclosure ended.

3.4.1 Geoarchaeological Data from Winchester Farm

We recorded the physical characterizations of sediments and collected sediment and flotation column samples from two contexts in our large trench, the embankment and ditch. Samples from the sediment column in the ditch and embankment were subjected to analyses of mass magnetic susceptibility (χ), frequency dependence of susceptibility (χ_{fd}), loss-on-ignition (LOI), particle size (ldPSA), and geochemical properties (i.e., P and Ca)[2]. Magnetic susceptibility and frequency dependence studies have been shown to demonstrate links between the enhanced magnetism of soils and human-related activities like subtle fire regimes, midden accumulation, and the deposition of magnetically-enhanced artifacts (e.g., burned daub and ceramics), in addition to long-term natural pedogenic processes and landform stability (Dalan 2006, 2008; Dalan and Banerjee 1998; Dalan and Bevan 2002; Dearing 1999; Dearing et al. 1996; Lowe et al. 2016a,b; Park et al. 2012). LOI studies are usually applied in environmental studies to examine the percent of organic content (OM%) and calcium carbonate ($CaCO_3$%) in sediments (Dean 1974; Heiri et al. 2001; Milek and Roberts 2013; Santisteban et al. 2004; Tolksdorf et al. 2013), which can be used to infer patterns of landform stability via pedogenic

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[2] Mass magnetic susceptibility (χ), loss-on-ignition (LOI), and particle size (ldPSA) analyses were conducted at the Geoarchaeological Laboratory at Washington University in St. Louis by ERH. Magnetic susceptibility data were collected using a Bartington MS3 unit and the MS2B sensor. LOI data were collected following the methodologies outlined in Dean (1974), Heiri et al. (2001), and Santisteban et al. (2004). Sediment particle size was measured using laser diffraction (see Blott and Pye 2006; Eshel et al. 2004; Sperazza et al. 2004) with a Micromeritics Saturn Digisizer II. Geochemical analyses were conducted at the University of Kentucky's Soil Testing Laboratories in Lexington, KY (http://soils.rs.uky.edu) using ICP (inductively coupled plasma spectroscopy) and are presented here in parts-per-thousand (ppt) (see: http://soils.rs.uky.edu/tests/methods.php#Routine for more information).

development and human occupation debris (OM%), or periods of aridity and the deposition of ash and calcined bone ($CaCO_3$%). Particle size analyses determine the percent of clast size (e.g., sand, silt, clay) that comprise a given soil or sediment. Understanding particle size can help geoarchaeologists determine what kinds of depositional processes occurred and how much pedogenic activity has transpired (cf. Canti 2015:37-8). Geochemical analyses can provide archaeologists with an understanding of a sediment's geological origins and provide insight into how much humans have altered a depositional context (see Canti and Huisman 2015:100-2). We focused on phosphate (P) and calcium (Ca) for several reasons. First, P can be used to examine how humans altered the organic content of soils and sediments and can be paired with considerations of Ca to search for stratigraphic contexts where ash deposition has occurred (see Holliday and Gartner 2007; Roos and Nolan 2012; Van Keuren and Roos 2013). Because the bedrock geology underlying the Winchester Farm enclosure is limestone (i.e., calcium carbonate—$CaCO_3$), Ca was also examined in conjunction with $CaCO_3$% to help examine the depths at which sediments originated.

3.4.2 Archaeobotanical and Zooarchaeological Data from Winchester Farm

The Adena-Hopewell florescence has been associated with broader trends of reliance on domesticated plants native to North America. Often referred to as the *Eastern Agricultural Complex* (EAC) (see Struever 1962; Struever and Vickery 1973), this suite of starchy and oily seeded plants is typically found in Middle Woodland contexts. Recently, archaeologists have argued that mound centers may be one venue where knowledge about the EAC was exchanged (Mueller 2013, 2018). We collected flotation column samples from the ditch and collected sediment from features encountered inside the enclosure to search for plant remains that might provide clues as to how people used the site.[3] Excavations over the topographic rise inside the Winchester Farm enclosure recovered a diverse assemblage of faunal remains. Concentrations of faunal debris are not typically found inside enclosures. However, feasting is often discussed as a common social mechanism in Middle Woodland societies of the Ohio Valley and Southeast (Carr 2005; Wright 2017). Medium to large mammals often dominate faunal assemblages at sites in the Eastern U.S., with deer comprising a large portion of most assemblages (Jackson and Scott 2002). Fauna from Winchester Farm was sorted, quantified, and analyzed following zooarchaeological methods common to North America (Kelly 1997; Reitz and Wing 2008).[4]

3.4.3 Artifact Analyses at Winchester Farm

We recovered small amounts of ceramic, lithic, and 'special use' artifacts from our excavations. Ceramic sherds were classified according to size, major temper type, sherd type (e.g., rim, body, basal), and surface treatment. Measurements of weight and diagnostic features (e.g., wall, rim) were also recorded. When possible, sherds were assigned to type descriptions for cultural phases. Lithic debitage was assessed for raw material type and assigned to a stage in a general bifacial reduction typology. What we refer to as 'special use' artifacts include items like pipe fragments, quartz crystal, celt fragments, and other geologic specimens that have some

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[3] Archaeobotanical analyses were carried out by NGM. In total, 94.25 L of sediment were floated. Light fractions were weighed and passed through nested sieves (2 mm, 1.4 mm, 0.71 mm, and 0.425 mm) to ease the process of sorting and analyzed according to North American standards discussed in Fritz (2005). All wood charcoal, nutshell, and other unidentifiable plant fragments larger than 2mm were sorted and weighed. Seeds/fruits and seed/fruit fragments greater than 2mm would have been both weighed and counted, but none were present. Only seeds/fruits and fragments of seeds/fruits were pulled from materials smaller than 2mm. All material larger than 0.71mm was scanned for identifiable plant remains. One-third of each fraction from the 0.425mm sieve was subsampled because of the dearth of identifiable seeds. None of these subsamples contained identifiable plant remains, so the remaining two-thirds of the 0.425mm fractions were not scanned. Heavy fractions were not analyzed for this analysis. There were two samples that contained tiny fragments of what is probably walnut shell (cf. Juglans sp.) in the light fraction (see Table 3.5). It is possible that analysis of the heavy fractions would have increased this sample somewhat, as nutshell is frequently recovered from heavy fractions.

[4] Two broad categories of identifiability were used when sorting the bones from the central feature: identifiable (ID) and non-identifiable (NID) (Gifford and Crader 1977). All data are reported in NISP (number of identifiable specimens). ID specimens were sorted by body part, taxonomic classification, and size using comparative collections from Washington University in St. Louis.

unique association with the enclosure (e.g., non-local origins or unusual context at the site). We note their presence here and, in the cases where they are of non-local origins, we note the closest sources in straight-line distances.

3.4.4 Bayesian Chronological Modeling of Radiocarbon Dates from Winchester Farm

To understand the temporality of enclosure-use throughout its various phases, we submitted 16 samples comprised of charred wood and *Cervidae* bone for radiocarbon (^{14}C) dating through accelerated mass spectrometry. However, the errors of individual dates are so large that archaeologists can't explore time on the order of a human life. Bayesian chronological modeling has become one way to explore more precise understandings of time based on ^{14}C dates in conjunction with archaeological information (e.g., stratigraphy or phases of site use) (Bayliss 2009, 2015; Bayliss et al., 2016; Bronk Ramsey 1995, 2009a, 2009b; Buck, 1999; Buck and Meson, 2015; Hamilton and Krus 2018).[5] Bayesian chronological modeling has allowed archaeologists around the world to statistically interrogate ^{14}C data to produce robust interpretations on the timing and tempo of social change (Barrier 2017; Darvill et al. 2012; Hamilton and Kenney 2015; Kidder 2006; Kidder et al. 2018; Krus et al. 2013; Lulewicz 2018; Pluckhahn and Thompson 2017; Quinn 2015; Whittle et al. 2011; Wright 2014b). However, like archaeological biographies, Bayesian chronological models can change as more information from ^{14}C and other chronometric data become integrated into models with substantial contextual information. Therefore, chronological models of the past should be considered as evolving, rather than a final say on the sequence of past events.

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[5] Our chronological modeling was conducted by ERH in the OxCal software package (OxCal v4.3; http://c14.arch.ox.ac.uk/). The posterior density estimates (i.e., modeled age ranges) from our models are rounded to the nearest 5 years and presented in *italics*. In OxCal, models must pass an agreement index of 60 percent for the dates and models to be considered consistent; indices above 60 percent do not mean a model is more consistent when compared to another model (see Bronk Ramsey 1995; Hamilton and Krus 2018). Specific mention of functions in OxCal are made in the `Courier` font so they are clearly identified (*sensu* Hamilton and Kenney 2015). The coding for our models is included in Appendix 1

3.5 Identifying and Understanding the Contexts of Itineraries at Winchester Farm

Here we describe each excavation context in detail to situate our interpretations of, what we argue, are the primary contexts through which we can assess itineraries of the enclosure. These include the embankment, the ditch, a post-enclosure we identified inside the enclosure, and a sheet midden our excavations identified as the source of the internal topographic rise.

3.5.1 The Embankment

Our excavation trench across the ditch and embankment identified dense clay-rich sediment fills used to construct the embankment and exposed a complex series of refilling events in the ditch (Figure 3.5). The physical descriptions of these contexts are presented in Table 3.1. The general stratigraphy suggests no intact sediment fills are present on the outer sloping boundary of the embankment. This implies the builders of the enclosure incorporated the natural terrace-edge of the landform into the design plan for Winchester Farm. This decision may have required less sediment to be incorporated into the embankment along its southeastern boundaries, compared to the opposite sides of the embankment situated, which were built at lower elevations in the floodplain. This would have made more sediment from the ditch around the southeastern portions of the enclosure available to construct sections of the embankment elsewhere. We have classified the sediments used to construct the embankment as ‘homogenous fills’ (following Sherwood and Kidder 2011:77-8). This matrix would have been created by mixing shallow A and B-horizon soils with deeper B- and C-horizon soils to establish a consistent fabric. Evidence from physical characterization that support this interpretation can be identified in the varied amounts of moderate-to-small-sized mottled clasts of deep brownish-yellow Bt-horizon silty clay loams that have been incorporated with shallow Bt-horizon silt loams in a way that makes any gradational differences between the Bt-horizons (i.e., Bt1-3) indistinguishable. Moreover, the embankment fills exhibit varying concentrations of residual bedrock fragments and ferrous

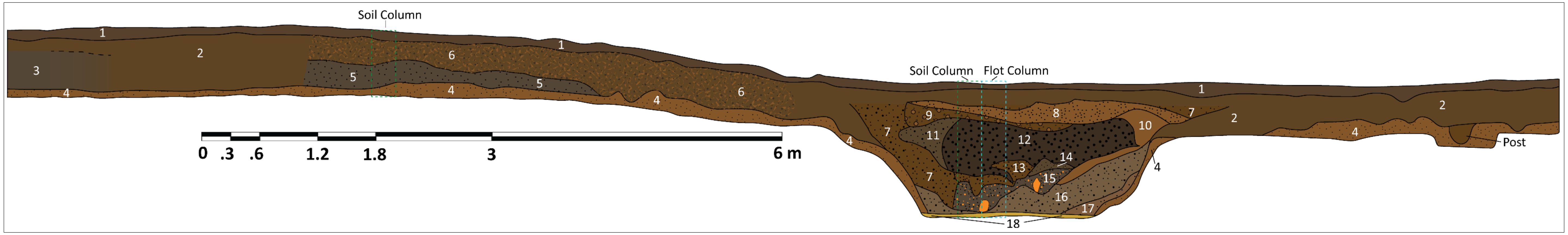

Figure 3.5. West profile of Trench 1. Descriptions of physical characteristics are listed in Table 3.1.

Table 3.1 Physical characterizations of strata in Trench 1 (Figure 3.5).

Stratum No.	Sediment Color	Physical Characterization	Horizon Designation	Notes
1	10YR 3/3: Dark Brown	Silt Loam	Ap	N/A
2	10YR 3/4: Dark Yellowish Brown	Silty Clay Loam	Bt1	light density of very small ferrous concretions
3	10YR 3/2: Very Dark Grayish Brown	Silt Loam	2Ab	very light density of charcoal flecking
4	7.5YR 4/6: Strong Brown	Silty Clay Loam	Bt2/3	moderate density of small to medium ferrous concretions; angular rock fragments increasing with depth
5	10YR 3/2: Very Dark Grayish Brown	Silt Loam	Ab	moderate density of charcoal flecking
6	10YR 3/4: Dark Yellowish Brown; 10YR 5/6 Yellowish Brown; 10YR 6/8 Brownish Yellow	Clay Loam	Bt2/3/C	moderate to heavy density of medium ferrous concretions; angular rock fragments
7	10YR 3/4: Dark Yellowish Brown	Silty Clay Loam	Bt1/2	moderate density of small to medium charcoal flecking
8	7.5YR 4/6: Strong Brown	Silty Clay Loam	A/Bt1	light density of charcoal flecking; embankment erosion?
9	10YR 3/4: Dark Yellowish Brown	Silty Clay Loam	Bt1	mottled with 8 & 12; charcoal abundant
10	10YR 3/4: Dark Yellowish Brown	Silty Clay Loam	Bt1/2?	N/A
11	10YR 3/3: Dark Brown	Silty Clay Loam	?	light to moderate charcoal density
12	10YR 2/2: Very Dark Brown	Silt Loam	A	moderate charcoal density
13	10YR 3/6: Dark Yellowish Brown	Silty Clay Loam	Bt2	heavy charcoal density
14	10YR 3/3: Dark Brown	Silty Clay Loam	A/Bt1	light density of charcoal flecking
15	10YR 3/2: Very Dark Grayish Brown	Silty Clay Loam	?	heavy charcoal density; heavy density of burned earth (incl. large nodules)
16	10YR 4/3: Brown	Silty Clay Loam	?	very wet; light to moderate charcoal density
17	7.5YR 4/4: Brown	Silty Clay Loam	Bt2/3	very light density of charcoal flecking
18	10YR 7/8: Yellow	Clay	C	void of inclusions; soil formation on bedrock
Post	10YR 3/6: Dark Yellowish Brown	Silt Loam	–	N/A

inclusions, also indicating a consistent mixing of the entire soil column. Producing this type of fill would have required the complete excavation of the whole soil sequence from the ditch, followed by the blending of sediments from that sequence to produce a homogenous fabric. No major differences in sediment fills were observed across the embankment as visible in our trench profile, which indicates the enclosure could have been constructed in one event. Webb’s (1941) excavations suggest the larger Mount Horeb enclosure, located 210 meters North of Winchester Farm, was built in a single event.

Beneath the embankment fill we documented a buried-A (Ab) soil horizon that exhibited moderate amounts of charcoal-flecking. The angle of this ancient ground surface reveals the natural slope of the alluvial terrace prior to the construction of the enclosure. However, there are portions of the embankment fill that do not cover an Ab, implying that the builders of Winchester Farm stripped some areas of the natural ground surface before construction. The very uneven interface between the embankment fills and the Bt1 horizon adjacent to the northern extent of the Ab likely represent excavation marks left when the builders of the enclosure penetrated the Bt1 horizon during removal of the A horizon. The practice of removing topsoil prior to embankment construction has been documented at larger enclosure complexes in Ohio (e.g., at Hopeton by Lynott and Mandel 2009).

3.5.2 The Ditch

Our trench excavations also revealed that the ancient builders of Winchester Farm excavated the ditch to limestone bedrock, situated roughly 135-140 cm below the ground surface. During our characterizations of the ditch profile, 10-20 cm of water continually refilled this bedrock surface, requiring us to regularly bail water from the ditch. The refilling sequence of the ditch can be characterized by non-uniform sediment packages (Figure 3.5). Some refilling strata contained large nodules of burned earth; others were rich in charcoal and contained large fragments of burned wood. We also observed strata comprised of mixed sediments and no charcoal. No clear evidence for erosion or A-horizon soil development were observed that might indicate the ditch was left open for long periods of time to refill naturally. We tested our interpretations of the enclosure construction and ditch refilling using the laboratory methods described above.

3.5.3 Laboratory-based Analyses of Sediments from the Embankment and Ditch

We measured the mass magnetic susceptibility (χ), loss-on-ignition (LOI), particle size (ldPSA), and geochemical properties (i.e., P and Ca) of sediment columns taken from the embankment and ditch. LOI data from the embankment profile exhibits consistently elevated levels of calcium carbonate ($CaCO_3$%) in the embankment fills, with a linear decrease occurring with depth in the Ab and Bt1 horizons (Figure 3.6). Because the underlying bedrock geology is limestone (i.e., $CaCO_3$) these data support our notion that the creation of the embankment fill matrix included the homogenization of sediments from throughout the soil column. Organic matter (OM%) in this profile is elevated near the interface of the modern Ap horizon and the embankment fills but decreases with depth to the Bt1 horizon. The embankment fills overlying the Ab in this area contained more OM% than the Ab, which may attest to the degree of pedogenic activity the embankment fills have endured. Low-frequency mass magnetic susceptibility (χ) and frequency dependence (χ_{fd}) both exhibit increased values in the Ab sediments, highlighting its enhanced magnetism. This paired increase could be a result of surface stability (i.e., natural organic and pedogenic activity; see Dearing et al. 1996), but it likely signifies human manipulation of the landscape through low-heat fires when the surface was exposed (see Dalan and Banerjee 1998; Lowe et al. 2016). This scenario is supported by the presence of visible charcoal flecking in the Ab horizon, the low amount of OM% in this portion of the sample column, and the relatively high concentrations of $CaCO_3$% in the Ab, which can

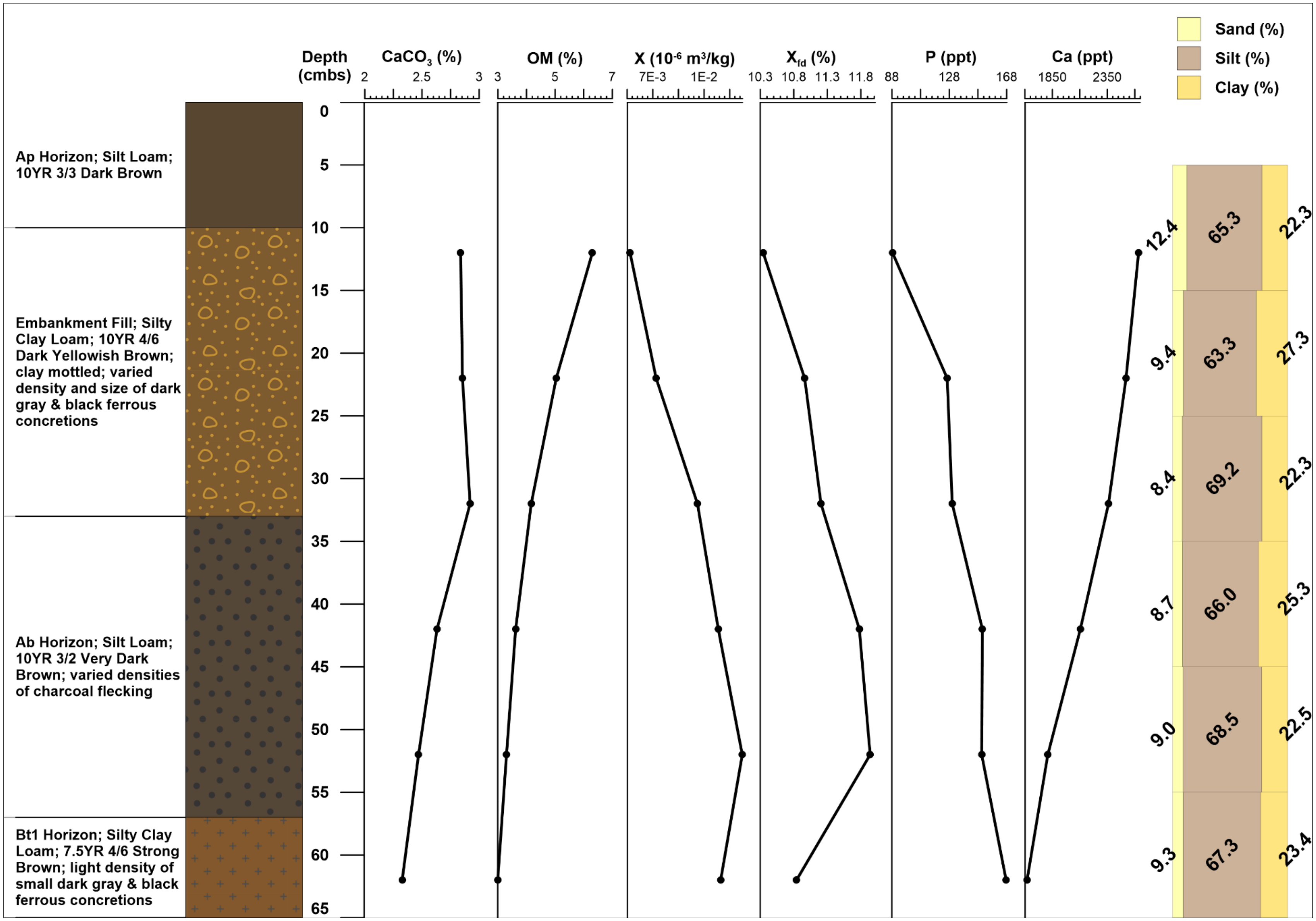

Figure 3.6. Data from geoarchaeological analyses of sediment samples from the embankment in Trench 1.

indicate the presence of ash from low-heat fires (see Canti 2014; Canti and Huisman 2015).

Phosphate (P) levels increase with depth in the embankment column. Because this P trend does not match an increase in OM%, but does match the increases in χ and χ_{fd}, there is support for an interpretation that the increases in P at the Ab are indicative of ash being incorporated into the ground surface from fires (see Holliday and Gartner 2007; Roos and Nolan 2012). This scenario supports an interpretation that the pre-enclosure landscape was manipulated with fire. Moderately high levels of P in the embankment fills, higher than near-surface values, suggests the homogenous embankment fills included A horizon in the composition. This interpretation is further supported by our observation that some of the A horizon was removed prior to embankment construction. The elevated levels of calcium (Ca) in the embankment fills and moderate levels corresponding with the Ab reinforces our explanations of the other sediment analyses. The increase in Ca matches trends in $CaCO_3$% as measured by LOI. Thus, the Ca and CaO_3% in the embankment fills are probably so high because the fills incorporate some of the Ab, which has enhanced levels of $CaCO_3$% from ash in the matrix, and B-C horizon soils that have high backgrounds of $CaCO_3$% from the limestone parent material. Because the soil column is dominated by silty loams and silty clay loams, particle size analysis (ldPSA) provides little information beyond confirming the soil column is dominated by silts. However, slight increases in the percentage of clays can be seen in the embankment fills—further support for our interpretations of homogenous sediment fill production.

In the ditch column we observed six refilling strata, in addition to modern pedogenic activity in the upper 25 cm of the soil column and a few centimeters of C horizon development resting on top of the limestone bedrock. LOI data from the ditch exhibit generally higher amounts of $CaCO_3$% than the embankment, but with intermittent increases and decreases in percentages with depth (Figure 3.7). The percent of $CaCO_3$% near the surface is moderate and values take a decreasing trend until the bottom of refilling stratum four (RS4). Another increase in $CaCO_3$% occurs near the middle of RS2, continuing until the base of the sample column. OM% in the sample column is high near the surface and decreases with depth until the bottom of RS2, where a slight increase occurs. The low frequency χ data almost mirrors the trend of OM% in the sample column, exhibiting elevated magnetism in near-surface sediments and decreasing with depth. The χ_{fd} shows a general increase throughout the sample column with a spike in the data situated in the middle of RS4. These four datasets show no evidence for any long-term surface stability in the ditch (e.g., A horizon development). With exception of the near-surface (e.g., 20-30 cm below surface), all elevated levels of OM% and χ correlate with RS that exhibit high amounts of charcoal and/or fragments of burned earth, which would elevate the organic content and magnetism of these strata. Percentages of χ_{fd} continually increase from RS6-2. Because there are no obvious paired increases in OM% and χ in these sediments that would indicate long-term pedogenic activity, we suggest these trends indicate the magnetic enhancement of paramagnetic grains occurred through fire.

P enrichment is moderate at the near-surface in the ditch column and decreases until approximately 60 cm below surface (the middle of RS4). From there, values increase until RS1 where a slight decrease is noted. A similar pattern can be seen in Ca, where values at the near-surface are elevated but decrease until approximately 40 cm below surface (the top of RS4). At this point, an increasing trend in Ca begins that spikes near the base of the ditch. Spikes in Ca and $CaCO_3$% near the base of the ditch may be affected by the limestone bedrock geology. However, this does not account for the high levels of P at this depth. When compared with the LOI and χ_{fd} data in the ditch column, P and Ca may indicate concentrations of ash as they did for

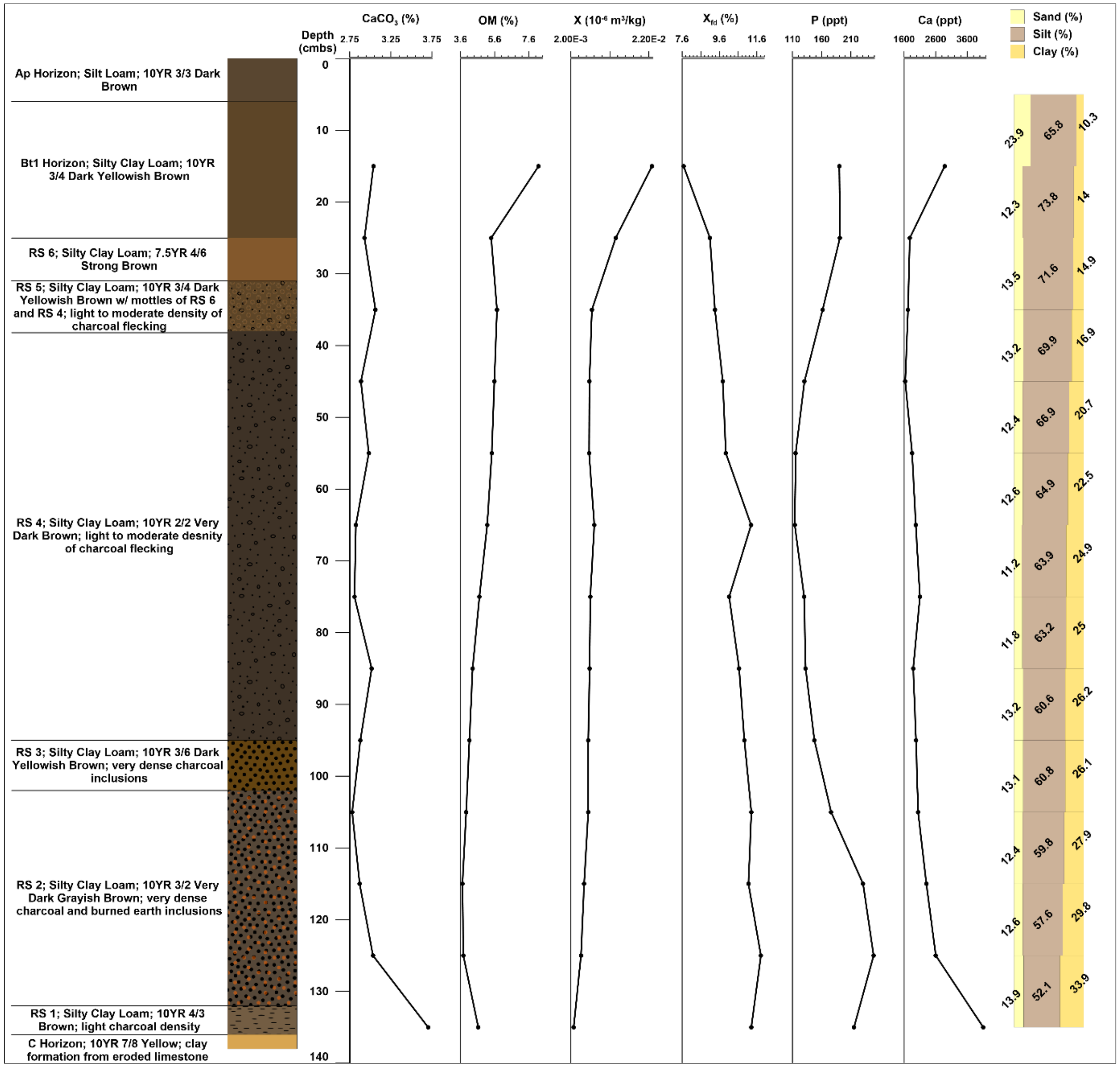

Figure 3.7. Data from geoarchaeological analyses of sediment samples from the ditch in Trench 1.

our embankment context. For instance, increasing trends in these measurements occur below 50 cm in the sample column. RS at these depths are characterized by moderate-to-heavy charcoal densities and RS2 exhibits a high density of burned earth inclusions. Therefore, we find it probable that these depositional episodes in the ditch coincide with burning events. Other increases in $CaCO_3$% and Ca in the ditch column may relate to the deposition of fills used in embankment construction. These correlations can be seen at approximately 55, 85, and 115-135 cm below surface. However, these fills may not be readily observable in profile because, as the ldPSA data show, enough pedogenic activity has occurred in the ditch to create a clear fining-downward sequence; approximately one-third of the particles near the base of the ditch are clay. Nevertheless, a scenario where people break apart the embankment fills and redeposit them in the ditch while burning them would account for the elevated values of P, Ca, $CaCO_3$%, χ_{fd}, and OM% near the base of the ditch, in addition to the high density of burned earth in RS2 and the dense amounts of wood charcoal in RS3 and RS4.

Together, our physical characterizations and lab-based analyses of sediments in the embankment and ditch show how ancient Adena-Hopewell groups built the Winchester Farm enclosure and provide insights into how the ditch refilled. First, a ditch was excavated to bedrock near the edge of an alluvial terrace that had experienced landscape manipulation through low-heat fires. During this process, portions of the A horizon adjacent to the ditch was removed from areas where the embankment would be placed. Next, the sediments removed from inside and around the ditch were mixed together to form a homogenous fill. This fill was then used to build an embankment exterior to the ditch, covering areas where the A-horizon had been removed and areas where it was still intact. Later, presumably sometime after the enclosure was abandoned, the ditch refilled very quickly. From the geoarchaeological analyses of the ditch strata, we surmise the refilling involved humans breaking up embankment fills, tossing them in the ditch, and burning them. With the history of enclosure construction and ditch refilling outlined for Winchester Farm enclosure, we now move to discuss how the interior of the enclosure was used.

3.5.4 Identifying What Took Place Inside the Enclosure

In our ditch-and-embankment trench, we encountered two posts at the edge of the interior platform (one in profile, another in the floor) (see Figure 3.5). Like the posts described by Webb (1941:152-3) at the nearby Mount Horeb enclosure, these posts were barely distinguishable from the surrounding Bt1 horizon. We identified additional posts after expanding our excavations along the edge of the interior platform (Figure 3.8). A total of 13 posts were exposed over approximately 5 linear meters of excavation trench. Reevaluation of the magnetic data from the enclosure revealed a faint linear magnetic anomaly that surrounds the interior platform and aligns to the orientation of posts identified in our excavations. Using the combination of our excavation and geophysical data, we estimate the internal post enclosure was comprised of roughly 110 posts and enclosed 132-m^2. The silty clay loam matrix that refilled the post holes does not suggest the posts were burned *in situ*; however, light densities of charcoal flecking were observed in the refilling sediments.

The post-enclosure surrounded the topographic rise inside Winchester Farm enclosure. Our excavations over this central feature recovered minimal amounts of lithic, ceramic, and faunal debris, in addition to a quartz crystal and fragmented portions of a pipe, a celt, and small galena nodules. Clusters of limestone were observed during excavation of this feature, some of which were burned and positioned in an ovular pattern (Figure 3.9). However, no stratigraphic differences could be identified in the 50-cm thick organic-rich sediment matrix. For this reason, we characterize the rise as a sheet midden. Nevertheless, the diversity and quantities of artifacts we recovered from this internal feature provide insights as to how people used this interior space

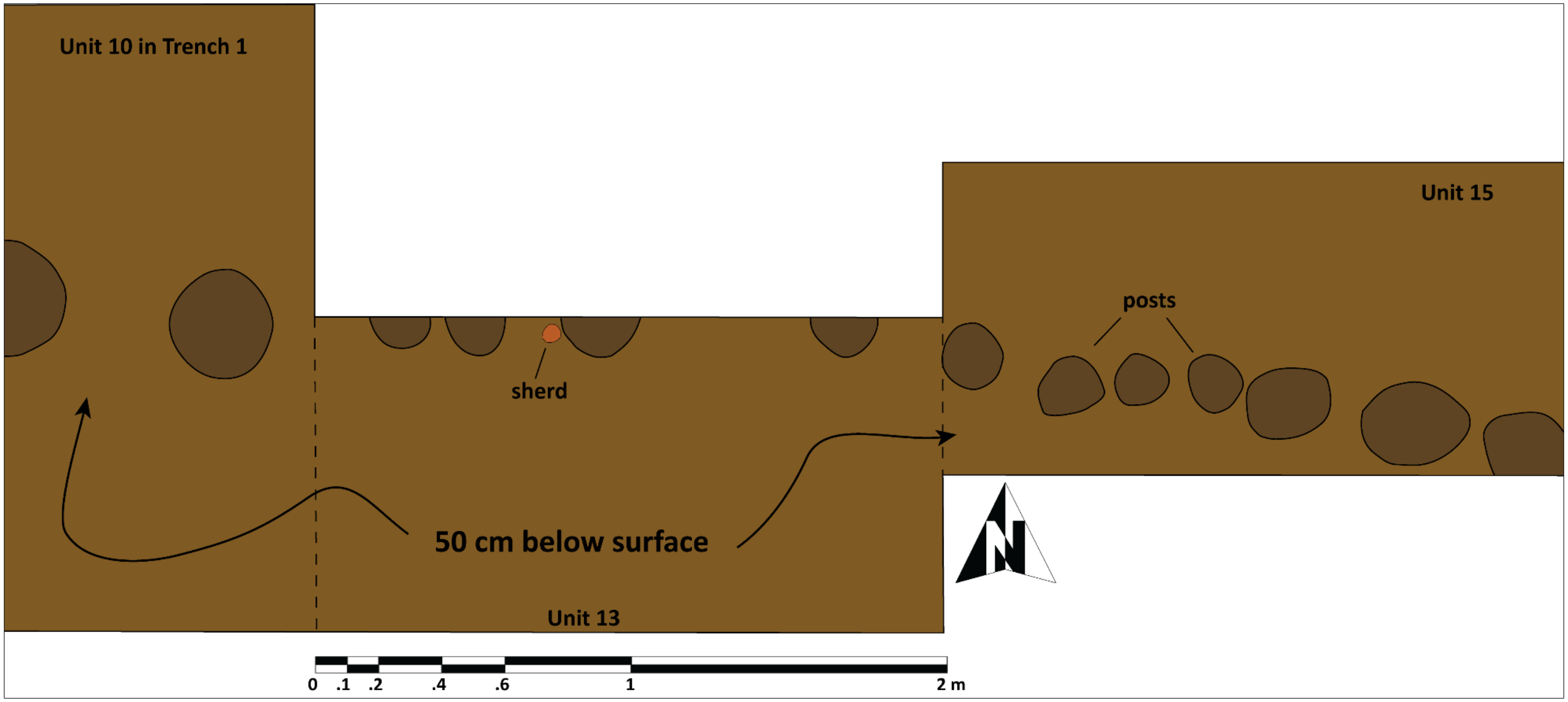

Figure 3.8. Planview map of posts identified in Trench 1 and adjacent excavation units. Sherd denoted above was Adena Plain.

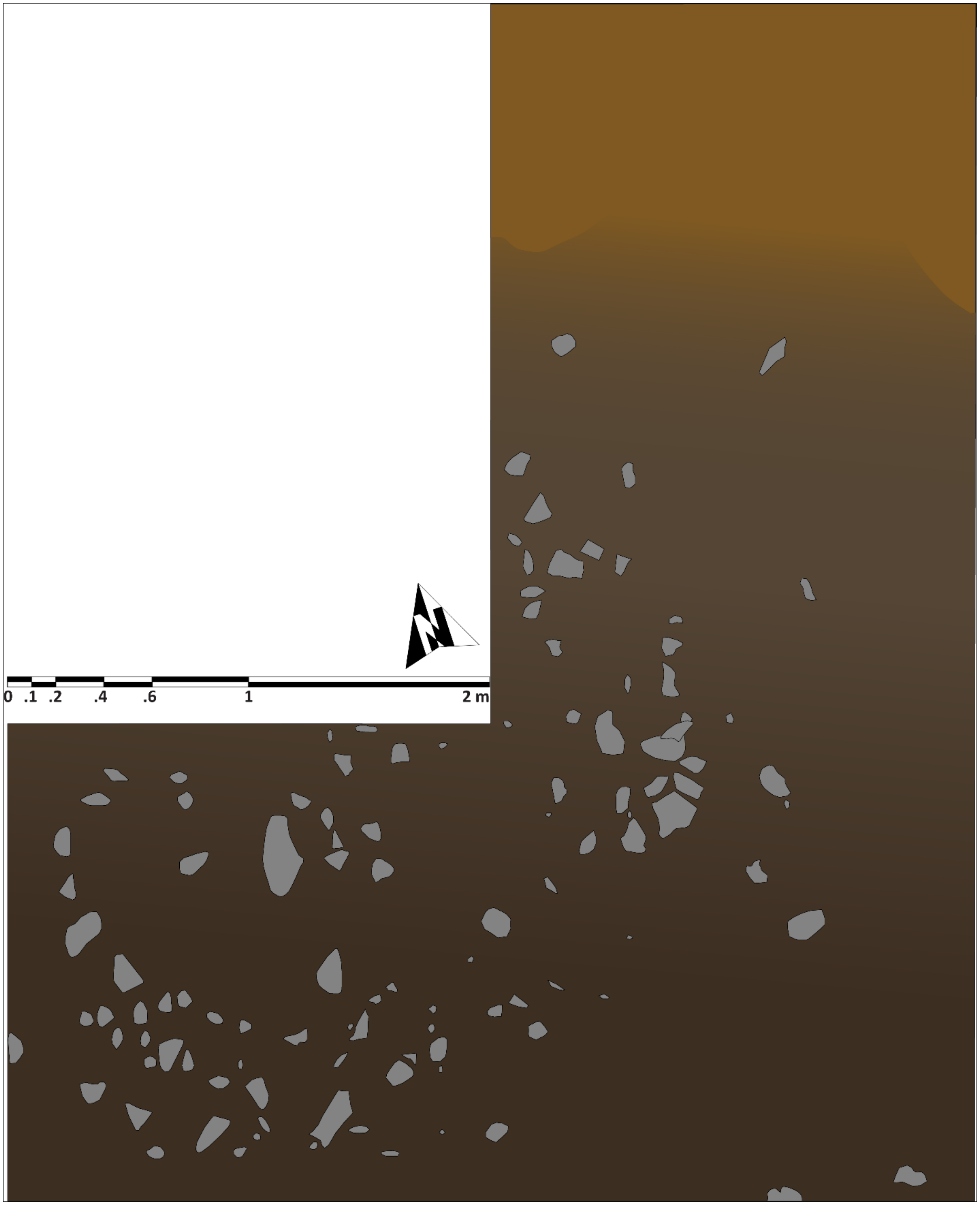

Figure 3.9. Planview map of Block 1 excavations over internal rise. Surface is approximately 30 cmbs. Note the ovular arrangement of limestone rock.

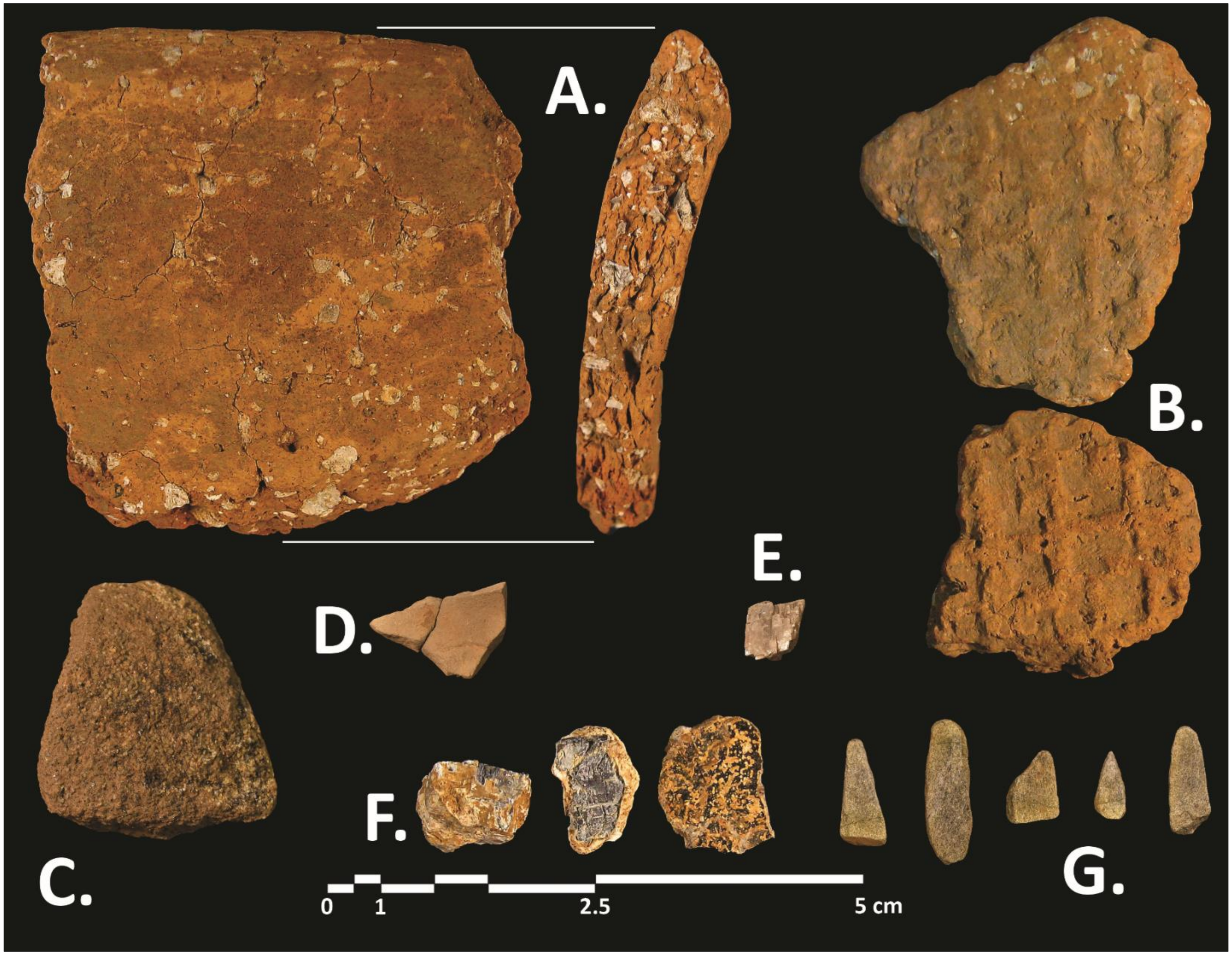

Figure 3.10. Artifacts recovered from Winchester Farm excavations A.) Adena Plain rim sherd. B.) Wright Check Stamped sherds. C.) Sandstone celt fragment (poll end). D.) Interior fragment of slate pipe. E.) Quartz crystal. F.) Galena debitage. G.) Shaped pieces of micaceous schist recovered from upper depths of the ditch.

Table 3.2. Ceramic data from sherds recovered within Winchester Farm enclosure.

Context	Ceramic Type	Sherd Type	Temper	< 2cm^2 (n)	> 2cm^2 (n)	Weight (g)	Thickness (mm)
Post from Enclosure	Adena Plain	Body	Limestone		2	21.56	9.7
Central Midden	Adena Plain	Rim	Limestone		1	19.85	8.3
		Body	Limestone	4		4.67	6.025
		Body	Limestone		1	3.48	6.3
		Basal	Limestone	1		2.48	7.6
		Body	Limestone		1	2.25	N/A
		Body	Limestone	1		0.83	4.3
		Body	Limestone		1	9.98	9.3
		Body	Limestone	1		0.88	N/A
		Body	Limestone		1	2.6	5.1
		Body	Limestone	1		1.75	4.7
		Body	Limestone	2		4.88	7.1
		Body	Limestone	3		2.36	5.75
		Body	Limestone	1		1	N/A
	Wright Check Stamped	Body	Limestone		1	3.12	5
		Body	Limestone	2		3.35	5.9
		Body	Limestone		1	6.8	5.9
		Body	Limestone		1	3.76	5.9
		Body	Limestone		1	3.48	5.6
	Total Adena Plain			14	7	78.57	μ=6.74 σ=1.73
	Total Wright Check Stamp			2	4	20.51	μ=5.66 σ=0.35

(Figure 3.10). For instance, sherds recovered from the central feature included Adena Plain, a local plain-surface ware (Webb 1940), and non-local Wright Check-Stamped ceramics, which is ubiquitous across portions of the Middle Tennessee River Valley in northeastern and central Alabama, southeastern Tennessee and northwestern Georgia (ca. 400 km away; see Haag 1939, 1942) (Table 3.2). An Adena Plain sherd was also recovered from a post in the enclosure. The low standard deviation in the measured thickness of the Wright Check Stamped sherds, in addition to the size and distribution of the checks in the stamp, alludes to their belonging to a single vessel. The weight of the Adena Plain and Wright Check Stamped ceramics we recovered is low, suggesting this feature was probably used sporadically and by small numbers of people. In addition, the greater amount of Adena Plain sherds might indicate that the enclosure was used primarily by local groups, with occasional visits from distant travelers. The lithic debitage we recovered from the central midden point to a similar scenario.

Although lithic debitage was recovered from many excavation contexts, the vast majority came from the interior portions of the enclosure—the post enclosure and central midden (Table 3.3). These contexts are the foundations of our discussion here. Debitage from inside the enclosure suggest that a small amount, but wide-range, of lithic reduction took place when people were gathered inside Winchester Farm. For instance, all types of reduction debitage were recovered, from early stage initial reduction flakes, to late stage pressure-flaked resharpening chips (Figure 3.11a). While each flake type was found in low quantities, shatter—often the result of thermal alteration (65.7%)—dominated the assemblage. This suggests the heating of raw materials was a common preparatory approach to tool production. No evidence for utilized flakes was identified during our analyses. This suggests that the focus of lithic manufacture inside Winchester Farm was on non-expedient tools. Raw materials identified in this assemblage include local (available within a few kilometers), semi-local (accessible within 50-75 km), and non-local (accessible beyond 75 km) chert types. Cane Run and Grier are local cherts that would have been available in drainages surrounding the enclosure (McDowell et al. 1988; Figure 3.11b). Boyle chert is semi-local to the Winchester Farm area, accessible in the east-Central portion of Kentucky. Muldraugh and St. Louis cherts could have been obtained in either the western parts of Kentucky or the east Central area (McDowell et al. 1988), making them semi-local or non-local in nature. Only one flake of non-local Kanawha chert was recovered from the central midden; its origins are around central West Virginia. In sum, the debitage assemblage from Winchester Farm suggests small numbers of people were periodically making and refurbishing bifacial stone tools when gathered at the site. Those people were either locals who had access to a spatially diverse range of stone materials, or—given the influential role of earthen enclosures in pilgrimages in and out of the Ohio Valley—it is possible that small numbers of local, semi-local, and non-local people were moving through this portion of Kentucky and stopped to participate in gatherings at Winchester Farm.

The notion that small groups of people, some from distant places, were using Winchester Farm for special events is supported by the recovery of ‘unique’ artifacts from the site. Shaped fragments of a micaceous schist were recovered from a shallow refilling zone in the ditch. However, from the central midden we recovered the poll-end fragment of a sandstone celt, a quartz crystal, fragments of burned earth, a slate pipe fragment, and galena debitage (Table 3.4). Galena debitage suggests people who used the enclosure were manufacturing ornaments from this lead ore mineral. Clay (1985) documented similar evidence for galena artifact production in his research at the nearby Peter Village enclosure. Quartz is considered a powerful substance

Table 3.3. Lithic data from debitage recovered at Winchester Farm.

Context	Raw Material	Flake Type	Heat Treated	Not Heat Treated	N	Weight (g)
Ditch	Boyle	Shatter	1	0	1	0.38
	Cane Run	Biface Initial Reduction	0	2	2	5
Posts from Enclosure	Boyle	Biface Finishing & Trimming	1	0	1	0.8
	Boyle	Flake Frag.	0	1	1	0.05
	Boyle	Flake Frag.	0	1	1	2
	Boyle	Shatter	0	1	1	0.15
	Boyle	Shatter	2	0	3	25.64
	Cane Run	Flake Frag.	0	1	1	0.2
	Kanawha (W.Va)	Biface Thinning & Shaping	0	1	1	0.12
	Muldraugh	Biface Finishing & Trimming	0	1	1	0.09
	St. Louis	Biface Initial Reduction	1	0	1	0.68
	UID	Chip	1	0	1	0.11
Central Midden	Boyle	Biface Finishing & Trimming	1	0	2	0.75
	Boyle	Biface Initial Reduction	0	1	1	0.75
	Boyle	Biface Initial Reduction	3	0	3	37.4
	Boyle	Biface Thinning & Shaping	0	2	2	10.09
	Boyle	Biface Thinning & Shaping	1	0	1	1.55
	Boyle	Bifacial Preform	0	1	1	101.43
	Boyle	Chip	9	0	9	1.64
	Boyle	Flake Frag.	0	6	6	3.62
	Boyle	Flake Frag.	20	0	20	35.11
	Boyle	Shatter	0	1	1	0.54
	Boyle	Shatter	52	0	52	231.83
	Cane Run	Biface Finishing & Trimming	0	1	1	0.42
	Cane Run	Biface Initial Reduction	0	2	2	14.18
	Cane Run	Biface Initial Reduction	1	0	1	8.39
	Cane Run	Biface Thinning & Shaping	0	1	1	0.58
	Cane Run	Biface Thinning & Shaping	1	0	1	6.5
	Cane Run	Flake Frag.	0	6	6	3.14
	Cane Run	Flake Frag.	3	0	3	4.19
	Cane Run	Shatter	0	1	1	14.68
	Cane Run	Shatter	5	0	5	4.3
	Grier	Biface Finishing & Trimming	1	0	1	0.38

	Grier	Biface Thinning & Shaping	0	1	1	1.04
	Grier	Bifacial Core	0	1	1	36.15
	Grier	Flake Frag.	4	0	4	4.7
	Grier	Shatter	2	0	2	10.88
	Grier	Shatter	0	1	1	6.25
TOTALS			**109**	**33**	**144**	**575.71**
Raw Material Summary		**Production Trajectory Summary**				
Total Non-local (g)	0.12	Total Biface Initial Reduction (n)	10			
Total Semi-Local (g)	454.5	Total Biface Thinning & Shaping (n)	7			
Total Local (g)	120.98	Total Biface Finishing and Trimming (n)	5			
Total UID (g)	0.11	Total Chips (n)	10			
		Total Flake Frag. (n)	42			
		Total Shatter (n)	67			
		Total Bifacial Preform (n)	1			
		Total Bifacial Core (n)	1			

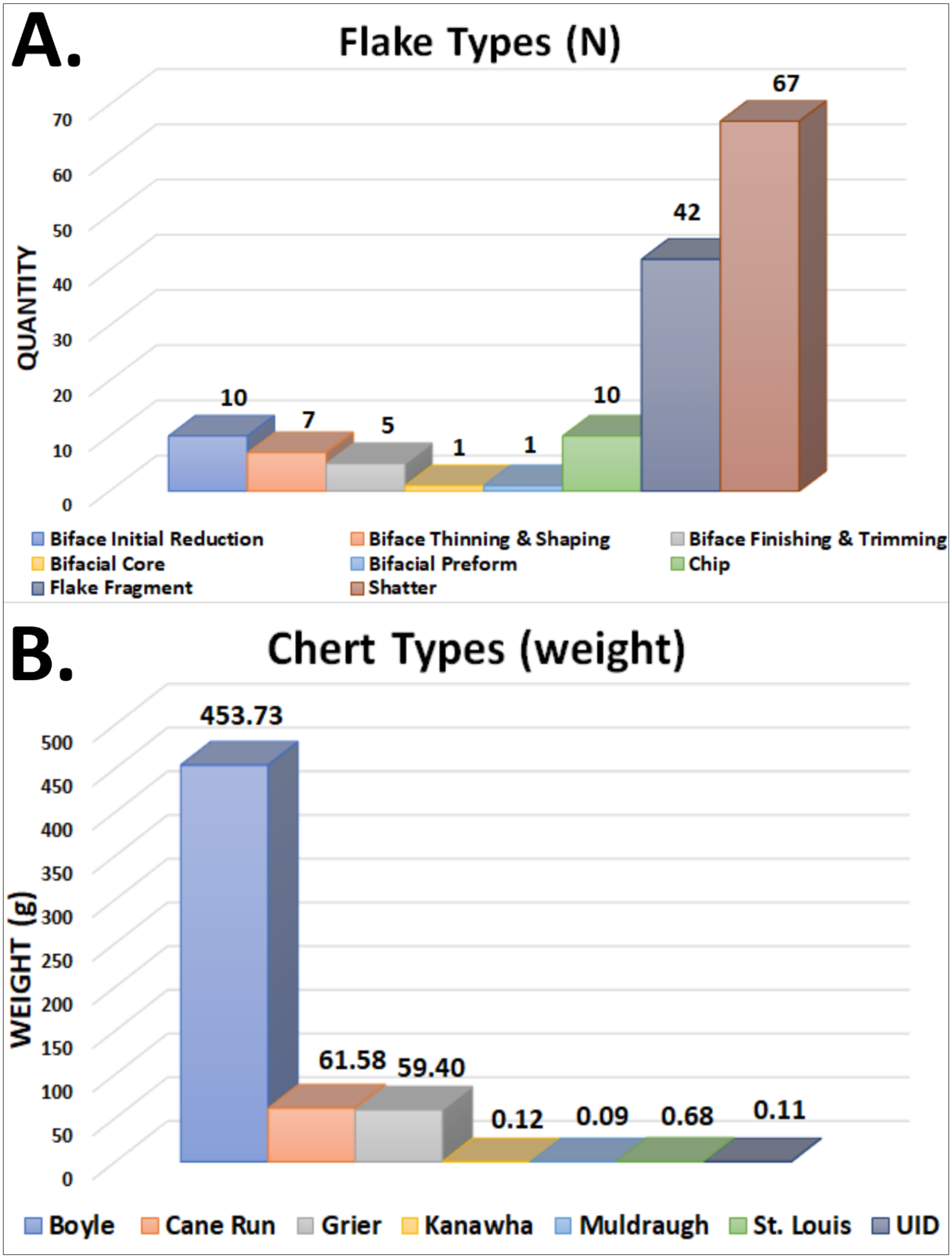

Figure 3.11. Distribution of lithic debitage recovered from Winchester Farm excavations. A.) Quantity of flake types in production trajectory. B.) Weight of raw material types recovered.

imbued with spiritual energies (Carr 2005:582, Wright and Loveland 2017:149). It could have been obtained in the same geographies as Boyle chert. However, the presence of micaceous schist, a metamorphic rock from the Appalachian Mountains, in the enclosure suggests the quartz may have been procured in that region too. The sandstone celt fragment is another artifact we recovered that originated in the southeasterly geographies of Kentucky. The slate pipe fragment provides an indication that smoking rituals occurred inside the enclosure (see Carmody et al. 2018).

In addition to the artifacts recovered from the central midden, botanical and faunal remains recovered during our work provides further insight into how people used the site. Minimal amounts of botanical information (three identifiable seeds) were recovered from the central midden (Table 3.5). This includes maygrass (*Pharlaris caroliniana*), purslane (*Portulaca oleracea*), and a probable locust seed (cf. *Robinia* sp.). While maygrass was widely consumed along the Ohio River and its tributaries at this time (Wymer 1993; 1996), the Ohio River is outside of its natural range, so this seed must have come from a cultivated plant. Maygrass may have been of ritual and nutritional importance to the ancient peoples of eastern North America—it often appears in special contexts from the Middle Woodland through the Mississippi era (ca. cal AD 1050-1600) (Fritz 2014). Portulaca is an edible weedy plant. Its seeds may appear at archaeological sites because it tends to colonize open spaces, but it was also consumed in the

Table 3.4. Weight and quantity of unique artifacts recovered from central midden at Winchester Farm.

Context	Artifact Type	N	Weight (g)
Ditch	Mica Schist	5	5.20
Central Midden	Sandstone Celt Fragment	1	54.48
Central Midden	Burned Earth Fragments	16	27.35
Central Midden	Quartz Crystal	1	1.64
Central Midden	Galena Debitage	3	4.19
Central Midden	Slate Pipe Fragment	1	2.3

Table 3.5. Synthesis of botanical remains recovered from flotation samples collected during excavations at Winchester Farm.

Feature	**FS**	**Light Fraction wt. (g)**	**Volume (L)**	**Wood weight (g)**	**cf. Juglans sp. nutshell weight (g)**	**cf. Cucurbita sp. rind weight (g)**	**Phalaris caroliniana (g)**	**Portulaca sp. (g)**	**cf. Robinia sp. (g)**	**UID seed/seed frag (g)**	**Carbonized root (g)**	**Unknown, not a seed (g)**	**Wood density**	**Seed total**
Ditch	101	84.15	6	22.56	0.01							198	3.76	
	129	14.7	5	0.11		0.01					2	2	0.02	
	130	23.41	3.5	0.44									0.13	
	111	96.14	6	4.15								28	0.69	
	126	14.38	4.5	0.47									0.10	
	122	67.63	4	1.25						2		1	0.31	
	119	267.51	6	0.58									0.10	
Feature Total		*567.92*	*35*	*29.56*	*0.01*	*0.01*	*0*	*0*		*2*	*2*	*229*	*0.84*	*0*
Midden	114	28.8	6	0.35			1			1		15	0.06	
	97	7.1	3.5	0.11					1				0.03	
	99	62.07	4	0.31	0.01			1				1	0.08	
	115	44.88	8.5	0.34									0.04	
	109	74.69	5	0.06									0.01	
	104	13.07	3.5	0.03									0.01	
	100	22.02	1.5	0.69									0.46	
Feature Total		*252.63*	*32*	*1.89*	*0.01*	*0*	*1*	*1*		*1*	*0*	*16*	*0.06*	*3*
Posts	116	20.5	4	0.07						2		1	0.02	
	19	15.55	1	0.13								2	0.13	
	117	14.49	4	0.04									0.01	
	110	12.04	2	0.81									0.41	
	113	17.12	1.5	0									0.00	
	131	60.62	5	0.21		0.01							0.04	
	107	9.33	3.5	0.14						1			0.04	
	105	8.16	1.5	0.01									0.01	
	118	14.73	1.5	0.01									0.01	
	102	4.54	1.5	0.04									0.03	
	103	1.92	0.75	0									0.00	
	98	5.28	1	0									0.00	
Feature Total		*184.28*	*27.25*	*1.46*	*0*	*0.01*	*0*	*0*		*3*	*0*	*3*	*0.05*	*0*
Total		1004.83	94.25	32.91	0.02	0.02	1	1	0	6	2	248	0.04	3

form of leafy greens and used as a medicine (Moerman 2009). The *Robinia* seed is probably from bristly locust (*Robinia hispida*), a shrubby relative of the black locust tree (*Robinia pseudoacacia*). The seed morphology is too small to be black locust and is somewhat small for bristly locust as well. However, it is unknown how much locust seeds shrink when carbonized. Bristly locust is an attractive flowering shrub whose branches and bark have various technological and medicinal uses (Moerman 2009). A few small fragments of probable walnut shell (cf. *Juglans* sp.) and squash rind (cf. *Cucurbita* sp.) were also recovered in the ditch fill. When compared to assemblages from contexts within other enclosures in the Ohio Valley (e.g., Seip Earthworks in Ohio; Wymer 2009) the assemblage is comparable. However, Winchester Farm is a unique enclosure site because of the central midden feature, but when compared to other Middle Woodland monumental sites like burial mounds in Kentucky (cf. Mueller 2018; Pollack et al. 2005), the archaeobotanical assemblage is sparse.

A total of 658 faunal specimens were recovered from the central midden (Table 3.6). Mammals make up 99.2% (607/612) of all ID specimens, the majority of which could not be classified further. All but two indeterminate mammalian specimens are categorized as either

Table 3.6. Synthesis of faunal remains recovered from excavation of the central midden.

TAXON	**NISP**
cf O. virginianus	1
Cervidae	20
Large mammal (>35 kg)	106
S. carolinensis	3
Sylvatragus	1
Medium mammal (1-35 kg)	476
Aves	3
Serpentes	1
Anura	1
Non-identifiable bone	46
TOTAL	658

large (>35 kg) or medium (1-35 kg) sized mammals. Mammalian taxa identified beyond class include the family Cervidae (deer), genus *Sylvilagus* (cottontail rabbits), and species *Odocoileus virginianus* (white-tailed deer) and *Sciurus carolinensis* (eastern grey squirrel). Identified non-mammalian taxa include the class Aves (birds), order Anura (frogs), and suborder Serpentes (snakes). Taphonomically, the bones from Winchester Farm are fairly uniform. Most of the faunal remains are burned (71.1%; 467/657) and 73.0% (341/467) of the burned specimens show signs of calcination (light gray/white coloration). Calcined bone indicates direct exposure to coals at temperatures of ~600° C or higher (Nicholson 1993; Stiner et al. 1995). In addition to burning, most of the faunal specimens are highly fragmented, most measuring 1 cm or less, which limits taxonomic classification.

The small quantities of local, semi-local, and non-local material culture found clustered at the center of this ritual enclosure points to evidence for ritual integration among local populations of the Mount Horeb landscape. However, they also signal what Carr (2005:582-6) describes as long-distance pilgrimage journeys where medicine persons, among others, seek to gain visions, power, and the knowledge of ceremonial rites. In these instances, individuals or small groups of people travel long distances to experience a powerful natural place and obtain a material token of that power. Alternatively, an individual or group may seek knowledge to perform a ceremonial rite that may have healing properties or the ability to help initiates cross into a new age-grade. While these scenarios for local and non-local organization rituals are somewhat different, they have similar material correlates that would include the acquisition and deposition of small quantities of powerful items from distant places. Moreover, the sharing of knowledge by situational and temporary shaman-like leaders can include feasting, a potential explanation for the small amount of faunal remains found in the midden fill. An alternative scenario for the faunal debris might include local leaders providing food to small groups of travelers who were passing through the Mount Horeb area during their pilgrimage journeys. Either scenario could explain the mixture of material and faunal remains encapsulated within the midden fills at the center of Winchester Farm. Whether Winchester Farm served as a stopping point for ritual journeys, a point for ritual integration among local inhabitants, or both, the timing and tempo of ritual practices must be understood to consider the itinerant influence and draw of the enclosure through time.

3.6 Winchester Farm and the Temporality of Ritual Dispositions

To understand the temporality of changing ritual dispositions that inspired the construction, use, and deconstruction of the enclosure, we initiated a robust ^{14}C dating system. We selected samples of charred wood, charred round wood, and uncharred bone to date diverse biographical contexts at the site. A total of 16 ^{14}C samples were submitted from contexts that include the Ab horizon beneath the embankment, the posts from the interior wooden enclosure, the central midden, and refilling sequences in the ditch (Table 3.7). We then situated those dates within different phases of site use and subjected them to multiple constraints in Bayesian chronological models. Our first model (Model 1) assessed the dates as belonging to three separate but sequential events: 1) enclosure construction; 2) use of the interior space; and 3) refilling of the ditch. Because we have little stratigraphic control outside of the ditch, we cannot be sure how much time elapsed between the construction of the enclosure and the use of the interior platform. Therefore, we created two sequential phases (i.e., TPQ for construction and interior use) and treated the refilling of the ditch as a contiguous sequence. Model 1 would not run because the model could not resolve the order of the dates as we had arranged them in the phases. This problem with Model 1 lies in how we used archaeological information from the site to structure our prior assumptions of phases from the Ab and central midden. For instance, four

Table 3.7. Radiocarbon assays obtained from Winchester Farm implemented in Bayesian chronological models.

Provenience	Context and Event Interpretation	Date of Assay	Lab	Lab #	Material	δ13C (‰)	D14C	pMC	±	Fraction modern (F_m)	F_m Error	RCYBP	1σ Error	Cal BC-AD (2σ - 95.4%)*	Median
FS101; Trench 1; Ditch - 115-132 cmbs	Ditch Refilling (refilling event 1-2)	2014	UGA CAIS	UGAMS-17003	UID charred wood	-25.0	n/a	86.77	0.28	n/a	n/a	1140	25	AD 770-980	AD 920
FS106; Trench 1; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2014	UGA CAIS	UGAMS-17004	UID charred wood	-27.6	n/a	77.57	0.26	n/a	n/a	2040	30	170 BC - AD 50	50 BC
FS110; Unit 13; Fea. 8 - Post Fill	Terminus Post Quem for Construction of Wooden Post Enclosure	2014	UGA CAIS	UGAMS-17005	UID charred wood	-22.9	n/a	79.1	0.25	n/a	n/a	1880	25	AD 70-220	AD 120
FS114; Unit 11; Fea. 4 - 50-55 cmbs	Interior Use of Enclosure	2014	UGA CAIS	UGAMS-17006	UID charred wood	-23.3	n/a	79.07	0.26	n/a	n/a	1890	25	AD 50-220	AD 110
FS14-1; Unit 14; Fea. 4 - 20-30 cmbs	Interior Use of Enclosure	2017	NOSAMS	OS-136446	Cervidae Rib (bone)	-21.6	-223.93	n/a	n/a	0.7820	0.0023	1980	25	50 BC - AD 70	AD 20
FS41; Unit 11; Fea. 4 - 30-40 cmbs	Interior Use of Enclosure	2017	NOSAMS	OS-136447	Cervidae (bone)	-21.8	-234.57	n/a	n/a	0.7713	0.0017	2090	20	180-40 BC	110 BC
FS108; Unit 12; Fea. 4 - 40-54 cmbs	Interior Use of Enclosure	2017	NOSAMS	OS-136888	UID charred wood	n/a	n/a	n/a	n/a	0.7820	0.0016	1980	15	40 BC - AD 70	AD 30
FS117; Unit 15; Fea. 13 - Post Fill	Terminus Post Quem for Construction of Wooden Post Enclosure	2017	NOSAMS	OS-136889	UID charred roundwood	n/a	n/a	n/a	n/a	0.7374	0.0021	2450	25	760-410 BC	580 BC
FS106; Trench 1; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2017	NOSAMS	OS-136890	UID charred wood	n/a	n/a	n/a	n/a	0.7887	0.0021	1910	20	AD 50-140	AD 90
FS111; Trench 1; Ditch - 125-135 cmbs	Ditch Refilling (refilling event 1)	2017	NOSAMS	OS-136891	UID charred roundwood	n/a	n/a	n/a	n/a	0.8665	0.0018	1150	15	AD 770-970	AD 900
FS129; Trench 1; Ditch - 110-120 cmbs	Ditch Refilling (refilling event 2 bottom)	2017	NOSAMS	OS-136892	UID charred wood	n/a	n/a	n/a	n/a	0.7839	0.0018	1960	20	30 BC - AD 90	AD 40
FS128; Trench 1; Ditch - 100-110 cmbs	Ditch Refilling (refilling event 2 top)	2017	NOSAMS	OS-136893	UID charred roundwood	n/a	n/a	n/a	n/a	0.8735	0.0021	1090	20	AD 890-1020	AD 960
FS127; Trench 1; Ditch - 90-100 cmbs	Ditch Refilling (refilling event 3)	2017	NOSAMS	OS-136894	UID charred roundwood	n/a	n/a	n/a	n/a	0.8665	0.0019	1150	15	AD 770-970	AD 900

FS126; Trench 1; Ditch - 80-90 cmbs	Ditch Refilling (refilling event 4 bottom)	2017	NOSAMS	OS-136895	UID charred wood	n/a	n/a	n/a	n/a	0.8713	0.0019	1110	20	AD 890-990	AD 940
FS125; Trench 1; Ditch - 70-80 cmbs	Ditch Refilling (refilling event 4 middle)	2017	NOSAMS	OS-136896	UID charred roundwood	n/a	n/a	n/a	n/a	0.8679	0.0018	1140	15	AD 780-980	AD 930
FS124; Trench 1; Ditch - 60-70 cmbs	Ditch Refilling (refilling event 4 upper)	2017	NOSAMS	OS-136897	UID charred roundwood	n/a	n/a	n/a	n/a	0.8656	0.0021	1160	20	AD 770-970	AD 870
* Calibrations made in OxCal v4.3 (Bronk Ramsey 2017), using the IntCal13 calibration curve (Reimer et al. 2013). Dates have been rounded to the nearest 10 years. The OxCal software is accessible at http://c14.arch.ox.ac.uk/															

Table 3.8. Structure and results of Model 2.

Name	**Modelled (BC/AD)**							**Indices: A_{model} 99; $A_{overall}$ 98.9**			
	from	to	%	from	to	%	median	A	C		
End: Site Use Boundary	105	240	68.2	85	455	95.4	185		97.1		
Span	570 yrs.	860 yrs.		525 yrs.	1185 yrs.		745 yrs.				
UGAMS-17005: F.8 Post R_Date (1880,25)	80	135		60	210		110	103	98.7		
UGAMS-17006: Midn. 50-55 cmbs R_Date (1890,25)	80	130		55	205		105	102	98.2		
OS-136890: Ab2 R_Date (1910,20)	70	125		50	130		90	99.5	98.8		
OS-136888: Midn. 40-54 cmbs R_Date (1980,15)	5	55		-40	65		25	99	99.1		
OS-136446: Midn. 20-30 cmbs R_Date (1980,25)	-20	60		-45	70		20	99.5	98.7		
UGAMS-17004: Ab1 R_Date (2040,30)	-95	5		-165	30		-45	99.6	97.1		
OS-136447: Midn. 30-40 cmbs R_Date (2090,20)	-165	-55		-175	-50		-110	99.6	98.3		
OS-136889: F.13 Post R_Date (2450,25)	-530	-410		-725	-405		-475	96.1	98.1		
Phase											
Start: Site Use Boundary	-610	-425		-855	-410		-545		98		
Winchester Farm Site Use Sequence											

uncalibrated dates (OS-136889, OS-136447, OS-136446, and OS-136888) precede the latest of our radiocarbon determinations from the Ab (i.e., OS-136890), suggesting there is a very good chance that use of the central midden began before the enclosure was constructed. This is not surprising. Evidence for pre-monumental use of Adena-Hopewell sites is prevalent beneath many burial mounds in the Middle Ohio Valley (Brown 2004; Webb 1940; Webb and Elliot 1942). To obtain prior information that would allow us to statistically assess which dates should be assigned to a pre-enclosure phase of site use, we created a phase-based model (Model 2; Table 3.8) and incorporated all dates from the Ab beneath the embankment, posts, and the central midden. Model 2 shows good agreement (A_{model} = 99%) with our assumption that the dates from the Ab, posts, and the central midden are associated with repeated ritual gatherings (Figure 3.12a) but it estimates that use of the locale where Winchester Farm was constructed began in *cal 855–410 BC* (*95.4%* probability) and likely in *cal 610–425 BC* (*68.2%* probability). The end of site use is estimated to have occurred at *cal AD 85–455* (*95.4%* probability) and likely in *cal AD 105–240* (*68.2%* probability). The overall span of site use at Winchester Farm is estimated (using the `Span` function in Model 2) to have persisted for *525-1185 years* (*95.4%* probability) and likely for *570-860 years* (*68.2%* probability) (Figure 3.12b). However, this long span of site use is not commensurate with the material culture recovered from excavations. Even if we consider the *likely* span of site use at 570-860 years, we would expect to see a different ceramic assemblage from the site that includes a thick and crude type called Fayette Thick (Clay 1985).

An `Order` function we included in Model 2 statistically assesses the probability that any given date in the phase occurred prior to another. We considered dates suitable for placement in a pre-construction phase if the `Order` function evaluated any date as at least 60% probable to have occurred before our latest date from the embankment (i.e., OS-136890). Our threshold of

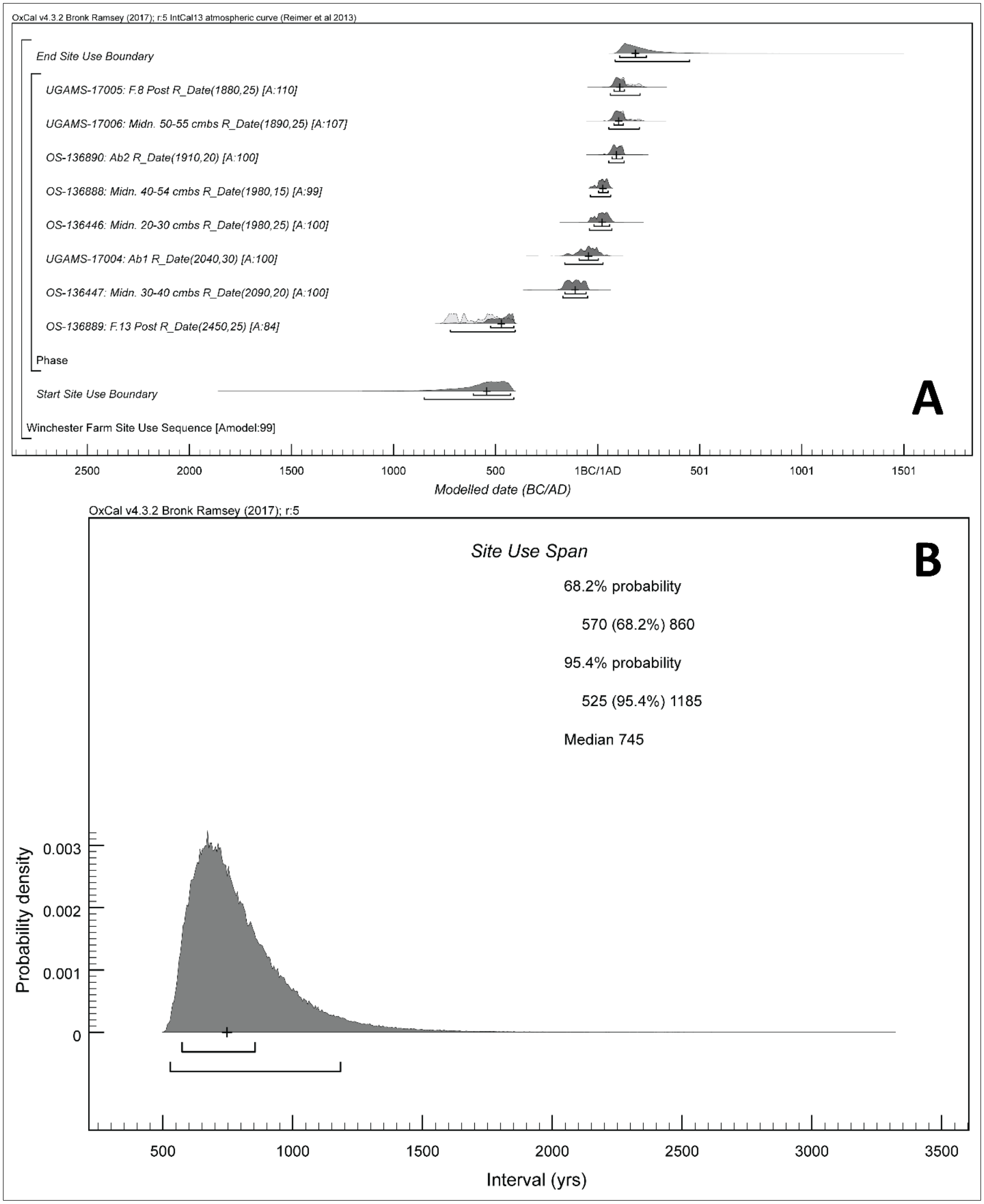

Figure 3.12. Results of Model 2 visualized in OxCal 4.3. A.) Posterior density estimates of Model 2. B.) Modeled span of site use.

Table 3.9. Results of the `Order` function applied to Model 2. Table displays the probability that any modeled date from Model 2 listed in the column “Order Function Table” came before date OS-136890.

Order Function Table	**OS-136890: Ab2**
OS-136889: F.13 Post	1.00
OS-136447: Midn. 30-40 cmbs	1.00
UGAMS-17004: Ab1	1.00
OS-136446: Midn. 20-30 cmbs	0.98
OS-136888: Midn. 40-54 cmbs	0.99
OS-136890: Ab2	0.00
UGAMS-17006: Midn. 50-55 cmbs	0.34
UGAMS-17005: F.8 Post	0.26

60% was selected to maintain a consistency with the OxCal threshold for the agreement index (also 60%). The `Order` function indicates four dates (e.g., OS-136889, UGAMS-17004, OS-136446, and OS-136888) could represent pre-construction use of the site. None of these dates fall below a 98% probability that they were earlier than OS-136890 (Table 3.9). Using this information as a prior, we created a three-phase sequential model that assumed a period of pre-enclosure use occurred, followed by construction of the enclosure, continued use of the interior platform, and finally the refilling of the ditch (Model 3).

Like Model 1, Model 3 would not run because OxCal could not resolve the order of the dates with our assumptions as we had structured them. At this point we felt outliers could be affecting our models and decided to test that assumption in another model (Model 4) using the `Outlier` function on two ^{14}C determinations. The first, OS-136889, was situated in the pre-enclosure phase of site use. This date is from one of the posts in the wooden enclosure. Because this sample was taken from post fill, it was possible charred wood that predated any cultural use of the landscape entered the fill during the excavation of the post hole, or during the placement and removal of the wooden posts. Moreover, Purtill et al.'s (2014) regional synthesis of directly dated posts from open-air post enclosures shows that the calibrated date range for these features extends to approximately cal 400 BC in the Middle Ohio Valley. The posterior density estimate for OS-136889 in Model 2 (i.e., *cal 725–405 BC, 95.4%* probability) is roughly 300 years earlier than Purtill et al.'s time-frame. Therefore, we treated OS-136889 as an outlier in our fourth model. Another date we suspected to be an outlier was OS-136892 from the ditch sequence. This date did not conform to the distribution of dates above or below it. Moreover, ditch refilling was almost certainly the result of human activity. Therefore, it is possible OS-136889 potentially entered the ditch as a result of mixing Adena-Hopewell and later deposits into the ditch fills.

Table 3.10. Structure and results of Model 3.

Name	**Modelled (BC/AD)**							**Indices: A_{model} 87.9; $A_{overall}$ 93.2**			
	from	to	%	from	to	%	median	A	P	C	
Difference: (End post-Enclosure Use, Begin Ditch Refilling)	825 yrs.	-740	68.2	-850	-665	95.4	-775			98.3	
End: Ditch Refilling Boundary	925	960		890	985		945			98.6	
Span: Ditch Refilling	0 yrs.	55 yrs.		0 yrs.	75 yrs.		20 yrs.			99.1	
OS-136897: Ditch 60-70 cmbs R_Date(1160,20)	925	955		890	970		940	87		99.4	
OS-136896: Ditch 70-80 cmbs R_Date(1140,15)	920	950		890	965		935	123		99.6	
OS-136895: Ditch 80-90 cmbs R_Date(1110,20)	920	950		890	960		930	84.7		99.5	
OS-136894: Ditch 90-100 cmbs R_Date(1150,15)	915	945		890	955		930	104.8		99.4	
OS-136893: Ditch 100-110 cmbs R_Date(1090,20)	905	945		890	950		925	61.4		99.3	
OS-136892: Ditch 110-120 cmbs R_Date(1960,20)	20	70		-25	85		40		0	99.8	
UGAMS-17003: Ditch 115-132 cmbs R_Date(1140,25)	885	940		885	950		920	132.6		99.4	
OS-136891: Ditch 125-135 cmbs R_Date(1150,15)	880	940		875	950		915	123.1		99.3	
Ditch Sequence											
Begin: Ditch Refilling Boundary	875	940		850	950		905			98.8	
Sequence											
End: post-Enclosure Use Boundary	90	145		80	220		130			99	
Span: post-Enclosure Use	0 yrs.	15 yrs.		0 yrs.	40 yrs.		5 yrs.			100	
UGAMS-17005: F.8 Post R_Date(1880,25)	90	135		75	205		115	120.3		99.6	
UGAMS-17006: Midn. 50-55 cmbs R_Date(1890,25)	90	135		75	210		115	111.4		99.6	
post-Enclosure Phase											
Begin: post-Enclosure Use Boundary	80	125		65	170		105			99.6	
End: Embankment Boundary	65	105		50	140		90			99.8	
OS-136890: Ab2 R_Date(1910,20)	60	95		50	125		80	95.4		99.9	
Embankment Phase											
Begin: Embankment Boundary	40	90		10	115		65			99.9	
End: pre-Enclosure Use Boundary	1	60		-30	75		30			99.9	
Span: pre-Enclosure Use	30 yrs.	115 yrs.		0 yrs.	145 yrs.		75 yrs.			99.7	
OS-136888: Midn. 40-54 cmbs R_Date(1980,15)	-40	30		-45	50		5	79		99.9	

OS-136446: Midn. 20-30 cmbs R_Date(1980,25)	-40	20		-45	50		-5	89.3		99.9	
UGAMS-17004: Ab1 R_Date(2040,30)	-60	5		-100	25		-30	115.9		99.8	
OS-136447: Midn. 30-40 cmbs R_Date(2090,20)	-80	-1		-130	5		-60	77.4		99.6	
OS-136889: F.13 Post R_Date(2450,25)	-745	-430		-755	-410		-575		0	99.7	
pre-Enclosure Use Phase											
Begin: pre-Enclosure Use Boundary	-115	-45		-170	-1		-75			98.3	
Winchester Sequence											

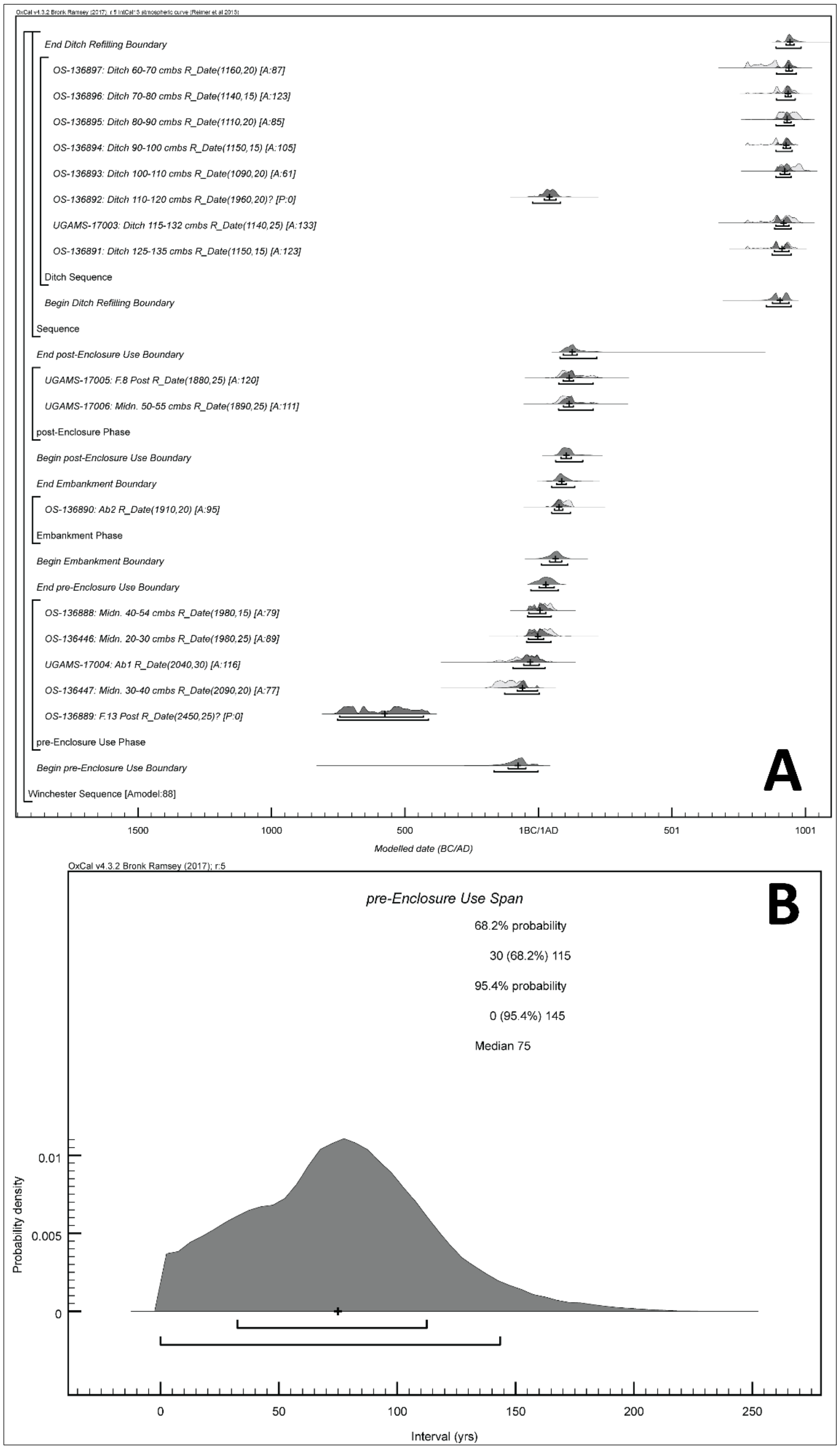

Figure 3.13. Results of Model 3 visualized in OxCal 4.3. A.) Posterior density estimates of Model 3. B.) Modeled `Span` of site use, including central midden, prior to enclosure construction.

Model 4 shows good agreement (A_{model} = 88%) and provides our best temporal evaluation of changing ritual practices at Winchester Farm (Table 3.10, Figure 3.13a). This model estimates pre-enclosure use of the site began in *cal 165 BC–AD 5* (*95.4%* probability) and likely in *cal 115–45 BC* (*68.2%* probability). Pre-Enclosure use of the site ended at *cal 30 BC–AD 80* (*95.4%* probability) and likely at *cal AD 1–60* (*68.2%* probability), the span of use lasting *0-145 years* (*95.4%* probability) but likely *30-115 years* (*68.2%* probability, Figure 3.13b). The construction of the enclosure had taken place by *cal AD 50–140* (*95.4%* probability; End Embankment Boundary) and likely by *cal AD 65–105* (*68.2%* probability). After the enclosure was constructed, the interior platform continued to be used. Use of this redesigned ritual space continued until *cal AD 80–225* (*95.4%* probability) but likely until *cal AD 90–145* (*68.2%* probability). Our current work shows that use of the site after the enclosure was built did not last long. Model 4 estimates it lasted only *0-40 years* (*95.4%* probability) and likely *0-15 years* (*68.2%* probability; Table 3.10, Figure 3.14a).

After the use of the site ended, a long period of time passed before the ditch began refilling. Our model suggests refilling began by *cal AD 850–950* (*95.4%* probability) and likely by *cal AD 875–940* (*68.2%* probability), ending by *cal AD 890–990* (*95.4%* probability) and likely by *cal AD 925–960* (*68.2%* probability). The duration of refilling is estimated to have lasted *0–75 years* (*95.4%* probability) and likely *0–55 years* (*68.2%* probability; Figure 3.14b), but potentially lasting only *20 years* (*median*). A `Difference` function we applied in this model assessed the amount of time that passed between the last evidence for the interior use of the enclosure (i.e., End post-Enclosure Use Boundary) and the first evidence we have for the ditch refilling (i.e., Begin Ditch Refilling Boundary). This parameter indicates that *670–850 years* (*95.4%* probability) and likely *740–825 years* (*68.2%* probability), or potentially *775 years*

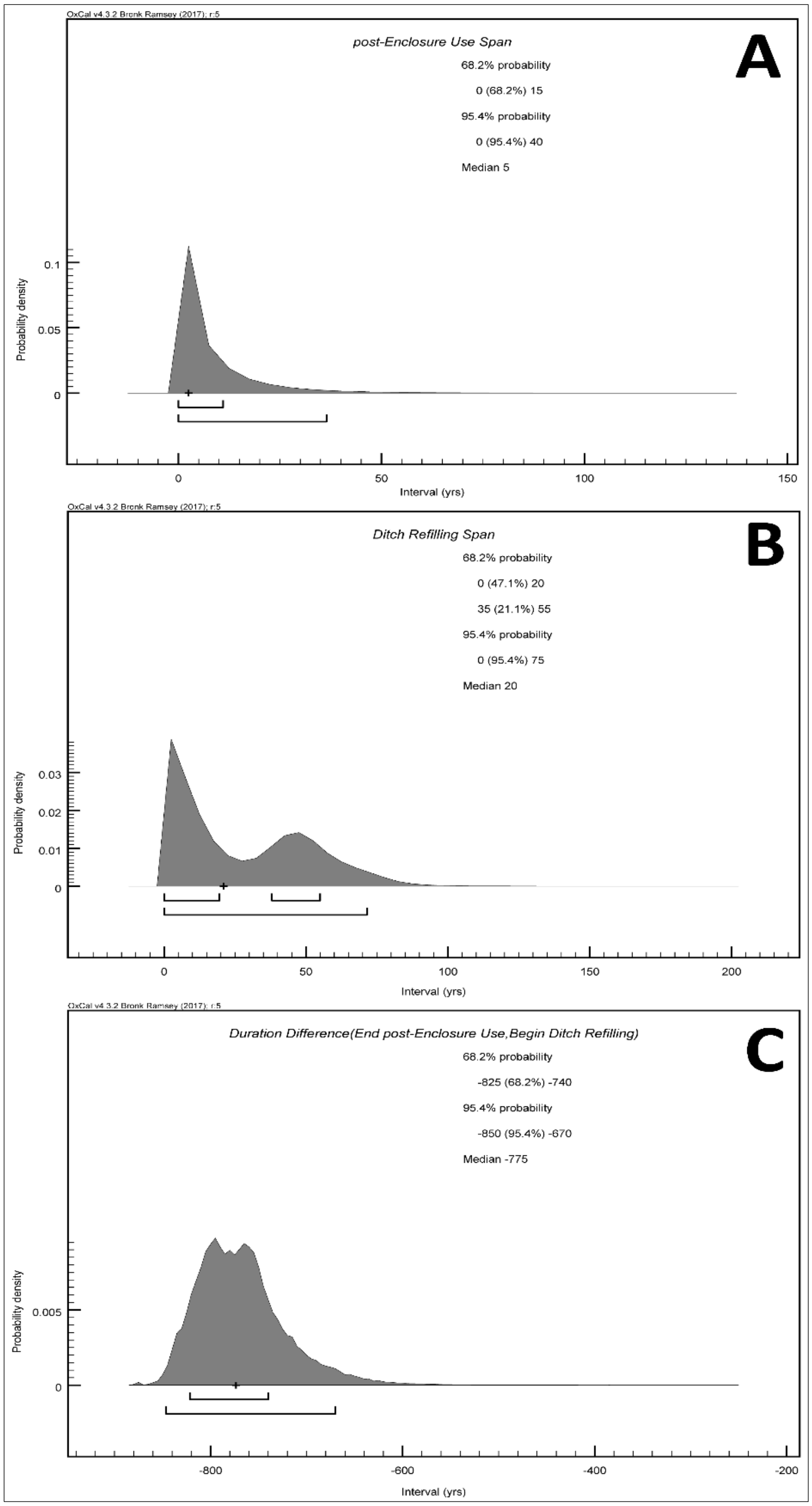

Figure 3.14. Further results of Model 3. A.) Modeled `Span` of time that interior of enclosure was used after construction of the ditch and embankment. B.) Modeled `Span` of time that transpired for the ditch to be refilled. C.) Time that elapsed between the end of the enclosure's interior use and the beginning of ditch refilling modeled using the `Difference` function.

(*median*) passed from the time the enclosure quit being used for ritual gatherings and the ditch began to be intentionally refilled (Figure 3.14c).

3.7 The Monumental Itinerary of Winchester Farm: A Discussion

Integrating our geoarchaeological, artifact, and chronological data allow us to detail the construction, use, and abandonment of the Winchester Farm enclosure. In addition, our ability to discern what activities preceded construction of the site, and therefore what influences may have led to the enclosure's construction of the site, permit us to examine the itineraries of movement through space and time. However, our task is not only to describe these temporal changes in material culture and landscape change, but to also address why these changes might have occurred. This responsibility requires us to rely on the material correlates of American Indian ethnohistory and the philosophical foundations for American Indian worldviews. In the discussion that follows we outline the monumental nature of itineraries related to the Winchester Farm enclosure through time. To begin, we must consider use of the landscape before the enclosure was constructed. Excavation of the topographic rise that became the center of the enclosure showed that it developed from numerous depositional events. We refer to this feature as the central midden because it had no stratigraphic integrity discernable through geoarchaeology or chronology. Artifacts and ecofacts deposited in this midden include ceramics and lithic debris from a variety of near and far distances, as well as unique materials like fragments of a smoking pipe and celt, crystals, and galena debitage. Faunal remains indicate people were consuming small amounts of medium to large mammals, and possibly small quantities of bird, reptiles, and amphibians.

Adena-Hopewell enclosures have long been considered ceremonial places where participation in ritual practices (e.g., feasting, dance, games) emphasized social integration at multiple scales (Byers 2011; Carr 2005; Clay 1987; Lynott 2015; Ruby et al. 2005; Webb 1941;

Wright and Loveland 2015). However, our work shows it is highly likely that small groups of people were engaging in cooperative ceremonies, evidenced by use of the central midden feature and the surrounding landscape, for *0-145 years* (*95.4%* probability) sometime between *cal 165 BC–AD 5* and *cal 30 BC–AD 80* (*95.4%* probability) before Winchester Farm enclosure was built. Gathering at this particular place on the landscape may have been simply a historical contingency or it may relate to cosmological principles retold in the myths of many American Indian tribes. For instance, the central midden is situated in close proximity to the confluence of a small tributary stream and North Elkhorn Creek. Water features like rivers, springs, and the confluence of streams are generally seen as places of spiritual significance in the cosmologies of American Indian tribes of the Eastern Woodlands. Often, they are associated with either the creation of, or emergence into, the world and/or the Under World (Bastian and Mitchell 2004: 89-91; Hall 1997:84; Hudson 1976:130; Romain 2009:160; Rooth 1957; Spencer 1909). Therefore, meeting at this place may have held a cosmological significance prior to the gathering of people wherein small-scale feasting and the deposition of geological items like crystal and galena occurred. However, once social gatherings began, they set in place a cycle of movement to and from this place for over a century.

Because we cannot directly date any of the ‘unique artifacts’ we described above, we cannot know if the pre-enclosure uses of the central midden feature included their deposition. However, our dating of deer bone from this feature shows that food consumption took place before the enclosure was built. Following Kassabaum’s (2014:314-31) reconceptualized continuum of feasting, we argue the small quantities of animal bone from the central midden indicate gatherings that occurred there before the enclosure was built were between small groups of people and likely reinforced group cohesion and equality rather than sociopolitical competition. When the deposition of local exotic and distant materials entered this feature the context of the midden may have shifted. In the case of the crystal and galena, and possibly the celt and pipe fragments, gathering the materials for these objects almost always requires entering the earth or traveling to a place where a material outcropped. In either case, there would have been a strong power, and potentially supernatural beings, associated with these materials (Carr 2005:582) and their places of origin, as has been documented for the social contexts of copper (Fox 1992; Trevelyan 2004). If the deposition of these items in the central midden represents the bundling of material and spiritual power with other communal forms of ritual practice like small-scale feasting and/or the passing of ritual knowledge, this place would have become powerful, and the people who participated in the creation of this place may have been bounded to it through their *sense of place* as defined Viola Cordova (2007:192-200). For instance, Pluckhahn et al. (2006:264) note that, "(p)lant remains are less commonly utilized in the archaeological identification of feasting", but when they are, botanical assemblages are highly diverse and rich. This is not the case for Winchester Farm. Therefore, we consider the low density of maygrass (*Pharlaris caroliniana*), purslane (*Portulaca oleracea*), and probable bristly locust (*Robinia hispida*) to imply the passing of medicinal or ritual knowledge.

Approaching the placement and use of the central midden from a perspective that recognizes it as cosmologically significant and accreting power as groups continued to use it for ritual gatherings, allows us to address why people continued to revisit the locale and eventually construct an earthen enclosure around it. When the enclosure was constructed, our geoarchaeological analyses of the Ab under the embankment suggests that the ground surface had been subjected to low-heat fires. When synthesizing ceremony among southeastern American Indian Nations, Hudson (1976:317-18) outlines ways human purity was maintained through separation from pollution. In a general sense, the use of fire was important to this separation as Hudson (1976:318) writes, “Fire was itself the ultimate symbol of [a person’s] struggle against pollution.” Using this notion, we might consider the burning of the landscape an act intended to purify the area where Winchester Farm was constructed. Functionally, this would have also made excavation of the ditch easier by removing any small wood and plant debris.

Our examination of the embankment and ditch shows that construction of the enclosure included the excavation of the ditch to bedrock. Sediments removed from the ditch were then manipulated to create a homogenized sediment fabric that was used to build the exterior embankments of the enclosure. This act may have served as a metaphor for kinship relations and world renewal, as those who participated in the construction of this enclosure came together to create what would be an enduring monument. In general, monumentalizing a place can serve as a mechanism to solidify notions of social consensus (Bradley 1998; DeMarrais 2016; DeMarrais et al. 1996; Dillehay 1990; Notroff et al 2014; Osborne 2014). In eastern North America mound construction has been considered an embodied ritual reflecting the recreation of the world, as expressed in origin myths from numerous American Indian language groups. In what are known as ‘Earth Diver’ myths, a water-based entity such as a turtle, crawfish, duck, muskrat, or water beetle dives into primordial seas to acquire the mud that land is made from (Hall 1997:19). However, the creation of monuments, even if an act of world renewal, also suggests that people interact with them on a regular basis for unknown periods of time. It is these cyclical interactions that can lead to unintended consequences (Pauketat 2000), whereby the process of remembering the past construction of a monument perpetuates notions of belonging and a sense of place or power (Henry 2017; Pauketat and Alt 2003). In the case of Winchester Farm, we must call attention to how the enclosure was meant to define a space that contained people and things within it, even if only temporarily. In doing so, the enclosure also facilitated the movement of some people and things from a diverse geographical range into and out of it. As we identified through our excavations, other local and non-local objects were left inside—bound within the enclosure forever.

As we experienced during excavation of the ditch, water would seep from the bedrock, filling it roughly 20-30 cm deep. Bounding the central midden with a geometric shape and water correlates well with Hall's (1976) ethnographic synthesis on the creation of boundaries for supernatural forces by American Indian Nations. He points out that water, including streams, served as a barrier that supernatural beings could not cross; these boundaries could be enhanced by their placement in a circular or geometric form and were used to repel the movement of spirits across them (Hall 1976:362). 'Sacred enclosures' like Winchester Farm are explicitly addressed as potentially being used in this way. However, Winchester Farm is the first enclosure that has been identified to have likely held water in the ditch. The symbolism of ditched enclosures in Western Europe, specifically Ireland, have been explained in similar terms. Warner (2000) describes the dichotomy of ditched hengiform enclosures and Iron Age hillforts as a juxtaposition of 'keeping in' and 'keeping out'. Hillforts are known to be defensive features and exhibit a ditch to the outside of an embankment, effectively keeping dangerous entities outside of the internal space. Alternatively, Warner (2000:41-2) draws on Irish mythology to propose that ritual leaders engaging the 'Otherworld' wanted to contain those forces to an internally-ditched enclosure space so they could not harm the outside world (Figure 3.15). Similarly, Hall's (1976) ethnohistory showed that many American Indian Nations (including those who lived in the Eastern Woodlands) used water barriers in ways similar to those described by Warner, including to impede the movement of spirits. Therefore, we argue that the construction of this enclosure

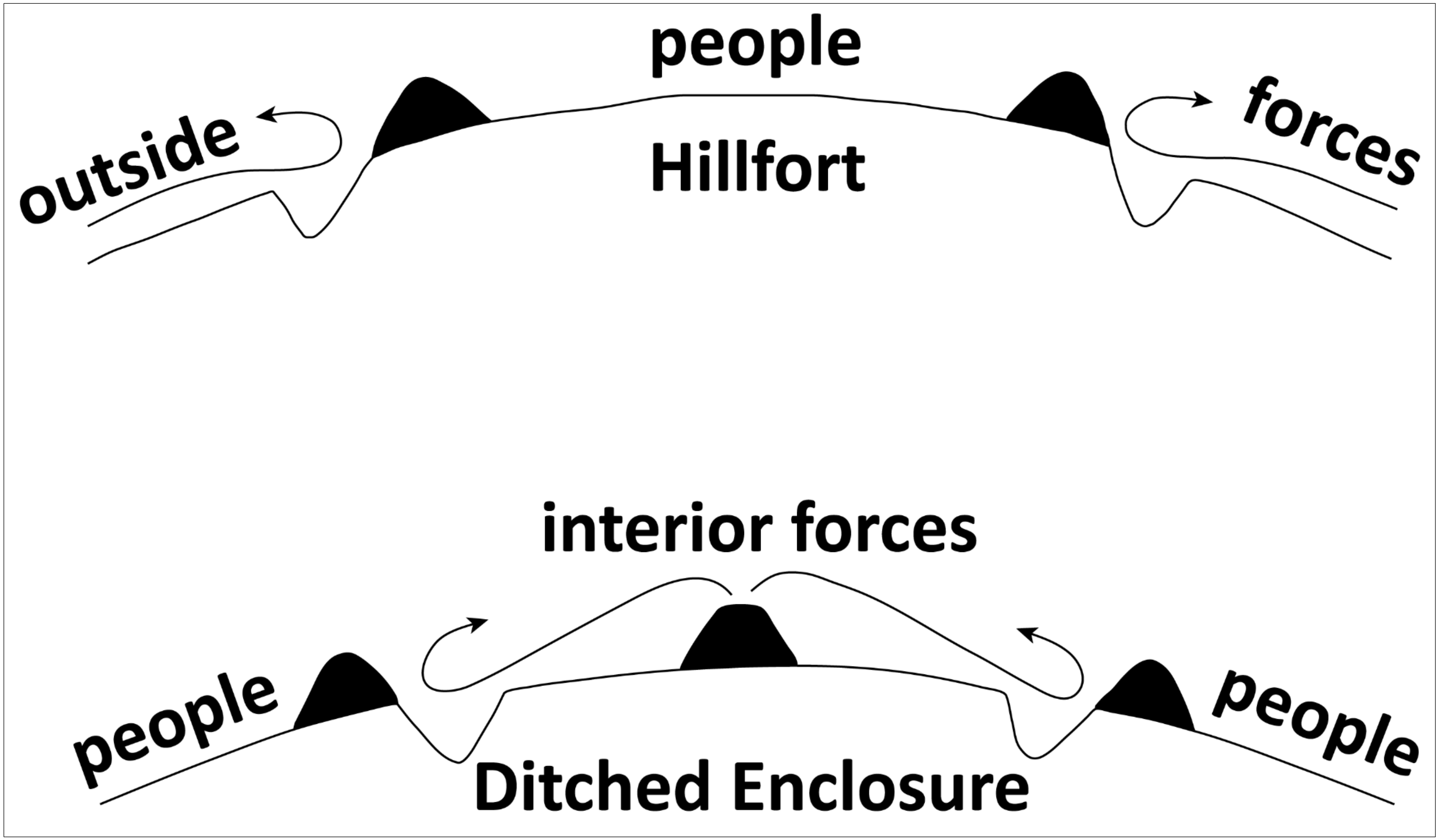

Figure 3.15. Schematic of differences in how the arrangements of ditches and embankments bound spirits and forces. Redrawn from Warner 2000 (Figure 2).

was, at least in part, intended to contain powerful forces entangled with the ritual gatherings and supernatural objects located inside it.

Our chronological models suggest that the enclosure had been built by *cal AD 50–140* (*95.4%* probability). After the construction of the ditch and embankment, groups from near and far continued to visit Winchester Farm enclosure for ritual gatherings. However, we can't ignore the notion that this earthwork was understood to be of great importance on a daily scale (Kidder and Sherwood 2017), beyond its use for periodic gatherings and a container for great and potentially dangerous power. The small fragments of non-local objects suggest the enclosure may have become a way point on pilgrimage journeys to sacred places and/or other enclosure complexes in the Eastern Woodlands, such as the large tripartite enclosures of the Scioto River Valley in present-day Central Ohio. Our chronological model suggests that use of the enclosure continued for another *0-40 years* (*95.4%* probability), ending sometime between *cal AD 80–225* (*95.4%* probability). While we cannot confidently discern when the internal post-enclosure was erected after the construction of the enclosure, information from the magnetic data and nearby Mount Horeb Circle offers one potential scenario. As we mentioned earlier, the post-enclosure discovered by Webb (1941) inside Mount Horeb had no clear gap in posts that would indicate an entrance or exit. Likewise, the magnetic data at Winchester Farm indicates the enclosure encased the entire internal platform. If, as we have argued for the ditched enclosure, the post-enclosures signify another boundary or means of containing supernatural forces, then they may be a component of site abandonment. The post enclosures may be a final act of closing off powerful animate entities from affecting the outside world. If this is the case, our temporal understandings of the ditch refilling can be properly placed in an interpretive context that reinforces this notion.

Excavation and geoarchaeological analyses of the ditch indicate the ditch did not refill through a long and alternating history of erosion or wash events followed by landform (pedogenic) development. Instead, we have argued the ditch likely refilled through human action that involved breaking apart portions of the embankment sediments, depositing them in the ditch, and burning them. Similar scenarios have been documented for kivas in the American Southwest (Van Keuren and Roos 2013; Walker 1995; Walker et al. 2000). However, our chronological model suggests refilling of the ditch began by *cal AD 850–950* (*95.4%* probability), some *670–850 years* (*95.4%* probability) *after* the enclosure was abandoned. The problem with this scenario is that we have absolutely no evidence the ditch refilled naturally during this time. Therefore, we can only assume the ditch was being maintained after the interior was no longer being used. We do not accept that no natural infilling of the ditch would have occurred over the course of 670-850 years. While we would venture that this pre-Columbian landscape was more stable than it is today, experimental work on the ditches of henge enclosures in Great Britain have shown how significant vegetation growth and natural infilling can occur in three to eight years, with accumulations of more than 20 cm of infill occurring by year eight (Bell et al. 1996; Crabtree 1971). Other experimental projects on henges propose a 10 to 20-year timespan before revegetation of an embankment and ditch occurs and infill erosion ceases (Reynolds 1999). An alternative scenario for the refilling of the ditch at Winchester Farm might have involved the ditch being cleaned out prior to the deconstruction event. However, we suggest that some form of evidence for this act would endure, visible in the presence of older or displaced sediments at the edges and base of the ditch.

The refilling of the ditch was rapid. Our ^{14}C modeling indicates the closure of the site occurred over *0–75 years* (*95.4%* probability) and potentially only *20 years* (*median*). The refilling as we have documented using ^{14}C dating ended by *cal AD 890–990* (*95.4%* probability). However, our geoarchaeological work shows no lull in refilling that might indicate pedogenic activity took place in between refilling episodes. Therefore, the paired geoarchaeological and chronological evidence from the ditch and the modeling of a potential 20-year span of refilling lead us to believe that this may have taken place in a single event. At the end of this event, shaped fragments of micaceous schist were deposited in the ditch. Their placement in this location may be related to the mixing and movement of sediments once comprising part of the central midden. However, if this were the case we should have recovered additional materials like bone, ceramic sherds, and lithic debris from the refilling sediments. It is possible that the schist was placed there to signal past connections to distant places, people, and power once contained within the enclosure.

3.8 Conclusion

Monuments are stationary on the landscape, but they serve as forms of ritual infrastructure that reflect and influence shifts in the ritual dispositions of others. Infrastructure in this sense facilitates and restricts the travel, or flow, of objects, ideas, power, and people across space and through time (Larkin 2013). From this perspective we might see how moving through time provides a way to view different roles and expectations placed upon, and expected of, monuments like Winchester Farm. Our work shows how the enclosure was not constructed as a place for people to gather within. Instead, it reflected shifts in the ritual dispositions of Adena-Hopewell societies who used the central midden prior to constructing it. This enclosure contained powerful objects and the residues of ritual gatherings that had happened earlier. In this sense, it was an animate object that acted to enclose various supernatural powers associated with human actions and objects found within its center. However, that was just one purpose along its journey through time. After construction, people from near and far continued to be drawn to the site for gatherings where ritual knowledge was shared, and foreign objects continued to be deposited. Some may have stopped at the site as part of longer prescribed pilgrimage journeys to other natural and built places in the Eastern Woodlands. In this sense, the itinerary of Winchester Farm is not only about time, it also concerns the movement of people, things, and ideas in and around it.

After Adena-Hopewell societies stopped using the site, later inhabitants of the landscape continued to remember the power bound inside the enclosure and worked to maintain the boundaries that contained it. Again, the dispositions of ritual practice had changed but movement associated with the site continued through the travel to and from it, and the labor required to maintain the ditch and embankment for up to eight centuries. When the ditch was refilled, some time in the mid-9th to early-10th centuries AD, another shift was signaled in how ritual dispositions were oriented toward the site. Had the occupants of the landscape forgotten what lie inside the enclosure? Perhaps the power contained in the enclosure had weakened, making it safe to cleanse the landscape of past materials associated with Winchester Farm. This era in the pre-Columbian history of the Eastern Woodlands is represented by a significant shift in settlement patterns, subsistence strategies, material culture, and sociopolitical dynamics (Cook 2008; Henderson 1992; Railey 1996). Earthen monuments ceased to be constructed in the Middle Ohio Valley, and evidence for long distance exchange virtually disappears. Perhaps, these changes accompanied a shift in ideology as well that resulted in the need to erase previous ritual places from the landscape. Nevertheless, our work shows that the itinerary of Winchester Farm played a role in the movement of people during this phase of cultural reorganization.

While another biographical approach might end there, with the ‘death’ of the enclosure, we recognize that movement is still structured with respect to the enclosure’s modern itinerary.

Constantine Rafinesque was drawn to map the site even though he was less impressed with it than other landscape features that surrounded it. Modern archaeologists (including ourselves) have been affected by the itinerary of this near-invisible place on the landscape. It structured the ways Milner and Jefferies (personal communication) moved about to map its topography on a particularly frigid winter day in December 1985, in addition to the ritualistic movement of geophysical survey conducted by one of us (ERH). Moreover, we acknowledge how recent archaeological excavations, another form of movement across space and time, were organized with respect to the remains of this buried monument. For now, the site rests in the pasture of a thoroughbred horse farm, where its slight topographic nature does not impede the movement of these multi-million-dollar animals. However, as time passes and itineraries change, Winchester Farm may influence the movement of people, animals, and things once more.

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Chapter 4

The Temporality of Adena-Hopewell Monuments: Bayesian Perspectives on the Chronology of Mounds and Enclosures in the Bluegrass Region of Central Kentucky

4.1 Introduction

The temporality of earthen monuments continues to be problematic for archaeologists investigating social developments in the Middle Ohio Valley of eastern North America. Small burial mounds and circular enclosures were once attributed to an "Adena" cultural entity dating to the Early Woodland period (ca. 1000–200 BC) (Figure 4.1). Alternatively, larger burial mounds and multi-shape geometric enclosures have been affiliated with Hopewellian societies who inhabited this region during the Middle Woodland era (ca. 200 BC–AD 500). However, over the last thirty years archaeologists have identified considerably more temporal overlap in the radiocarbon chronologies associated with the material signatures of what was once traditionally considered Adena and Hopewell (Clay 1991, 2014; Lepper et al. 2014; Lynott, ed. 2009; Lynott 2015; Miller 2018; Purtill et al. 2014; Railey 1991, 1996). This overlap has now created a confusing mixture of understandings related to culture history in the Middle Ohio Valley and what Adena and Hopewell should represent in the archaeological vocabulary. Both have been referred to within the context of interaction spheres, clans, cults, mortuary programs, religion, and more vaguely, a "phenomenon" (Abrams 2009; Beck, Jr. and Brown 2006; Brown 1997; Byers 2004, 2011; Caldwell 1964; Carr and Case, eds. 2005; Charles and Buikstra, eds. 2006; Clay 2014; Dragoo 1963; Hays 2010; Prufer 1964; Struever and Hoart 1972; Webb and Snow 1945; see also Applegate and Mainfort, Jr., eds. 2005).

While a continued trend in Adena-Hopewell studies centers on identifying regional variability in how societies participated in, and contributed to, the elaboration of ceremonialism that pervades this period of pre-Columbian history in the eastern United States, many

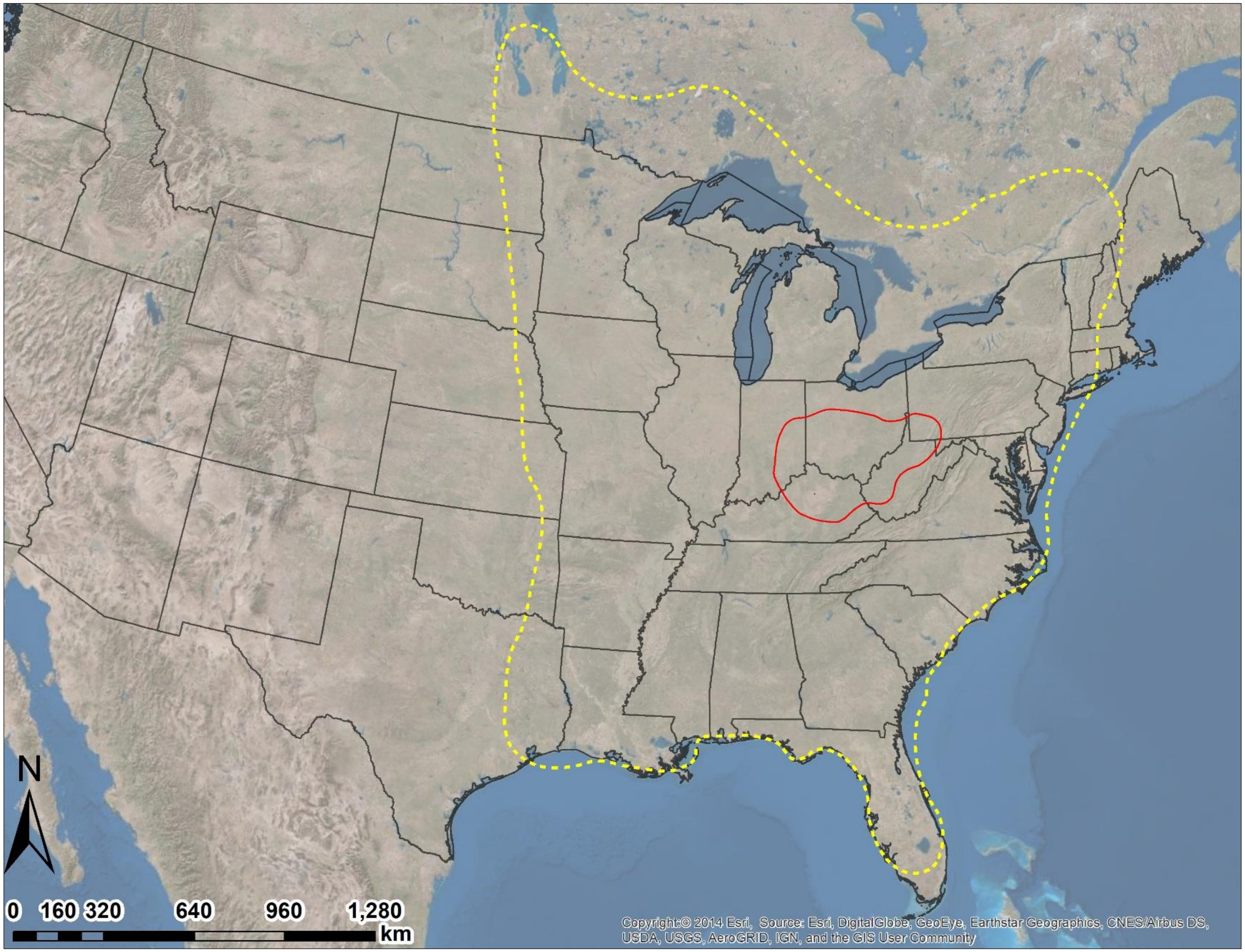

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Figure 4.1. Extent of Adena (500 BC–AD 250) cultural sphere (red boundary) and Hopewell (200 BC–AD 500) cultural sphere (yellow boundary).

archaeologists still recognize Adena as fundamentally distinct from Hopewell. Those that do consider the Adena to span approximately 500 BC–AD 250 and Hopewell approximately 200 BC–AD 500. The near 500-year overlap between these time ranges have led other scholars to emphasize the need for archaeologists to consider the material evidence for ritual behaviors, not as separate cultural developments, but instead a broad historical trajectory of mortuary ritual, ceremonial exchange of elaborate craft items, and the construction of unique earthen monuments (cf. Clay 2014). It has been argued that these perspectives should involve multi-scalar analyses allowing one to tack back-and-forth between "local and global perspectives" on Adena-Hopewell societies (Wright 2017). Following Greber's (2005) proposal that archaeologists focus more on local histories of ritual development between roughly 500 BC and AD 500 would likewise provide a better understanding of when, and under what contexts, the initial construction of monuments began in the Middle Ohio Valley. In addition, this chronological approach to local histories would provide an opportunity through which to examine how and when shifts in attitudes toward monuments occurred, potentially identifiable in how later inhabitants of the Middle Ohio Valley landscape interacted at sites constructed hundreds of years earlier.

Here I explore the localized nature of monument construction in the Bluegrass Region of Central Kentucky by using Bayesian chronological modeling on published and unpublished chronometric dates for two types of earthen monuments: burial mounds and geometric earthen enclosures. The modeling of more than 60 radiocarbon (n=66) and two Optically Stimulated Luminescence (OSL) dates from 14 sites suggests burial monuments were the first earthen constructions to appear in the region during the late-Early Woodland (Figure 4.2). This research also identified that earthen enclosures appeared in the late first-century BC, suggesting a temporal shift in how communities on Kentucky's Bluegrass landscape coalesced to participate

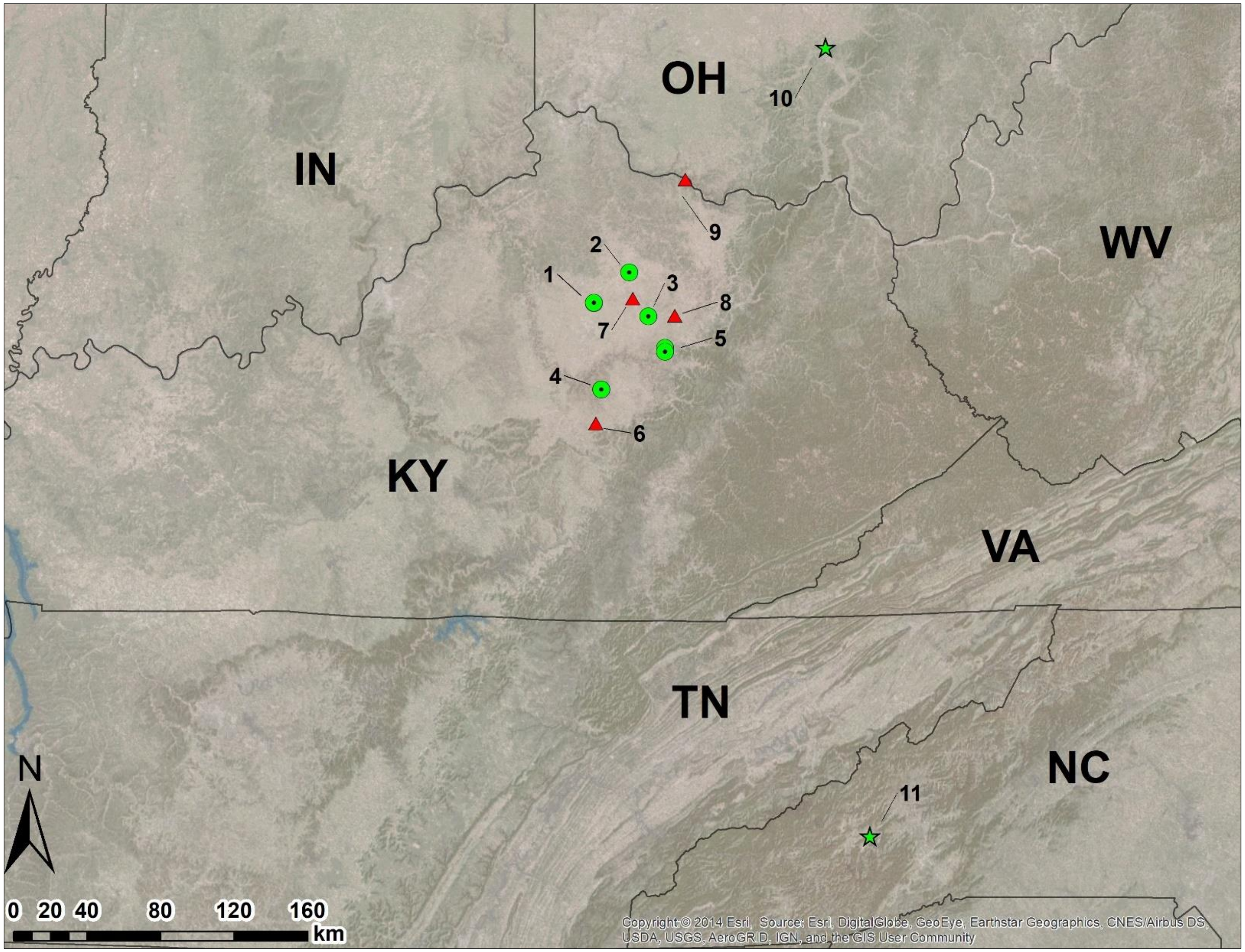

Figure 4.2. Sites discussed in text. Circles = enclosures, Triangles = burial mounds. 1.) Mount Horeb & Winchester Farm enclosures; 2.) LeBus Circle; 3.) Nelson-Gay mound & enclosure; 4.) Bogie Circle & Bogie West; 5.) Earthwalker & Goff Circles; 6.) Walker-Noe mound; 7.) Auvergne mound; 8.) Wright mounds; 9.) Dover mound; 10.) Hopeton enclosure & Adena mound; 11.) Garden Creek mound & enclosure complex.

in organized monument construction. Moreover, this research identified differences in how communities who inhabited the Bluegrass after Adena-Hopewell societies interacted with enclosure monuments. Together, these data speak to the long temporal nature of place-based interactions among pre-Columbian Native American communities. In the subsequent chronological examination of monuments from Central Kentucky, I first present background information and previous considerations of monument construction in the region. I then introduce the basic concepts underlying Bayesian statistics and their application to chronological modeling. The presentation and discussion of the results for the chronological models developed for this study follows. I end by discussing the implications of these results within the broader context of monumentality and Adena-Hopewell in the Eastern U.S.

4.2 Models for Adena-Hopewell Monumentality in Kentucky's Bluegrass Region

Most archaeologists agree that there is "discontinuous" material evidence that traditional Hopewellian societies inhabited Kentucky (see Applegate 2008:356-81). Enclosures situated on Kentucky's side of the Ohio River opposite the mouth of the Scioto River, in addition to the Camargo complex in the southeastern portion of the Bluegrass, offer evidence for monumental constructions that exhibit Hopewellian characteristics (Hardesty 1965; Henderson et al. 1988; Lewis 1887). However, most ideas about the development of monumentality in Kentucky, and especially the Bluegrass Region, come from mound and enclosure sites typically resigned to an Adena designation. There are three main views on the development of monumentality in the Bluegrass Region. Clay (1991) and Railey (1991) offer two contrasting, but not incompatible, models for ritual development that involve the construction of monuments in a diachronic framework. Clay's (1991) model separates ritual development into three phases: Early (500–150 BC), Middle (150 BC–AD1), and Late (AD 1–250) Adena. Early Adena is characterized by the appearance of burial mounds that served multiple communities and were situated at the intersection, or peripheries, of social boundaries (Clay 1991:31-2). Middle Adena included an increase in local community-centered monument construction, often over the remnants of ritual post-enclosures. Clay (1991:33) proposes that these facilities shifted to serve individual, rather than multiple, communities at this time. Finally, Late Adena is considered the apogee of cultural and monumental development as geometric enclosures, enclosure complexes, and mound complexes that include very large burial mounds appear on the Bluegrass landscape (Clay 1991:34). Applegate's (2008) recent reconsideration of earthen monuments and ritual behaviors in Kentucky led to slight modifications of this organizational scheme, placing large irregular enclosures in the Early Adena phase and large hilltop enclosures in the Late Adena phase.

An alternative to these two views comes from Railey (1991), who argues that monumental architecture served as territorial markers for dispersed lineage-based kinship communities. He does not separate the chronology into developmental phases, however, because the chronological data are too sparse. Instead, he promotes the notion that monumentality grows increasingly more important from 500 BC–AD 250 (Adena) when Newtown community organization (ca. AD 250–700) shifted focus from dispersed societies to settlement aggregation and the formation of incipient villages (Railey 1991:66). This implies that monumental architecture was rendered unnecessary because there was no longer a need for dispersed populations to maintain centralized gathering locales after villages emerged.

While these models help explain how monuments of different types (e.g., burial mounds and enclosures) may have served as places for social integration on the landscape, they lack any solid chronological footing. Nevertheless, they can serve as testable hypotheses for the current study that emphasizes chronology building by using robust chronometric data sets. These models for ritual development also provide some prior knowledge that can be tested using the Bayesian approach to chronological modeling. The outcomes of this research are not intended to provide a clear division of Adena or Hopewell in the region. In this sense, Clay's (2014:183) statement on the nature of chronologies in the region is appropriate, "…there seems to be an underlying faith that if we only had a good run of modern dates it would all straighten out and Adena would be unambiguously early, fully justifying its misplaced appellation as [Middle] Ohio Valley Early Woodland and somehow, in some unspecified manner, developing into Hopewell." While this research does present 'a good run of modern dates', it also uses what we know about the nature of monument construction and use to inform the models presented below. In doing so, I am less concerned with whether the people who created these monuments self-identified as something approximating 'Adena' or 'Hopewell'. Instead, I am interested in tracing the history of landscape modification in this region and learning if it fits with previously conceived notions of monument construction that earlier archaeologists have labelled 'Adena' and 'Hopewell'. Moreover, I am interested in any evidence that reveals ways in which later societies treated these monuments—something that has received very little attention by archaeologists (but see Mann 2005; Seeman 1992; and Chapter 3 here).

4.3 A Bayesian Approach to Chronology Building and the Past

Since the 1990s archaeologists have been using Bayesian statistics to inform the creation of chronological and historical frameworks based on the pairing of chronometric data and archaeological knowledge (Buck 1999; Buck et al. 1994; Bronk Ramsey 1995; Litton and Buck 1995). The statistical foundations and mathematics underlying Bayes' theorem and the Bayesian process has been discussed extensively in a variety of European and American publications (Bayliss 2015; Bayliss et al. 2007a; Buck and Meson 2015; Buck et al. 1994; Bronk Ramsey 1995, 2009a; Hamilton and Krus 2018; Lulewicz 2018). For this reason, I provide only a brief discussion that focuses on terminology of modeling used here. First, Bayesian analyses allow researchers to consider new data or interpretations pertaining to a question within the context of former knowledge about that question (Figure 4.3). In this sense, Bayesian models are constantly in flux, changing with the addition of new data (e.g., chronometric dates).

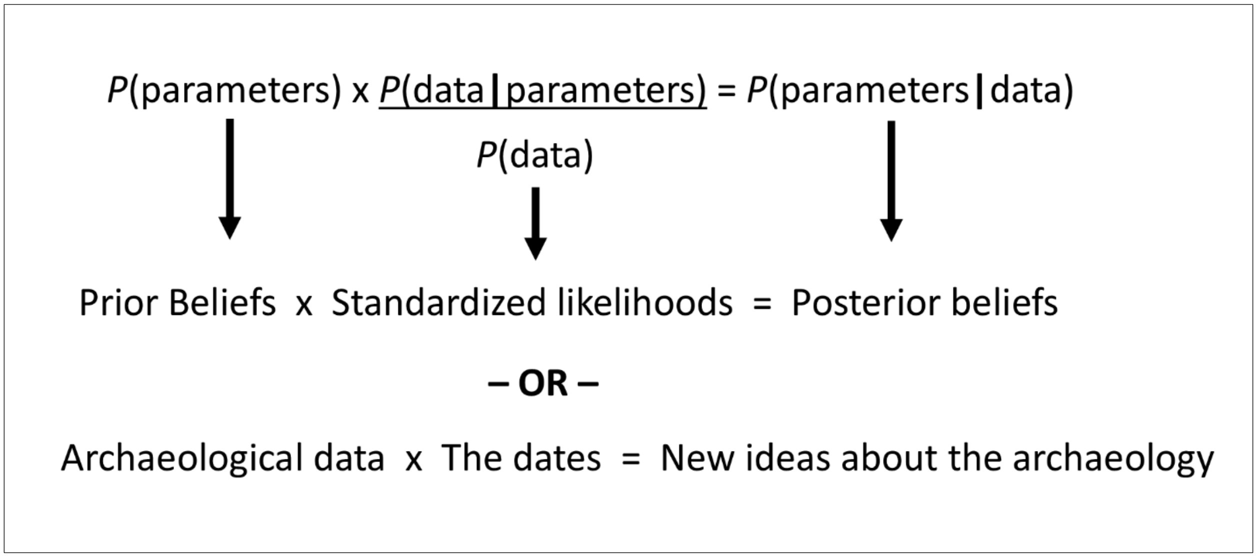

Figure 4.3. Schematic representation of Bayes's theorem.

In the OxCal software package (Bronk Ramsey 1995, 2017), Bayesian analyses of chronometric dates are structured in *phases* and *sequences*. A phase assumes that an unordered group of events (e.g., dates for moundbuilding) takes place over a uniform prior distribution. Any of the events in a phase are as likely to be occurring within a single period of activity. Sequences assume some form of order and rely on information such as stratigraphy in archaeology. *Boundaries* mark the start and end of phases, sequences, or even phases within a sequence. The standard boundaries assume a uniform prior distribution of events transpires, but alternative boundaries (e.g., Sigma and Tau boundaries) can be use when there is valuable archaeological evidence that suggests a given material phenomenon may appear very quickly and slowly fade from use or vice versa, or overlap with another phenomenon. Dates in phases and sequences are considered statistically significant if they pass the 60% agreement index.

However, because OxCal's agreement indices are considered *pseudo*-Bayes factors (Hamilton and Krus 2018), larger agreement indices should not be used to argue for any model being more probable. Finally, as with any statistical analysis, there can be outliers. In radiocarbon dating, especially, outliers are an issue because charcoal can move up and down soil columns via bioturbation, charcoal can be moved around a site by ancient inhabitants, 'old wood' effects are present when dating unidentified pieces of charcoal, and there can be lab inconsistencies—particularly when it comes to integrating legacy radiocarbon assays into models. However, there are ways of accounting for outliers through various general and/or exponential charcoal-based outlier models that can be incorporated into an overall model structure, as well as exponential boundaries that account for events that do not fall within a uniform distribution (Bronk Ramsey 2009b; Dee and Bronk Ramsey 2014).

The application of Bayesian methods to chronological modeling have transformed the creation of (pre)histories in European archaeology, where interpretive attention can now be turned to discussions of lifetimes, generations, and singular events rather than cultural periods (e.g., the Neolithic or Bronze Age) (Bayliss et al. 2007b; Darvill et al. 2012; Hamilton and Kenny 2015; Hamilton et al. 2015; Whittle et al. 2007; Whittle et al. 2001). Archaeologists working in the New World have lagged behind their European counterparts in adopting Bayesian approaches. However, this is rapidly changing, particularly in North America where archaeologists are beginning to assess the archaeological record from a historical standpoint (Barrier 2017; Cobb et al. 2015; Kidder 2006; Krus et al. 2013; Krus et al. 2015; Lulewicz 2018; McNutt et al. 2012; Overholtzer 2015; Pluckhahn et al. 2015; Schilling 2013). Among Middle Woodland scholars in the eastern U.S., Bayesian methods have been sporadic (Hermann et al. 2014; Miller 2018; Wallis et al. 2015; Wright 2014) but offer the potential to elucidate the chronological boundaries of problematic cultural history units that were developed prior to chronometric dating techniques.

4.4 Bayesian Models from the Bluegrass: Burial Mounds and Earthen Enclosures

Models were structured around the dates presented in Tables 4.1 and 4.2. When the ^{14}C dates are examined at their 95.4% calibration ranges we see use of the landscape from approximately 1000 BC to the present day (see Table 4.1). However, incorporating prior knowledge into the modeling of these dates allow us to examine them within their archaeological contexts. From this perspective, multiple Bayesian models were created to examine the chronology for two types of earthen monuments constructed in the Bluegrass Region of Central Kentucky and generally assigned to an Adena-Hopewell cultural affiliation: burial mounds and earthen enclosures. While all dates in Table 4.1 could not be effectively incorporated into models I present, they represent the calibrated range of cultural activity for monuments that have been identified as constructed by Adena-Hopewell societies in this region. In this section I first discuss dates and models from enclosure sites, followed by models that examine the construction of burial mounds. Modeled age ranges are rounded to the nearest five years and presented in *italics*. When I refer to a particular command used in OxCal it is written in a `Courier` font to reference the Chronological Query Language (CQL2) coding used. All codes mentioned here can be found in the appendix.

4.4.1 Earthen enclosures

Chronometric dates were available from seven earthen enclosures across Central Kentucky. Dates from buried ground surfaces that were preserved beneath the embankments fills were available for four of these enclosures. In each case, the ground surfaces were burned prior to construction, creating a sealed context that served as a *terminus post quem* (TPQ) for dating each enclosure’s construction (Figure 4.4). Model 1 tests the assumption that all dates from these

Table 4.1. Radiocarbon assays used in this study.

Site	Provenience	Context and Event Interpretation	Date of Assay	Source	Lab	Lab #	Material	δ13C (‰)	Δ14C	pMC	±	Fraction modern (F_m)	F_m Error	RCYBP	1σ Error	Cal BC-AD (2σ - 95.4%)*	Median
15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 115-132 cmbs	Ditch Refilling (refilling event 1-2)	2014	This Study	UGA CAIS	UGAMS-17003	UID charred wood	-25.0	—	86.77	0.28	—	—	1140	25	AD 770–980	AD 920
15Fa153 (Winchester Farm Enclosure)	Trench 1; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2014	This Study	UGA CAIS	UGAMS-17004	UID charred wood	-27.6	—	77.57	0.26	—	—	2040	30	170 BC–AD 50	50 BC
15Fa153 (Winchester Farm Enclosure)	Unit 13; Fea. 8 - Post Fill	Terminus Post Quem for Construction of Wooden Post Enclosure	2014	This Study	UGA CAIS	UGAMS-17005	UID charred wood	-22.9	—	79.10	0.25	—	—	1880	25	AD 70–220	AD 120
15Fa153 (Winchester Farm Enclosure)	Unit 11; Fea. 4 - 50-55 cmbs	Interior Use of Enclosure	2014	This Study	UGA CAIS	UGAMS-17006	UID charred wood	-23.3	—	79.07	0.26	—	—	1890	25	AD 50–220	AD 110
15Fa153 (Winchester Farm Enclosure)	Unit 14; Fea. 4 - 20-30 cmbs	Interior Use of Enclosure	2017	This Study	NOSAMS	OS-136446	*Cervidae* sp. Rib (bone)	-21.6	-223.93	—	—	0.7820	0.0023	1980	25	50 BC–AD 70	AD 20
15Fa153 (Winchester Farm Enclosure)	Unit 11; Fea. 4 - 30-40 cmbs	Interior Use of Enclosure	2017	This Study	NOSAMS	OS-136447	*Cervidae* sp. (bone)	-21.8	-234.57	—	—	0.7713	0.0017	2090	20	180–40 BC	110 BC
15Fa153 (Winchester Farm Enclosure)	Unit 12; Fea. 4 - 40-54 cmbs	Interior Use of Enclosure	2017	This Study	NOSAMS	OS-136888	UID charred wood	—	—	—	—	0.7820	0.0016	1980	15	40 BC–AD 70	AD 30
15Fa153 (Winchester Farm Enclosure)	Unit 15; Fea. 13 - Post Fill	Terminus Post Quem for Construction of Wooden Post Enclosure	2017	This Study	NOSAMS	OS-136889	UID charred roundwood	—	—	—	—	0.7374	0.0021	2450	25	760–410 BC	580 BC
15Fa153 (Winchester Farm Enclosure)	Trench 1; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2017	This Study	NOSAMS	OS-136890	UID charred wood	—	—	—	—	0.7887	0.0021	1910	20	AD 50–140	AD 90
15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 125-135 cmbs	Teminus Ante Quem for the Start of Ditch Refilling (refilling event 1)	2017	This Study	NOSAMS	OS-136891	UID charred roundwood	—	—	—	—	0.8665	0.0018	1150	15	AD 770–970	AD 900
15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 110-120 cmbs	Ditch Refilling (refilling event 2 bottom)	2017	This Study	NOSAMS	OS-136892	UID charred wood	—	—	—	—	0.7839	0.0018	1960	20	30 BC–AD 90	AD 40
15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 100-110 cmbs	Ditch Refilling (refilling event 2 top)	2017	This Study	NOSAMS	OS-136893	UID charred roundwood	—	—	—	—	0.8735	0.0021	1090	20	AD 890–1020	AD 960
15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 90-100 cmbs	Ditch Refilling (refilling event 3)	2017	This Study	NOSAMS	OS-136894	UID charred roundwood	—	—	—	—	0.8665	0.0019	1150	15	AD 770–970	AD 900

15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 80-90 cmbs	Ditch Refilling (refilling event 4 bottom)	2017	This Study	NOSAMS	OS-136895	UID charred wood	—	—	—	—	0.8713	0.0019	1110	20	AD 890–990	AD 940
15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 70-80 cmbs	Ditch Refilling (refilling event 4 middle)	2017	This Study	NOSAMS	OS-136896	UID charred roundwood	—	—	—	—	0.8679	0.0018	1140	15	AD 780–980	AD 930
15Fa153 (Winchester Farm Enclosure)	Trench 1; Ditch - 60-70 cmbs	Ditch Refilling (refilling event 4 upper)	2017	This Study	NOSAMS	OS-136897	UID charred roundwood	—	—	—	—	0.8656	0.0021	1160	20	AD 770–970	AD 870
15Fa1 (Mount Horeb Circle)	Downhole Mag. Sus. Core 2: 130 cmbs	Beneath Embankment Fills; Prior to Any Construction	2010	This Study	ISGS	ISGS-6586	UID charred wood	-25.0	—	—	—	—	—	2070	80	360 BC–AD 80	100 BC
15Fa1 (Mount Horeb Circle)	Downhole Mag. Sus. Core 2: 130 cmbs	Beneath Embankment Fills; Prior to Any Construction	2010	This Study	ISGS	ISGS-A3568	UID charred wood	-24.8	-218.4	—	—	0.7816	0.0015	1980	20	40 BC–AD 70	AD 20
15Fa1 (Mount Horeb Circle)	Trench 1; East Wall; upper hearth	Beneath Embankment Fills of Phase 2; Prior to End of Construction	2016	This Study	NOSAMS	OS-125719	UID charred wood	—	-216.87	—	—	0.7893	0.0018	1900	20	AD 50–210	AD 100
15Fa1 (Mount Horeb Circle)	Trench 1; East Wall; bottom hearth	Beneath Embankment Fills of Phase 2; Prior to of End Construction	2016	This Study	NOSAMS	OS-125720	UID charred wood	—	-219.99	—	—	0.7862	0.0019	1930	20	AD 20–130	AD 70
15Fa1 (Mount Horeb Circle)	Trench 1; Unit 3; East Wall; Orig. Ab "activity area"	Beneath Embankment Fills of Phase 1; Prior to Any Construction	2016	This Study	NOSAMS	OS-125721	UID charred wood	—	-220.75	—	—	0.7854	0.0020	1940	20	AD 10–130	AD 60
15Bb01 (LeBus Circle)	Trench 2; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2009	Henry 2011	ISGS	ISGS-A1425	UID charred wood	-26.1	-224.6	77.50	0.0013	—	—	2045	15	110 BC–AD 10	50 BC
15Bb01 (LeBus Circle)	Trench 2; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2009	Henry 2009	ISGS	ISGS-A1256	Bulk Sediment from Ab	—	—	70.56	—	—	—	2800	20	1010–900 BC	950 BC
15Bb01 (LeBus Circle)	Trench 1; 260-270 cmbs	Terminus Post Quem for Refilling of Expired Spring (i.e., pit)	2009	Henry 2009	ISGS	ISGS-A1258	UID charred wood	—	—	98.02	—	—	—	160	20	AD 1660–post-1910	AD 1770
15Bb01 (LeBus Circle)	Trench 2; Base of Ditch	Terminus Post Quem for the Beginning of Ditch Refilling	2009	Henry 2009	ISGS	ISGS-A1262	UID charred wood	—	—	95.58	—	—	—	365	25	AD 1450–1640	AD 1520
15Bb01 (LeBus Circle)	Trench 2; Embankment-Ab interface (14C)	Terminus Post Quem for Enclosure Construction	2017	This Study	NOSAMS	OS-136791	UID charred roundwood	—	-224.67	—	—	0.7808	0.0027	1990	30	50 BC–AD 80	AD 10
15Ck10 (Nelson-Gay Mound)	Block 1; Ceramic scatter 1	Use of Feature	2016	This Study	NOSAMS	OS-125677	UID charred roundwood	—	-231.51	—	—	0.7746	0.0023	2050	25	170 BC–AD 20	60 BC
15Ck10 (Nelson-Gay Mound)	Block 2; interior area of post enclosure	Internal Use of Post Enclosure	2016	This Study	NOSAMS	OS-125674	UID charred wood	—	-124.29	—	—	0.8826	0.0031	1000	30	AD 980–1160	AD 1030
15Ma44 (Bogie Circle)	Core 1.1; 70-75 cmbs; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2015	This Study	DirectAMS	D-AMS-012514	UID charred wood	-24.4	—	79.32	0.26	—	—	1861	26	AD 80–230	AD 150
15Ma44 (Bogie Circle)	Core 4.1; 15-20 cmbs; base of ditch	Beginning of Ditch Refilling	2015	This Study	DirectAMS	D-AMS-012515	UID charred wood	-27.0	—	98.94	0.28	—	—	86	23	AD 1690–1930	AD 1850
15Ma44 (Bogie Circle)	Trench 1; South Profile; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2016	This Study	NOSAMS	OS-125679	UID charred wood	—	—	—	—	—	—	1920	20	AD 20–130	AD 80

Bogie Circle West (no site no.)	Interior post enclosure; Post #4	Terminus Post Quem for Enclosure Construction	2017	This Study	NOSAMS	OS-136792	UID charred wood	—	—	—	—	—	—	1940	20	AD 10–130	AD 60
Bogie Circle West (no site no.)	Interior post enclosure; Post #2	Terminus Post Quem for Enclosure Construction	2017	This Study	NOSAMS	OS-136930	UID charred wood	—	—	—	—	—	—	960	25	AD 1020–1160	AD 1100
15Jo02 (C&O Mounds)	Post under mound; Acc. # 1938.006 B13	Pre-dates Mound Construction	2017	This Study	NOSAMS	OS-136445	*Cervidae* sp. antler tine	-22.45	-240.38	—	—	0.7585	0.0017	2200	20	360–200 BC	290 BC
15Ck07 (Goff Circle)	Block 1; sub. Feature 1	Terminus Post Quem for Ditch Refilling	2015	This Study	DirectAMS	D-AMS-012516	UID charred wood	-34.5	—	101.10	0.36	—	—	Modern		Modern	
15Ck07 (Goff Circle)	Trench 1; East Wall; charred log at base of ditch	Teminus Ante Quem for the Start of Ditch Refilling	2015	This Study	DirectAMS	D-AMS-012517	UID charred wood	-22.9	—	80.10	0.27	—	—	1779	27	AD 130–340	AD 250
15Ck07 (Goff Circle)	Trench 1; Ditch; 70-80 cmbs	Refilling of Ditch at Depth	2015	This Study	DirectAMS	D-AMS-012520	UID charred wood	-24.8	—	93.40	0.27	—	—	545	23	AD 1310–1440	AD 1400
15Ck07 (Goff Circle)	Trench 1; Ditch; 60-70 cmbs	Refilling of Ditch at Depth	2016	This Study	NOSAMS	OS-125671	*Juglandaceae* sp. Charred Nut Shell	—	-43.55	—	—	0.9640	0.0020	295	15	AD 1520–1650	AD 1550
15Ck07 (Goff Circle)	Block 1; Ditch trench; burned log	Refilling of Ditch	2016	This Study	NOSAMS	OS-125678	UID charred wood	—	-209.52	—	—	0.7967	0.0019	1830	20	AD 130–240	AD 180
Earthwalker Circle (no site no.)	Trench 1; Mid-Fills of Ditch (sample #2)	Teminus Ante Quem for the Start of Ditch Refilling	2015	This Study	DirectAMS	D-AMS-012518	UID charred wood	-22.7	—	77.15	0.26	—	—	2084	27	190–40 BC	110 BC
Earthwalker Circle (no site no.)	Trench 1; Burned matrix in upper ditch fill; East Profile	Upper Refilling of Ditch	2015	This Study	DirectAMS	D-AMS-012519	UID charred wood	-27.4	—	99.37	0.33	—	—	51	27	AD 1690–1920	AD 1880
Earthwalker Circle (no site no.)	Block 1; Post 3	Terminus Post Quem for Placement of Wooden Post	2015	This Study	DirectAMS	D-AMS-012521	UID charred wood	-24.4	—	99.00	0.27	—	—	81	22	AD 1690–1920	AD 1850
Earthwalker Circle (no site no.)	Trench 1; Bottom of Ditch (sample #1)	Teminus Ante Quem for the Start of Ditch Refilling	2016	This Study	NOAMS	OS-125669	UID charred wood	—	-209.13	—	—	0.7971	0.0024	1820	25	AD 120–320	AD 190
Earthwalker Circle (no site no.)	Block 1; Ditch; 14C on bedrock	Teminus Ante Quem for the Start of Ditch Refilling	2016	This Study	NOAMS	OS-125670	UID charred wood	—	-187.63	—	—	0.8188	0.0019	1610	20	AD 390–540	AD 460
Earthwalker Circle (no site no.)	Block 1; Post 2	Terminus Post Quem for Placement of Wooden Post	2016	This Study	NOAMS	OS-125672	UID charred wood	—	-30.27	—	—	0.9774	0.0020	185	15	AD 1660–post-1930	AD 1770
Earthwalker Circle (no site no.)	Block 1; Post 4	Terminus Post Quem for Placement of Wooden Post	2016	This Study	NOAMS	OS-125673	UID charred wood	—	-12.02	—	—	0.9958	0.0022	35	20	AD 1700–1920	AD 1900
Earthwalker Circle (no site no.)	Block 1; Post 1	Terminus Post Quem for Placement of Wooden Post	2016	This Study	NOAMS	OS-125675	UID charred wood	—	-23.55	—	—	0.9842	0.0023	130	20	AD 1670–1940	AD 1830
Earthwalker Circle (no site no.)	Block 1; Rock Post	Terminus Post Quem for Placement of Wooden Post	2016	This Study	NOAMS	OS-125676	UID charred wood	—	-72.66	—	—	0.9347	0.0019	545	15	AD 1320–1430	AD 1410
15Ms27 (Dover Mound)	Surface of mound phase three	Terminus Post Quem for Construction of Mound Phase Three	2017	This Study	NOAMS	OS-136343	UID charred wood	—	-221.04	—	—	0.7790	0.0019	2010	20	50 BC–AD 60	10 BC
15Ms27 (Dover Mound)	Surface of mound phase three; Sample 117 (v42)	Terminus Post Quem for Construction of Mound Phase Three	1952-3	Libby 1954	Chicago	C-759	UID charred wood	—	—	—	—	—	—	2650	170	1230–390 BC	810 BC

15Ms27 (Dover Mound)	Charred wood associated with Burial 55; Sample L48 (v38); Average of 2 dates from same sample	Terminus Post Quem for Burial 55 & Construction of Phase Five	1952-3	Libby 1954	Chicago	C-760[a]	UID charred wood	—	—	—	—	—	—	2169	175	770 BC–AD 130	260 BC
15Ms27 (Dover Mound)	Charred wood near Burial 9	Teminus Ante Quem for Burial 9	1972	Crane & Griffin 1972	Michigan	M-2239	UID charred wood	—	—	—	—	—	—	2260	140	770–1 BC	330 BC
15Ms27 (Dover Mound)	Charred wood near Burial 9; Acc. # 1950.001 V13	Teminus Ante Quem for Burial 9	2017	This Study	NOSAMS	OS-136344	UID charred wood	—	-220.87	—	—	0.7791	0.0018	2010	20	50 BC–AD 60	10 BC
15Mm7 (smaller Wright Mound)	Near Burial 2; Acc. # 1937.002 V1	Teminus Ante Quem for Burial 2	2017	This Study	NOSAMS	OS-136346	Charred *Arundinaria gigantea*	—	-226.24	—	—	0.7725	0.0018	2070	20	170–40 BC	90 BC
15Mm6 (Wright Mound)	Surface of mound phase one; Acc. # 1938.013 V34	Terminus Ante Quem for Construction of Mound Phase One	2017	This Study	NOSAMS	OS-136347	Charred *Arundinaria gigantea*	—	-236.73	—	—	0.7622	0.0018	2180	20	360–170 BC	300 BC
15Mm6 (Wright Mound)	Within mound phase two; Acc. # 1938.013 V24	Terminus Post Quem for Completion of Mound Phase Two	2017	This Study	NOSAMS	OS-136348	Charred *Arundinaria gigantea*	—	-222.02	—	—	0.7768	0.0024	2030	25	120 BC–AD 60	30 BC
15Mm6 (Wright Mound)	Feature 10 (Burials 6 & 7); mound phase three; Acc. # 1938.013 V10	Terminus Post Quem for Construction of Mound Phase Three	2017	This Study	NOSAMS	OS-136943	UID charred wood	—	-243.83	—	—	0.7551	0.0026	2260	30	400–200 BC	290 BC
15Mm6 (Wright Mound)	Feature 8 (Burial 2); Mound phase four; Acc. # 1938.013 V13 (with copper residue)	Terminus Post Quem for Completion of Mound Phase Four	2017	This Study	NOSAMS	OS-136882	UID wood bark	—	-215.61	—	—	0.7832	0.0021	1960	20	30 BC–AD 90	AD 40
15Mm6 (Wright Mound)	Feature 19 (Inside Burial 13)	Terminus Post Quem for Construction of Mound Phase Two	1972	Crane and Griffin 1972	Michigan	M-2238	Charred wood (*Gleditsia triacantros* or *Gymnocladus diocica*)	—	—	—	—	—	—	1740	140	30 BC–AD 600	AD 290
15Mm6 (Wright Mound)	Charred logs covering primary mound	Terminus Ante Quem for Construction of Mound Phase One	1972	Crane and Griffin 1972	Nuclear Science and Engineering, Inc.	N. R.	UID charred wood	—	—	—	—	—	—	1900	50	AD 1–240	AD 110
15Gd56 (Walker-Noe Mound)	Concentration of Cremations; Unit 9, Zone 2 Level 2	Terminus Post Quem for Cremations Under Mound	2005	Pollack et al. 2005	Beta Analytic	Beta-152838	*Polygonum erectum*	—	—	—	—	—	—	2000	60	170 BC–AD 130	10 BC
15Gd56 (Walker-Noe Mound)	Concentration of Cremations	Terminus Post Quem for Cremations Under Mound	2005	Pollack et al. 2005	Beta Analytic	Beta-152839	UID Charred Wood	—	—	—	—	—	—	1990	60	170 BC–AD 130	AD 10
15Gd56 (Walker-Noe Mound)	Concentration of Cremations; Feature 2	Terminus Post Quem for Cremations Under Mound	2017	Mueller 2018	NOSAMS	OS-134355	*Polygonum erectum*	—	—	—	—	—	—	1950	25	30 BC–AD 130	AD 50
15Bb16 (Auvergne Mound)	Charcoal Associated with Central Inhumation	Terminus Post Quem for Mound Construction	pre-1983	Clay 1983	UGA	UGA-1239	UID charred wood	—	—	—	—	—	—	2945	225	1750–550 BC	1170 BC
15Bb16 (Auvergne Mound)	Charcoal Associated with Central Inhumation	Terminus Post Quem for Mound Construction	pre-1983	Clay 1983	UGA	UGA-3617	UID charred wood	—	—	—	—	—	—	1680	115	AD 80–600	AD 360

***** Calibrations made in OxCal v4.3 (Bronk Ramsey 2017), using the IntCal13 calibration curve (Reimer et al. 2013). Dates have been rounded to the nearest 10 years. The OxCal software is accessible at http://c14.arch.ox.ac.uk/

[a] This radiocarbon determination was first reported as a calculated average of two assays made on the same sample material. The individual assays were 2260 ± 220 & 2078 ± 290. In calibrating this sample I have used an `R_Combine` function rather than using the average reported by Libby (1954)

Table 4.2. Optically Stimulated Luminescence (OSL) dates used in this study.

Site	Provenience	Context and Event Interpretation	Date of Assay	Source	Lab	Lab #	Material	Particle Size (µm)	Equivalent Dose (Gray)[a]	OSL-YBP	1σ Error	Cal BC-AD* (95.4%)	Median
15Fa153 (Winchester Farm Enclosure)	Core 1.1; Interface of Embankment Fills and Ab	Terminus Post Quem for Enclosure Construction	2015	This Study	Baylor Geochronology Lab	OSLHL	Single Aliquot	4-11	15.80 ± 0.91	3780	325	2425–1120 BC	1770 BC
15Ma44 (Winchester Farm Enclosure)	Core 2.1; Embankment-Ab interface	Terminus Post Quem for Enclosure Construction	2015	This Study	Baylor Geochronology Lab	OSL1F1	Single Aliquot	4-11	7.40 ± 0.45	2005	175	350 BC–AD 355	AD 5

* Calibrations made with reference to datum year of 2010. Calibrated age ranges rounded to the nearest five years.

[a] Equivalent dose calculated on a pure quartz fraction and analyzed under blue-light excitation (470 ± 20 nm)

surfaces represent a uniform distribution of TPQs for construction using a Phase with standard boundaries. However, this model does not provide a good fit with data; the agreement index falls below 60% (A_{model} = 59).

Model 2 applies additional priors to the collection of dates in the phase. For instance, OSL date OSLHL (3780 ± 325) from the Winchester Farm (15Fa153) site only has a 14% agreement index in Model 1 and likely represents a problem with securing a quartz grain from the upper levels of the Ab soil horizon for dating. Moreover, it contrasts with ^{14}C dates from the upper 2 cm of the Ab horizon at the interface with the embankment fills at the site. Therefore, it could be an outlier. In addition, ^{14}C date ISGS-A1256 (2800 ± 20) is a bulk sediment date from the Ab horizon at the LeBus Circle (15Bb01) site. Sediment dates are notorious for carbon intrusions that can come from ground water and other natural sources of contaminants (see Wang et al. 1996). For this reason, I decided to test whether these two dates could be outliers using OxCal's general `Outlier` analysis. Finally, dates ISGS-6586 (2070 ± 80) and ISGS-A3568 (1980 ± 20) were assays made on the same piece of charcoal from a push-tube soil core prior to excavations at the Mount Horeb (15Fa1) site. Because ISGS-6586 is the only conventional date from the sealed contexts beneath embankments (the other ^{14}C dates are AMS) in this phase I also removed it from the model using the `Outlier` analysis.

The results for Model 2 shows good agreement (A_{model} = 105) between the data and the assumptions I applied. The model shows that there is 0% probability that dates OSLHL and ISGS-A1256 should be situated in the positions denoted in Model 1. The conventional date from Mount Horeb (ISGS-6586) shows only a 30% probability that it should be situated in the model. The start boundary for Model 2 indicate that the Ab surfaces began being burned and sealed by embankment fills in *cal 125 BC–AD 10* (*95% probability*; Figure 4.5; *Start: pre-Construction*

Surface Boundary) and likely in *cal 70–5 BC* (*68% probability*). These construction-related activities ended in *cal 80–200 AD* (*95% probability*; Figure 4.5; *End: pre-Construction Surface Boundary*) and likely in *cal 95–150 AD* (*68% probability*). A `Span` function applied to the modeled dates in this phase estimates the duration of activity, or the amount of time that passed before the enclosures in this dataset all appeared on the landscape. This function estimates that the enclosures in this dataset appeared within *75-225 years* (*95% probability*; Figure 4.6; *Enclosure Span*) or likely within *105-175* years (*68%* probability).

While Model 2 provides a good fit between the assumptions inherent to the model and the data, some further steps can be taken to generate priors that can lead to a more precise understanding of enclosure construction in this context. For instance, OSL date OSL1F1 (2005 ± 175) shows good agreement in Model 2 (A_{model} = 132.5) but the nature of OSL dating this far back in time presents large error ranges in the dates. The nature of ^{14}C dating also introduces the possibility that materials are susceptible to inbuilt age errors (e.g., old wood and heartwood offsets). In these cases, an exponential outlier can be applied that shifts the distribution of data toward younger ages that are derived from an exponential probability function (a.k.a.: Charcoal Outlier model) (Dee and Bronk Ramsey 2014:85).

In Model 3, charcoal outlier and general outlier models were applied individually to dates depending if they were assays on unidentified charred wood (Charcoal Model applied) or on small pieces of charred roundwood (General Outlier Model applied). The OSL date OSL1F1 was removed from this analysis to test only the ^{14}C chronology of the enclosures. Model 3 shows good overall agreement (A_{model} = 95) but convergence values fall below 95%, an indication that the model is unstable, and the results should not be used (Bayliss et al. 2007:6). In this case, I reexamined the data being inserted into the model (i.e., the dates) and considered the

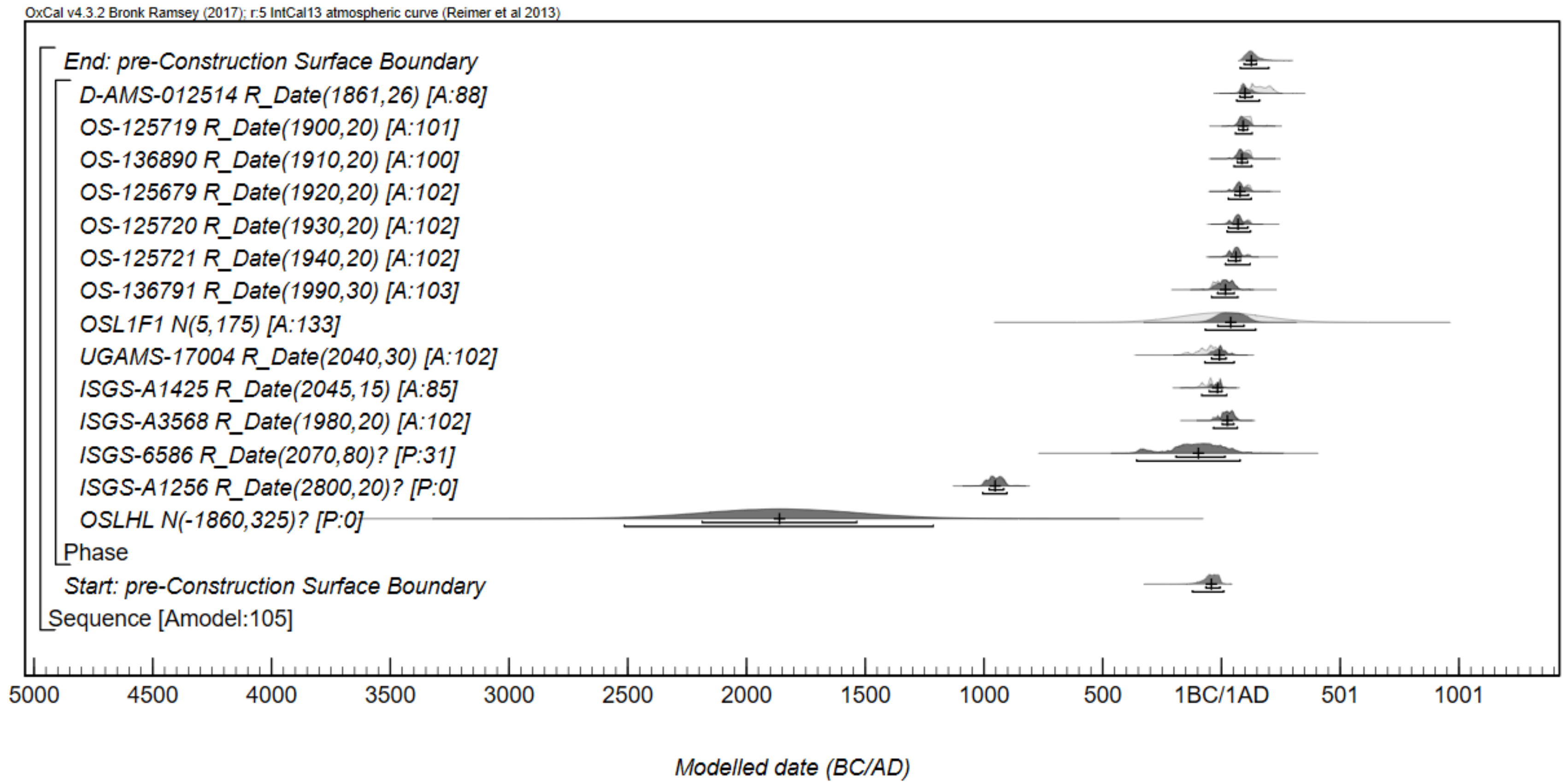

Figure 4.4. Results of Model 2 plotted in OxCal.

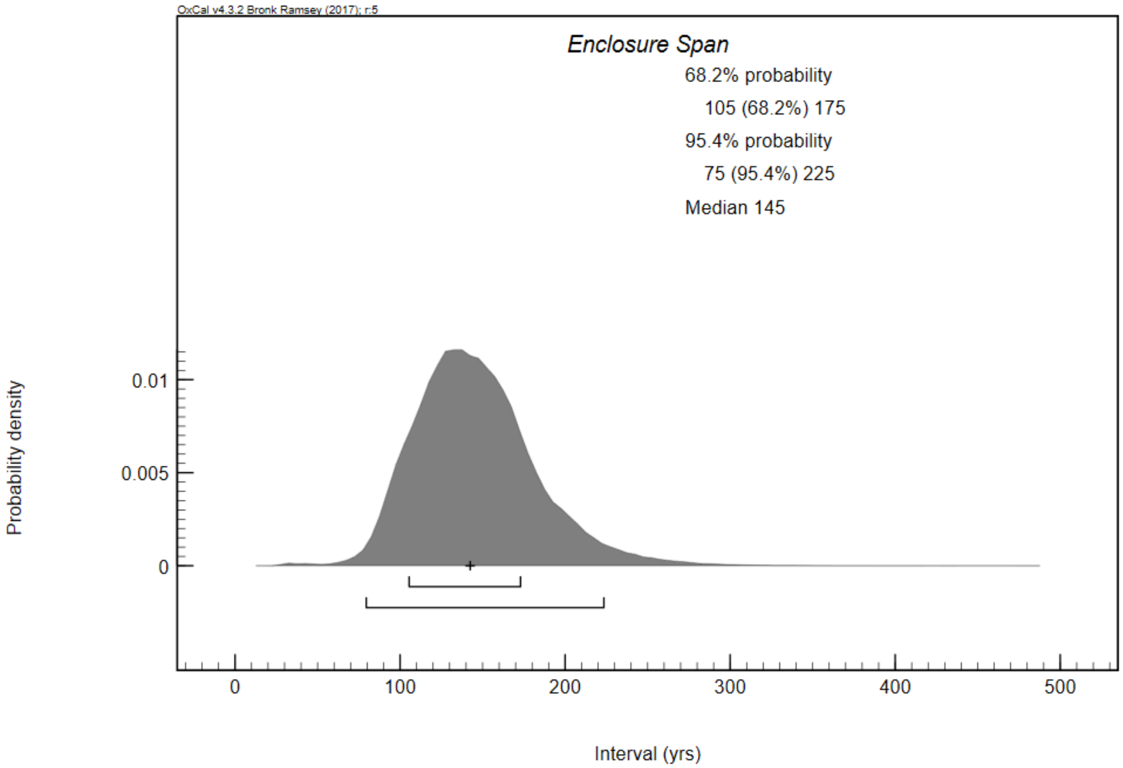

Figure 4.5. Span of enclosure construction for Model 2.

Table 4.3. Results of χ^2 test using `R_Combine` function in OxCal.

Site	Dates	RCYBP	Error	T' (5%) Threshold	T' value	Pass/Fail
Mount Horeb 1	ISGS-A3568	1980	20	7.8	8.195	Fail
	OS-125721	1940	20			
	OS-125720	1930	20			
	OS-125719	1900	20			
Mount Horeb 2	OS-125721	1940	20	6	2.2	Pass
	OS-125720	1930	20			
	OS-125719	1900	20			
Winchester Farm	UGAMS-17004	2040	30	3.8	13.08	Fail
	OS-136890	1910	20			
LeBus Circle	ISGS-A1425	2045	15	3.8	2.7	Pass
	OS-136791	1990	30			
Bogie Circle	OS-125679	1920	20	3.8	3.2	Pass
	D-AMS-012514	1861	26			

possibility that multiple dates from an identical context (e.g., a series of dates from an Ab horizon at a given enclosure) may not be the best representation of the *last* activity before that Ab was covered by embankment construction. To test whether multiple dates from identical contexts at an enclosure were statistically significant I used a χ^2 test (Ward and Wilson 1978) using the `R_Combine` feature to determine which dates might represent the same event (i.e., embankment construction). Results of the χ^2 test suggests ISGS-A3568 from the Mount Horeb site and UGAMS-17004 from the Winchester Farm site do not date similar events (Table 4.3). Therefore, I excluded them from Model 4 where a Sum function was applied to sites with multiple dates from the Ab surfaces.

Model 4 shows good overall agreement ($A_{\text{model}} = 95$) and convergence above 95% (Figure 4.7). The results of Model 4 suggest Ab surfaces began being burned and sealed by embankment fills in *cal 140 BC–AD 25* (*95% probability*; Figure 4.7; *Start: pre-Construction Surface Boundary*) and likely in *cal 70 BC–0 BC/AD* (*68% probability*). These construction-related activities ended in *cal 80–225 AD* (*95% probability*; Figure 4.7; *End: pre-Construction Surface Boundary*) and likely in *cal 100–165 AD* (*68% probability*). Model 4 estimates that all of the enclosures in this dataset appeared within *70-225 years* (*95% probability*; Figure 4.8; *Span*) or likely within *100-170* years (*68%* probability). In addition, an `Order` function applied to these modeled dates suggests Lebus Circle may have been constructed first, followed by Mount Horeb, and Winchester Farm and Bogie Circle. The latter two were built very close in time to one another, Bogie possibly being the last of the two constructed (Table 4.4).

The results of Model 4 show it is likely that all enclosures on the Bluegrass landscape were built in less than 170 years. However, this applies to only four of the seven earthen enclosures examined because the three others (i.e., Bogie West, Earthwalker, and Goff Circle) do

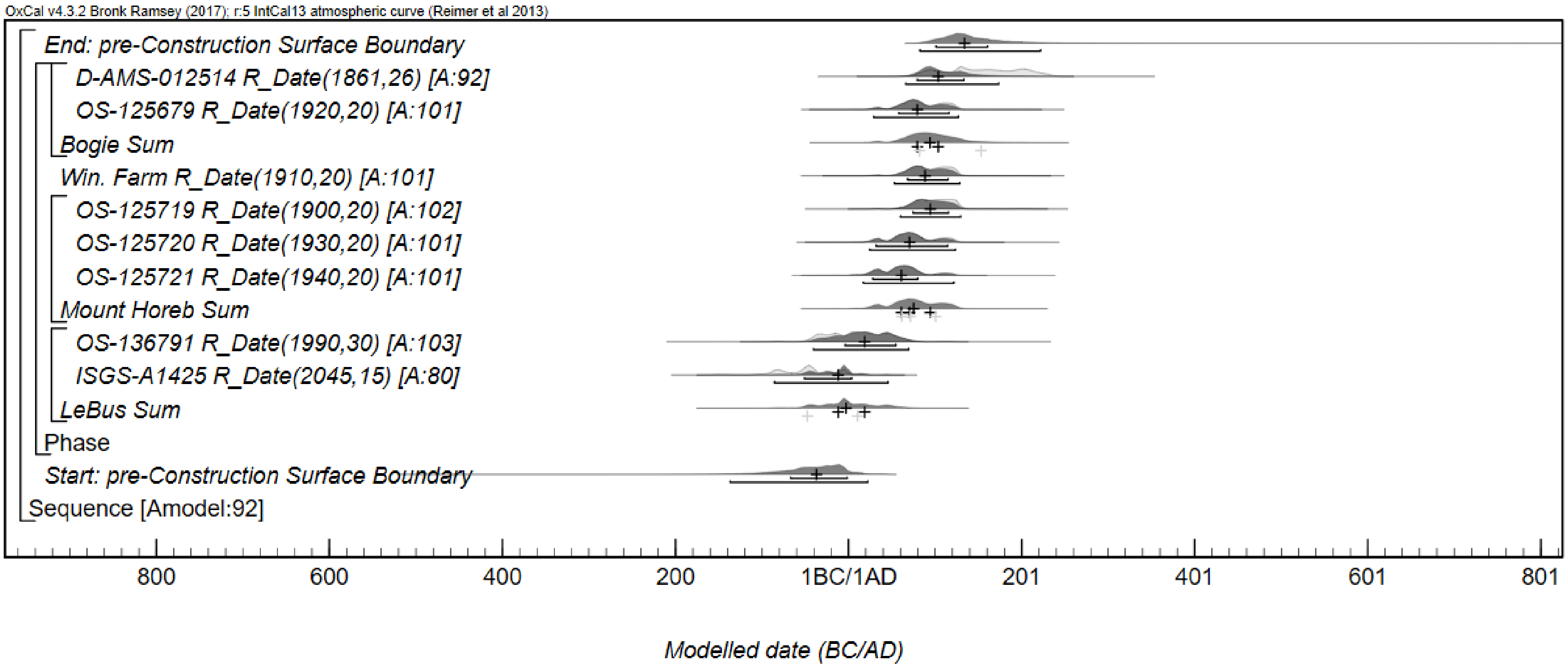

Figure 4.6. Results of Model 4 plotted in OxCal.

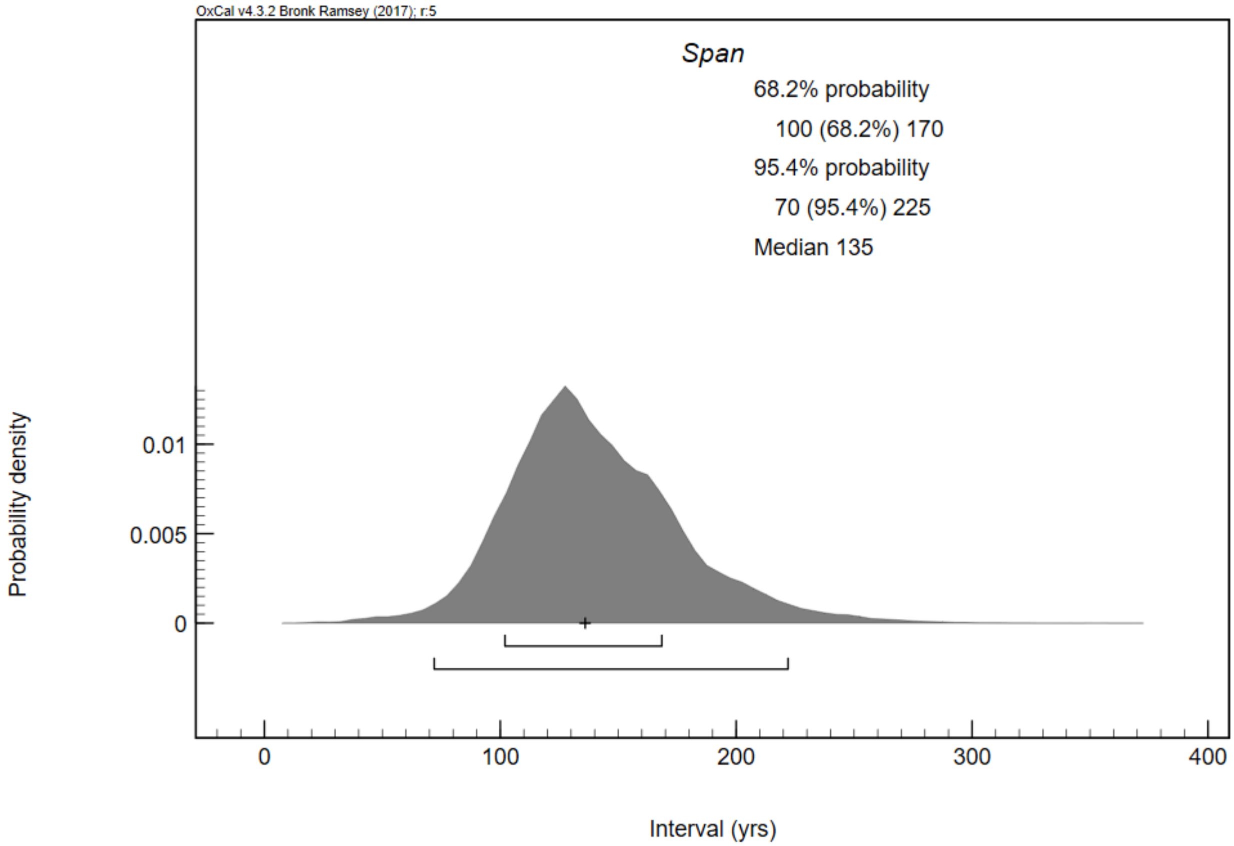

Figure 4.7. Span of enclosure construction for Model 4.

not have embankments preserved that would protect any original ground surfaces beneath them. However, there are still dates from contexts such as the refilling of ditches at other sites that can provide chronological information pointing to when they were used, including *terminus ante quems* (TAQs) for the construction of these sites. Moreover, contexts such as refilling events in ditches can provide insights into how long people continued to interact with these sites, even if it was to deconstruct them (see Chapter 3). To model this information and incorporate dates from enclosures with no surviving embankments that might lead to understanding when, and for how long, Native American groups continued to interact with the sacred sites, I added all dates from ditch contexts at the Earthwalker and Goff Circle sites into individual phases.

Table 4.4. Results of `Order` function applied in Model 4. Table shows the probability that any date situated in the column under the 'Order' title came before a date in the Order 'row'.

Order	**ISGS-A1425**	**OS-136791**	**OS-125721**	**OS-125720**	**OS-125719**	**OS-136890**	**OS-125679**	**D-AMS-012514**
ISGS-A1425	0	0.8686	0.9943	0.9977	0.9999	0.9997	0.9991	1
OS-136791	0.13144	0	0.8673	0.9224	0.9882	0.9789	0.9583	0.9952
OS-125721	0.00567	0.13275	0	0.6324	0.8733	0.8273	0.7465	0.9341
OS-125720	0.00228	0.07759	0.3676	0	0.7774	0.7175	0.6232	0.8743
OS-125719	0.00012	0.01176	0.12674	0.2226	0	0.4267	0.3278	0.6797
OS-136890	0.00034	0.02105	0.17266	0.28254	0.5733	0	0.3981	0.7358
OS-125679	0.00088	0.04168	0.25348	0.3768	0.6722	0.6019	0	0.8046
D-AMS-012514	0.00001	0.00479	0.06588	0.12567	0.3203	0.26418	0.19544	0

Model 5 incorporated dates from the refilling of the Goff enclosure in two phases. This included two samples from burned timbers lying on and near the floor of the ditch (OS-125678; D-AMS-012517), as well as another two samples from a charcoal dense upper zone that represents the near completion of the ditch refilling (D-AMS-012520; OS-125671). The results of Model 5 show good overall agreement (A_{model} = 94.6) and appropriate convergence values. This model suggests that the ditch at Goff Circle began refilling in *cal 355 BC–AD 310* (*95% probability*; Figure 4.9; *Start: Lower Refilling Boundary*) and likely in *cal AD 55–230* (*68% probability*). The ditch had almost refilled entirely by *cal AD 1515–present* (*95% probability*; Figure 4.9; *End: Upper Refilling Boundary*) and likely by *cal AD 1530–1755* (*68% probability*). However, the start boundary for this model exhibits a left-skewed distribution. This suggests the 68% probability values for the model likely best represent the chronological range for the beginning of ditch refilling. If this is the case, Model 5 suggests that Goff Circle was constructed within the same timeframe of enclosures outlined in Model 4 (see Figure 4.9). In addition, this model points to the possible terminal deconstruction of Goff Circle by Shawnee groups. Goff Circle is located within an area referred to as 'Indian Old Fields'. This area was

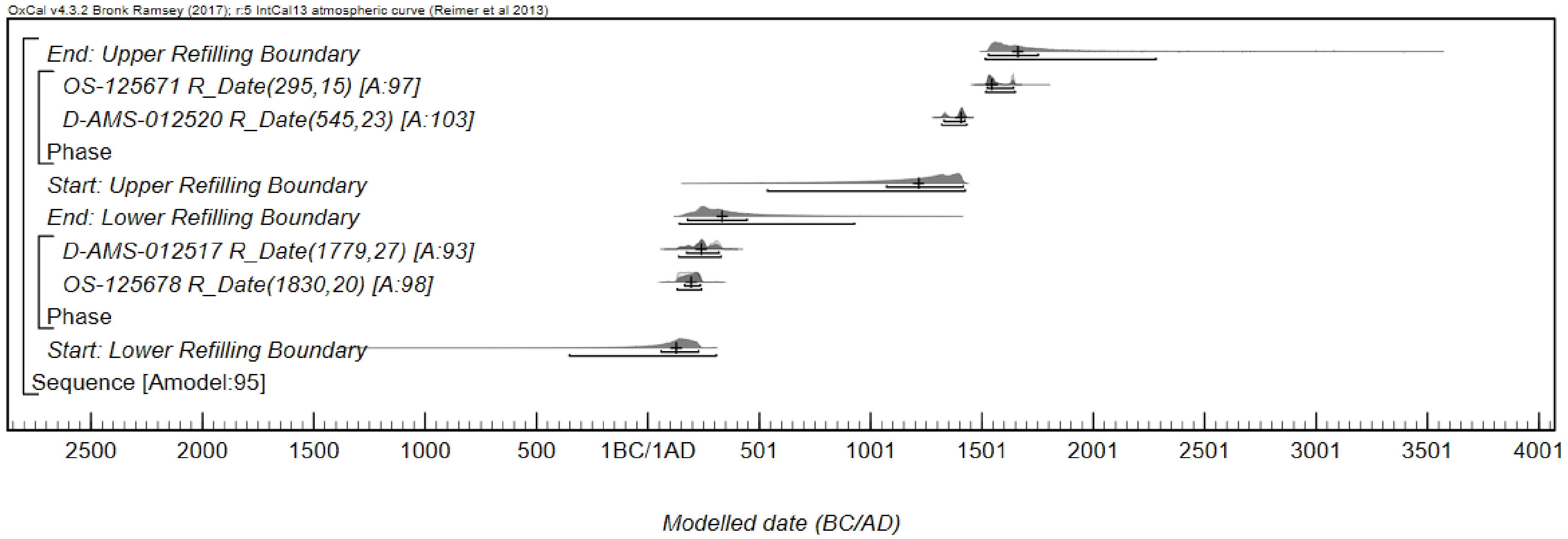

Figure 4.8. Results of Model 5 plotted in OxCal.

reported by early European explorers of Kentucky to have been the location of the last Shawnee village in the state, called *Eskippakithiki* (blue lick place) and built possibly as early as the late 1600s, is recorded as being potentially occupied in a French census in 1736, and abandoned by 1754 (Clark 2015:1, 15, 16). The likely date range of the final burned refilling zone in the ditch at Goff overlaps with this historical account well.

A similar phase-based model was used to understand the chronology of ditch refilling at the Earthwalker enclosure. A second phase model that examined the posts identified in excavation outside the ditch was not possible because all but one date (OS-125676) exhibit multiple late intercepts with the radiocarbon calibration curve (see Table 4.1) that indicate they are the result of modern activity. However, the morphology of the posts suggests a pre-European origin. For instance, the size of the post molds and the shape of their bases indicate they were not shaped using metal tools. Because a clear *in situ* burning event in the upper layers of the ditch dates very late (D-AMS-012519), it is possible that Early European landscape modifications that utilized fire led to relatively modern carbon material intruding into the fill of post molds. Nevertheless, adding outlier analyses to all but one date in a phase renders the model unstable even if the model indicates good agreement. The non-modern date associated with a post mold (OS-125676), suggests that the posts were set sometime near cal AD 1320–1430 (95.4%; Table 4.1).

For the ditch refilling phase, an outlier analysis was applied to two dates because one (D-AMS-012518) was collected stratigraphically above a much later date (OS-125669) and the other (D-AMS-012519) likely represents modern modification of the landscape. Model 6 shows good overall agreement ($A_{\text{model}} = 98.3$) and appropriate convergence values. Model 6 estimates that the ditch at Earthwalker began refilling in *cal 570 BC–AD 240* (*95% probability*; Figure 4.10; *Start:*

Ditch Boundary) and likely in *cal 570 BC–AD 235* (*68% probability*). The start boundary is left-skewed and the similarity of the 95% and 68% probabilities suggest that these data may not be best modeled as a uniform prior distribution. However, archaeology cannot inform the model any further. If the median (*cal AD 5*) can be appropriately drawn upon as an estimate for the beginning of ditch refilling, then Earthwalker was likely built within the same time range of other enclosures in the region. Nevertheless, more data are needed from this site to make a stronger argument for this statement.

4.4.2 Burial Mounds

Radiocarbon assays are available from five burial mounds that range in size from under a meter tall (e.g., Walker-Noe and Auvergne) to a maximum of almost 10 meters in height (e.g., Wright Mound; 15Mm6). Radiocarbon dates from these sites include both legacy dates (assays measured before 1990; n=9) and modern dates (n=8) acquired for this study. Here I examine phase-based models that examine broader historical patterns of monument construction in Central Kentucky. The first model combined all dates, including some of the original Libby dates, into a single phase. The results of this model (Model 7) do not produce a good agreement between the dates and the assumption that the data resemble of uniform distribution (A_{model} = 48). While only three of the legacy dates fell below the 60% agreement index (UGA-1239; C-759; UGA-3617), Model 8 used additional information to test the efficacy of multiple legacy dates using the `Outlier` analysis. In fact, the only date not subjected to this test was UGA-3617, which Clay (1983) suggests was the best representation for a central inhumation at the Auvergne Mound.

Model 8 shows good overall agreement (A_{model} = 62) and appropriate convergence values. This uniform distribution of the dates estimates that burial mounds began being used and

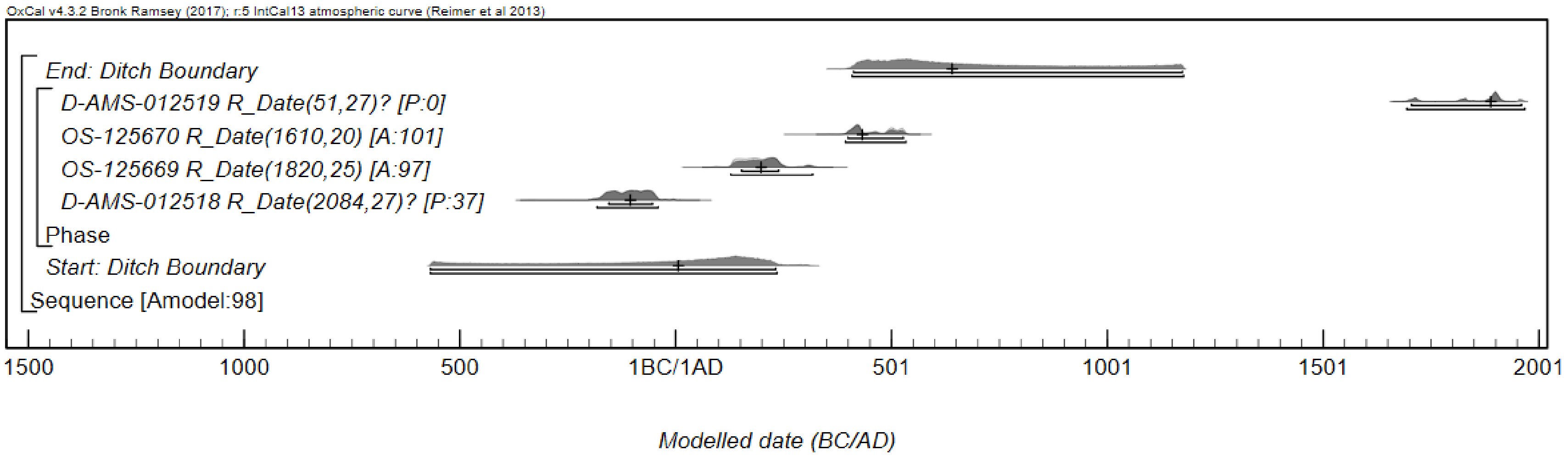

Figure 4.9. Results of Model 6 plotted in OxCal.

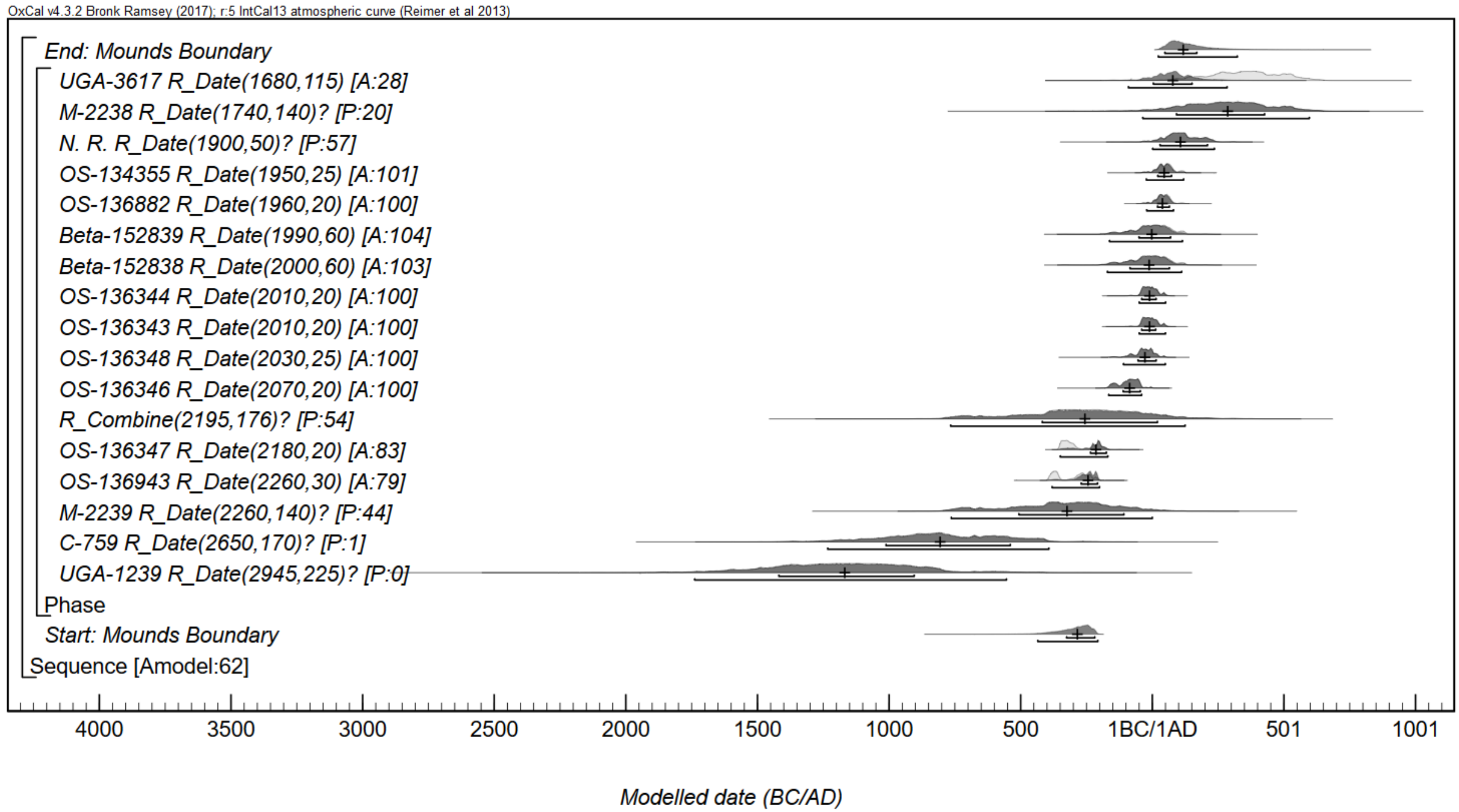

Figure 4.10. Results of Model 8 plotted in OxCal.

constructed in *cal 440–205 BC* (*95% probability*; Figure 4.11; *Start: Mounds Boundary*) and likely in *cal 330–215 BC* (*68% probability*). The end of mound use in this model is estimated at *cal AD 20–325* (*95% probability*; Figure 4.11; *End: Mounds Boundary*) and likely in *cal AD 45–170* (*68% probability*). UGA-3617 still exhibited poor agreement with the model (A = 28.2%), therefore it was removed from further models. None of the other legacy dates that had an `outlier` analysis applied to them reached a probability threshold over 60%, therefore they were also removed from additional analyses.

In a final model for the dates from burial mounds, all legacy dates measured prior to 1990 were removed and a general `Charcoal Outlier` model was applied to the data. The outlier model was applied to test the assumption that any dates on unidentified charred wood in this model might not represent the actual date of construction or act of burial, and instead may be material incorporated from elsewhere, affected by old wood, or and assay comprised of heartwood. A general outlier model (5% probability) was applied to other dates on short-lived plant species from mound contexts. Model 9 exhibits good overall agreement (A_{model} = 94.5), appropriate convergence values, and estimates that the construction of burial mounds in Central Kentucky began in *cal 455–175 BC* (*95% probability*; Figure 4.12; *Start: Mounds Boundary*) and likely in *cal 330–205 BC* (*68% probability*). The end of mound use in Model 9 is estimated at *cal AD 20–230* (*95% probability*; Figure 4.12; *End: Mounds Boundary*) and likely in *cal AD 45–130* (*68% probability*). The model estimates that mounds were built and used, at least for their initial mortuary purposes, for *cal 220–450* years (*95% probability*; Figure 4.13; *Span*) and likely over *cal 245–355* years (*68% probability*).

4.5 Discussion

The Bayesian chronologies for Adena-Hopewell earthen enclosures presented here suggests that the first monuments to appear on Kentucky's Woodland-period Bluegrass

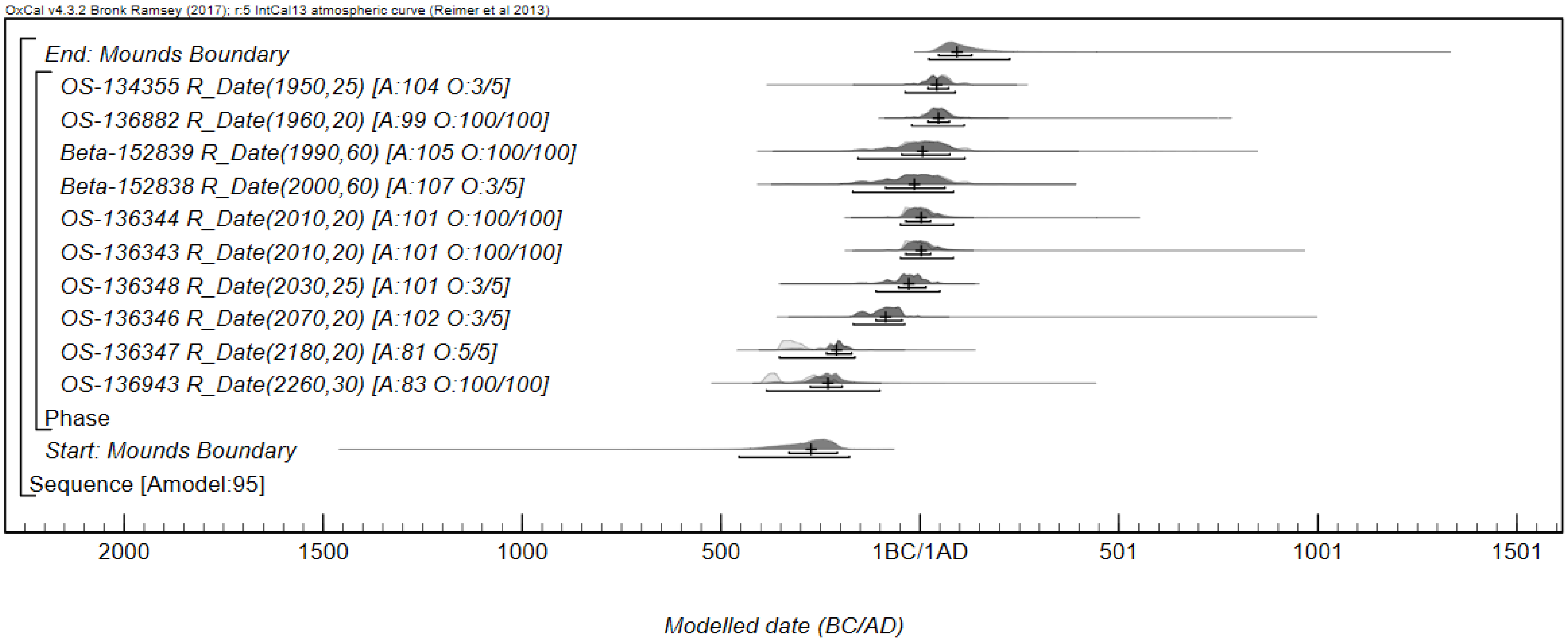

Figure 4.11. Results of Model 9 plotted in OxCal.

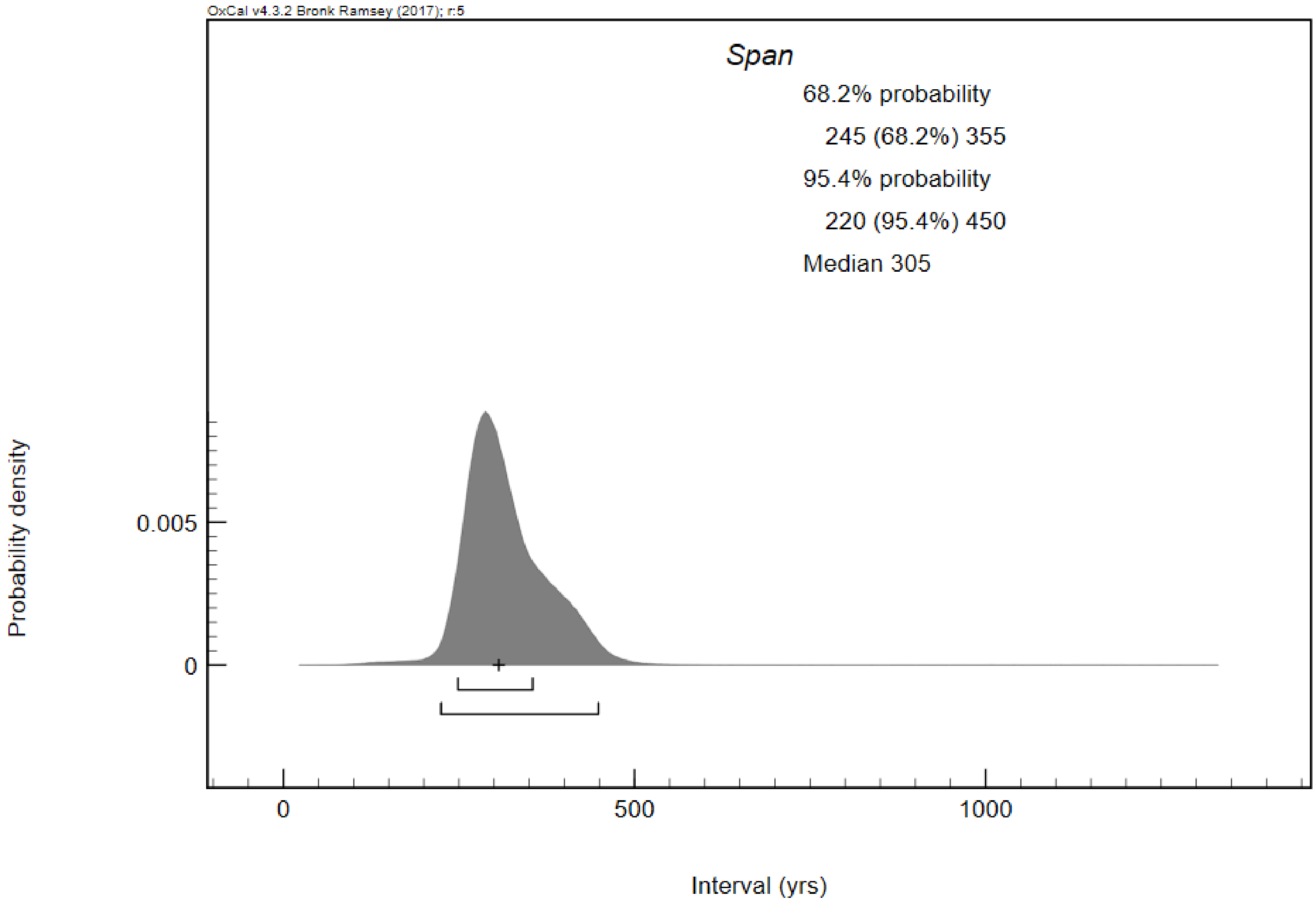

Figure 4.12. Span of burial mound construction and use for Model 9.

landscape were burial mounds and they likely emerged sometime between 330–205 BC The other earthen monument built and used by Adena-Hopewell societies in this region, the earthen enclosure, likely began being built and used sometime around 70 BC and the BC/AD transition. This shift in the construction and use of sacred ritual spaces on the Middle Woodland landscape in this area suggests an increasing need to integrate diverse populations that may be dispersed on the landscape or maintaining a relatively frequent state of mobility. In this sense, individuals and/or small groups of people would be traveling between regions at this time. Such mobility patterns have been confirmed among populations contemporary with the Bluegrass Adena-Hopewell societies considered here, through ancient-DNA analyses of skeletal material from burial mounds in Central Ohio and the Illinois River Valley (Bolnick and Smith 2007; Mills 2003). In this case study, the authors conclude their data represent gene flow coinciding with social exchanges that:

> reflected the movement of a small number of individuals each generation. These individuals may have moved directly between Ohio and Illinois, but the genetic patterns reported here could also be due to the cumulative effects of short-range and incremental movements, perhaps via local and regional mating networks. [Bolnick and Smith 2007:640]

If similar patterns of social mobility were occurring in and across the Bluegrass Region—and the material evidence suggests this is the case—the construction of earthen monuments would have served two purposes. First, they would have reinforced a shared sense of consensus and cooperation among those who constructed them. This connection to the landscape essentially provided material mnemonics for the actions of past labor events and provided expectations for future social interactions (Henry 2017; Henry and Barrier 2016). Second, they would have provided a familiarity for those who were moving through the landscape, offering something recognizable in a non-locale setting (see Pluckhahn and Thompson 2013). In this sense, the move to create regional ties through the construction of earthen monuments in similar methods and forms served to create not only familiarity but also set expectations and created possibilities for how people interacted with reference to these places (Bradley 1998; Howey 2012; Osborne 2014).

The shift from mortuary monuments to earthen enclosures might indicate the steep increase in the movement of people, ideas, and crafted ritual materials (e.g., mica, carved shell, obsidian, copper). While regional models for the construction of geometric enclosures have considered them to be later in the Middle Woodland cultural sequence in the Bluegrass Region (ca. post-0 AD) (Applegate 2008; Clay 1991), this study suggests the practice occurs as early as the mid-second century BC but likely somewhere around the BC/AD transition. Scholars in the Ohio Valley are finding other ‘Hopewell’ material indicators like Flint Ridge blades to date to a similar era, and enclosures outside the region (e.g., the Appalachian Mountains) have dated contexts suggesting construction *before* the first century AD, therefore potentially contemporary with enclosure construction occurring further north (Miller 2018; Wright 2014:290). The chronologies of these material suggest is that the BC/AD transition was a time of quick and intensive interregional interaction and the spread of ideas. In fact, this work suggests all the enclosures examined in this study were likely built in less than 170 years. The timing of individual enclosures suggests a potential north-to-south spread of ritual ideas pertaining to the creation of enclosures and ritual space. If this is the case, LeBus Circle was the first enclosure constructed in the Bluegrass Region. This is consistent with the geographical position of the enclosure, at the confluence of two major creeks that create a fork of the Licking River before draining north toward the Ohio River. This system of tributaries would have been easily navigated by canoe travel.

After LeBus, Mount Horeb was constructed, followed by Winchester Farm and Bogie Circle. While I can confidently argue for Goff and Earthwalker having been built during this span of time I cannot place them in the sequence of regional enclosure construction. Interestingly, where the construction of all enclosures occurred quickly at a regional-scale, this research indicates that the abandonment or disuse of enclosures each followed a unique trajectory likely related to the outcomes of historical contingency at local scales. For instance, as I discuss in Chapter 3, Winchester Farm was potentially maintained for centuries after people quit using it before the 'deconstruction' of the enclosure occurred. Alternatively, the ditch at Goff Circle likely started refilling after AD 55–203. Likewise, the ditch at Earthwalker probably began refilling around AD 5 but more work is needed to determine the chronology of this enclosure. Other enclosures like Bogie Circle and Mount Horeb never refilled, while sites like LeBus Circle began to refill very late (ca. post–AD1450). I argue that the variation in when and how quickly these ditches refilled speaks to the differing ritual needs and dispositions of local communities who continued to engage with the landscape as they saw fit.

The timing for the start of burial mound construction presented here complements the proposed chronology of ritual organization in the region (Clay 1991; Railey 1991). However, the models incorporating dates from burial mounds suggest the construction and use of these features ended earlier than previously suggested AD 250. My work estimates that burial mounds were no longer used after AD 230. Moreover, models explored during this study show that larger complex burial mounds like Wright (15Mm6) were not the products of late interregional interactions but had very long histories beginning as early as the mid-4th century BC. These histories included the potential for competitive displays of monumentality if the smaller Wright Mound (15Mm7) is any indication. The smaller monument has long been considered to pre-date the larger burial monument, but this study suggests they were contemporary at the early stages of construction.

4.6 Conclusions

This study used Bayesian statistics to model the chronologies of multiple burial monuments and earthen enclosures on the Bluegrass landscape of Central Kentucky. The results show that burial monuments were constructed first and used for centuries before geometric earthen enclosures began being built and used for periodic ritual gatherings. While both forms of monumentality fall within the temporal boundaries of 'Adena' as it is defined by archaeologists (e.g., 500 BC–AD 250) this study shows how ideas spread through the region and temporal overlap with other monuments in areas far removed from the Bluegrass. Temporal overlap for burial mounds occur in the context of the original Adena mound in Ohio (Lepper et al. 2014), which has been confirmed to be a Middle Woodland monument.

In the case of earthen enclosures, significant temporal overlap can be identified with the construction of the large Hopeton enclosure in Central Ohio, a 'Classic Hopewell' site (see Schilling in Lynott 2015:265). I would argue that the data from this study can be interpreted in two different ways. One is to use these data to reinforce the Adena and Hopewell cultural divide. However, the amount of overlap and the near instantaneous construction of enclosures in Central Kentucky after the BC/AD transition indicates that ideas were spreading rapidly with the movement of people and ritual objects across the Eastern Woodlands. Therefore, it might be more useful to consider Adena, as it has previously been conceived of in Kentucky, to be a regional variant of Hopewell (*sensu* Railey 1996) that helps drive the movement and development of Middle Woodland ceremonialism outside of Ohio, rather than a separate cultural entity that faded into history as Hopewell societies reached their apogee. In this sense, in

Kentucky perhaps what occurs is a social milieu that can be referred to as ‘Adena Hopewell’ in the same ways people refer to ‘Illinois Valley Hopewell’.

Stepping away from the chronological issues with Adena-Hopewell for a moment, this research highlights the broad temporal depth in which pre-Columbian Native American societies engage with places on the landscape. The models for enclosures in this study suggest social groups continued to interact with these monuments long after they quit being used. In many cases (e.g., Winchester Farm, Earthwalker, Goff), this evidently involved deconstructing the sites and refilling the ditches. However, at Earthwalker posts placed outside the entrance to the site suggest markers were erected that denoted where sites once existed. Similar uses of posts to mark ceremonial places on the landscape have been reported elsewhere through pre-Columbian time in the eastern U.S. (Redmond 2016; Wright 2014). These long-term forms of placemaking exhibit the dynamic nature of Native American interactions with the landscape and reinforce ties to the deep past through them.

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Chapter 5
Conclusions

5.1 Introduction

This collection of research helps fill in a variety of gaps in the knowledge of ancient Native American societies who inhabited eastern North America from approximately 500 BC–European contact. In many ways, what I learned of the ways people interacted with enclosure sites centuries after they had fallen out of use surprised me. However, I'm not sure it should have. While earning my Master's degree in anthropology at the University of Mississippi I had discovered that late Fort Ancient societies (post-AD 1400 societies in the Middle Ohio Valley) had continued to visit and alter the environment in and around the LeBus Circle (Henry 2009, 2011). Moreover, American Indian nations have long tried to call attention to the connections themselves and their ancestors had with natural and built places on the landscape. Moreover, Native American philosophers and scholars have emphasized the importance of relational connections between person, place, and notions of the past and present, including the ways these work together to afford people future possibilities (Cordova 2007; Deloria, Jr. 1992; Norton-Smith 2010; Watts 2013). Ethnographies of Native American place-based interactions have shown how performed myths and stories can encode the histories of past people on the landscape (Basso 1996).

Apart from these ideas pertaining to the long history of placemaking in Central Kentucky, I also identified some interesting new information on the ways Adena Hopewell societies made their places on the Bluegrass landscape. In the following sections I will summarize the research chapters and then discuss where the research presented here leaves us regarding the Adena vs. Hopewell problem in North American archaeology. I will then back out and reconsider why later inhabitants of the Central

Kentucky landscape were revisting earthen enclosures. I will end with some thoughts on future research directions and unanswered questions relating to late-Early and Middle Woodland societies in Central Kentucky.

5.2 Chapter Summaries

In Chapter 1, I laid out the research problems that lie at the foundation of this research. I covered the historical development of Adena and Hopewell cultural units in Americanist archaeology. I noted how the mounds and earthen enclosures of the Middle Ohio Valley had once been considered the remnants of a lost race of humans that were killed out by American Indian groups encountered by European settlers. I outlined how the development of archaeology as a discipline paralleled the notion Adena was a less complex predecessor to Hopewell and how this had affected modern research and understandings of early complex societies in eastern North America. Further, I mentioned how this was restraining our understandings of ancient histories in the Eastern Woodlands. I challenged the meaning archaeologists had attributed to words like Adena and Hopewell. In doing so, I asked whether these terms might be best used to refer to different aspects of the same social movement that lay at the intersection of the development of a common worldview (or cosmology) and the materialization of new institutions and infrastructure that helped frame the spread of this worldview through ritual practice and performance.

In chapter two, my colleague Carl Shields and I explored the degree at which late-Early and Middle Woodland societies on the Bluegrass landscape of Central Kentucky participated in the Adena-Hopewell movement by examining the region for previously unknown earthen monuments that once served as ritual infrastructure. We discussed the advantages and disadvantages of using novel aerial remote sensing technologies to search for new sites. We also outlined how a multi-staged approach to examining the landscape for new sites benefited from the integration of geophysical and geoarchaeological methods that not only help test assumptions made from LiDAR and aerial imagery, but also geophysical imagery. We concluded that there are probably many more enclosure and mound sites in the region, but LiDAR was not necessarily the best tool to search for these unknown sites. Instead, the best approach relied on the integration of multiple methods that helped test hypotheses made from one, in a following stage of research.

The ‘thick description’ of one Middle Woodland enclosure was the focus of Chapter 3, co-authored with Natalie Mueller and Mica Jones. In this chapter we used a variety of approaches that included geoarchaeology, paleoethnobotany, zooarchaeology, artifact analyses, and Bayesian chronological modeling, to examine the construction, use, and abandonment of the Winchester Farm enclosure in detail. We discovered that the enclosure was probably built after a long period of site-use for ritual gatherings that included small-scale feasting and other forms of ritual deposition. When the enclosure was built, the sediments that were removed from the ditch were manipulated into a homogenous fill that was used for embankment construction. The ditch was excavated to bedrock. The enclosure was then used for a short period of time before a post-enclosure was built inside it and the site was no longer used for ritual gatherings. However, our understanding of the sediments that refilled the ditch implied that humans maintained the ditch feature for more than six centuries. This maintenance abruptly ended with the intentional and rapid deconstruction of the site, which involved the breaking-up of embankment fills, redepositing them in the ditch, and burning them.

In Chapter 4, I modeled the chronology of Adena-Hopewell earthen monuments in Central Kentucky using a large suite of ^{14}C dates and two OSL dates. Using Bayesian statistics and a working knowledge of how each site related to one another, I explored the chronology of earthen enclosures versus burial mounds. I learned that burial mounds had unique histories that began as early as the 5th century BC and likely extended into mid-2nd century AD (i.e., roughly four centuries) However, I defined how the largest burial mounds in the region were not late products of interregional interaction, but instead the product of longer histories of mortuary practice and social integration. My chronological models for earthen enclosures suggest that they were all built very rapidly, likely in 170 years or less. This understanding suggests the Adena-Hopewell 'movement' was rapid and may have included the spread of ritual ideas from the north, possibly Central Ohio. However, unlike burial mounds, earthen enclosures were places where later Native American groups continued to visit, often with the intent to refill ditches and effectively 'erase' these pieces of ritual infrastructure from the landscape.

5.3 Synthesis

In sum, this research showed that more communities in the Central Kentucky Bluegrass Region were participating in the Adena-Hopewell movement than previously thought. In the contexts where ritual practice showed the ways in which people were building and using sacred space, I was able to trace unique historical trajectories of site construction, use, and abandonment. This suggests that local communities had the autonomy to take larger cosmological ideas and reinterpret them to work within their local social systems. This shows the complex interplay between institutions guiding human action and human practice invoking change within institutions. In the cases where I was able to identify rather quick refilling of ditches after the construction and use of enclosures, there may be evidence that Adena-Hopewell religious institutions were no longer viable to maintain an appropriate degree of social consensus. In other cases, enclosures are used for much later than archaeologists conceive of Adena-Hopewell, suggesting social institutions were more effective.

Most enclosures were being deconstructed around or after AD 1000. This is interesting given the social changes that accompany this time. For instance, there is a shift to intensive maize agriculture and sedentary village formation. With these subsistence and domestic changes came shifts in ideologies as well, evidenced by a significant transformation in ritual iconography (Cook 2008; Henderson, ed. 1992; Pollack et al. 2002). Archaeologists refer to these broad cultural changes as *Fort Ancient*. If there was a major shift in worldview related to the development of Fort Ancient societies, one of their priorities may have been erasing evidence of past ritual infrastructure from the landscape. Regardless this long trajectory of place-based interaction provides further evidence to counter the ‘noble savage’ trope for American Indians. While this research speaks to the ways American Indian societies valued and maintained a deep historical connection to places (built and natural) on the landscape, that doesn’t mean a place such as an enclosure that was sacred at one time stayed that way forever. History is always at work. Dillehay (2007) refers to the process whereby meanings and attitudes toward particular places remain in flux as, *landscapes in motion*. The Bluegrass landscape in Central Kentucky was certainly in motion, affording the movement of ideas, sacred objects, and people during the Middle Woodland period, and moving toward becoming something new in the aftermath of Adena-Hopewell.

So, what does all of this say about the nature of separating Adena and Hopewell as cultural types? This research supports the idea that monumental activity occurs early in this region. However, it also traces a significant shift in the focus of monumentality around the BC/AD transition. The construction of earthen enclosures at a very rapid pace indicates something important had changed socially and the reverberations of this change can be seen across the entire Eastern Woodlands. This this change in ritual practice occurred about 200 years after the earliest evidence for large multi-form geometric enclosures in the Scioto River Valley of Central Ohio (known as the epicenter for Classic Ohio Hopewell). If larger ideas about cosmology and world renewal spread and are evidenced in the construction and use of earthen enclosures at a local scale among small communities, then the stage was set for participation in larger cycles of situational gatherings in Central Ohio. If, as many archaeologists have argued, Central Ohio was a center for pilgrimage journeys (Lepper 2004, 2006; Wright and Loveland 2015), there has to be a way that local practices help instill a sense of what is to be expected when the journey takes place. I believe that the local adoption and use of earthen enclosure as ritual infrastructure helped prepare new age groups, sodalities, or other forms of non-affinal kin groups for these journeys. This may help explain why monuments are not being built after roughly AD 300 in the Bluegrass Region. If the focus of ritual cycles was on journeys into Central Ohio, there was no need to keep building new infrastructure locally. It was already available for local events and as stop-overs for travelers from further away.

Archaeologists have recently started paying attention to the situational and temporary nature of social phenomena. This includes a range of behaviors that relate things such as leadership structures and the nature of self-identity (Angelbeck and Grier 2012; Wengrow and Graeber 2015). I think it is good to consider these perspectives as they relate to the historical divide of Adena and Hopewell. Adena could represent the local representation of cosmological beliefs materialized through ritual practice. Alternatively, Hopewell may represent something much larger than a cultural unit, but a cycle of ritual gatherings that draws on the majority of populations who once inhabited the Eastern U.S. After all, many of the enclosures in the region align to the 18.6-year cycle of the lunar standstill. Moreover, there is a precedent for similar phenomena in pre-Columbian eastern North America at Poverty Point, where pilgrimage may have influenced the draw of people and material culture from across the Mississippi and Ohio River drainages and along the Gulf Coast (Spivey et al. 2015).

5.4 Future Research Directions

The work that is presented here, like any piece of research, offers more questions than is answers. Future research on enclosures in the Central Kentucky area would benefit from more dates and additional chronological modeling. Some of the ditch refilling sequences I have presented relied on only four dates. Additional dates would allow archaeologists to understand the histories of all enclosures in the same ways we analyzed the Winchester Farm enclosure. Tieing down these chronological sequences would also offer an opportunity to learn the cycles of time in which each enclosure was built. Could this be happening roughly every 20 years, in time with the ritual cycles suggested by the astronomical alignments of enclosures? Bayesian modeling would help answer that question.

Advanced spatial modeling would help inform the search for additional unknown enclosures and other earthen monuments. The examination of LiDAR presented here was primarily qualitative. Using artificial intelligence to 'seek out' particular topographic patterns is something that is becoming used in other scientific disciplines and it would benefit the archaeology of Middle Woodland geometric earthworks as well.

Finally, the sealed ground surfaces identified beneath the preserved embankment have the potential for preserving paleoenvironmental data (e.g., pollen, diatoms) that may provide the environmental and climatological context for the rise of Middle Woodland Ceremonialism. Likewise, the lower portions of ditches could provide the context for its decline.

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Appendix A: OxCal Codes for Bayesian Chronological Models Presented in Chapter 3

Model 1

```
Plot()
 {
  Sequence()
  {
   Boundary("pre-Construction");
   Phase("Enclosure Construction")
   {
    R_Date("UGAMS-17004: Ab1", 2040, 30);
    R_Date("OS-136890: Ab2", 1910, 20);
   };
   Boundary("post-Construction");
   Phase("Interior Use")
   {
    R_Date("OS-136889: F.13 Post", 2450, 25);
    R_Date("OS-136447: Midn. 30-40 cmbs", 2090, 20);
    R_Date("OS-136446: Midn. 20-30 cmbs", 1980, 25);
    R_Date("OS-136888: Midn. 40-54 cmbs", 1980, 15);
    R_Date("UGAMS-17006: Midn. 50-55 cmbs", 1890, 25);
    R_Date("UGAMS-17005: F.8 Post", 1880, 25);
   };
   Boundary("End of Interior Use");
   Sequence()
   {
    Boundary("Begin Ditch Refilling");
    Sequence("Ditch Refilling")
    {
     R_Date("OS-136891: Ditch 125-135 cmbs", 1150, 15);
     R_Date("UGAMS-17003: Ditch 115-132 cmbs", 1140, 25);
     R_Date("OS-136892: Ditch 110-120 cmbs", 1960, 20);
     R_Date("OS-136893: Ditch 100-110 cmbs", 1090, 20);
     R_Date("OS-136894: Ditch 90-100 cmbs", 1150, 15);
     R_Date("OS-136895: Ditch 80-90 cmbs", 1110, 20);
     R_Date("OS-136896: Ditch 70-80 cmbs", 1140, 15);
     R_Date("OS-136897: Ditch 60-70 cmbs", 1160, 20);
    };
    Boundary("End Ditch Refilling");
   };
  };
 };
```

Model 2

```
Plot()
 {
  Sequence("Winchester Farm Site Use")
  {
   Boundary("Start Site Use");
   Phase()
   {
    R_Date("OS-136889: F.13 Post", 2450, 25);
    R_Date("OS-136447: Midn. 30-40 cmbs", 2090, 20);
    R_Date("UGAMS-17004: Ab1", 2040, 30);
    R_Date("OS-136446: Midn. 20-30 cmbs", 1980, 25);
    R_Date("OS-136888: Midn. 40-54 cmbs", 1980, 15);
    R_Date("OS-136890: Ab2", 1910, 20);
    R_Date("UGAMS-17006: Midn. 50-55 cmbs", 1890, 25);
    R_Date("UGAMS-17005: F.8 Post", 1880, 25);
    Order()
    {
    };
   };
   Span("Site Use");
   Boundary("End Site Use");
  };
 };
```

Model 3

```
Plot()
 {
  Sequence(Winchester Farm)
  {
   Boundary("Begin pre-Enclosure Use");
   Phase("pre-Enclosure Use")
   {
    R_Date("OS-136889: F.13 Post", 2450, 25)
    {
     Outlier();
    };
    R_Date("OS-136447: Midn. 30-40 cmbs", 2090, 20);
    R_Date("UGAMS-17004: Ab1", 2040, 30);
    R_Date("OS-136446: Midn. 20-30 cmbs", 1980, 25);
    R_Date("OS-136888: Midn. 40-54 cmbs", 1980, 15);
    Span("pre-Enclosure Use");
   };
   Boundary("End pre-Enclosure Use");
   Boundary("Begin Embankment");
   Phase("Embankment")
```

```
   {
    R_Date("OS-136890: Ab2", 1910, 20);
   };
   Boundary("End Embankment");
   Boundary("Begin post-Enclosure Use");
   Phase("post-Enclosure")
   {
    R_Date("UGAMS-17006: Midn. 50-55 cmbs", 1890, 25);
    R_Date("UGAMS-17005: F.8 Post", 1880, 25);
    Span("post-Enclosure Use");
   };
   Boundary("End post-Enclosure Use");
   Sequence()
   {
    Boundary("Begin Ditch Refilling");
    Sequence("Ditch")
    {
     R_Date("OS-136891: Ditch 125-135 cmbs", 1150, 15);
     R_Date("UGAMS-17003: Ditch 115-132 cmbs", 1140, 25);
     R_Date("OS-136892: Ditch 110-120 cmbs", 1960, 20)
     {
      Outlier();
     };
     R_Date("OS-136893: Ditch 100-110 cmbs", 1090, 20);
     R_Date("OS-136894: Ditch 90-100 cmbs", 1150, 15);
     R_Date("OS-136895: Ditch 80-90 cmbs", 1110, 20);
     R_Date("OS-136896: Ditch 70-80 cmbs", 1140, 15);
     R_Date("OS-136897: Ditch 60-70 cmbs", 1160, 20);
     Span("Ditch Refilling");
    };
    Boundary("End Ditch Refilling");
    Difference("Duration", "End post-Enclosure Use", "Begin
Ditch Refilling");
   };
  };
 };
```

Appendix B: OxCal Codes for Bayesian Chronological Models Presented in Chapter 4

Model 1

```
Plot()
 {
  Sequence()
  {
```

```
   Boundary("Start: pre-Construction Surface");
   Phase("")
   {
    Date("OSLHL",N(2010-3870,325));
    R_Date("ISGS-A1256", 2800, 20);
    R_Date("ISGS-6586", 2070, 80);
    R_Date("ISGS-A1425", 2045, 15);
    R_Date("UGAMS-17004", 2040, 30);
    Date("OSL1F1",N(2010-2005,175));
    R_Date("OS-136791", 1990, 30);
    R_Date("ISGS-A3568", 1980, 20);
    R_Date("OS-125721", 1940, 20);
    R_Date("OS-125720", 1930, 20);
    R_Date("OS-125679", 1920, 20);
    R_Date("OS-136890", 1910, 20);
    R_Date("OS-125719", 1900, 20);
    R_Date("D-AMS-012514", 1861, 26);
    Span(Enclosure Construction);
   };
   Boundary("End: pre-Construction Surface");
  };
 };
```

Model 2

```
Plot()
 {
  Sequence()
  {
   Boundary("Start: pre-Construction Surface");
   Phase("")
   {
    Date("OSLHL",N(2010-3870,325))
    {
     Outlier();
    };
    R_Date("ISGS-A1256", 2800, 20)
    {
     Outlier();
    };
    R_Combine("Mt Horeb")
    {
     R_Date("ISGS-6586", 2070, 80);
     R_Date("ISGS-A3568", 1980, 20);
    };
    R_Date("ISGS-A1425", 2045, 15);
    R_Date("UGAMS-17004", 2040, 30);
```

```
    Date("OSL1F1",N(2010-2005,175));
    R_Date("OS-136791", 1990, 30);
    R_Date("OS-125721", 1940, 20);
    R_Date("OS-125720", 1930, 20);
    R_Date("OS-125679", 1920, 20);
    R_Date("OS-136890", 1910, 20);
    R_Date("OS-125719", 1900, 20);
    R_Date("D-AMS-012514", 1861, 26);
    Span(Enclosure Construction);
   };
   Boundary("End: pre-Construction Surface");
  };
 };
```

Model 3

```
Plot()
 {
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Outlier_Model("General",T(5),U(0,4),"t");
  Sequence()
  {
   Boundary("Start: pre-Construction Surface");
   Phase("")
   {
    R_Date("ISGS-A1425", 2045, 15)
    {
     Outlier("Charcoal",1);
    };
    R_Date("UGAMS-17004", 2040, 30)
    {
     Outlier("Charcoal",1);
    };
    R_Date("OS-136791", 1990, 30)
    {
     Outlier("General",0.05);
    };
    R_Date("ISGS-A3568", 1980, 20)
    {
     Outlier("Charcoal",1);
    };
    R_Date("OS-125721", 1940, 20)
    {
     Outlier("Charcoal",1);
    };
    R_Date("OS-125720", 1930, 20)
    {
```

```
     Outlier("Charcoal",1);
    };
    R_Date("OS-125679", 1920, 20)
    {
     Outlier("Charcoal",1);
    };
    R_Date("OS-136890", 1910, 20)
    {
     Outlier("Charcoal",1);
    };
    R_Date("OS-125719", 1900, 20)
    {
     Outlier("Charcoal",1);
    };
    R_Date("D-AMS-012514", 1861, 26)
    {
     Outlier("Charcoal",1);
    };
    Span(Enclosure Construction);
   };
   Boundary("End: pre-Construction Surface");
  };
 };
```

<u>Model 4</u>

```
Plot()
 {
  Sequence()
  {
   Boundary("Start: pre-Construction Surface");
   Phase("")
   {
    Sum("LeBus")
    {
     R_Date("ISGS-A1425", 2045, 15);
     R_Date("OS-136791", 1990, 30);
    };
    Sum("Mount Horeb")
    {
     R_Date("OS-125721", 1940, 20);
     R_Date("OS-125720", 1930, 20);
     R_Date("OS-125719", 1900, 20);
    };
    R_Date("Win. Farm", 1910, 20);
    Sum("Bogie")
    {
```

```
     R_Date("OS-125679", 1920, 20);
     R_Date("D-AMS-012514", 1861, 26);
    };
    Span();
    Order();
   };
   Boundary("End: pre-Construction Surface");
  };
 };
```

Model 5

```
Plot()
 {
  Sequence()
  {
   Boundary("Start: Lower Refilling");
   Phase("")
   {
    R_Date("OS-125678", 1830, 20);
    R_Date("D-AMS-012517", 1779, 27);
   };
   Boundary("End: Lower Refilling");
   Boundary("Start: Upper Refilling");
   Phase("")
   {
    R_Date("D-AMS-012520", 545, 23);
    R_Date("OS-125671  ", 295, 15);
   };
   Span();
   Boundary("End: Upper Refilling");
  };
 };
```

Model 6

```
Plot()
 {
  Sequence()
  {
   Boundary("Start: Ditch");
   Phase("")
   {
    Curve("IntCal13","IntCal13.14c");
    R_Date("D-AMS-012518", 2084, 27)
    {
     Outlier();
```

```
    };
    R_Date("OS-125669", 1820, 25);
    R_Date("OS-125670", 1610, 20);
    R_Date("D-AMS-012519", 51, 27)
    {
     Outlier();
    };
   };
   Boundary("End: Ditch");
  };
 };
```

Model 7

```
Plot()
 {
  Sequence()
  {
   Boundary("Start: Mounds");
   Phase("")
   {
    R_Date("UGA-1239", 2945, 225);
    R_Date("C-759", 2650, 170);
    R_Date("M-2239", 2260, 140);
    R_Date("OS-136943", 2260, 30);
    R_Date("OS-136347", 2180, 20);
    R_Combine(C-760)
    {
     R_Date("C-760a", 2260, 220);
     R_Date("C-760b", 2078, 290);
    };
    R_Date("OS-136346", 2070, 20);
    R_Date("OS-136348", 2030, 25);
    R_Date("OS-136343", 2010, 20);
    R_Date("OS-136344", 2010, 20);
    R_Date("Beta-152838", 2000, 60);
    R_Date("Beta-152839", 1990, 60);
    R_Date("OS-136882", 1960, 20);
    R_Date("OS-134355", 1950, 25);
    R_Date("N. R.", 1900, 50);
    R_Date("M-2238", 1740, 140);
    R_Date("UGA-3617", 1680, 115);
   };
   Boundary("End: Mounds");
  };
 };
```

Model 8

```
Plot()
 {
  Sequence()
  {
   Boundary("Start: Mounds");
   Phase("")
   {
    R_Date("UGA-1239", 2945, 225)
    {
     Outlier();
    };
    R_Date("C-759", 2650, 170)
    {
     Outlier();
    };
    R_Date("M-2239", 2260, 140)
    {
     Outlier();
    };
    R_Date("OS-136943", 2260, 30);
    R_Date("OS-136347", 2180, 20);
    R_Combine(C-760)
    {
     Outlier();
     R_Date("C-760a", 2260, 220);
     R_Date("C-760b", 2078, 290);
    };
    R_Date("OS-136346", 2070, 20);
    R_Date("OS-136348", 2030, 25);
    R_Date("OS-136343", 2010, 20);
    R_Date("OS-136344", 2010, 20);
    R_Date("Beta-152838", 2000, 60);
    R_Date("Beta-152839", 1990, 60);
    R_Date("OS-136882", 1960, 20);
    R_Date("OS-134355", 1950, 25);
    R_Date("N. R.", 1900, 50)
    {
     Outlier();
    };
    R_Date("M-2238", 1740, 140)
    {
     Outlier();
    };
    R_Date("UGA-3617", 1680, 115);
   };
```

```
   Boundary("End: Mounds");
  };
 };
```

Model 9

```
Plot()
 {
  Outlier_Model("General",T(5),U(0,4),"t");
  Outlier_Model("Charcoal",Exp(1,-10,0),U(0,3),"t");
  Sequence()
  {
   Boundary("Start: Mounds");
   Phase("")
   {
    R_Date("OS-136943", 2260, 30)
    {
     Outlier("Charcoal", 1);
    };
    R_Date("OS-136347", 2180, 20)
    {
     Outlier("General", 0.05);
    };
    R_Date("OS-136346", 2070, 20)
    {
     Outlier("General", 0.05);
    };
    R_Date("OS-136348", 2030, 25)
    {
     Outlier("General", 0.05);
    };
    R_Date("OS-136343", 2010, 20)
    {
     Outlier("Charcoal", 1);
    };
    R_Date("OS-136344", 2010, 20)
    {
     Outlier("Charcoal", 1);
    };
    R_Date("Beta-152838", 2000, 60)
    {
     Outlier("General", 0.05);
    };
    R_Date("Beta-152839", 1990, 60)
    {
     Outlier("Charcoal", 1);
    };
```

```
    R_Date("OS-136882", 1960, 20)
    {
     Outlier("Charcoal", 1);
    };
    R_Date("OS-134355", 1950, 25)
    {
     Outlier("General", 0.05);
    };
    Span();
   };
  Boundary("End: Mounds");
 };
};
```