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Bronze and Iron Age salt production on the Italian Tyrrhenian coast

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TRACING TECHNOLOGY
FORTY YEARS OF ARCHAEOLOGICAL RESEARCH
AT SATRICUM

Edited by
Marijke Gnade and Martina Revello Lami



PEETERS
Leuven - Paris - Bristol, CT
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Bronze and Iron Age salt production on the Italian Tyrrhenian coast

An overview

Luca Alessandri, Clarissa Belardelli, Peter Attema,
Francesca Cortese, Mario Federico Rolfo, Jan Sevink, Wouter van Gorp

Abstract

A synthesis of the current knowledge of the so-called Italian giacimenti a olle d'impasto rossiccio (reddish jar potsherd deposits) is presented. These sites are common along the Tyrrhenian side of Central Italy and are usually interpreted as salt-production sites, because of parallels with similar European specialised sites. In the latter, salt was obtained by boiling a brine in special disposable pottery, a technique known as briquetage. However, the analogies are not straightforward and alternative hypotheses, e.g. fish-processing, and a more complex intertwined economy have also been put forward. To solve the interpretation issues, we advocate to use a multidisciplinary approach involving quantification of the ceramics encountered, establishment of their morphological and functional typologies, and physico/chemical analyses to identify their use.

INTRODUCTION

Salt is an essential part of the human diet, although the necessary intake has been controversial.¹ At the moment the physiological adequate intake for an adult is estimated at 1.5 gr per day.² The need of domestic animals for salt is much greater: according to Bergier, a cow needs around 90 grams per day and a horse 50 grams.³ In a meat-based diet, the necessary intake of salt can probably be obtained from food, but in an agricultural diet possibly not. That is why hunter-gatherer tribes generally do not trade salt but agricultural societies sometimes do.⁴ However, in antiquity salt was also used for other purposes: to preserve foodstuffs through its antimicrobial property, as part of ritual activities, and in the tanning process.⁵ Only three sources of salt can be exploited all over the world: rocks, brine springs, and sea water. Only the latter is available in Italy, with a few small exceptions of halite deposits in Sicily and Calabria.⁶ Salt can be extracted from the sea water in two ways: by means of solar evaporation or boiling a brine, which can be obtained by partial solar evaporation. In Italy, evidence for saltworks has been traced only from the Roman period onward, but these works leave scanty traces on the ground and the precise technique used is hard to establish.⁷

Several different techniques have been used all around the world to obtain salt from brine. The *briquetage* technique is the most widespread in

Europe.⁸ Basically, the process consists of boiling the brine in earthenware vessels and then to break the containers to extract the salt cakes. In the secondary firing, the jars are thought to acquire a reddish hue due to some chemical processes. This explains the at times huge amount of reddish broken pottery that characterizes these specialised sites. Combustion structures onto which the brine boiling containers were placed and vats placed around such structures to store and/or evaporate brine are typical features of these workshops. Typical examples of the latter are Landrellec and Enez Vihan (so-called *ateliers de briquetage*, in French), in Bretagne (fig. 1).⁹ However, evidence of *briquetage* has been found in almost all continental Europe and along the English coastline.¹⁰ The earliest evidence comes from some Neolithic sites in Romania,¹¹ although the peak of the phenomenon is to be placed in the Iron Age and Roman period, especially in northern Europe.

The first salt hypothesis

Along the Italian Tyrrhenian coast, accumulations of sherds of reddish-brown earthenware jars, mostly dated to the Final Bronze Age (FBA) and/or Early Iron Age (EIA), have long been considered as traces of "industrial" sites. In the Italian literature, they are referred to as *giacimenti a*

*olle d'impasto rossiccio*¹² or *installazioni funzionali*, as opposed to settlements with a domestic function that show a much wider variety of pottery wares and shapes (fig. 2; table 1). Already in 1991, Marco Pacciarelli¹³ suggested that these accumulations of FBA and EIA impasto sherds might be evidence for salt production. Pacciarelli based his hypothesis on the strong predominance of these jars within the archaeological assemblages found at these sites and on their reddish colour, which he tentatively attributed to secondary firing. He noted that this pottery assemblages resembled the deposits of the *ateliers de briquetage*. Another possible parallel is provided by the Iron Age salting mounds of Essex, large heaps of burnt and broken potsherds that were discovered at the end of the 19th c. CE¹⁴, and the Bronze Age/Iron Age evidence from Lincolnshire.¹⁵ Interesting is the recurring use of locations for salt production such as in the modern saltern of Tarquinia (Saline di Tarquinia) where accumulations of reddish-brown potsherds were found that, according to Pacciarelli, could be related to EIA salt production (Fig 2, 22).¹⁶ Below we give an overview of recent evidence brought to light since the phenomenon was first defined by Pacciarelli, followed by a discussion about the interpretation of the *giacimenti a olle d'impasto rossiccio* as salt production sites.

Evidence north of the Tiber

Over the last two decades, many sites characterized by accumulations of reddish-brown sherds of jars have been found along the Tyrrhenian coast (table 1). The northernmost location is Isola di Coltano (Fig 2, 1).¹⁷ Here the University of Pisa excavated thousands of sherds found in layers on the banks of an ancient lagoon. About 70% of the pottery sherds of the deposit belonged to large ovoid or half-conical locally made vessels.

Between 2001 and 2008, excavations carried out by the archaeological service of Tuscany (*Soprintendenza per i Beni Archeologici della Toscana*) on the shores of the Baratti Gulf¹⁸ (fig. 2, and 6) and on the southernmost shores of the Gulf of Follonica¹⁹ (fig. 2, 8-14) led to the discovery of several furnaces, characterized by both single and double compartments having either vertical or horizontal draft channels (fig. 3). G. Baratti interpreted the furnaces from Baratti and Puntone Nuovo – Le Chiarine (kiln B) as salt production facilities,²⁰ noting their similarity with the French *briquetage* kilns of Enez-Vihan, Landrellec²¹ and Moyenvic, Les Crôleurs, in the Seille valley.²² However, the kilns can, according to us, also be compared with the Minoan cross-draft channel kilns known from Hagia Triada²³ (LM IB) and Kommos²⁴ (LM IA)

that were used for firing pottery.²⁵ Two recently explored Iron Age sites from Tombolo di Feniglia – Poggio Pertuso²⁶ (fig. 2, 19) and Duna Feniglia,²⁷ dated to the 9th-8th c. BCE – feature the presence of typical reddish-brown potsherds as well. Here the excavations led to the discovery of a kiln similar to the one from Baratti and different types of pits (elliptical, rectangular) sometimes associated with layers of pure clay – probably to produce vessels – and reddish-brown impasto sherds (fig. 4). Prior to the Tombolo di Feniglia discoveries, similar structures were found in 1994 at Marangone (fig. 2, 30) where a pit filled with ash and potsherds was found.²⁸ Comparable structures were found in excavations at Acque Fresche²⁹ (fig. 2, 25) at Torre Valdaliga³⁰ (fig. 2, 26) and at La Mattonara.³¹

Evidence South of the Tiber

Between 2001-2002, the Groningen Institute of Archaeology excavated the FBA site of Pelliccione (also known as P13) on the Tyrrhenian coast (fig. 2, 38).³² The archaeological deposit consisted of a huge amount of reddish-brown impasto jar sherds, found together with fragments of tufa chunks bearing traces of fire. The tufa chunks were interpreted as provisional stands for the vessels that, filled with brine, would have been placed over a fire. In the same area, numerous other sites with the presence of the reddish-brown sherds (Le Grottacce, Saracca, Area Stop 4, Fosso Moscarello) have been identified³³ (with references. Fig. 1, 37 and 39-42, respectively).

In 2017, in a joint excavation of the universities of Groningen and Rome Tor Vergata on two small islands in the lagoon of Caprolace, a number of ceramic pedestals were found in combination with Middle Bronze Age (MBA) ceramics (fig. 5). Similar pedestals have been found in England, at the site of Brean Down³⁴ and in France, where they are called *piliers*.³⁵ The pedestals have a slightly rounded base with a concave centre and, where preserved (rarely), a set of three lobes on the top. The shank is circular in section. Such features are usually found in the *briquetage* sites, all over Europe, and are usually interpreted as pedestals on which the vessels were placed during the brine evaporating process.³⁶ The chronology of the Bronze Age phase at the Caprolace site spans the MBA to Recent Bronze Age,³⁷ although the age of the context with the pedestals is restricted to the beginning of the MBA (subphases 1 and 2). Elsewhere on the islands, also the characteristic reddish-brown potsherds, mostly belonging to half-conical vessels, are quite common, but pedestals were absent. The chronology of the layer



Fig. 1. Map of Tyrrhenian sites featuring the presence of accumulations of reddish-brown jars discussed in the text. See table 1 for the related toponyms. Background imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus, DS, US&A, USGS, AeroGRID, IGN, GIS User Community.

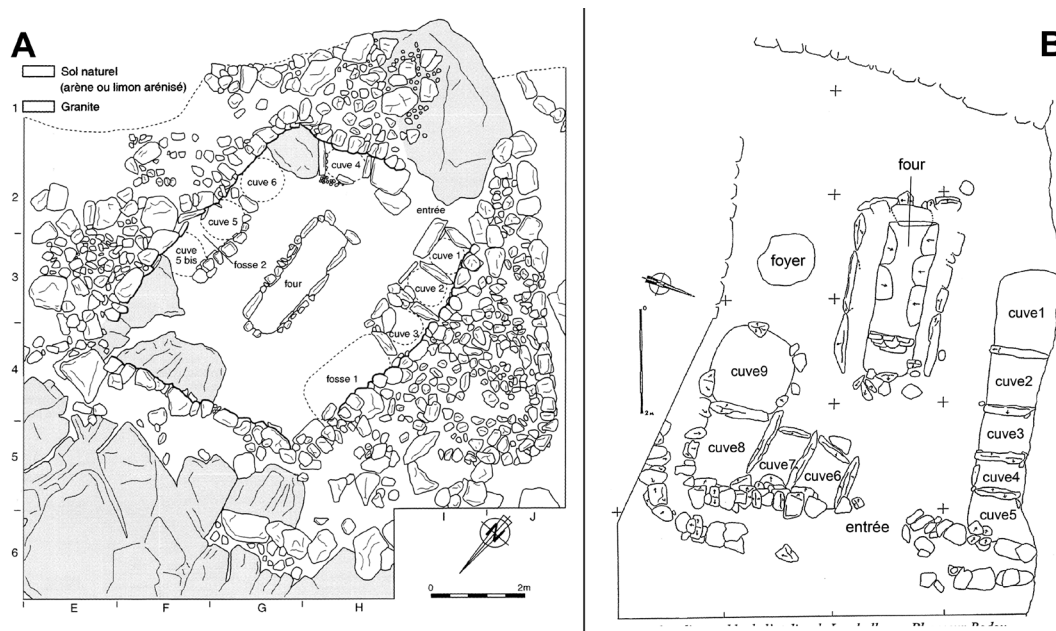


Fig. 2. A, plan of the briquetage atelier of Enez Vihan, (from Daire et al. 2001). B, plan of the briquetage atelier of Landrellec (from Daire 2002).

Num.	Site	Reddish jar potsherds	Pit(s)	Kiln(s)	Hearths	Ash layer	Fire- dogs	Stands	Settlement ev.	Chronology
1	Isola di Coltano	70%, local prod.			Yes		Yes			MBA1-2 to FBA
2	Galafone	Majority, local. prod.					Yes			FBA?, EIA
3	Riva degli Etruschi	Majority								FBA
4	Poggio del Molino	Majority							Yes	RBA, FBA
5	La Torraccia	Majority								FBA3 or EIA
6	Baratti	Majority	Clay deposit	1						FBA or EIA
7	Torre Mozza	Majority								FBA or EIA
8	Puntone Nuovo-Le Chiarine	Majority	Clay deposit	3						FBA
9	Puntone Nuovo-Campo da Gioco	95%, local production	With CaCO ₃ layer	3						EIA
10	Puntone Nuovo-Meleta	Majority		3						EIA
11	Puntone Nuovo-Fiumara	Majority								MBA, FBA
12	Puntone Nuovo-Fosso del Fico	Only								FBA
13	Portigliani - Campo da Gioco	Majority	"Some with CaCO ₃ layer; one lined with burnt clay"							FBA3 or EIA
14	Portigliani	Majority								
15	Poggio Carpineta	Majority								
16	Tombolello	Only								FBA or EIA
17	Casa San Giuseppe	Only (and one amphora)								EIA
18	Punta degli Stretti	65,9%								FBA3
19	Poggio Pertuso	Majority				2				EIA
20	Duna Feniglia	Majority	Often lined with clay, often with CaCO ₃ layer	1						EIA

Num.	Site	Reddish jar potsherds	Pit(s)	Kiln(s)	Hearths	Ash layer	Fire- dogs	Stands	Settlement ev.	Chronology
21	Fontanile delle Serpi	Majority?							Yes	FBA or EIA
22	Le Saline di Tarquinia	Majority								EIA
23	Bagni Sant'Agostino	Only								EIA
24	La Frasca	Majority	Yes						Yes	EIA
25	Acque Fresche	Majority		1					Yes	EIA
26	Torre Valdaliga	51%	Lined with clay						Yes	EIA
27	La Mattonara	63%	Some lined with clay							FBA?, EIA
28	Punta del Pecoraro	Only								EIA
29	Malpasso	Only (in the EIA)								EIA
30	Marangone	Only (in the EIA)								EIA
31	Torre Chiaruccia/ Foce Guardiolo	Majority	Lined with clay							EIA
32	Colonia dei Calabresi	Only reddish fragments								EIA
33	Quartaccia	Only, and one bowl								FBA?, EIA
34	Grottini	Only, and one bowl							Yes	EIA
35	Greppa della Macchiozza	Majority								FBA or EIA
36	Cretarossa/San Rocco	Majority								EIA
37	Le Grottacce	Majority								FBA
38	Pelliccione	80-85%								FBA
39	Saracca	Majority	Clay deposit							RBA
40	Area Stop 4	Majority								EBA?, MBA?, FBA?
41	Fosso Moscarello	Majority								FBA
42	Caprolace	Majority						Yes		MBA
43	La Cotarda	Majority								?

Table 1. Briquetage sites shown in figure 2: characteristics and chronology (see Alessandri et al. 2019 for the references).

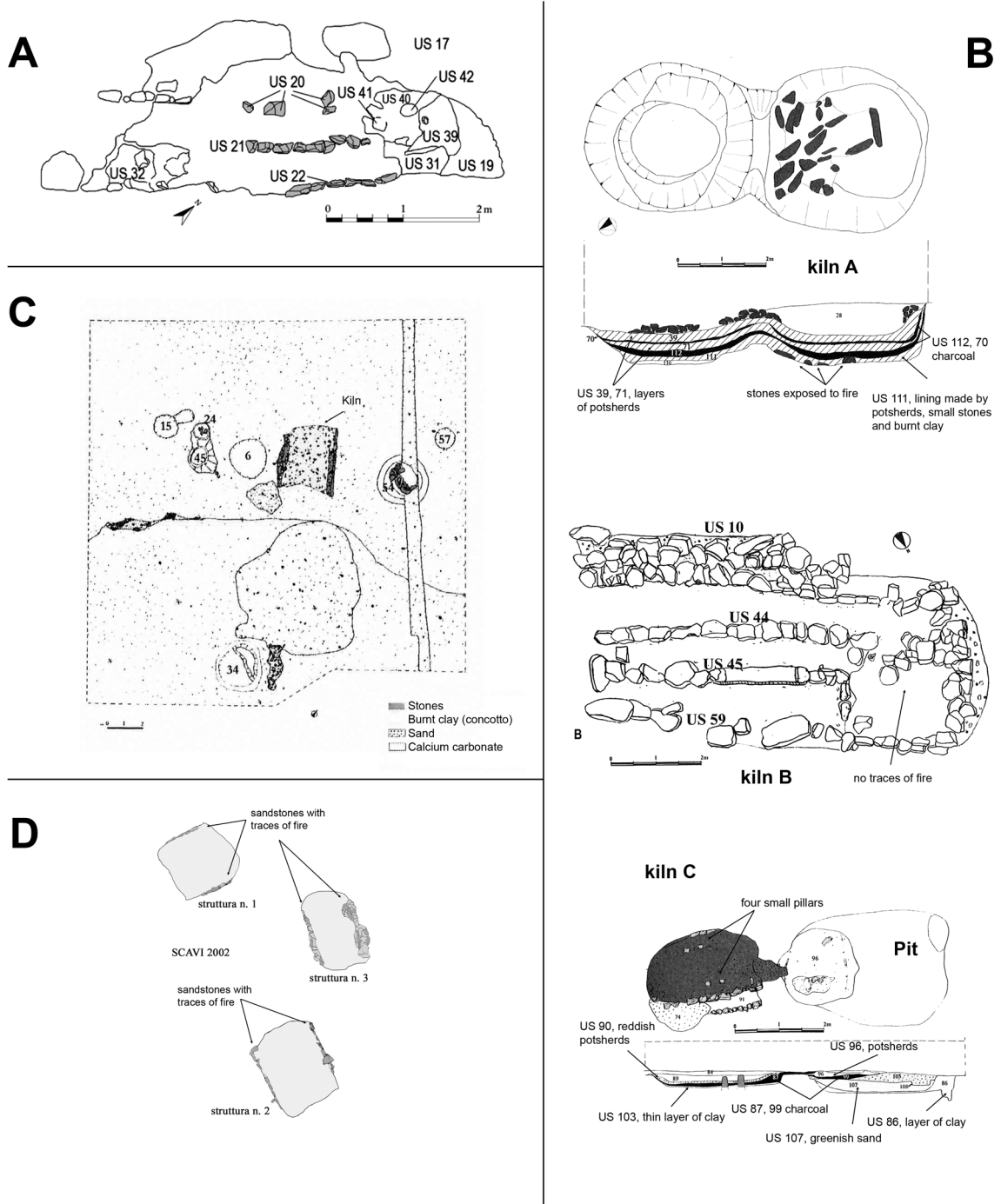


Fig. 3. A, Baratti, area Centro Velico (from Baratti 2010). B, the three kilns at Puntone Nuovo – Le Chiarine (from Aranguren 2009); C, ‘Saggio A’ at Portigliani – Campo da Gioco (from Aranguren & Castelli 2011); D, the three kilns at Puntone Nuovo – Campo da Gioco (from Aranguren et al. 2014).

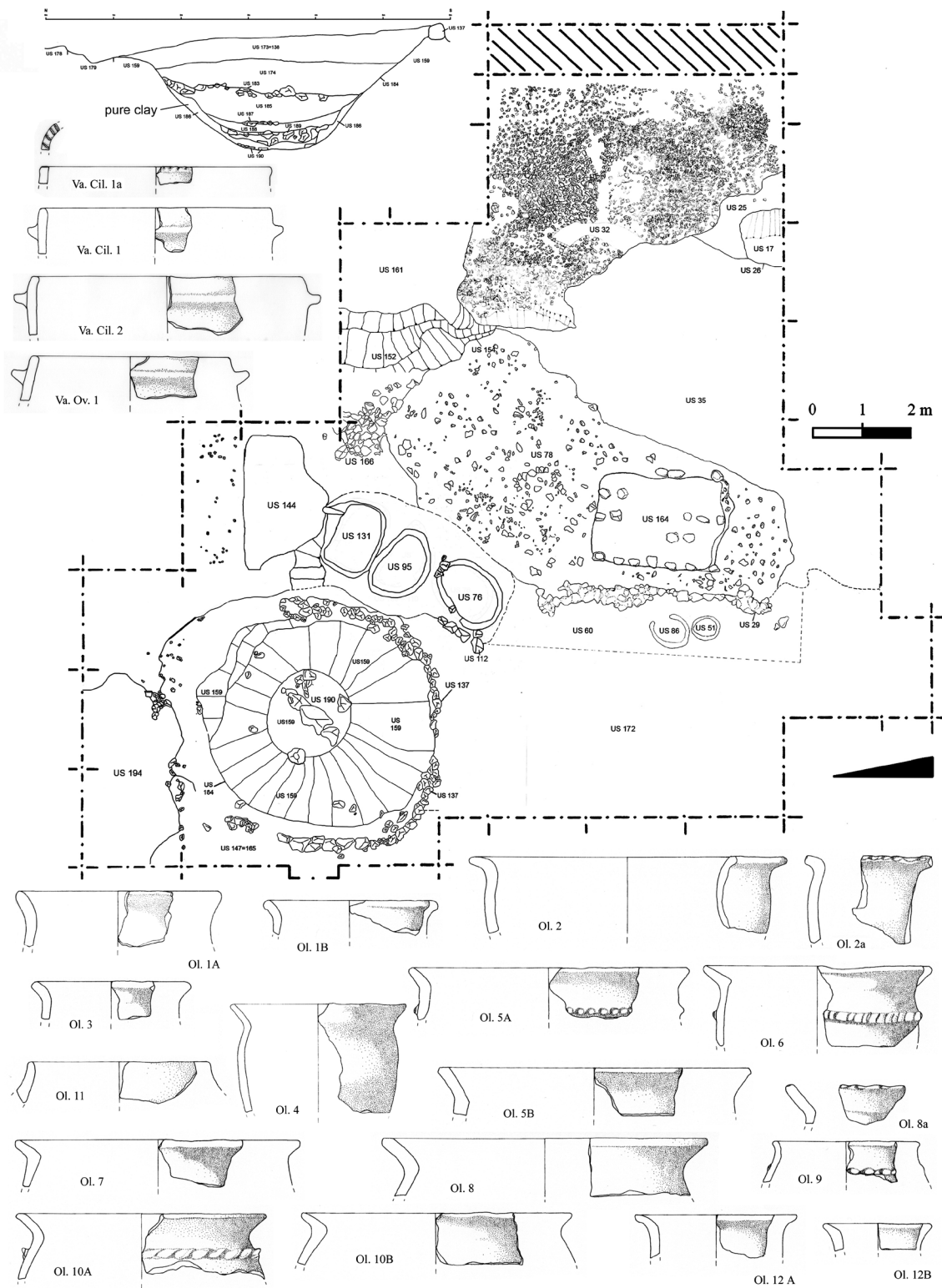


Fig. 4. Excavation area at Duna Feniglia (Saggio D) and the profile of the large pit (from Rossi et al. 2014); the jar typology: Va.Cil., cylindrical vessels; Va.Ov., ovoid vessels; Ol., jars; scale 1:8 (from Benedetti et al. 2008).

with the reddish-brown jars is uncertain, due to the lack of diagnostic fragments: at the moment only one decorated potsherd could be dated to the final stage of MBA (subphase 3).

To conclude this overview, we mention a group of FBA sites from Campania, at San Marco, Agropoli,³⁸ and Napoli, Duomo,³⁹ where considerable quantities of reddish-brown sherds of impasto jars were found on the ancient shoreline, in combination with pits, fire traces, and a vat lined with white concretions.

DISCUSSION

Pottery production and dating

At the moment, a presumed local provenance of the vessels at the various sites mentioned can only be hypothesised. Preliminary chemical analyses of a number of potsherds from Puntone Nuovo – Campo da Gioco and Isola di Coltano, however, did point to a local origin of the clay.⁴⁰ At the site of La Saracca, two vats filled with clay (ready to use?) were found in a sandy profile.⁴¹ The location was at only a short distance from an exposure of Marne Azzurre, exposed by marine erosion, which could have been used to obtain the clay. Finally, in Duna Feniglia, a very large vat was excavated, partially filled with a layer of clay (SU 186). The feature has been interpreted as a clay deposit for pottery making (*fig. 4*).⁴²



Fig. 5. Selection of pedestals from Caprolace.

Almost all the jars from the Bronze and EIA Age sites north and south of the Tiber have been studied and classified (*fig. 4* and *6*). North of the Tiber most of the potsherds come from sites located at the foot of the Tolfa Mountains and are dated to the EIA.⁴³ The ceramic assemblage includes many reddish-brown coarse ware jars, with a fairly rough surface, frequently with a horizontal cord decoration, and occasionally with a semi-circular, rectangular or trapezoidal saddle grip. Because of the large number of horizontal angular handles of the same type of impasto, we think that many jars had handles. Most of the rims, either unclassifiable or of uncertain origin, probably belong to this group of jars. South of the Tiber, the majority of the reddish potsherds come from the Pelliccione site.⁴⁴ Here, the ceramic assemblage is characterized by 80/85% jars, half-conical or ovoidal in shape. The vessels are often decorated just below the rim by horizontal notched ribs with sometimes incorporated grips. The published vessels from Duna Feniglia show a very similar typology.⁴⁵

The dating of these sites is mostly based on ceramic typology and spans from the Isola di Coltano and Caprolace MBA layers to the EIA, although the peak of the phenomenon has to be placed within the latter. Only a few radiocarbon dates are available. These includes two dates on animal bones from Pelliccione (*fig. 1, n. 38*) which were 2945 ± 45 BP (GrA 22090, 1278-1012 calBC) and 3005 ± 45 (GrA 22092, 1399-1113 calBC) and confirm the FBA chronology of the site.⁴⁶ Another radiocarbon date, on charcoal, comes from Portigliani-Campo da Gioco (*fig. 1, n. 13*): 2660 ± 40 BP (Beta 215476, 901-792 calBC), placing the context in the EIA.⁴⁷ All dates mentioned are calibrated using OxCal 4.3, IntCal 13, with a probability of 95,4%.

Content

On the content of the jars there are no decisive data yet. So far chemical analyses are only available for some potsherds from Puntone Nuovo – Campo da Gioco. These analyses, however, did not yield unequivocal evidence for their use in a salt production process.⁴⁸ Following on Pacciarelli's initial hypothesis that the coastal sites mentioned above might be related to salt production, other scholars have suggested other possible uses for the jars, for example to boil food products containing fish and salt.⁴⁹ In this context it is worth noting that small ports for fish breeding and/or the production of *garum* were built during the Roman period at four Iron Age coastal sites

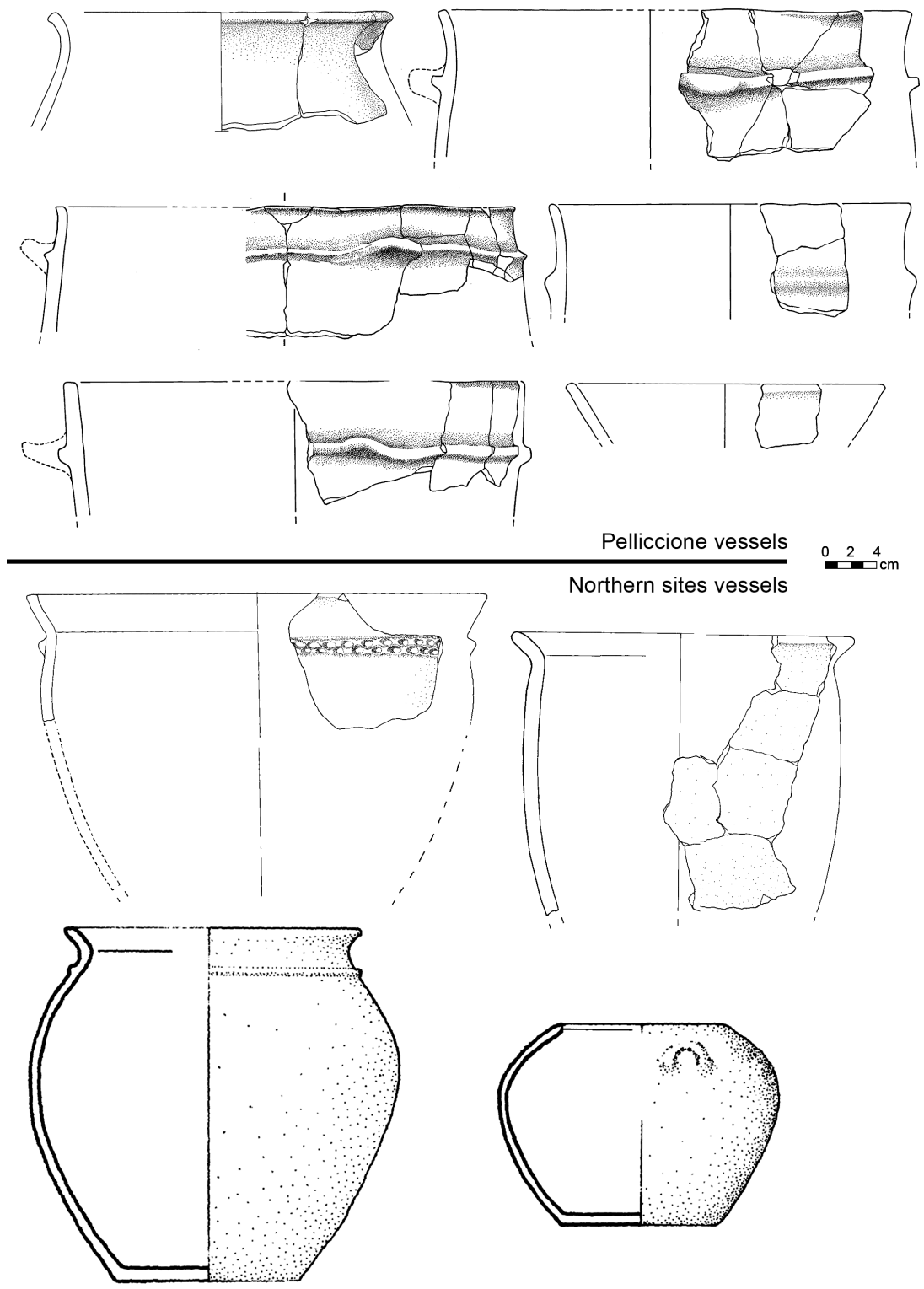


Fig 6. Representative samples of the “briquetage” vessels North of the Tiber (from Belardelli, 2013) and South of the Tiber (Pelliccione, from Nijboer et al., 2006).

north of the Tiber (Torre Valdaliga, La Mattonara, Punta Pecoraro, Torre Chiaruccia/Foce Guardiole).⁵⁰ Similarly, south of the Tiber several fishponds have been found on the coast between Nettuno and Torre Astura⁵¹ at locations where several sites with reddish-brown jars have been found (Le Grottacce, Pelliccione, Saracca, Area Stop 4). This observation has led some authors to postulate that the Romans may have built further on a fish industry that had its roots in the proto-historical period, benefitting from the same environmental conditions to produce a comparable commodity.⁵² Obviously there is a chronological hiatus here, but in support of this hypothesis we may mention that at the site of Cretarossa/San Rocco (also known as Nettuno, Depuratore) deposits of reddish-brown pottery dating from the 7th century BCE to the Archaic period have been recorded and published,⁵³ while the current excavations of the Groningen Institute of Archaeology, the Soprintendenza di Etruria and the University of Naples at Puntone di Scarlino have revealed ceramic deposits dating to the Orientalising period (7th century BCE, pers. comm. M. R. Cinquegrana).

Nature of the production sites

From the contexts cited we can deduce that the specialised activity indicated by the pottery debris heaps and related excavated structures took place either in specific areas within settlements or completely separated from settlements. In the former case, the evidence is the presence of other shapes and wares than reddish-brown impasto jars, i.e. both open and closed shapes and fragments of a finer coarse ware, usually smoothed and burnished. In such cases functional elements other than furnaces and vats were also present, like building remains and objects related to domestic activity (i.e. kilns, bobbins, and spindle whorls). This is the case, for example, at Torre Valdaliga⁵⁴ and Caprolace (unpublished). Differentiation within the archaeological assemblages can be used to discern between residential and specialized activities, even when dealing with surface finds, like at Le Saline di Tarquinia.⁵⁵

However, when the pottery debris heaps occur without clear evidence of domestic use in the form of a minimal presence of tableware potsherds, which north of the Tiber often have Iron Age Villanovan decoration, we likely deal with veritable special activity sites whose location is separated from domestic sites. We note, however, that up to now sites have only been partially excavated.

Socio-economic context

The sites listed here mainly date to the later stages of the Bronze and initial stages of the Iron Age, which is a period characterized by fundamental changes in settlement organization, both north and south of the Tiber. In southern Etruria, a network of nearly 70 settlements, with an average size of 5-6 hectares, was abandoned with the population concentrating in five vast settlement areas of more than 100 hectares.⁵⁶ Also for northern Etruria, a similar process of synoecism has been hypothesised, especially for the coastal area around the Iron Age settlement of Populonia.⁵⁷ In the same time span, in *Latium Vetus* the sub-coastal inland settlements expanded, for example Lavinium, Ardea and, slightly afterwards, Rome.⁵⁸ Moreover, south of the Tiber the grave inventories become richer, featuring indicators of political-military and religious functions, which are commonly interpreted as signs of an emerging elite.⁵⁹ The expansion of the settlement areas, notably in Etruria, reflects population growth and increasing food demands, among which probably marine products. Hence, the common hypothesis is that these contemporary specialized coastal sites were organized by the elites of the developing urban settlements as part of a new territorial organisation.⁶⁰

Paradoxically, later in the Iron Age, in a period of concomitant economic and demographic growth as is evident from burial grounds and settlement sizes, the number of specialized sites decreases. As far as salt production is concerned, we note that to produce large quantities of salt, solar evaporation of salt water in artificial basins in coastal lagoons is a mode of production that is more efficient and less labour intensive than the *briquetage* technique. Interestingly, traces of Roman saltworks, dated to the first century BCE, have recently been excavated near the Maccarese lagoon, at the mouth of the Tiber river.⁶¹ This is in a location where many Roman authors placed the salterns of the Etruscan city of Veio and, later, the *Campus Salinarum Romanarum*.⁶² In this formerly wet area, which was only seasonally submerged, also FBA artificial mounds together with clear evidence for cooking and/or boiling activities (kilns and fireplaces) have been found. The area has already been interpreted as a specialized area where agricultural and artisanal practices took place: mostly breeding but also dairy activities, tissues and bone processing.⁶³ It is well possible that briquetage-like activities took place here alongside solar evaporation to obtain salt. Since the solar evaporation of seawater produces unrefined salt (with other impurities and miner-

als like magnesium and calcium carbonates), which is bitter and has an unpleasant taste,⁶⁴ the specialized activities detected on the mounds may have been partially related to a subsequent phase of salt-refinement.

CRITICAL ISSUES

In the interpretation of the evidence discussed so far, several critical issues remain to be further investigated, especially the salt production hypothesis.⁶⁵

Absence of typical briquetage equipment

It must be noted that, at a number of sites, the typical *briquetage* equipment (e.g. pedestals, furnace grids, firedogs) is absent. Firedogs have been found only at Isola di Coltano and Galafone. The chronology of the former covers the beginning of MBA up to the FBA;⁶⁶ Galafone is an Iron Age site with possible FBA and/or 7th/6th century BCE layers.⁶⁷ Tufa chunks with traces of fire come from the FBA Pelliccione.⁶⁸ On the Tyrrhenian side of Italy, pedestals have only been collected in Caprolace. On the Adriatic side, a large quantity of pedestals has been found at Castelliere degli Elleri, together with some half-conical vessels that might be connected with the production of salt.⁶⁹

The presence of reddish colour in no briquetage-related pottery

In a modern replica of the briquetage process, the vessels indeed acquired a reddish hue after secondary exposure to high temperatures in the presence of oxygen.⁷⁰ Analyses carried out on some potsherds from two Chalcolithic Romanian briquetage sites, Hălăbutoaia à Țolici and Căcica⁷¹ led to the same conclusions. However, the red colour could also be due to an oxidising atmosphere during the pottery production process itself, as seems to be the case at Puntone Nuovo – Campo da Gioco.⁷² Moreover, some other presumably domestic vessels, not involved in the salt production process, have the same colour, like those from Pelliccione, Saracca and Fosso Moscarello (Fig 2, 38, 39 and 41, respectively).⁷³ This would imply that a direct connection between the jar colour and their use in the boiling phase cannot be established with certainty.

Inconclusiveness of the chemical analyses

Several attempts have been made to develop an analytic method for assessing the involvement of the jars – and thus their sherds – in the *briquetage*

process. All of them focus on anomalous quantities of both Chlorine (Cl) and/or Sodium (Na) in the ceramic fabrics. At the sites of Champ-Durand (Vandée, France) and Barycz (Poland), for example, XRF analyses did reveal a very high concentration of chlorine in the pottery in which the brine was supposedly boiled.⁷⁴ Moreover, at the Chinese site of Zhongba, SEM-EDS studies of potsherds revealed a relatively high concentration of both Na (0.7-0.8 wt%) and Cl (0.2-0.3 wt%), progressively decreasing from the interior surfaces towards the exterior, approaching zero at a depth of about, respectively, 1.7-2.1mm and 1.1mm.⁷⁵ A SEM-EDX analysis in a modern replica of the briquetage process gave essentially the same results, with Cl virtually absent at 2mm.⁷⁶ However, advanced chemical analyses (XRDP and SEM-EDS) carried out on a number of potsherds from Puntone Nuovo – Campo da Gioco, supposedly used to boil brine, failed to find Na or Cl in such concentrations that they should be ascribed to salt production. However, Na and Cl are highly mobile elements, which after the deposition of the potsherds may be easily washed out by meteoric or phreatic waters.⁷⁷

Different shapes of containers

The Italian reddish jars are often different from the usual central and Atlantic European briquetage vessels, in both shape and in size. Vessels known from briquetage sites from the latter areas are quite small and half-conical or cylindrical, to enhance the evaporation process, like the ones which have been found at Castelliere di Elleri, on the Adriatic side of Italy. The vessels from the sites described in this paper, which are all on the Tyrrhenian side of Italy, are usually much bigger and some shapes do not seem fit for the evaporation process. Besides, some of them seem too refined for being disposable containers. Even if it is likely that other kinds of vessels were in use, for example for transporting brine or even salt, their percentage seems too high.

Distance of salt source

Finally, it should be noted that sites with large quantities of reddish-brown pottery also occur in inland contexts at significant distance from the coastline or coastal lagoons. Only recently, J. Sevink and W. van Gorp identified in the Pontine plain a new yet unpublished site at La Cotarda, (fig. 1, 43) featuring large quantities of reddish-brown impasto sherds – almost all jars and dolia – at the surface level. La Cotarda may prove to be a key site in the interpretation of this class

of containers, since there are no salt sources in the nearby area (the sea is at 14 km distance). Thus, at least in this case, the hypothesis of salt production must be ruled out. Unfortunately, at the moment, the potsherds collected so far are not suitable for a precise dating.

CONCLUSION

Following Pacciarelli's hypothesis in 1991, the availability of new data has given rise to new questions – as this usually goes – instead of answering the initial one. In fact, several lines of research are still needed to test the hypotheses which have been brought forward so far. In particular, more physical/chemical analyses are needed to assess both the provenance and the contents of the reddish impasto jars. Some analyses are currently being executed by the Groningen Institute of Archaeology at the site of Puntone Nuovo di Scarlino, north of the Tiber, and in the site of Caprolace, south of the Tiber.

Next, we call for more consistent quantitative studies concerning the number of vessels to assess the scale of production.⁷⁸ Even though some authors refer to “quasi industrial” processes,⁷⁹ this statement needs to be more solidly substantiated. Without doubt, the concentration and quantity of reddish jars in Isola di Coltano, Duna Feniglia and Pelliccione are remarkably high. Unfortunately, none of these sites have been completely excavated, hence the impossibility to assess the overall quantity of potsherds debris and to quantify the estimated output. However, as a comparison we can recall here the “proto-industrial” (Iron Age 7th- 1st centuries BCE) *briquetage* sites in the Seille Valley where 3-4 million m³ of *briquetage* potsherds have been identified in 12 meters high mounds.⁸⁰ Here the term “industrial” has been used with a different meaning. Additional evidence in this sense might also be obtained from environmental studies since for the heating process, when the *briquetage* technique is used, substantial quantities of fuel (probably wood) are needed, which should have resulted in a serious environmental impact on the surrounding landscape.⁸¹

Moreover, the current resolution of the chronologies is too large to determine the intensity of production. Hence, we are not able to distinguish between protracted but seasonal (or occasional) and very intensive but short activities.

As for the shapes of the vessels, a comprehensive morphological and functional typology which encompass all the collected potsherds together, at least on a regional basis, has never been attempted. Such a typology would serve as

a basis to assess both the function and the circulation of vessels and/or ideas.

At the moment, the accumulations of the typical reddish jars along the Tyrrhenian coast cannot be explained only with the ‘salt hypothesis’ and in fact a more diversified coastal economy may have existed at the sites discussed north and south of the Tiber, especially between the FBA and the EIA. In fact, even assuming that most of the sites were related to fisheries and fish processing, another part must have been devoted to salt production for storage and preservation. If that was the case, part of the jars might have been used to transport salt from the production sites to the places where fish was processed. Moreover, if a large part of the products was traded, as suggested by many authors,⁸² the differences in shape between the jars may be explained by the different traded products: fish, sauces, salt. It must be noted that many of the sites we discussed are located in or near lagoons, which could mean that access to inland fresh water was necessary, as is the case with seafood production.⁸³ The exact nature of the content of the jar and the possible trading networks would also shed new light on the relationships between these sites and the emerging early states, both in Etruria and in *Latium Vetus*. The very existence of an intertwined and complex organization for the exploitation of both fish and salt would assume, for example, the presence of labour division and coordination, and a flow of information which would have required the presence of a ruling class i.e. the emerging elite of the early states.

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NOTES

- 1 Harding 2013.
- 2 Cappuccio/Capewell 2010.
- 3 Bergier 1982.
- 4 Kurlansky 2002.
- 5 Harding 2013; Heth 2015.
- 6 Lugli *et al.* 2007; Roveri *et al.* 2014; Harding 2014.
- 7 Lanciani 1888; Grossi *et al.* 2015.
- 8 Harding 2013; Weller/Brigand 2015.
- 9 Daire/Le Brozec 1990; 1991; Daire *et al.* 2001; Daire 2002.
- 10 Kinory 2012.
- 11 Weller *et al.* 2008; Sordoillet *et al.* 2018.
- 12 Pacciarelli 2001.
- 13 Pacciarelli 1991.
- 14 Lane and Morri, 2001.
- 15 Chowne *et al.*, 2001.

- 16 Mandolesi 1996; Pacciarelli 2001.
 17 Di Fraia/Secol, 2002; Di Fraia 2006.
 18 Baratti 2010.
 19 Aranguren 2001; 2002; 2003; Aranguren/Castelli 2006;
 Aranguren 2008; Aranguren *et al.* 2014; Aranguren/
 Cinquegrana, 2015.
 20 Baratti 2010.
 21 Daire/Le Brozec 1990; 1991; Daire *et al.* 2001; Daire
 2002.
 22 Laffite 2002.
 23 Levi/Laviosa 1986; Puglisi 2011.
 24 Shaw *et al.* 2001.
 25 Belardelli *et al.* forthcoming.
 26 Negroni Catacchio/Cardosa 2002; Cardosa 2004.
 27 Benedetti *et al.* 2008; 2010; Rossi *et al.* 2014; Rossi 2017.
 28 Belardelli/Pascucci 2002; Trucco, di Gennaro/D'Ercole
 2002.
 29 Mandolesi/Trucco 2002.
 30 Belardelli 1999.
 31 Pascucci 1998; 1999; Belardelli/Trucco/Vitagliano 2008.
 32 Attema/Nijboer/Rooke 2002; Attema/de Haas/Nij-
 boer 2003; Nijboer/Attema/van Oortmerssen 2006.
 33 Alessandri 2013.
 34 Bell 1990.
 35 Weller 2000 figs 47–49.
 36 Nenquin 1961; Weller 2000 fig. 83.
 37 Alessandri 2013. Pending the draft of this contribute,
 Alessandri *et al.* 2019 has been published which con-
 firms the chronology of the briquetage phase.
 38 Albore Livadie *et al.* 2010.
 39 Belardelli *et al.* forthcoming.
 40 Di Fraia/Secoli 2000; Aranguren *et al.* 2014.
 41 Alessandri 2007.
 42 Ross, 2017.
 43 Belardelli 2013.
 44 Nijboer/Attema/van Oortmerssen 2006.
 45 Benedetti *et al.* 2008.
 46 Attema/de Haas/Nijboer 2003.
 47 Aranguren/Castelli 2011.
 48 Aranguren *et al.* 2014.
 49 Belardelli/Pascucci 1996; Belardelli 2013.
 50 Belardelli 2013.
 51 Higginbotham 1997.
 52 Belardelli 2013.
 53 Alessandri/Tol 2007; Tol *et al.* 2012.
 54 Maffei 1981; Belardelli/Pascucci 1996.
 55 Mandolesi 1996; 1999.
 56 di Gennaro/Peroni 1986; Pacciarelli 2001; Barbaro 2010.
 57 Bartoloni/Rossetti 1984; Milletti 2015.
 58 Guidi 2006; Alessandri 2013; Fulminante 2014.
 59 Bietti Sestieri 2005; Guidi 2010; De Santis 2011; Alessan-
 dri 2016.
 60 Pacciarelli 2001; Negroni Catacchio/Cardosa 2002;
 Alessandri 2013; Belardelli 2013.
 61 Ruggeri *et al.* 2010; Grossi *et al.* 2015.
 62 Pavolini 1989; Camporeale 1997; Morelli/Forte 2014.
 63 De Castro *et al.* 2018.
 64 Harding 2013.
 65 Di Fraia, forthcoming.
 66 Pasquinucci/Menchelli 2002.
 67 Pasquinucci/Del Rio/Menchelli 2002.
 68 Attema/Alessandr, 2012.
 69 Càssola Guida/Montagnari Kokelj 2006; Montagnari
 Kokelj 2007.
 70 Tencariu *et al.* 2015.
 71 Sandu *et al.*, 2012.
 72 Aranguren *et al.* 2014.
 73 Nijboer/Attema/van Oortmerssen 2006; Alessandri
 2007.
 74 Ard/Weller 2012.
 75 Flad *et al.* 2005.
 76 Tencariu *et al.* 2015.
 77 Flad *et al.* 2005; Horiuchi *et al.* 2011; Sandu *et al.* 2012.
 78 Costin 1991; 2001.
 79 Pacciarelli 2001; Alessandri 2013.
 80 Olivier/Kovacik 2006; Olivier 2009; Jusseret *et al.* 2015.
 81 Villalobos/Ménanteau 2006; Riddiford *et al.* 2012.
 82 Pacciarelli 2001; Alessandri 2013; Belardelli 2013.
 83 Belardelli/Pascucci 1996; Thurmond 2006.

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