4.0 Characterising Sites and Salt-Producers. The Archaeology of an Ancient Craft and Identification of 'Know-How'

4.1 Introduction

Chapter **4.0** presents the archaeological evidence according to the *processes*/*stages of salt-production* and within these categories highlights evidence for 'know-how' and skillsets long lost. These categories present presents key examples of archaeology associated with each stage of the salt-production *process*, as defined in **2.2.2** (Figure 2.2), as a way of understanding *technique*s and variations in technology in more detail. This then reveals some of the knowledge required and acted out within sites by skilled salt producers.

The main themes considered in this chapter are listed in Table 4.1.

Table 4.1 Common Themes presented in Chapter 4.0

Common Themes	Stages of Salt-Production
	Techniques of Salt-Production
	Lifecycle and Narratives of Sites and Objects
	Uses of Space within the Site
	Site Organisation and Management
	Characterising Salt-Production Sites in the Study Area

With such emphasis on the problems presented by inconsistent, 'disconnected' and potentially generic terminology in **3.0**, it is important that key terminology/themes/concepts used within this chapter are made clear at the outset.

Key terminology used within this and the following chapters, is listed in Table 4.2.

Table 4.2 Common terms used within Chapter 4.0

Common Terms	Description
Site Lifecycle	The '*chaîne opératoire'* of a site, including artefact production, feature use and salt-production
Site Narrative	The story of a site from start to finish and the way in which this 'story' was acted out over time and space
Salt-Production Process	All the components required to produce salt, including all site preparation, groundworks and artefacts. This incorporates human action as well as technology
Salt-Production Technique	A series of human actions and methods taking place in a certain order to produce crystal salt
Stages of Salt-Production	Main events required in order to produce crystal salt
Use of Space	The way in which different areas of a site was perceived and used for different activities
Working Area	The main working area in the salt-production site salt (containing at least Stage 2/3 and probably Stage 1)

4.1.1 Presentation of Chapter 4.0

As stated above, this chapter focuses upon salt-production as a process that took place within the lifecycle of a site.

The term *process* can sound 'sterile'. Salt-production at its core, *is* a process of actions acted out in a certain order, to achieve the end goal of obtaining crystalline salt from solution. Therefore in order to illustrate this, diagrams have been frequently used throughout this thesis, to explain technical factors and actions involved in production. However, this does not imply that salt-production was in anyway 'automatized' or carried out in a uniform, systematic way across *all sites*. Far from it; every single different variable, including technological stages, feature and briquetage design and the way that space was used, were all dependent upon human decision making.

Decisions were required at every step of salt-production; from the primary decision to produce salt, through to the choice of location, the management and use of space, the types/quantities of salt to produce, techniques, and the eventual decision to close the site.

At the end of every salt-production season, producers would need to consider whether they intended to re-use the site in the next season. The way the site was used, and the way waste was managed, would have been partially dependent upon whether they were going to reuse the site or whether it was a ‘one-off’ event. Also, at the heart of these decisions was ‘why’ salt was being produced and where it was going. The salt could have been produced purely for local consumption, or it could have been intended to distribute and trade it further afield.

Therefore, given all these decisions to be considered, it would perhaps appear overly ‘reductive’ to break these sites down into basic physical components, linked to stages within a process. However, mapping out of key stages, does provide the basis for further discussions of technology, technique and use of space.

The techniques derived from the archaeological evidence are presented in flow diagrams for ease of presentation. However, it should be acknowledged that each ‘arrow’ in these diagrams represents people of various ages as well as gender.

The salt producers were people actively living out daily activities. They frequently would have made many short and longer term decisions *before*, *during* and *after* salt was produced. The archaeological remains are therefore ‘echos’ of these actions and thoughts. Therefore, where possible, consideration of different decisions faced by salt-producers are considered.

The most exciting aspect of studying archaeological remains associated with production activities is that unlike many other forms of evidence that represent single ‘snapshot’ events, production sites represent the remains of specialised, repetitive and frequent cycles of activity over longer periods of time in specific spaces.

Therefore this chapter is presented in a way that maps out a general list of actions and decisions that would have had to be considered by salt-producers, in order to explore whole lifecycles of salt-production and their physical remains.

This is a deliberately ‘generic’ overview, and it is acknowledged that these variables would have been at the mercy of complex human and environmental conditions that could have resulted in adaptations to ‘normal’ procedures.

Data tables for this chapter are provided in Appendix **10.2**.

4.2 Narratives of a Salt-Production Site

As stated above, there were many actions, events and skills required for the creation and establishment of a salt-production site. These actions were determined by individual or group choices, which would have been different for each site, dependent upon rules and norms of localised and regional social organisation and topographical conditions.

As stated above, the archaeological remains preserve the result of these actions. These sites contain evidence of at least one season of use, where, as stated above, repetitive actions could have taken place.

Therefore each site had a unique individual lifecycle and narrative, which incorporated its creation, *use*, disuse and abandonment. Unravelling this lifecycle is required in order to deconstruct a site into its basic components, which can then be contextualised and understood in more detail.

This includes the lifecycle of the site, the cycle of production and technology, including briquetage creation and deposition, as well as the daily cycle of living for individuals using the site (Figure 4.1). There were multiple lifecycles simultaneously taking place within each site.

All of the elements are important to understanding each site, and it is the element of site ‘use’ that is of most importance in this research project. Space was occupied and used in specific ways, and different techniques were employed over variable periods of time to achieve the production of salt (aim).

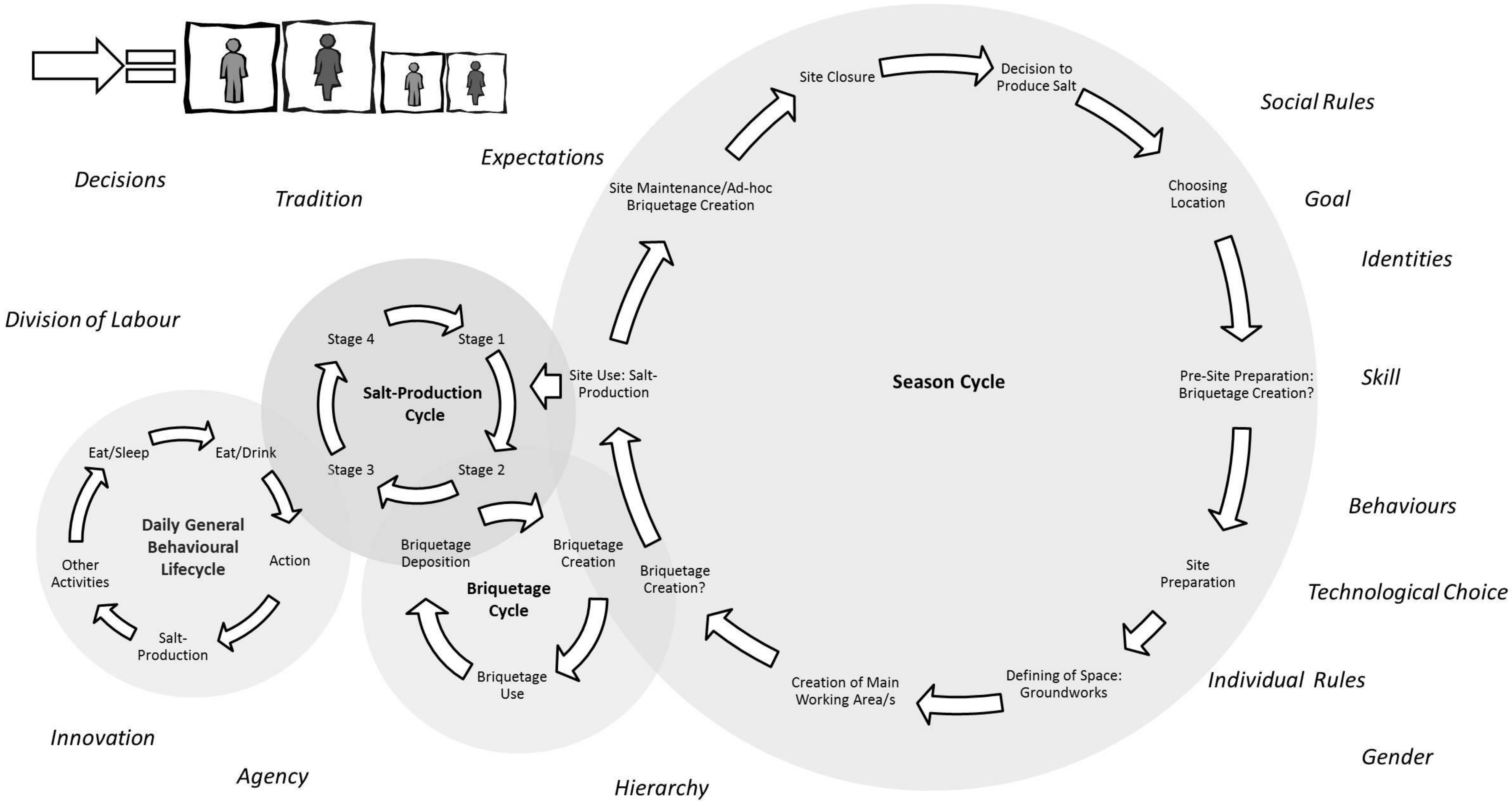

Figure 4.1 Simplified 'breakdown' of site and event cycles revealing the multiple 'layers' of action and thought potentially associated with salt-production. Each arrow represents people associated with this process

4.2.1 Planning a Salt-Production Site

Planning to produce salt before the site had been created required consideration of many important factors. This included knowledge of the local economy, landscape and most importantly and essentially, the knowledge and skill base needed to actually produce salt.

There were many factors that would have influenced the *location* of sites in order to produce salt (Table 4.3).

Table 4.3 Factors affecting the choices of where to locate a salt-production site (the most important factors are highlighted in bold)

Factor Type	Factors
Logistical	**Access to saltwater**
	Access to transport/trade routes (land and water)
	Location of main consumers
	Territory boundaries
	Location of settlements
	Local meat and fish supplies (if they are to be salted)
Environmental	**Seasonality**
	Local rainfall
	Salinity levels
	Speed of water movement and sedimentation
	Raw materials
	Topography/Geology
Social	**Tradition and Perception**
	Technology/Technique Choice
	Skill/knowledge base

4.2.1.1 Logistical Factors

Every salt-production site required access to saltwater either directly on the coastline or indirectly within estuaries and marshes with inlets. Not all coastal or inlet sites are practical for producing salt.

Those sites producing salt for use beyond local requirements would have required good access to trade routes by land or sea to transport the salt. Poole Harbour and North Kent are good examples of areas that had well-established trade networks by the Late Iron Age, distributing many goods including large quantities of pottery (Cunliffe 2005).

Access to local meat and fish supplies may have also been important to those sites specialising in the salting of foodstuffs as a secondary product to the salt.

Some sites were located nearby or within settlements. Other sites were created some distance away from settlements and were occupied by small numbers of people, presumably mainly during the summer months. Territorial/political boundaries would perhaps have also been an important consideration in the placement of sites.

4.2.1.2 Environmental Factors

The onset of warmer and sunnier weather would have been an important indicator that it was time to begin production of salt. Similarly the end of summer would have provided a natural end to most salt-production sites, which were reliant on the hot sun to aid in the *initial* processing and concentration of seawater to produce brine.

Local environmental factors would have played a massive role in the location of a salt-production site as this process is highly sensitive to subtle variations in climate, salinity levels and geology. Therefore areas with less rainfall would have been preferable as salt-production nearly always took place outdoors (rainfall would affect salinity levels). The higher the salinity the more efficient salt-production would be. Ideally a site would also be exposed to wind as this is an integral part of the brine evaporation process, as demonstrated by the locations of many Red Hill sites in Essex including Osea Road (De Brisay 1978: 39).

The local environment and topography would also have been important in determining the *method used to produce salt,* as different areas offer different options for salt extraction. This is especially important if ‘sleeching’ was used, involving the extraction of salt from salt-impregnated organic material such as silts and plants.

4.2.1.3 Social and Cultural Factors

Environmental factors were out of human control and salt-production had to adapt to them. However, they were not the sole consideration. Social and cultural factors also have to be taken into account and it is important not to underestimate the importance of these in the planning of salt-production site.

For example, tradition may have dictated who was permitted to produce salt and there may have been taboos as to where it could be carried out. Some social perceptions may have dictated that taking anything from the sea was symbolically complex and therefore required a degree of ritual behaviour to make extracting the salt socially acceptable (Hathaway, 2008).

4.3 Raw Material Procurement and Site Preparation

Good access to appropriate raw materials was a hugely important factor when planning a salt-production site. Firstly, a good source of local clay would be required, not only to make the briquetage, but also to provide working floors and the lining for settling and/or evaporation tanks, water storage features, open and enclosed hearths and ovens.

Access to fuel supplies was also very important in order to fire briquetage and heat the hearths or ovens (MacGregor and De Wardener 1998: 66; Gale 2003: 35; Akridge 2008: 1453). The types of fuel used were only recorded for 13 sites (Table 10.2.1) with peat and charcoal being the most popular. Evidence for peat-cutting potentially indicating it was used as fuel in salt-production was revealed by fieldwork in the Central Somerset Levels (**6.0**).

The use of wood for fuel in industrial processes can drastically change the surrounding landscape, if they were carried out over a longer time or larger scale, as seen in the Seille region of France (Olivier and Kovacik 2006). Peat cutting can also have a drastic effect on the appearance of a landscape such as the Somerset Levels (Nicholson and Connor 2000).

4.3.1 Briquetage Creation

The bulk of briquetage creation would have probably taken place before the site was created, as the forms were closely linked to hearth types and dimensions. However, supplementary and replacement briquetage would also have been created during salt-production. It seems probable that new briquetage was created for each new season as many of the containers would have been broken up during use in the previous season.

Preparations for briquetage creation may also have involved removing impurities from the clay and adding temper such as gravel, sand and grass. The type of temper used would have largely depended of the availability of local resources.

Most briquetage containers observed during this research were slab-built including both straight-sided and curved forms. Some earlier circular forms could have been made using the coil technique. Nearly all the containers were tempered to strengthen the fabric, however most supports were not tempered and were left with mostly natural inclusions.

Many rectangular container fragments have the impressions of wood and finer linear impressions on one side and there was often little attempt to smooth these (although there are some minor ‘wiping’ impressions on the surfaces of some containers). These impressions were made when clay slabs were laid flat and pressed down onto wooden tables or planks (Figure 4.2).

This simple method of container manufacture was probably commonly used across Europe and beyond. One example on the Black Sea coast had been made by 'placing a cloth into hollowed wooden mould and pressing a thin layer of plastic clay on it' (Riehm 1961: 190).

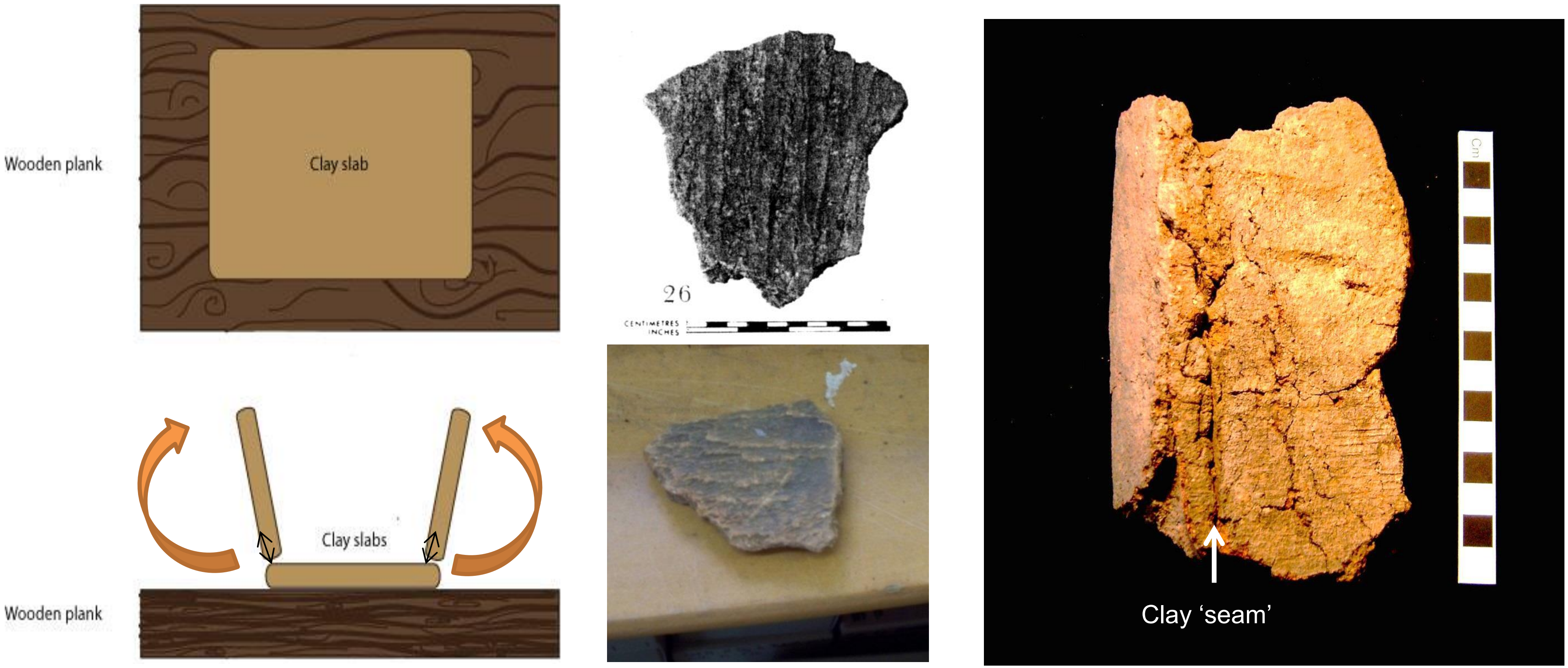

Figure 4.2 Left: Diagram showing technique of slab-building rectangular containers by pressing the clay flat onto a wooden surface Centre: Two sherds of rectangular briquetage containers with impressions of wood on the exterior (Top: Godslington Heath, Dorset (Adapted from Farrar 1975: 16) Bottom: Ebber Rocks (Site 296), Cornwall (Author: 2009)) Right: Base of a briquetage container showing a poorly sealed ‘seam’ between two slabs which began to separate slightly during firing and subsequent use (Author: 2004)

Some bases of briquetage containers from Essex also have the impression of ‘wattling’ (grooves in the clay), probably indicating the placement of wet clay containers onto sticks for ease of moving around and firing (De Brisay and Evans 1975; De Brisay 1981).

Many cylindrical briquetage containers have knife-cut edges and it is probable that these were made in a large single slab, which was cut and curved to meet on two edges and pressed together.

Slabs were made in a similar way by being impressed onto one surface and smoothed on the other; these slabs could be easily formed by cutting the edges with a knife. There is evidence that some slabs in Somerset were impressed on a surface of organic materials and hobnail footwear was pressed onto the upper exposed surface (**6.0**).

The technology used to fire briquetage containers remains unclear, as there are no obvious features associated with this on many sites. However, it is feasible that for those sites associated with local contemporary pottery production, briquetage containers were fired (perhaps using a lower heat) within pottery kilns. For those sites not near pottery kilns, it is most likely that a simple make-shift bonfire or clamp kiln was used to fire containers. This could have simply involved the excavation of a pit within which a fire was created, after the fire was sufficiently smouldering and hot, the containers could have been placed within the pit, and the pit covered with turf. With this in mind, irregular burnt areas within a site should be further explored for evidence of this technique. It is also feasible that containers could have been fired within the main salt-production hearth, as this would also have fired the lining of the hearth for further use.

Bars were made by forming a thick long ‘sausage’ of clay and then cutting the edges with a knife or pressing the edges against a flat edge. Given the hard and robust nature of many bars, it is probable that they were also fired, similarly to containers.

Pedestals were the easiest supports to make and simply involved rolling a sausage of clay, then squeezing and twisting it into a cylinder (Figure 4.3).

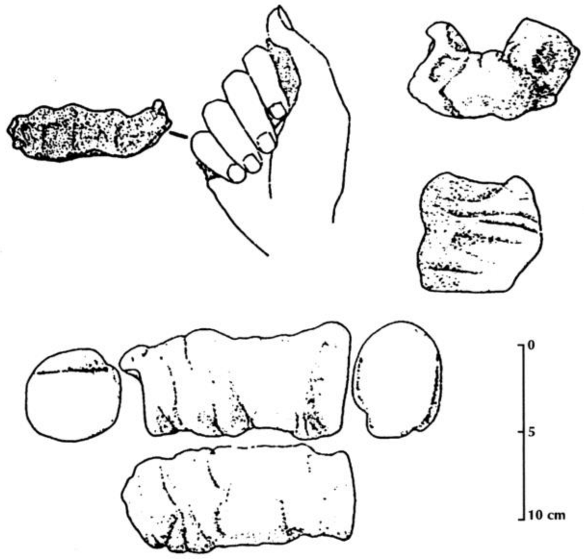

Figure 4.3 Method of forming simple pedestals and rods as found on Iron Age and Roman salt-production sites in France and Britain (Adapted from Daire 2003: 45)

Sometimes the ‘twist’ and even finger impressions are still visible whilst others are smoothed over to form a ‘cigar shape’ (Figure 4.4). Some pedestals have impressed notches or angled areas at the top, probably to support containers better or provide an area on which raw clay could be impressed to attach to the underside of a container.

Figure 4.4 A selection of pedestals found at Site 213 at Hamworthy. Poole Harbour, Dorset (Author: 2004)

Notched pedestals were found on an Iron Age salt-production site in Lincolnshire where the pedestals were thought to have been used in position where the notch was at the base (Lane and Morris 2001: 43-44).

Unlike containers, bars and slabs, which all appear to have been consistently fired, pedestals appear to have only been baked (i.e. left in the sun to harden) and then further hardened during use within a hearth. This evident in the softer nature of the fabric when handled, including a powdery residue often left behind.

Figure 4.5 shows a possible scenario for creating pedestals and may explain why some pedestals have circular notches in the top, as seen in Poole Harbour. Perhaps the pedestals were baked in rows with a small stick running along the upper ends.

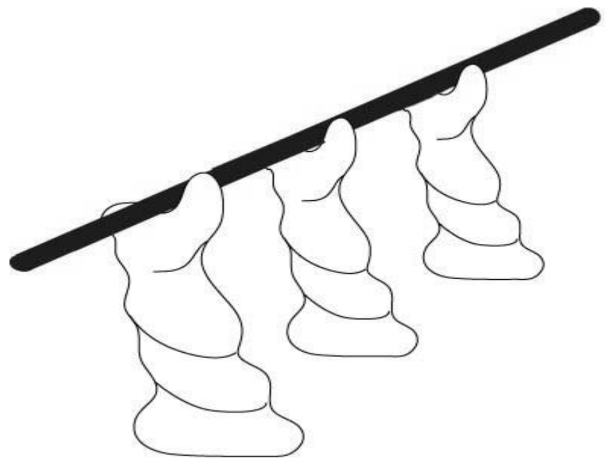

Figure 4.5 A possible scenario for producing squat hand-squeezed pedestals, by baking in the sun (Keith Jarvis *pers comm* 2004)

There is evidence from at least seven sites for discreet areas of raw clay deposited in pits to make the stabilisers and platforms as required (Table 10.1.16). It is also possible that raw clay was kept within containers near the hearths.

4.3.2 Planning the Space: Groundworks and Site Creation

Following or perhaps during the creation of briquetage, ground-works were needed to provide the features required for making salt. This would involve planning the way that space was going to be used within the site.

This could involve digging channels to supply the saltwater, creating small settling/storage tanks and constructing hearths to heat brine and to dry salt. For many sites, this would also have involved the creation of central **working areas** (Table 4.2).

This term will be used throughout this thesis to describe the main area where salt was produced. These working areas often contained a hearth and associated water management tanks.

There would also have to be a strategy for the disposal of waste depending on the scale and the length of time salt-production took place.

4.4 Stages of Salt-Production

As outlined in **2.2.2** (Figure 2.2), the salt-production process can be separated into four main stages: Stage 1: Water Management; Stage 2: Salt Crystallisation; Stage 3: Salt Drying and Stage 4: Debris Deposition.

Table 4.4 Stages of salt-production

Stage		Description
1	**Water Management**	This can involve both the supply of saltwater to a site as well as the subsequent storage and provisional processing of seawater. This can include natural inlets, man-made feeder channels, tanks and reservoirs.
		Brine Concentration through Partial Solar Evaporation In the *case of most sites*, saltwater was placed directly within settling tanks and left to partially evaporate in the sun
1/2	**Salt Crystallisation**	**Brine Concentration through Artificial Heating of Organic Material** An alternative technique *potentially used on some sites* involved the collection of salt-impregnated coastal silts/plants, burning them within tanks or hearths and then saltwater added to concentrate the brine obtained from the organic material
2		Concentrated brine (from both techniques) is heated in order to crystallise salt within a combustion feature (commonly a hearth)
3	**Salt Drying**	Wet salt remaining from artificial heating is dried over a low heat over a different simple hearth
4	**Debris Deposition**	The organisation and deposition of all debris produced salt-production, which can include all briquetage as well as fuel ash and domestic debris

The most common method of producing salt within the study area was to concentrate brine directly from seawater (Figure 4.6: left) using briquetage, or, on some sites, metal containers. This was achieved by using either a combination of solar and artificial evaporation or potentially just artificial evaporation (**1.5.3-1.5.4**).

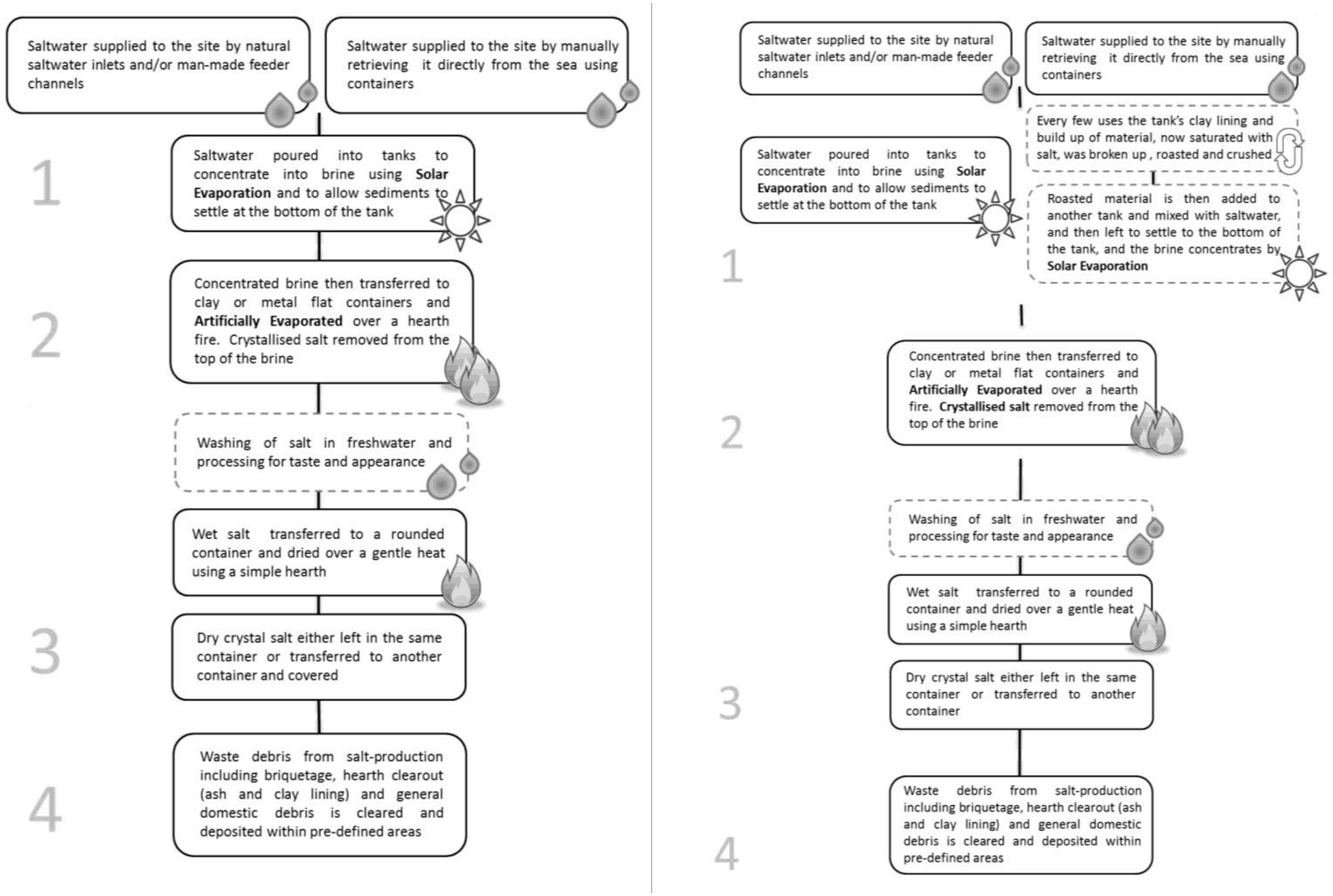

Figure 4.6 Left: Technique I: The most common method used to produce salt directly from seawater in the study area Right: Technique II: Variant of Technique I, where tank lining is re-cycled to obtain salt

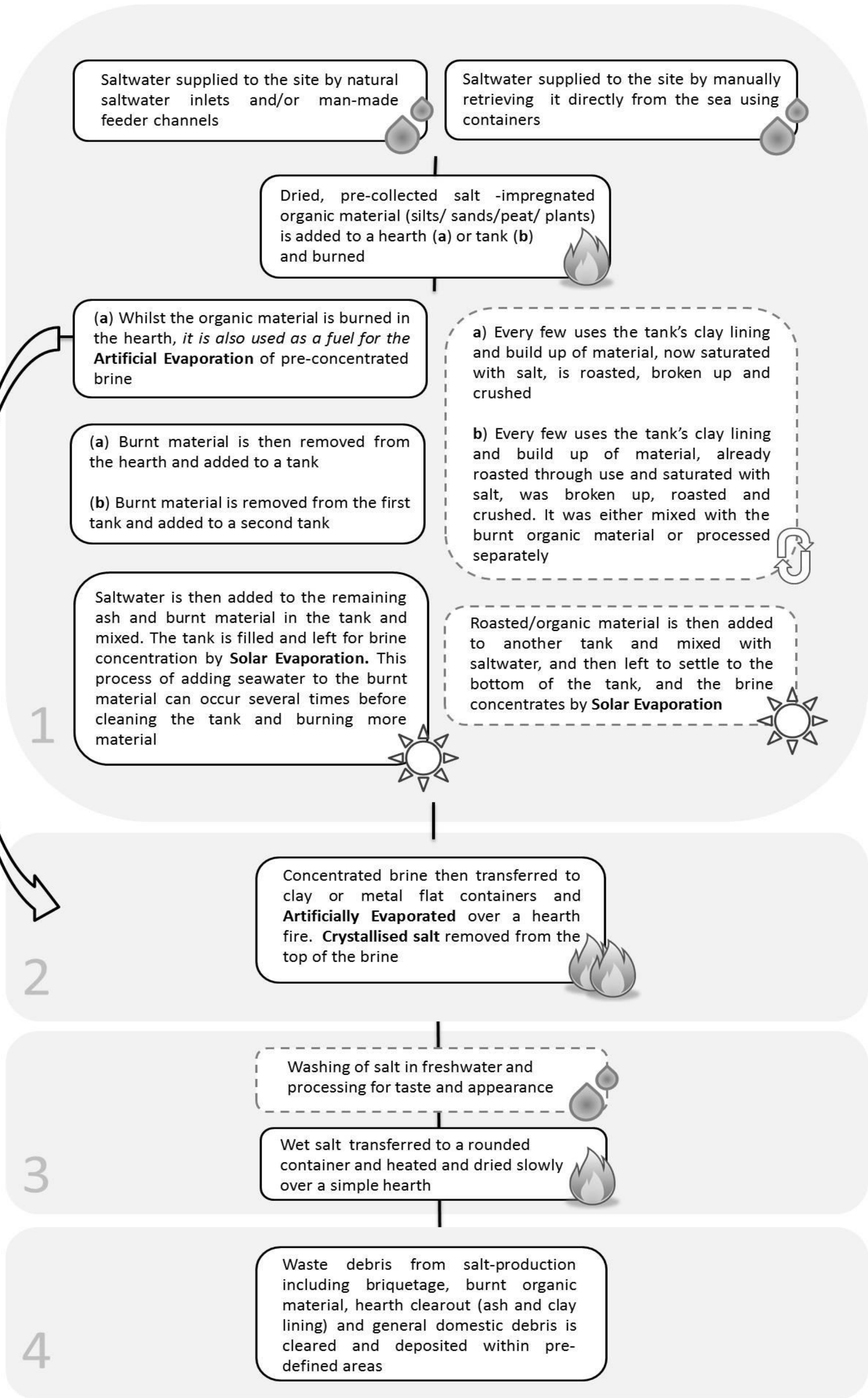

Figure 4.7 Technique III: Method for producing salt by the burning of salt-impregnated organic material

As discussed in **1.5.4**, there were also variants in technique that could have been used to obtain salt on some sites. This could have involved the roasting of clay tank linings periodically to obtain salt (Figure 4.6: right), or the more labour-intensive alternative method of obtaining salt from salt-impregnated materials (sleeching) such as silts, peats and/or plants (Figure 4.7).

Evidence for the use of all three techniques has been evidenced in the study area and they primarily differ in the way that *brine was obtained during Stage1.*

Essentially, all three techniques require the same stages of production and many of the same features. However, due to the differences in the way brine was obtained in Stage 1 (Water Management Stage), the features could potentially be visibly different, reflecting differing treatment and function of features.

Data relating to the evidence for the main stages of salt-production represented across the study area are provided in Appendix **10.2**: Tables 10.2.2-10.2.3. Figure 4.8 summarises the evidence for all stages of the process.

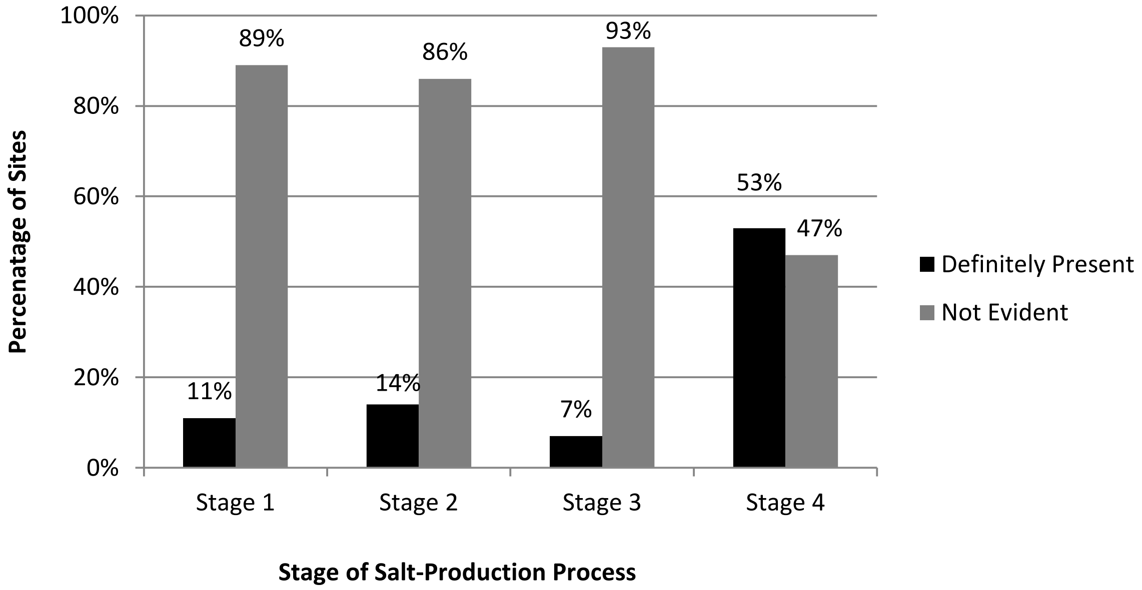

Figure 4.8 Main stages of the salt-production process for all 276 sites (Table 10.2.3)

Stage 1 is evident at only 11% of the sites. Survival of this stage is problematic on coastal sites. If water channels were created, these features are likely to have been obliterated through coastal erosion.

Tanks used to process and store brine may well preserve better, as they are more likely to have been located closer to the hearth working area further inland and are pits that have been cut into the ground and lined with clay.

However, in areas of natural clay, these features are likely to have been cut straight into the ground and may not have survived as well archaeologically.

Stage 2 is evident at 14% of the sites. Evidence for this stage includes hearths which, although often broken up after use, usually survive archaeologically, even if only by small burnt patches. Alongside Stage 4, this stage shows up particularly well in geophysical surveys.

Stage 3 was only positively recorded at 7% of the sites. In most cases it is unclear whether salt was dried in a different hearth or within the same evaporation hearth with a lower heat. Open hearths are less likely to preserve in the archaeological record as they would leave only ephemeral imprints on the ground surface in most cases.

The presence of an 'Open Hearth' cannot definitely prove that is was used for the drying of salt, or even within the salt-production process at all. These simple features could also have been used for cooking or evaporating brine on a small scale. However many 'Open Hearths' are recorded on sites, which also have more complex enclosed hearths. If a site has a contemporary enclosed hearth, then it is plausible that the open hearth was used for drying salt. It is also plausible however, that the same hearth could have been used for both Stages 2 and 3. Therefore Stage 3 has not been confidently identified as a clearly defined separate stage from the data collected.

Stage 4 is the best represented part of salt-production, being identified in at least 53% of the 276 sites. This is to be expected given that briquetage survives so well in the archaeological record.

4.5 Stage 1: Water Management (Table 10.2.4)

As shown in Figures 4.6-4.7, Stage 1 would have differed in Techniques I-II and Technique III, required potentially more investment and effort. Although the features associated with Stage 1 would basically be of a similar form, there would potentially be subtle differences in the way that they had been used, which may be reflected in the archaeological record. Also, the use of Technique III could potentially blur the difference between a hearth and a tank on some sites.

There are a variety of potential different features that could have been used in water management. As presented in Figures 3.30-3.31, there are a total of 242 features associated with water management from 29 sites (Table 10.2.4 and Figure 4.9). This total is dominated by tanks (172), most of which were found on a single site (Site 82: Lydd Quarry, Kent). Stage 1 features were found on nearly half (29/60) the 'Actual Sites'.

Figure 4.9 provides a summary of the main water management feature types across the study area (by number of sites).

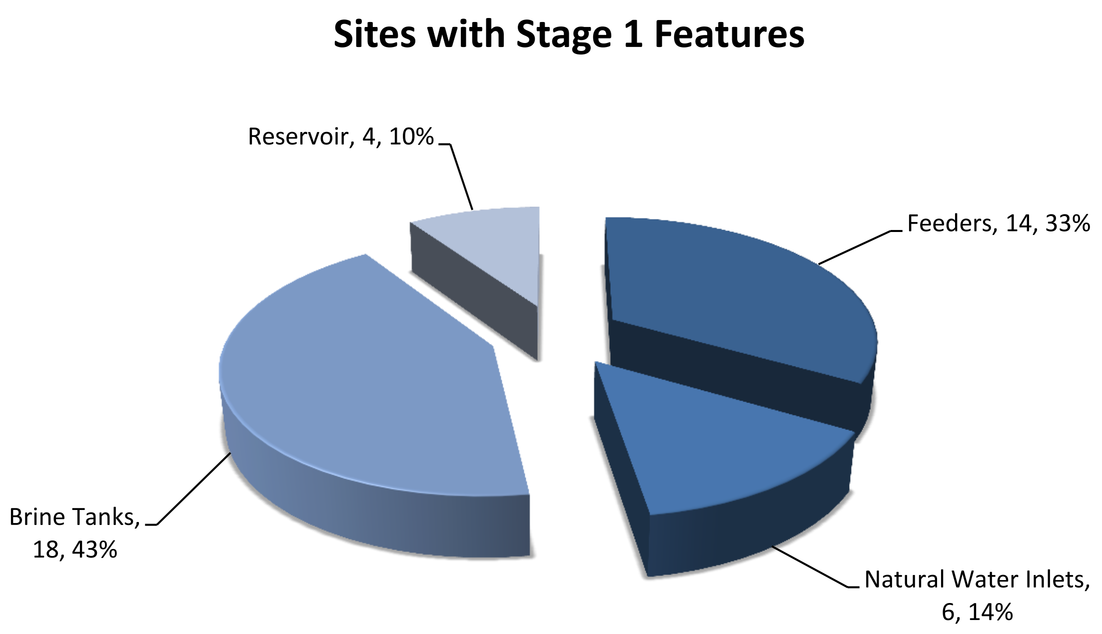

Figure 4.9 Summary of Stage 1 Water Management features across all sites (Total=29 Sites)

Brine Tanks and **Feeders** were the most common water management features. **Brine Tanks** were created primarily to process seawater and concentrate brine. They could provide three main functions:

1. Settling of sediments contained in seawater
2. Partial solar evaporation and concentration of seawater into brine
3. Storage of brine/seawater

Their main purpose was to allow the saltwater to ‘settle’, allowing any sediments or impurities to fall to the base of the tank whilst brine slowly concentrated naturally in the sun. In reality most tanks were recorded as ‘settling/evaporation tanks’, or ‘water storage pits’, it is probable that many were used for multiple functions. Therefore, the term ‘brine tanks’ or simply ‘tanks’ will be used from this point onwards, allowing for this.

Detailed recording of tanks can provide invaluable information on the salt-production process, especially the technique used. For example, burnt or removed lining could indicate the roasting of tank linings to obtain salt or the burning of salt-impregnated organic material within the tanks.

There were also 14 sites containing Feeders (Feeder Channels) (30 in total, with most occurring in Site 82), (Tables 10.1.19, 10.2.4 and Figure 4.9).

Feeders were created to supply seawater to the site, or exploited natural inlets to provide seawater. Feeder channels were probably dug in the area between the high-tide point and the salt-production site.

Although details were often not provided, at least eleven feeder channels were recorded as U-shaped and these would have provided slow-moving, easily controlled water. There must have also been a method of controlling water intake and flow. The most probable way of doing this would have been to somehow cap the water intake of the ditch at the point where it was fed by the sea.

If the feeder channels were positioned within the inter-tidal zone the ditches would only have been fed at high-tide, which is one way of managing intake of water.
The only clear evidence for a sluice system was at Lydd Quarry (Site 82), where the remains of wooden sluice gates were found within some ditches (Priestley-Bell 2002; 2006). This is probably the way that most other water intake systems were controlled, and this system would have been essential, if tanks were placed at the end of the channels.

Natural **Inlets** were also exploited within at least six sites, to supply saltwater to the site (Tables 10.1.19, 10.2.4 and Figure 4.9).

At least two sites (Sites 82 and 231) had certain evidence for the attachment of tanks to the ends of inlets and feeder channels (Table 10.2.4). In addition, tanks with connection channels leading towards the sea have been recorded at Site 228, Furzey Island, Poole Harbour, which were probably also connected to feeders originally.

Larger storage tanks (**Reservoirs**) were rarely recorded in the study area, being identified at only four sites. These large seawater storage areas and suggest a greater investment in water management. Reservoirs would be particularly useful if direct access to saltwater was not possible. They may often have been located on the edge of a salt-production site. Therefore many may not have been discovered because of limitations in excavation area and coastal erosion.

However, reservoirs do not appear to have been commonly found outside the study area either, except perhaps in the Fenlands, where several have been identified. These include a large natural pool used as a reservoir on a Bronze Age salt-production site at Tetney, Peterborough (Palmer-Brown 1993) and a Late Romano-British salt-production site at Middleton, Norfolk (Crowson 2001).

4.5.1 Examples of Stage 1 Water Management

4.5.1.1 Sites with Feeders and Channels

Sites 213 and 231, Poole, Dorset

These are two adjacent sites on the edge of Holes Bay in Poole Harbour. The sites lie on reclaimed land, which offered an opportunity to observe water management features that would otherwise not have preserved due to coastal erosion/sea level rise. Salt-production on Site 231 appears to have taken place in the Late Iron Age whilst on Site 213 it predominantly dated to the Early Romano-British period.

Site 231 (Figure 4.10) was only subject to limited archaeological observation during the extension of the local Tile Works. A local vicar carried out rescue excavations and he was able to record observations made by workers (Smith, 1931).

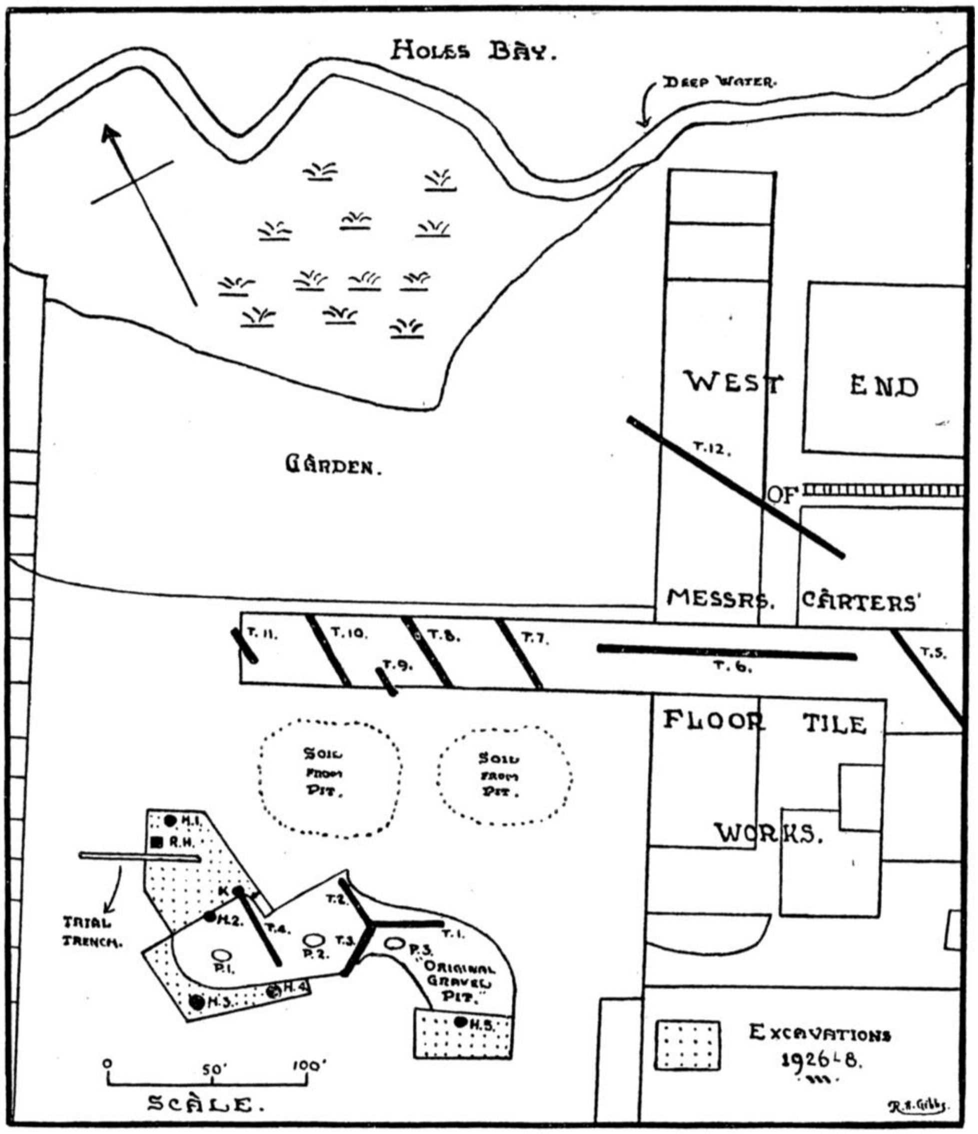

Figure 4.10 Plan of the excavations at Hamworthy Peninsula near Holes Bay (Site 231) (Smith, 1931: facing p98)

The ditches were originally described as 'trenches' (providing some initial confusion as to their nature) which are labelled as 'T' in the plan (Smith, 1931). These 'trenches' were interpreted as drainage ditches and were found to be c.2m deep in places, with most containing Late Iron Age pottery and briquetage. The briquetage was not recognised originally and was thought to represent pottery kiln furniture. However the material was later re-interpreted as briquetage after re-assessment (Lyne 1993).

Three of the ditches (T1-T3) were recorded as meeting at a central 'silt hole' feature filled with 'a black slushy soil, which 'ran from the barrows as it was being wheeled away' (Smith 1931: 98). Most of the other ditches (T4, T7-T8 and T10-

T12) were also found to contain this distinctive silty material and it was also found in three circular pits (P1-P3) surrounding the ‘silt hole’.

Nearly all the ditches probably formed part of a water management system associated with salt-production. Most of the ditches formed flat-bottomed supply channels. Most of the ditches ‘run in an unbroken line to the water; some of them proceeded so far then stopped’ (Smith 1931: 98). If indeed the true seaward limits of the ditches ended before the coastline, this can easily be explained by land reclamation. The presence of briquetage within many of the ditches also supports their association with salt-production.

The ‘silt hole’ feature probably represents a central tank fed by channels. Features P1-P3 were probably also brine tanks.

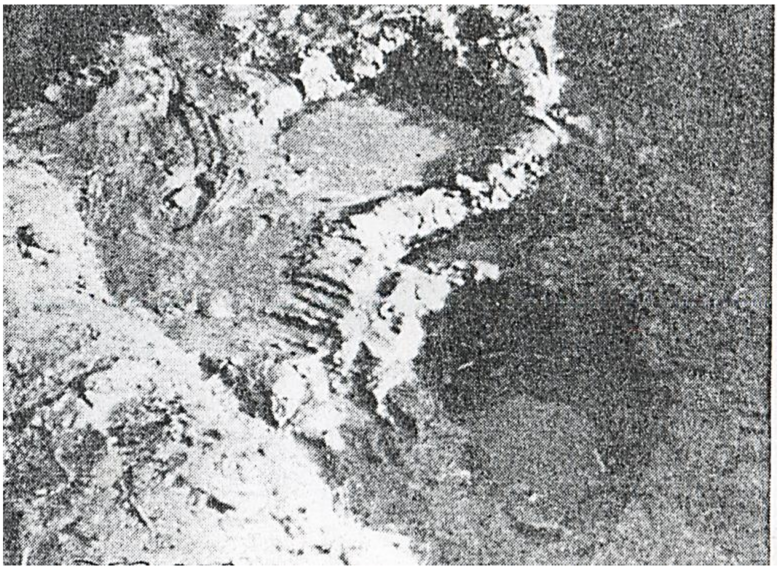

Figure 4.11 Brine tanks at Site 231, Hamworthy (Farrar 1975: 15 (After H.P Smith 1949: site archive))

The function of the radial pattern of ditches T1-3 is less clear. However, the photograph in Figure 4.11 taken at the site, probably shows brine tanks with connecter channels, most likely terminating at ends of the radiating ditches. A similar formation was observed during excavations of a Red Hill salt-production site in Peldon, Essex, (De Brisay 1978). These features closely resemble tanks recorded at Site 228, Furzey Island, just to the south of Site 231 in Poole Harbour (presented shortly).

The function of ditches T5 and T6 is less clear as they do not appear to lead towards the coast. They could have formed part of a more elaborate system of connected channels or were perhaps boundary ditches. Feature T9, unlike the other ditches, did not contain the wet black silts and instead appeared to have been used to store clay (perhaps at later date). Late Iron Age huts were also apparently found in close proximity to the water management features in the (Figure 4.10: bottom left).

Site 213 was also producing salt in the Late Iron Age period. There was also a second short period of salt-production in the later 1st Century AD contemporary with substantial remains of a Roman military supply base. Large ditches formed a rectilinear enclosure and a large warehouse was also found (Bellamy 2003a, 2003b, 2004a, 2004b).

Like Site 231, Site 213 produced a series of Late Iron Age linear ditches representing evidence for feeder channels supplying saltwater from the harbour edge (Figure 4.12: green features).

These ditches also provided small working areas in separate rectilinear enclosures (with one side open for access). Also dated to this period is at least one large reservoir connected to a feeder ditch, which was recut during military occupation of the site.

The second phase of water management in the 1st century AD. can be seen in the parallel ditches cutting the Late Iron Age ditches (Figure 4.12: Features 945 and 955, (light blue)). They are in a characteristic formation that has been found on other salt-production sites in the Fens (Lane and Morris 2001) and at Chidham, West Sussex (Site 98), (Bradley 1992).

These parallel ditches were used to feed saltwater and were sometimes reused as enclosed hearths (Lane and Morris 2001). The limited excavation at Site 213 means that the full extents of the ditches were not observed. Therefore it is unknown whether they were subsequently used as hearths, although it seems unlikely as separate enclosed hearths were found.

Although tanks were not definitely present, it is possible that some of the circular features scattered towards the northern end of the site (Figure 4.12), could have functioned in this way.

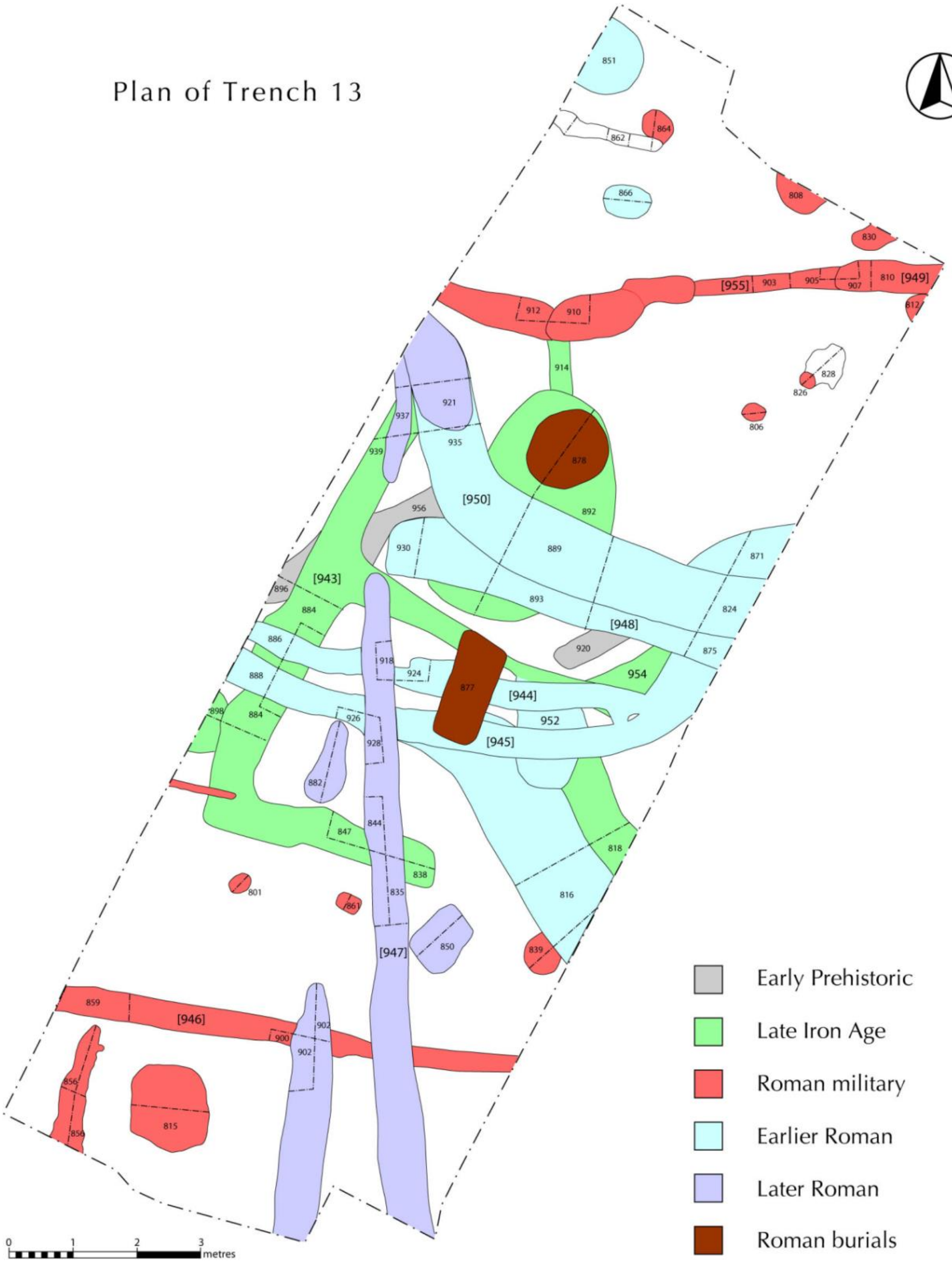

Figure 4.12 Plan of Trench 13: Site 213 (Terrain Archaeology Site Archive: 2004)

Limitations of the linear trench excavation meant that the full character, significance and extent of this site remains unknown.

Site 242: Creek Field/Pycroft Brickworks, Langstone Harbour, Hampshire

Site 242, although not as extensively recorded as Sites 231 and 213, also contained a pair of ditches associated with water management (Allen 2000).

These ditches were U-shaped, and ran at right angles to each other. They contained a large amount of pottery, briquetage and burnt flint 'pot boilers'. It is possible that pot boilers were used to aid artificial brine evaporation at this site. However, this technique is not commonly evidenced elsewhere in the study area. Alternatively, the pot boilers could have been associated with general domestic cooking.

As well as these two ditches, which were probably feeder channels, there was also a linear gully terminating in a circular feature, which contained burnt flints and charcoal. As at Site 231, these could represent a feeder channel connected to a tank.

Site 98: Chidham, West Sussex

This site contained very well preserved features and briquetage associated with Early Romano-British salt-production.

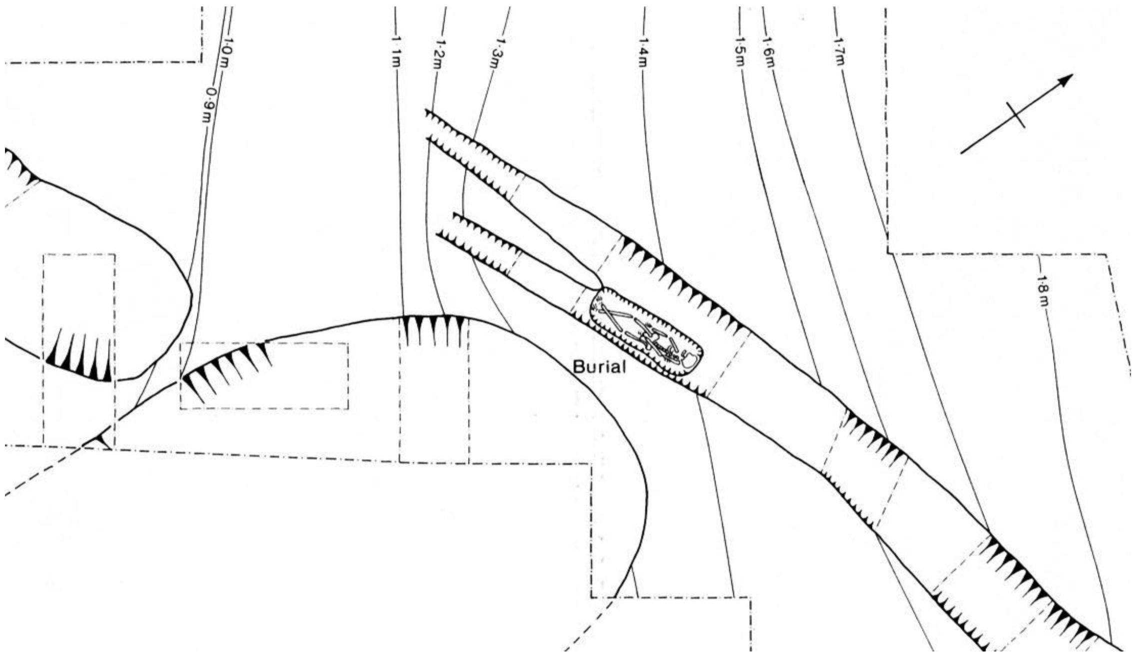

Figure 4.13 Plan of Chidham Site B in West Sussex (Site 98), (Bradley, 1992: 32)

This included water management features (Figure 4.13) as at Site 213. There was a large reservoir to store saltwater found at the edge of the excavations which was probably connected to a feeder ditch. There is a rectilinear ditch formation and the ditch separates into two small parallel gullies (Figure 4.13). The gullies were re-used as enclosed linear hearths.

Both Sites 213 and 98 contained adult inhumations, burials associated with some salt-production sites is considered further in **7.6.1**.

Site 228: Furzey Island, Poole Harbour, Dorset

This site consists of a series of circular features scattered across the shoreline of Furzey Island, all of which were clay-lined. Many of these features appear to have been created using cut clay briquettes. Access to this island is limited due to oilfield activity and therefore detail examination has not always been possible.

However, Cox and Hearne (1991) speculated that the features were probably associated with salt-production, given their coastal location, despite a complete lack of briquetage. The island is associated with a large Middle-Late Iron Age enclosure (Cox and Hearne 1991), where some possible briquetage container fragments were found. It is possible that the shoreline features are contemporary.

There were at least 12 circular clay-lined features eroding on the shoreline, (there were probably many more originally). Some of them were connected to each other, and some had evidence for burning. When presented at conferences by the author, it had been speculated that the features could represent medieval fishtraps (linked to the medieval pottery scattered on the foreshore). However, these features can now be confidently assigned to salt-production despite the lack of briquetage *directly associated* with the site.

The features represent a series of small separate hearths and brine tanks. This includes single, separate tanks (Figure 4.14: A), groups of separate tanks (Figure 4.14: B), inter-connected tanks and tanks connected to feeder channels (Figure 4.14: C). In addition, there were small single separate hearths and hearths that were connected to tanks. Inter-connected tanks are rare in the study area, with the only other example recorded at Site 166 in the Central Somerset Levels (Figure 6.7).

This site is one of the best preserved salt-production sites in Dorset, and has one of the best examples of a varied water management system in the study area.

Figure 4.14 Clay-lined brine tanks from Site 228, Furzey Island, Poole Harbour, Dorset (north-western shore) A: Single, separate brine tank (Cox and Hearne 1991: 57) B: Group of four closely associated brine tanks (Cox and Hearne 1991: 58) C: Single brine tank with the remains of a feeder channel (Author: 2004)

Whether all these features were contemporary is difficult to prove conclusively. However it is probable, given they are all similarly constructed and share similar forms. Also there do not appear to have been any inter-cutting features suggesting multi-period use.

Site 82: Lydd Quarry, Romney Marsh, Kent

This large predominantly Late Iron Age-Early Romano-British site represents an extensive salt-production site, found during quarry excavations in Romney Marsh, Kent (Priestley-Bell 2006).

This large area of coastal pea shingle contained a complex of natural water inlets, man-made feeder channels and large reservoirs, as well as multiple working areas containing closely associated groups of single hearths and multiple tanks, as well as tanks that were joined to hearths, similar to examples from Site 228.

This large complex contained at least 129 tanks (Figure 4.15) and over 25 hearths as well as potential reservoirs (one of which is highlighted in Figure 4.16). Most of the tanks were separate (Figure 4.15), and found scattered over a large area (Figure 4.16: blue features).

Figure 4.15 Deep tank from Site 82 (Archaeology South-East Site Archives: 2008)

The plan in Figure 4.16 shows just one part of the large site (Phase 12B), the full plan can be seen in **5.0** (Figure 5.15). The partial plan in Figure 4.16 provides a detailed overview of the complex channels and inlets used to provide seawater to the site (bottom half of Figure 4.16). The red features are hearths, and the orange features are briquetage spreads.

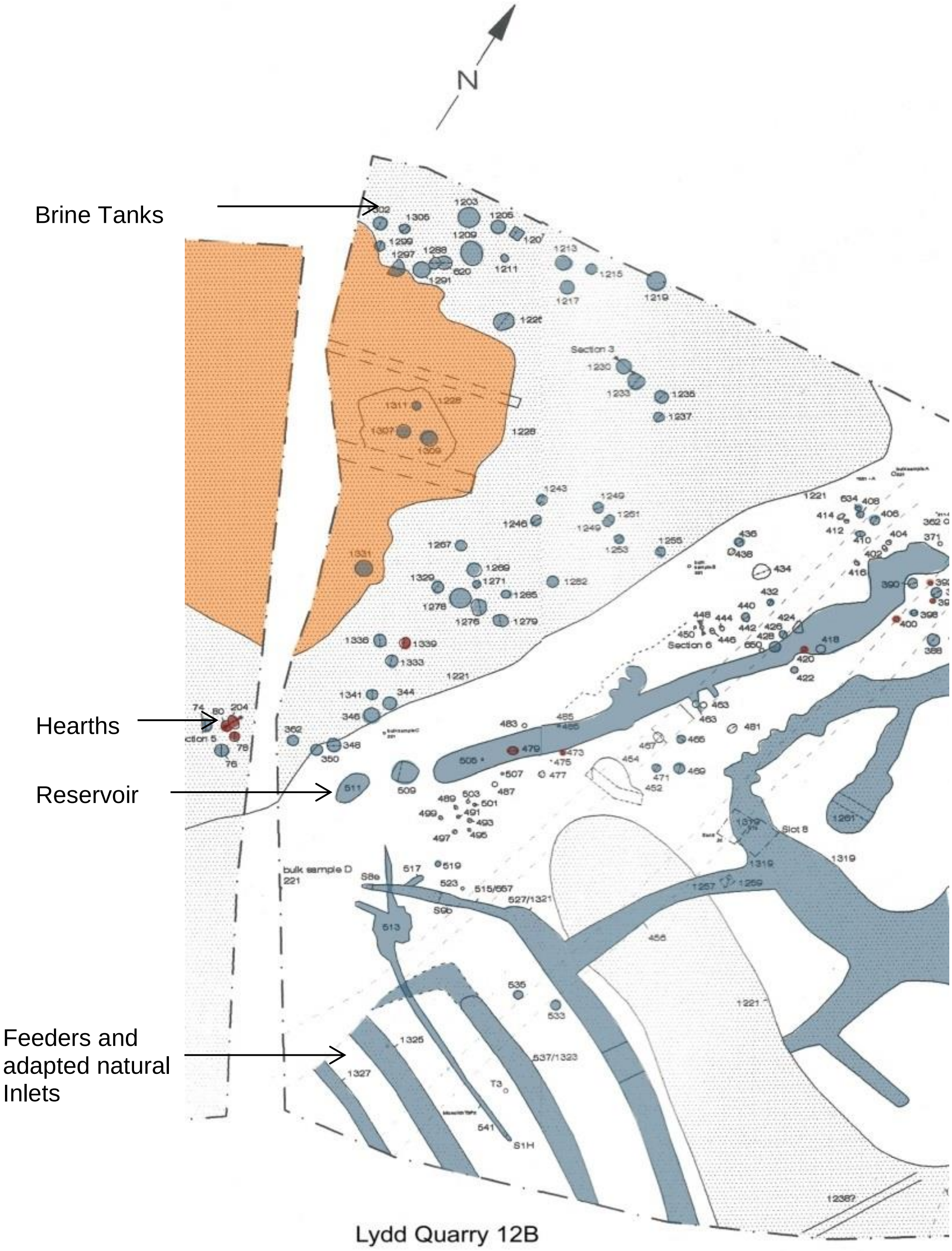

Figure 4.16 Plan of phase 12B of the Lydd Quarry excavations revealing a substantial salt-production complex with an elaborate Stage 1 Water Management System (Archaeology South-East Site Archives: 2008 (Adapted: colour/text added by author to emphasis different feature types)

Within these feeder channels and water inlets, there was evidence for the use of wooden sluice structures to control the supply of saltwater to the site (Priestley-Bell 2006) which is a rare an important discovery. As discussed above, this provides an insight into the way that tidal seawater supply was controlled, and was probably used on other similar sites with feeder channels.

Many of the modifications made to the natural inlets and creeks, dated to the 1st century AD and probably reflect continuous re-cutting from the Late Iron Age. It is probable that the site was used over several seasons and that the water management features required regular modification.

4.5.2 Working Areas with Multiple Brine Tanks

Site 166: Central Somerset Levels

This site comprised a debris mound closely associated with a working area, which included a large hearth (Figure 4.39) and possibly five tanks (Figures 4.17 and 6.7). The presence of five tanks within a single working area is rare in the study area.

Figure 4.17 Two pairs of inter-connected brine tanks at Site 166 (only half of each pair is visible in this photograph), (Brunning 2006: 20)

Four of the tanks formed two inter-connected pairs (Figure 4.17) similar to those observed at Site 228, whilst the fifth appears to have been joined to a feeder channel. It is possible that the use of inter-connected tanks represents a filtering process, where one tank was set slightly lower than the other, as is used in some traditional modern water management systems (Paul Noyce *pers comm*). This site is considered further in Chapter **6.0**.

Sites 30 and 90: Cooling and Funton Marsh, North Kent

Site 30 is a well-preserved nearly complete Early Romano-British salt-production site with evidence for twin-hearths, brine tanks and a debris mound (Figure 4.18), (Miles 2004).

There were two separate working areas. The first (Figure 4.18: left), had two hearths and four tanks, whilst the other (Figure 4.18: right) had two tanks and one hearth. They were not contemporary. The former was c.1st century AD in date, whilst the latter was c.3rd century AD in date.

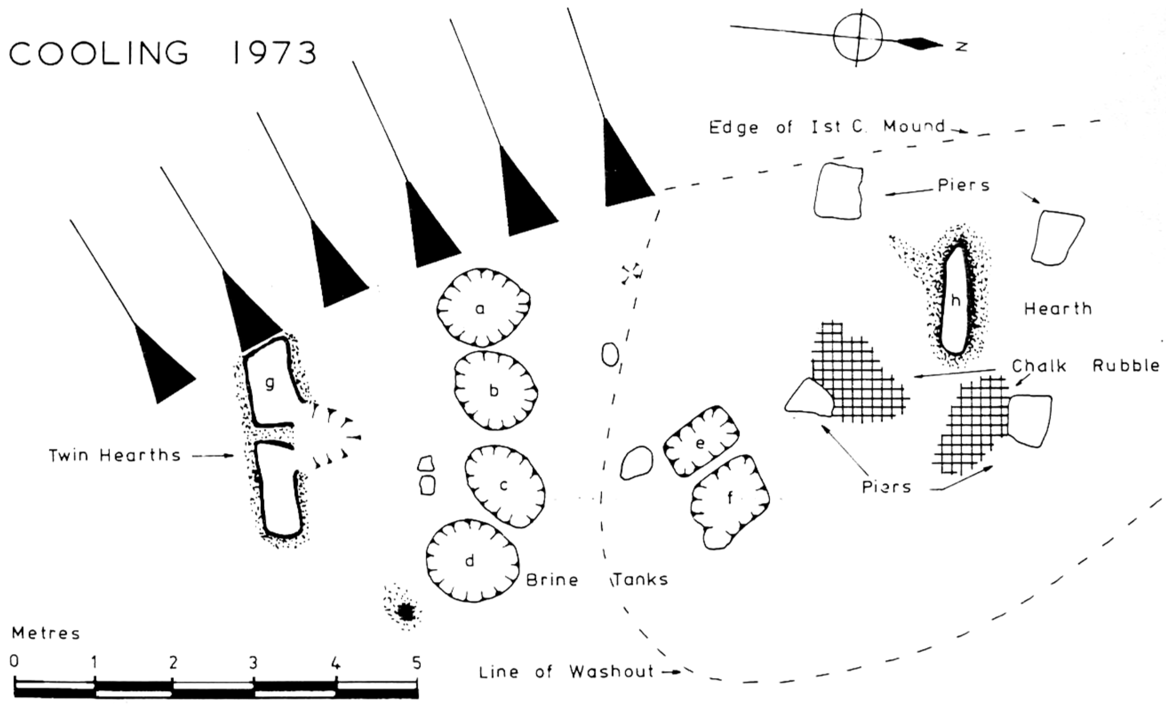

Figure 4.18 The salt-production site at Cooling, North Kent (Site 30), (Miles 2004: 29)

As at Site 82, separate tanks were used at Site 30 in both working areas. This type of simple separate tank is the most commonly recorded in the study area.

The working area on the left of Figure 4.18 is unique to the study area, in that it contains the only twin hearth to be found in the study area, and contained four tanks whereas most working areas have 1-3 tanks (with the exception of Site 166 above, that contained five tanks).

The only other site with a similar compact group of four tanks is at Site 228, Furzey Island (Figure 4.14: B) and they both share a similar formation.

The working area on the right of Figure 4.18 is also uncommon in that is uses rectangular tanks, as opposed to the more common circular tanks.

Site 90 at Funton Marsh was another Romano-British site located in the Chetney Marshes at the edge of the Medway Estuary, Kent, to the south of Site 30 (Figure 4.19).

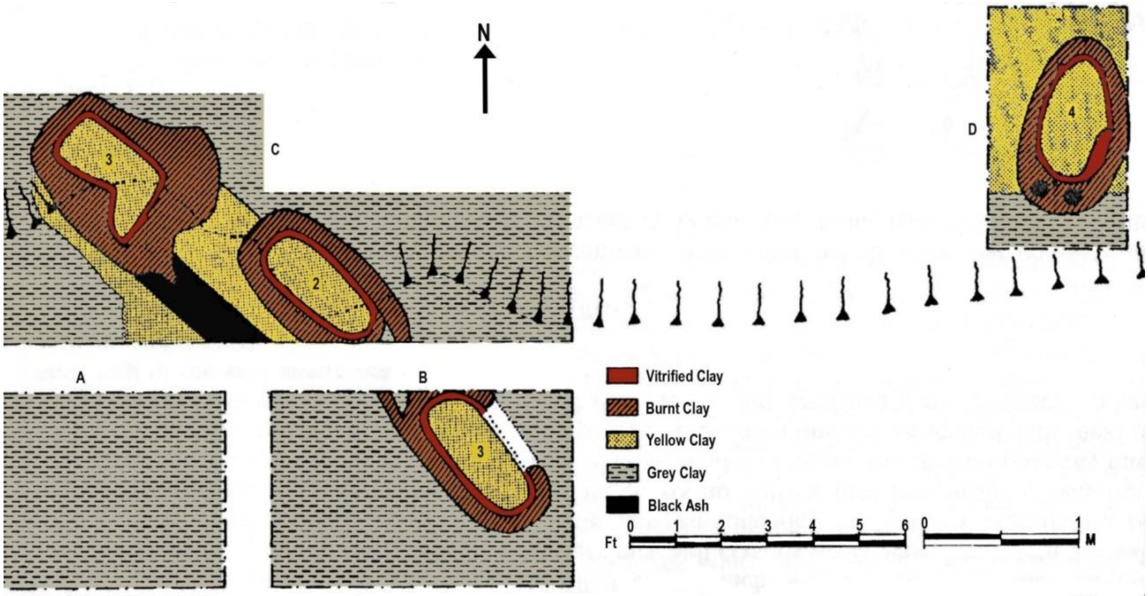

Figure 4.19 Funton Creek (Site 90), (Adapted from Detsicas 1984: facing 66)

This site also had sub-rectangular tanks, and these appear to have been very closely linked. Groups of 'joined tanks' often created in single large hollows in Kent, are are unique to the study area, but not in Britain, where similar joined tanks are known in Essex (Fawn *et al.* 1990; Biddulph *et al.* 2012) and the Fenlands (Lane and Morris 2001).

The tanks at Site 90 all had vitrified hearth linings, which could suggest the use of Technique III (Figure 4.7), where the tanks had been used to burn salt-impregnated organic material.

Site 61: Upchurch Marshes, North Kent

This site also has three settling tanks (Figure 4.20), which have close similarities to those in Essex. The conjoined tanks have been created by excavating a large kidney-shaped hole. This was then filled with clay into which three tanks were cut.

The tanks have been truncated and eroded resulting in their uneven appearance and there is no evidence of burning within the tanks.

The sites discussed within this section have provided good examples for showing the amount of preparation and organisation required just for the first stage of the salt-production process involving the management of saltwater.

Figure 4.20 View across three joined circular brine tanks (F103-105) with two hearths in the background (F99 andF101): Site 61. (Jackson, 1993 personal archive)

The method for water management varied according to the distance from the saltwater source and, more importantly, the scale and organisation of salt-production. At the top of the ‘scale’, with its elaborate water management system is Site 82, involving the construction of wooden sluice gates, in the centre are the use of inter-connected and grouped tanks, and at the more simple end there are only single, separate tanks.

A complex water management system was not obligatory. Indeed it is possible that some small basic sites may have simply taken seawater directly from the sea and heated it. This would still produce crystal salt, but the salt would probably have contained more impurities.

4.5.3 Natural Water Management Features?

Site 214, Hobarrow, Dorset and Multiple sites: Central Somerset Levels

It is possible that some coastal sites utilised natural grooves in rock formation for settling tanks. There is one possible contender on the Isle of Purbeck, Dorset.

Site 214 is located on a cliff-top and consists of a briquetage debris mound (Late Iron Age/Early Romano-British). Below the cliff at low-tide is an exposed large area of natural hard geology (Figure 4.21).

Figure 4.21 View over the cliff to the east of a briquetage mound (Site 214). Note the ledge below with natural grooves filled with seawater (Author: 2005)

Within the exposed geology there are a series of eroded grooves which that naturally fill with seawater at high tide and then reduce to shallow pools at low-tide. These would then naturally evaporate in the sun during low-tide.

However, there are at least two factors that do not support this theory. The first is that is seems very unlikely that the pools would have had enough time to evaporate/settle before the next tidal inundation. The second is that it is unclear whether the landscape and waterscape was similar in the Iron Age and Romano-British periods. This is pertinent when considering the unusual high position of this salt-production site (and others scattered along the cliffs). It is very possible that the landscape was far less eroded at the time of original use and that there was a gradual slope leading from the mound to the beach below.

4.5.4 Overview of Water Management

Evidence for water management was only found on a small number of sites in the study area (29). However, as emphasised previously, many features were probably not uncovered due to limitations in excavation area and many will have certainly been lost to coastal erosion.

In addition, some sites would not have had suitable ground conditions to construct feeder channels. If a site was located on harder pebble beach terrain for example, as at example Wyke Regis, Weymouth (Site 217), cutting a channel would have been extremely difficult. In this case the water was taken directly from the sea manually.

Most sites would probably have had some saltwater storage features, However, many sites would not have needed elaborate water management systems as they were simply not required because of the location of the site and/or the scale of production.

The presence of feeder channels however, reflects management and planning. These features were perhaps only used on sites where larger scale production was carried out possibly over longer periods. Some of these sites have evidence for the re-cutting of ditches after they became silted, suggesting longer tern use.

4.6 Stages 2 and 3: Salt Crystallisation and Salt Drying

As stated earlier, it has been difficult to differentiate evidence for Stage 3 from Stage 2, therefore, it is probable on many sites that the same hearth was used for both stages.

Stage 2 is certainly identifiable in the archaeological record and was evident at 14% of all sites. Although this is a low percentage, the recorded examples are well-preserved, providing great insight into this stage of the process.

Of the 144 features across 56 sites attributed to Stages 2 and 3 (Tables 10.1.16-10.1.19; 10.2.5 and Figures 3.30-3.31), 120 features from 51 sites were identified as hearths or ovens, of which there were four main types (Figure 4.22).

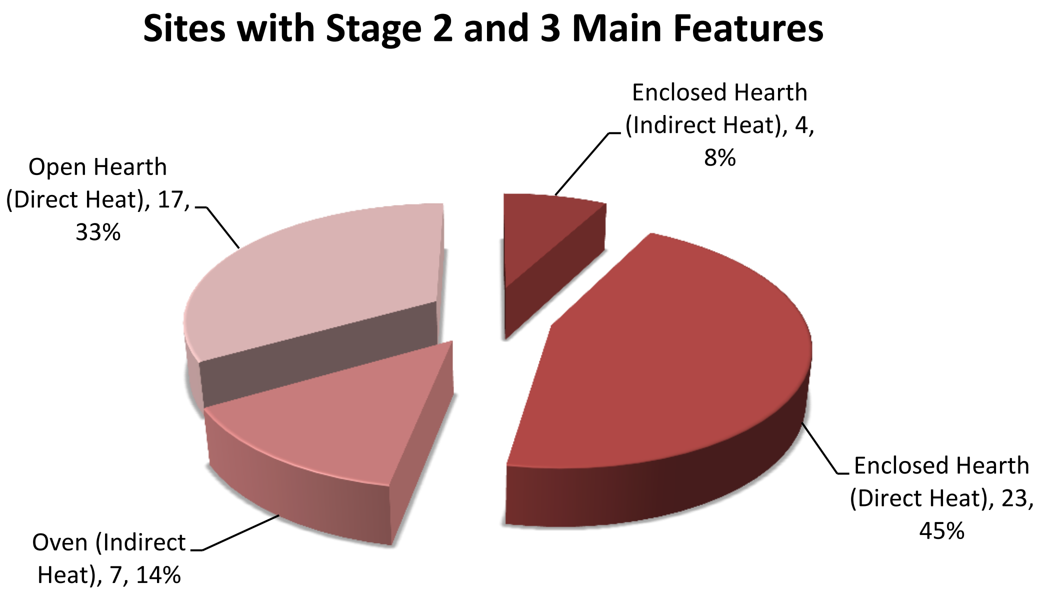

Figure 4.22 General Feature Types associated with Stages 2 and 3 of salt-production (Total=51 Sites)

Enclosed Hearths using **'Direct Heat'** was the most common feature used for the artificial heating of brine/saltwater across the study area (Stage 2), of which most (66) were simple clay-lined pits varying from round to rectangular and linear or irregular in form. There were also several other features that could have been used within these two stages, as listed in Table 10.2.5.

'Open Hearth' includes a greater variety of feature types as it also incorporated clay platforms used as surface hearths; examples will be presented shortly.

It is possible to directly link enclosed hearths or ovens with Stage 2, as brine evaporation would require a controlled, steady heat, for which an enclosed pit is ideal. However, the surface or open hearths are less simple to attribute certain function as technically they could be used for both Stages 2 and 3, however it remains true that open hearths, providing a more gentle heat and more exposure to wind would provide ideal conditions for the drying of salt (Stage 3).

It is also possible that the lower quantity of certain Stage 3 features (Open Hearths were in 14% of all sites with combustion structures as shown in Figure 4.22), could be due to the way salt was processed. It is plausible that on some sites, salt was fully dried *inland after distribution*. This would at least account for the presence of briquetage inland. This possibility is further considered in **7.0**.

The most potential for the identification of Stage 3 on a site therefore remains in the presence of *contemporary* flat and trough or bowl-shaped containers on a site (Type 3: Figure 3.34). As stated above, it is accepted that in general these represent separate functions in that the flat container was for evaporation, whilst the curved container was for drying (Lane and Morris, 2001). It has not been possible to explore this fully due to a lack of recorded detailed briquetage forms, however there was at least one site in the study area that clearly contained both forms, therefore confirming that Stages 2 and 3 were taking place. The Early Romano-British site at Chidham, West Sussex (Site 98) contained two distinctive areas of production activity (recorded in the report as A and B), (Figure 4.13 shows Area B). Both areas contained distinctively different briquetage types, evidenced in flat Type 1/2 containers in one part of the site and Type 3 in the other part of the site. This therefore showed that Stages 2 and 3 were carried out in separate areas of the site (Bradley 1992). It is rare to have the forms of briquetage plotted across a site in this way, however, it might be possible to employ this spatial mapping technique on other sites in the future to investigate Stages 2 and 3 further in the future.

All the detailed feature forms associated with Stages 2/3 were compared across the study area. The results can be seen in Tables 10.2.6-10.2.9.

4.6.1 Examples of Stages 2-3 in the Study Area

This heating stage of the salt-production process requires a particularly specialised skill set. Effective heating is required for evaporation and drying the salt to form crystals, and different grades of salt, including crystal size, could have been produced dependant on the intended use.

As stated above, simple clay-lined sunken hearths without superstructures were the most common, with 66 examples recorded. Hearths that had an extended walled superstructure made of clay or stone (not covered), were recorded in only three instances (Tables 10.1.16 and 10.1.19: Surface Clay Walled Hearth’). The one instance of a ‘Chambered ‘Oven’ was placed within this category, although it is not a clearly recorded example.

Sometimes the hearths had a stokehole or flue so that the heat could be controlled more effectively. However, only six examples were recorded within the study area and this technology appears to have been more commonly used in the Fens (Lane and Morris 2001) and Essex (De Brisay 1975; Fawn *et al.* 1990).

As shown above, **Enclosed Hearths** were the most common and ranged from small circular hearths that held a single container, to large linear hearths that could hold several containers. Clearly the more containers a hearth could hold, the more salt that could be produced from that hearth. Employing larger hearths with several containers brought with it more structural challenges in terms of supporting these heavy vessels over a hearth or within an oven. This is where the creation of 'Structural' briquetage including Types 1-2 (Figure 3.61) comes into play, as this material was used to stabilise multiple briquetage containers and supports. It is therefore possible to infer hearth types by the presence of different briquetage forms, and by observing the surface colouration on some briquetage supports. This is explored further later (**4.6.3**).

Examples of sites with each of each of the four main combustion feature types for Stage 2 and 3 are provided below.

4.6.1.1 Enclosed, Single Container Circular/Oval Hearths

Circular and oval Enclosed Hearths are commonly found within Kent. Examples from the rest of the study area were rare, with only a few potential examples in Poole Harbour. Small circular hearths could only comfortably hold a single container, in contrast, oval hearths were larger, and could hold at least two containers. However, as shown shortly, some oval hearths were still only used to hold one container on some sites. By the Middle Iron Age, most sites were employing larger hearths that could hold several containers.

Smaller Hearths with Larger Joined Tanks

There were at least four examples from three sites (Sites 62, 82 and 228) of circular conjoined hearths (Enclosed Hearths Direct Heat) that were physically linked to brine tanks. These are outlined below.

Sites 228 and 82: Furzey Island, Dorset and Lydd Quarry, Kent

Two very similar joined hearth and tank formations were found at Sites 82 and 228. The example from Furzey Island (Figure 4.23) was found alongside a scatter of other separate hearths and tanks (Figure 4.14).

Figure 4.23 An eroding joined tank and hearth at Site 228 (Alan Bromby: 2004)

This example was also found at Site 82 (Figure 4.24), similarly, also associated with working areas containing separate hearths (at least 30), (Figure 4.25) and tanks (at least 129), (Figures 4.15-4.16).

Figure 4.24 Hearth with accompanying brine tank. Both are clay-lined and cut into the gravel. Four *in-situ* briquetage support pedestal bases were in the base of the hearth (Archaeology South-East Archives: 2008)

Both formations contain a much larger clay-lined tank attached to a small clay-lined hearth. The similarity between these two examples is remarkable, but no other similar examples have been identified outside Kent and Dorset. These combined hearths and tanks provided an ideal, compact working area suitable for a single individual to operate. Although separate hearths were more common on both sites, they also appear to have been associated with groups of tanks creating larger working areas.

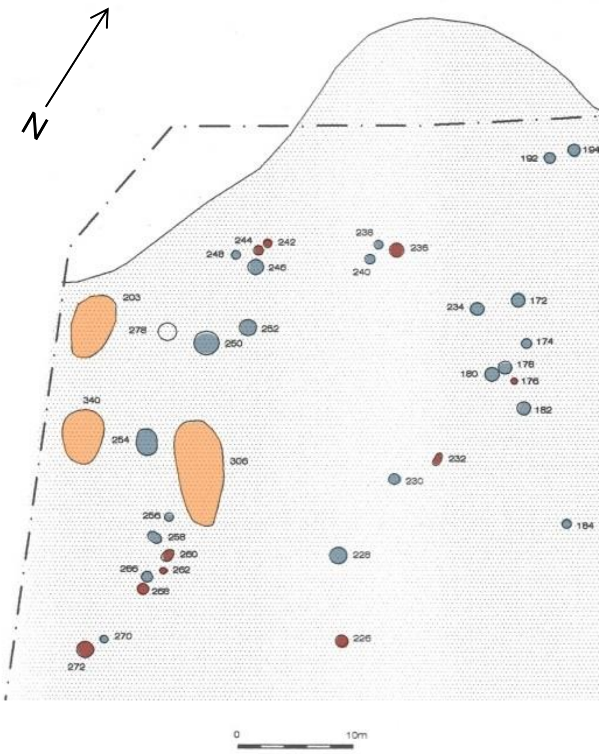

Figure 4.25 Part of the plan of phase 12A of the Lydd Quarry excavations showing several hearths(Archaeology South-East Site Archives: 2008 (Adapted: colour/text added by author to emphasis different feature types. Red features are hearths and blue are tanks)

Identification of at least three working areas containing tanks and hearths can be identified at Site 82, and these are outlined further in **5.3.1**.

Most of the hearths in Site 82 appear to have been used in combination with four rounded pedestals that would have held a single flat container. This is evidenced by the preservation of pedestal bases *in-situ* across the site (Figure 4.24 and 4.26). All the hearths were Directly Heated and Enclosed, round or oval clay lined pits.

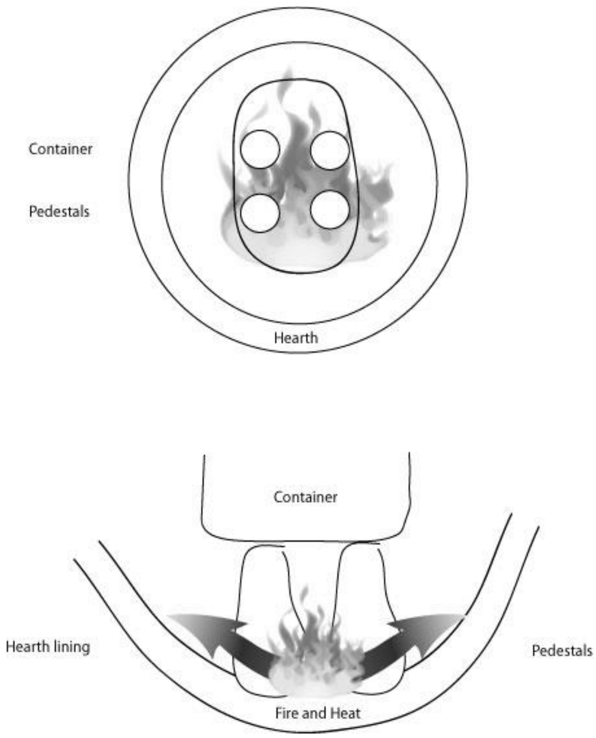

Figure 4.26 Reconstruction of the hearth in Figure 4.24 with briquetage pedestals used with a single container

Circular or oval hearths were popular in Kent whereas rectangular linear hearths were more commonly used in the rest of the study area. Site 228, Dorset is the only other site where circular hearths have been found.

The remarkable similarity between the combined hearths/tanks at Sites 82 and 228 is of interest, especially since they could have potentially been contemporary. The similarity is so strong, that it does suggest a close link between these two sites. They both represent examples of a site complex (multiple working areas), which is rare in the study area. This technological link and organisational link (complex) could suggest that similar individuals could have been involved in the management of both sites.

Larger Hearths with Smaller Joined Tanks

There was also a reversal of the combination above, at Site 61, where the hearth was larger than the tank (Figure 4.27).

Site 61: Medway Estuary, Kent

Site 61 was exceptionally well-preserved and contained a working area of three water management tanks (Figure 4.20) and a hearth. The hearth had a conjoined small circular brine storage tank (Figure 4.27) and had been well used, with several episodes of re-lining. The presence of an attached tank, when three other larger tanks were also present (and presumable contemporary) raises the question as to why this was required. It is possible that the larger tanks were added later possibly where the scale of production at the site increased.

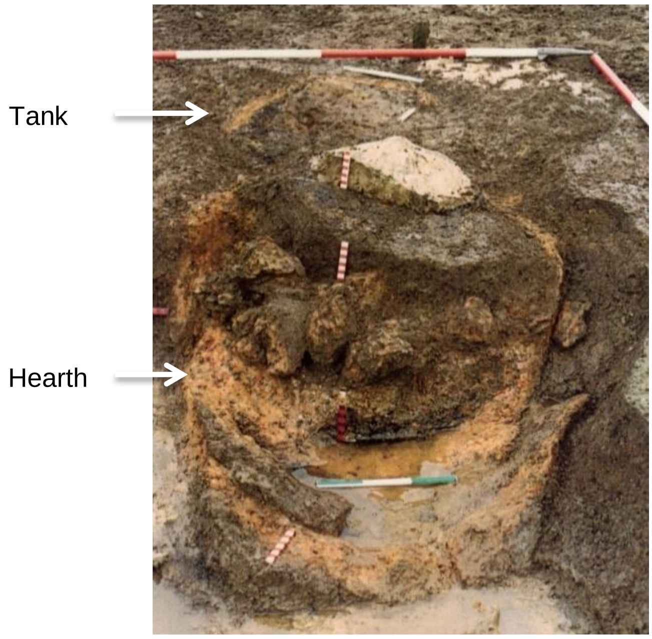

Figure 4.27 Joined larger oval hearth and small circular tank at Site 61 (Ian Jackson Personal Archives)

Hearths with Partitioned Tanks

These features are similar to those outlined above in that they are combined hearths and tanks. However, these features differ, in that the two have become more 'merged'. These features consist of hearths that have a *partitioned or divided area* for brine storage. This feature has been identified on at least three sites (Sites 61, 82 and 316), all in Kent.

Site 82: Lydd Quarry, Romney Marsh, Kent

The hearth in Figure 4.28 had a more integrated partitioned area (left) which could appear on first glance to represent a change in hearth shape and a re-cutting episode. However it is more likely to represent an area for *brine storage*, which is further considered in **5.3.1**.

Figure 4.28 One of the many oval enclosed hearths at Site 82. This hearth has the remains of four briquetage support pedestals at the base cut into the gravel and clay-lined (Archaeology South-East Archives)

As with the example shown in Figure 4.24, *in-situ* briquetage pedestals were found in the base of the hearth, which suggests that despite the hearth being larger, that it still was only used to hold a single container.

Site 316: Cliffe, Kent

This Romano-British site was found eroding on the shore and consisted of two enclosed hearths (Figure 4.29). The left hearth in Figure 4.29 closely resembles the hearth at Lydd Quarry (Figure 4.28) in form and size. However in this case, there was also a second contemporary, simpler separate oval hearth to the right (Figure 4.29).

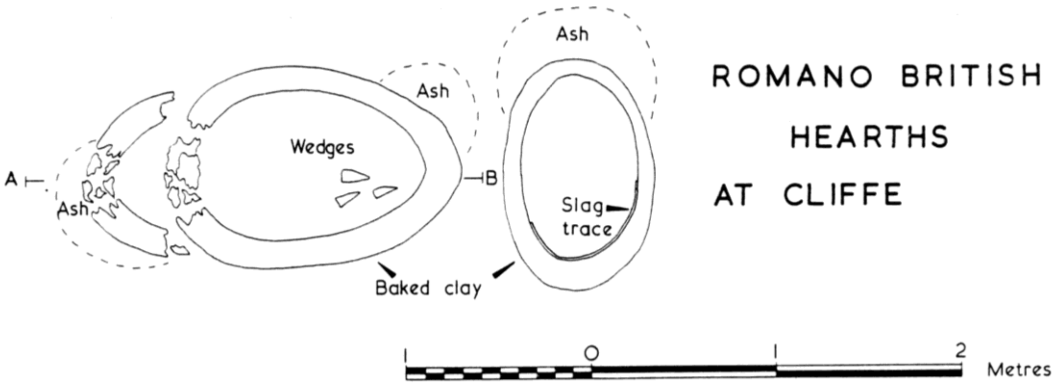

Figure 4.29 A plan of the two salt-production hearths discovered at Cliffe, Kent (Site 316) (Adapted from Miles 1975: 28)

This formation is unique and perhaps represents a site modified in its later stages. The right hearth could have originally been a settling tank later converted to a hearth, so more salt could be produced. Again, the partitioned hearths appear to be exclusive to Kent, however it is possible that similar examples exist on the shores of Furzey Island, Dorset (Site 228).

The three examples from Sites 61, 82 and 316 were all associated with very different briquetage supports. This indicates that, despite the similarity of features, individuals working on these sites chose different forms of briquetage. People using Site 61 employed embedded slabs, whilst those at Site 82 used large rounded pedestals and the workers at Site 316 used embedded wedge supports (Figure 4.30).

Figure 4.30 A briquetage wedge support found within one of the hearths at Cliffe, Kent (Author: 2009)

Separate Hearths

Sites 82 and 62: Lydd Quarry and Medway Estuary, Kent

Two further different hearth formations were also identified in Kent on Sites 62 and 82. On first appearance, both the formations shown in Figure 4.31 are somewhat confusing. However, upon further inspection it appears that originally, they closely resembled the formations shown in Figures 4.23-4.24, in that there was a single small hearth and a large tank. But these formations were different in that they *were not joined*.

Then, at some point in their lifecycles, both the formations in Figure 4.31 appear to have been *modified*. Firstly, the tank and hearth features were *reversed* (hearths became tanks and vice versa), and secondly, an additional hearth was added, giving the ‘double hearth’ effect in Figure 4.31.

Figure 4.31 Top: Working areas of hearths/tanks at Site 82 (Archaeology South-East Site Archive) Bottom: Small hearth containing a nearly complete pottery vessel (left) and two adjoining brine tanks filled with burnt debris (right) at Site 62) (Ian Jackson personal archive)

This is certainly the case at the example in Site 82 (Figure 4.31: top). However, the example in Site 62 could requires more investigation. The presence of a brine transfer vessel in the smaller feature suggests it was a tank, and the burnt material in the larger two features suggest that they were hearths. However, on closer inspection, the 'hearths' are lacking clay lining. This could be a rare example of tanks that have been stripped of lining to extract salt at the end of the last cycle of salt-production on this site (a result of Technique II). This will be further explored in **5.3.1**.

Site 228: Furzey Island, Poole Harbour, Dorset

A final example of a separate small circular hearth is at Site 228 (Figure 4.32). This was also probably originally associated with a single or pair of brine tanks.

Figure 4.32 Small 'hearth' at Site 228, Furzey Island, Dorset (Author: 2004)

4.6.1.2 Enclosed Multiple Container Sub-Rectangular/Rectangular Hearths

Similar to those presented in the previous section, most of these hearths are associated with the 'Direct Heat' method and are simple, deep pits, lined with clay. These types are more common than circular hearths and have been found in Somerset, Cornwall, Dorset and Kent. These hearths had more capacity to hold multiple containers and therefore potentially produced more salt.

Sites 213 and 216: Shapwick Road and 12 West Quay Road, Poole, Dorset

Both these sites contained very well-preserved sub-rectangular Enclosed Hearths (Direct Heat), (Figures 4.33 and 4.35). The hearth at Site 213 was in such good condition that the individual clay briquettes used to construct it were clearly visible and episodes of re-lining were observed.

The briquetage assemblage included a variety of complete support pedestals that were probably used on the sides of the hearth to support containers. There were no bar supports, just many twisted squat pedestal supports and larger triangular 'brick' pedestals and slabs; some of which were perforated.

Although a variety of briquetage container and support forms were found within the fill of this hearth, it is unlikely they were all used simultaneously, and some were probably related to a nearby open hearth (Figure 4.33: left).

Figure 4.33 Left: Probable open hearth close to the main enclosed hearth (top right) at Site 213 Right: Enclosed Hearth (Direct Heat) before excavation filled with compacted briquetage at Site 213 (Terrain Archaeology Site Archive: 2004)

Simple reconstructions of how the briquetage forms could have been used in the evaporation of salt from brine in this feature can be seen in Figure 4.34.

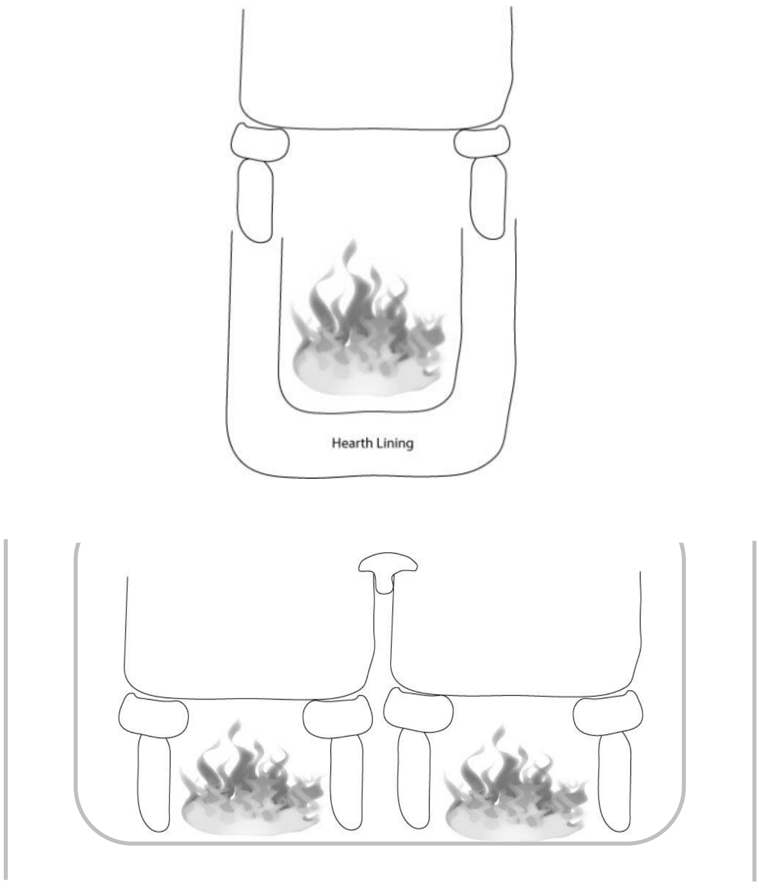

Figure 4.34 Two possible reconstructions for a rectangular enclosed hearth (direct heat) found at Hamworthy, Poole, Dorset (Site 213)

Most of the squat briquetage supports were pale orange with a ‘powdery’ surface suggesting they had never been subjected to great heat. The containers had been fired, but again there was no evidence of the heat effect/damage expected from being used over a fire.

Two other nearly identical Enclosed Hearths (Direct Heat) were observed at Site 216, just to the east of Site 213, perhaps showing that the same individual/s were operating at both sites (Figure 4.35). Similar squat pedestals were observed at Site 216 but instead of perforated slabs, at least one fragment of a rare perforated shallow container was found within the hearth fill (Figure 4.74).

Given that it was found within a salt-production hearth it has been assumed to have functioned as briquetage. However this is not definite, and is further discussed in **4.6.5**.

Figure 4.35 Enclosed Hearth 2, partially excavated at Site 216, Poole, Dorset (Poole Museum Site Archive: 2004)

Site 198: East Huntspill, Somerset

Clay-lined rectangular/sub-rectangular hearths were also used in the North and Central Somerset Levels during the Romano-British period.

Examples of hearths cut into a briquetage mound can be seen at Site 198 (Figure 4.36). Here, groups of hearths cutting into each other clearly showed that this site was used over several periods of salt-production.

There were briquetage bars and slabs as well as pedestals but there were no containers, which is a common factor with mound sites in this area. It is possible that the slabs, bars and pedestals were used together in this case. One scenario is that the pedestals sat within the hearth base, holding horizontal bars which supported flat slabs. However it could also be the case that smaller open hearths for drying salt were also used, but were not located within the excavation area.

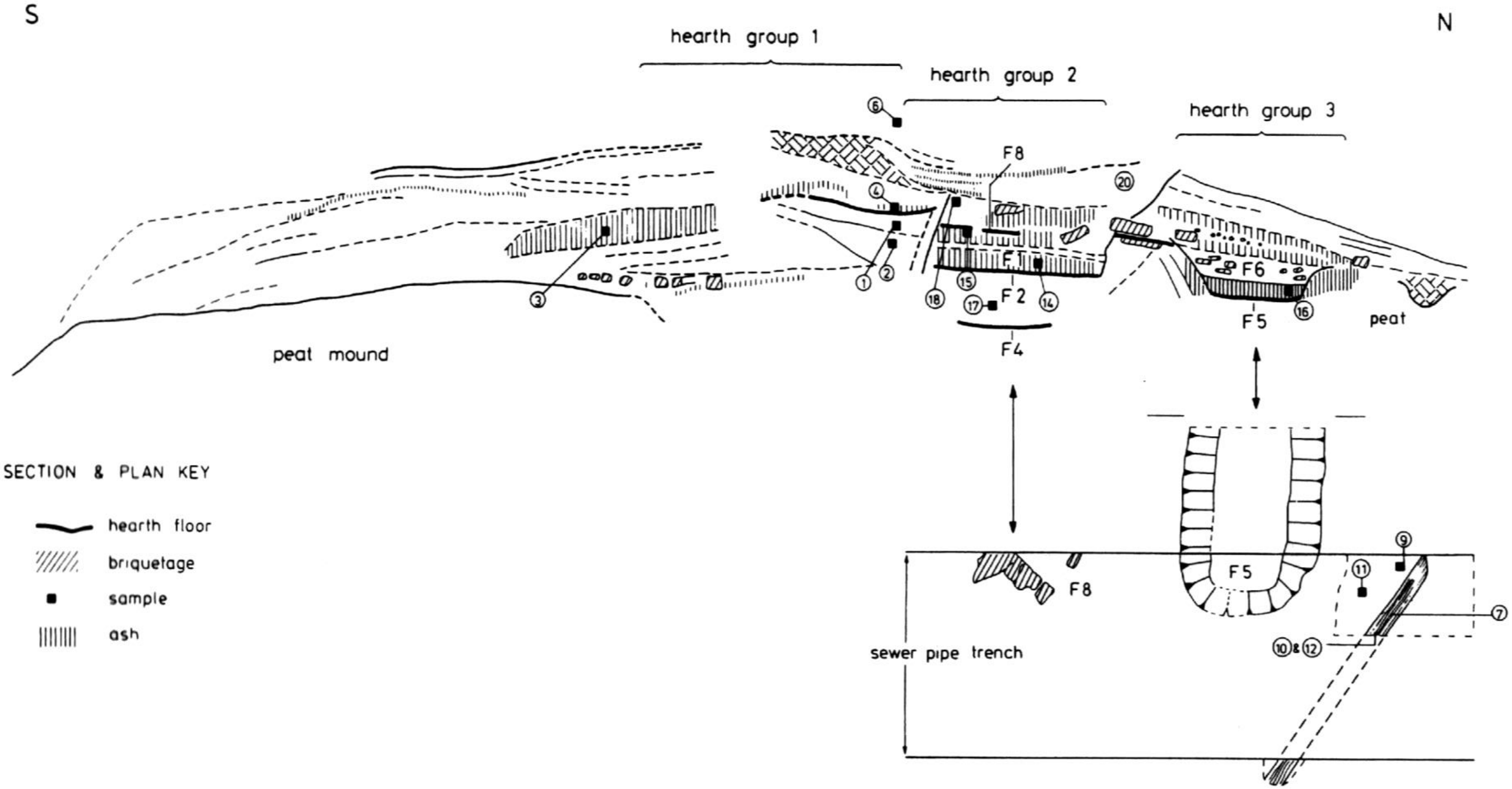

Figure 4.36 Section of Site 198 (not to scale) (Leech *et al.* 1983: 75)

Site 217: Wyke Regis, Weymouth, Dorset

As stated previously, most enclosed hearths were made from clay alone; however a few examples were lined with stone then clay. Most of these occur inside buildings, although there is one example of a stone hearth located on the shore at Wyke Regis, Dorset (Site 217), (Bailey 1962). This Enclosed Hearth (Indirect Heat) incorporated a natural rock ledge to form one side and more rocks were used to form the lining for the rest of the hearth (Figure 4.37).

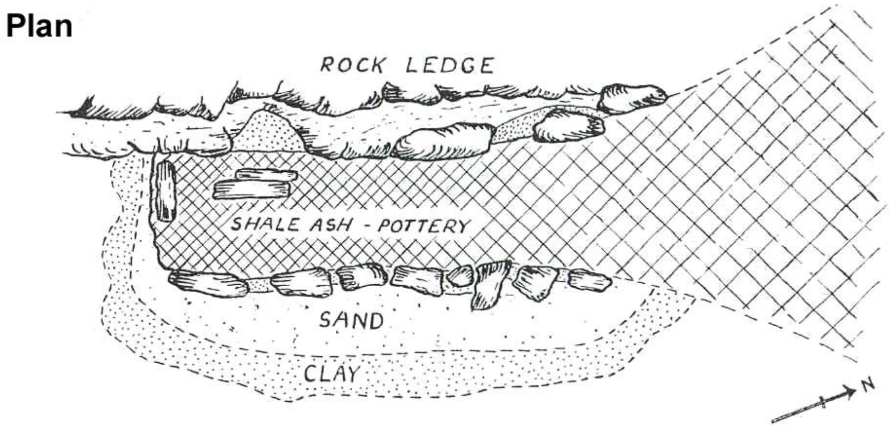

Figure 4.37 Plan of the stone-lined enclosed hearth found on the shore at Wyke Regis (Site 217) (Adapted from Bailey,1962:133)

Although eroded, it does appear that the hearth utilised a stokehole to provide indirect heat. The use of stone as lining at this site took advantage of local rock outcrops. A clay lining was probably applied to the sides but has subsequently eroded.

Although little briquetage was found with this feature (some possible container sherds mixed with pottery), the form of this feature, combined with its coastal location suggests that is very probably an enclosed hearth used in salt-production. It is possible that this hearth was used with pottery vessels to produce brine, which would have been plausible, especially on small-scale sites.

Shale was used as a fuel on this site and was abundantly available locally. Shale provides an ideal fuel as it is slow burning with a short flame.

Site 30: Cooling, Kent

The rectangular settling tanks at this site have already been discussed. In the same working area were two linked, rectangular, clay-lined hearths (Figure 4.18). These hearths, together with the four settling tanks, represent a particularly sophisticated site that was producing salt on a larger scale than single hearth sites with one or two tanks. These hearths could have held at least two containers. This working area is discussed and compared further with other Kent working areas in **5.3.1**.

4.6.1.3 Linear Enclosed Multiple Container Hearths (including Ditch/Gully Hearths)

Other sites also employed linear hearths but these were more irregular and generally longer and narrower. These types of hearth often utilised an existing gully or ditch.

There are five examples of ditch/gully hearths (Table 10.2.5); these have already been discussed as they were feeder channels which were subsequently converted to hearths. Their rarity is to be expected, as it is difficult to explain why separate hearths were not constructed, as feeder channels were presumably required to feed saltwater before the heating process. The only plausible explanation is that either the feeders belonged to an earlier period and were re-used or the feeder channels have been misinterpreted and were simply long hearths.

Site 229: East of Corfe River, Poole Harbour, Dorset

A good example was found at a Late Iron Age-Early Romano-British site to the east of Corfe River on the Isle of Purbeck, Dorset (Site 229). Salt-production was evidenced through briquetage spreads as well as a feature originally interpreted as a kiln or furnace (Cox and Hearne 1991), (Figure 4.38).

This was originally thought to have been associated with iron working (Cox and Hearne 1991) but was subsequently re-interpreted as a salt-production hearth (Hearne and Cox 1991). The clay-lined divisions within the hearth probably stabilised the containers that rested upon them. These could also have acted as divisions of areas used by different individuals.

A circular clay-lined feature near to the hearth (similar to a clay pit at Site 213) could have stored water or provided a storage area for clay required for making briquetage or an open hearth (Figure 4.38).

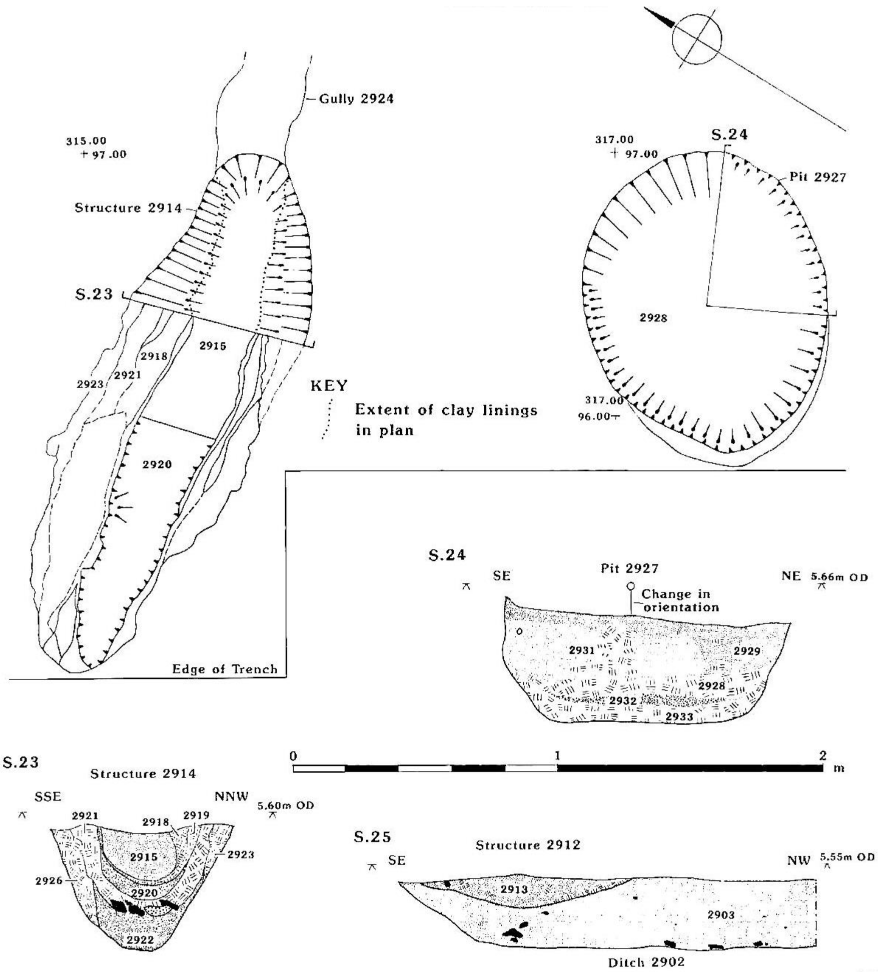

Figure 4.38 Plan and sections of oven/furnace and associated clay lined pit (Cox and Hearne 1991: 39)

Most of the briquetage was concentrated around an enclosed area, used as the focus for salt-production. There were various briquetage forms including sub-circular containers and several types of supports, including pedestals, bars and fragments of what appears to be part of a briquetage 'grid' system. This grid hearth is further considered shortly (**4.6.1.5**).

Site 166: Central Somerset Levels

An exceptionally large hearth (over 4m in length) was found in association with briquetage support bars and slabs (Figure 4.39). Given the colouration of some of the bars found in the river adjacent to this site, it seems that the bars were used horizontally with each side partially embedded within the clay lining.

Figure 4.39 Section of Site 166 at East of Woolavington Bridge, River Huntspill, Somerset showing the large hearth/oven structure (Brunning 2006: 21)

4.6.1.4 Hearths with Suspended Floors?

Previously it has been suggested that many briquetage slabs probably acted as a form of suspended floor within an enclosed hearth or oven structure. Most slabs are simple rectangles or squares, although many slabs from the Poole Harbour area have impressed, decorated edges, whilst a few were plain and 'tongue-shaped' in form (Figure 4.40). One slab from Site 218 (Figure 4.40) was even inscribed with a numeral/letter.

One suggestion for the function of the plain square or rectangular briquetage slabs is that that they served as 'dividers' within a larger briquetage container (or lids) to produce consistent amounts of salt cakes (Nenquin 1961: 125). However this seems unlikely, because slabs are often found with bars and pedestals and therefore may well have been used with other supports types.

However it is rare to find a combination of slabs, bars and pedestals that have been used together and it seems more plausible that slabs were either used with bars or pedestals rather than a combination of the three.

One insight into how some slabs were used for salt-production is provided by Gouletquer (1974a) in observations made on sites in other areas of Europe, especially in the Seille Valley and Brittany:

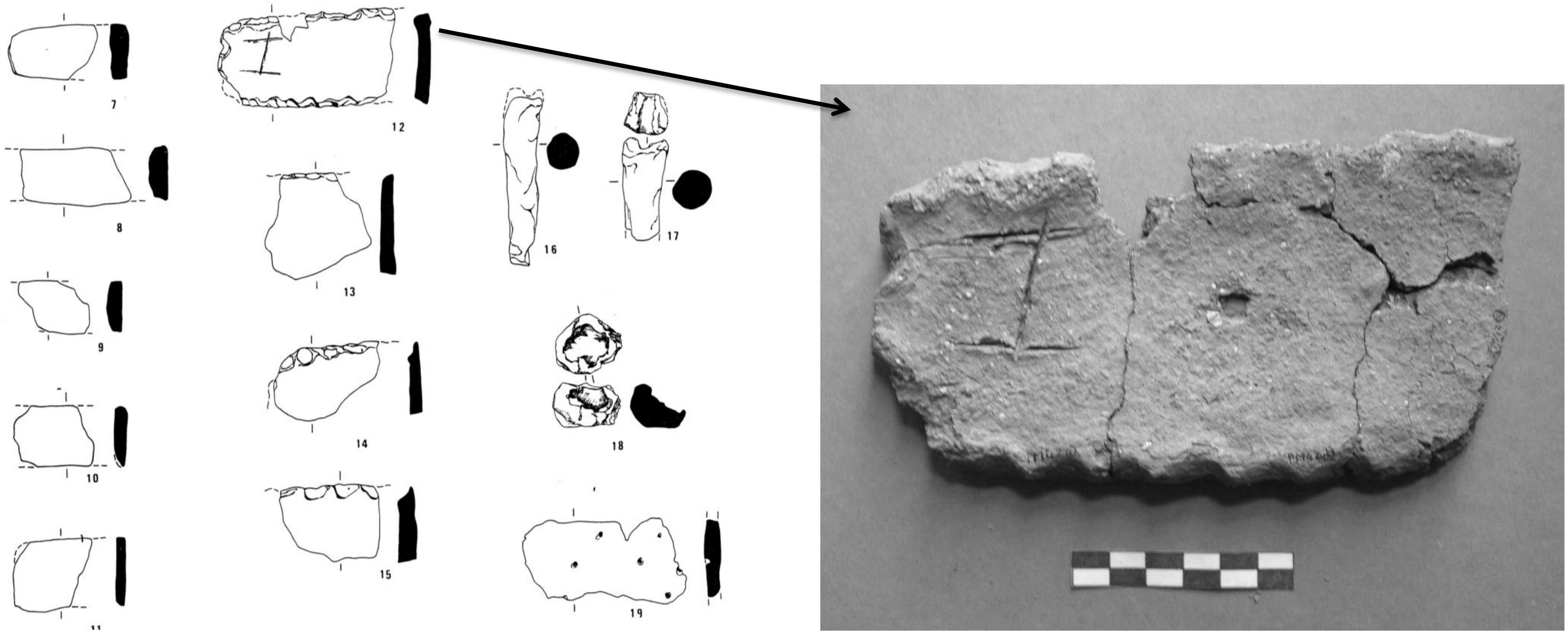

Figure 4.40 Left: Illustrations of Romano-British briquetage slabs and objects described as ‘plates’ from ‘Boat House Clump’, Upton Park, Dorset (Site 218), (Jarvis 1986a: 160) Right: Photograph of a decorated and inscribed slab (illustration 12 in left image) also from Site 218 (Author: 2004)

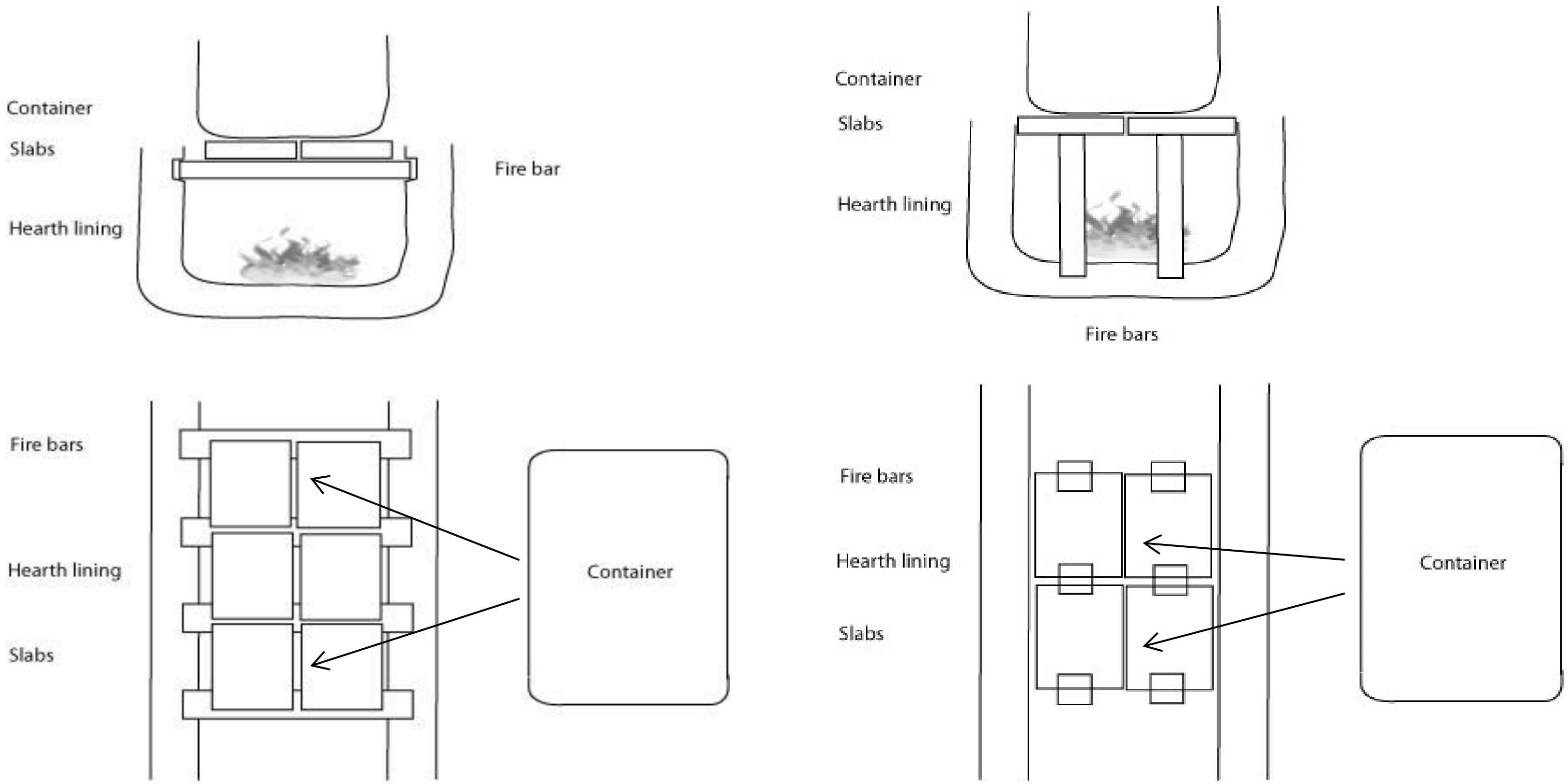

Figure 4.41 Examples of how slabs could have been used with bars over a hearth to produce salt. Left: Horizontal bars Right: Upright bar

...fire-bars were placed across rectangular hollows, the salt-moulds *(containers)* being put across the fire-bars, or on flat bricks set across those fire-bars. (Gouletquer 1974: 7)

The 'flat bricks' in this case are probably the same as the slabs seen in Britain. Reconstructions showing how the slabs could have been used are shown in Figures 4.41-4.42.

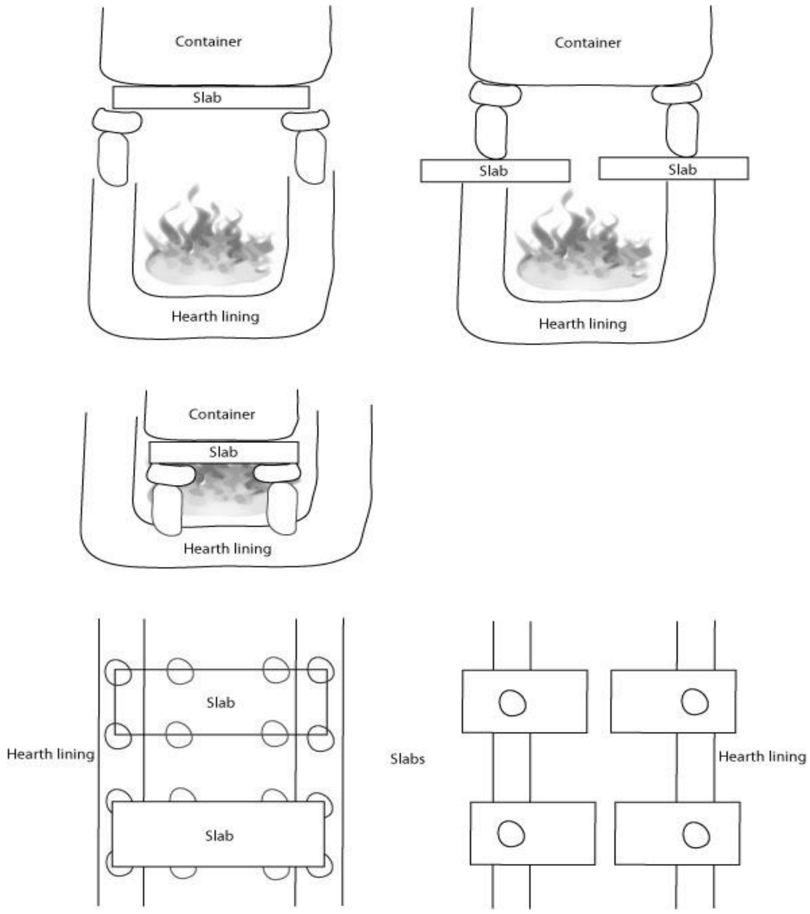

Figure 4.42 Examples of the way in which slabs and pedestals could have been used together. Top: Pedestals underneath supporting slabs Bottom: Slabs with pedestals above

Either scenario shown in Figures 4.41-4.42 would have been possible, although supports were similar in form on most sites and could have been used in different positions dependant on individual preference. Unlike the bars and pedestals, there is little evidence for discolouration on slabs. However, nearly all slabs have one rough surface and one smooth. In the case of sites that used lead containers, this would have protected the containers from melting.

A handful of slabs were reported to have been perforated (although not recorded in detail or illustrated) across the study area. Presumably these would have acted as suspended hearth floors which allowed more heat to reach the containers (Figure 4.43).

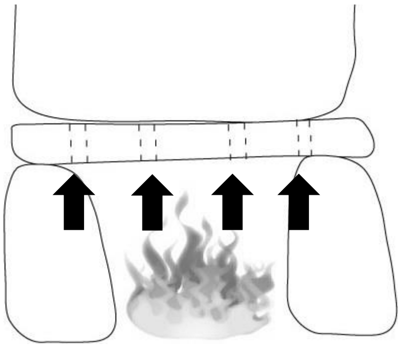

Figure 4.43 Reconstruction of a briquetage perforated slab within a hearth supporting a container

4.6.1.5 Alternative Hearths

Site 229, East of Corfe River and Multiple Romano-British Sites in the Medway Estuary

Grill Hearths? Site 229, East of Corfe River, Dorset

Evidence of an unusual linear hearth with internal divisions at Site 229 has already been outlined. Within the general briquetage assemblage from this site, there were some fragments that appeared to represent a grid system (Figure 4.44).

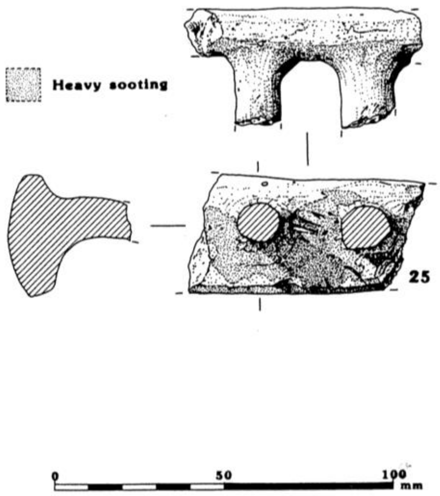

Figure 4.44 'Gridded briquetage from Site 229 (Adapted from Cox and Hearne, 1991: 153)

This gridded briquetage is unique to the study area and perhaps Britain. It was used to create ‘Type 7’ in the Bar Form Typology (Figure 3.51). However, in the Seille Valley, France, there is evidence for complex gridded briquetage, representing above ground ‘grill furnaces’ (Figures 4.45-4.46).

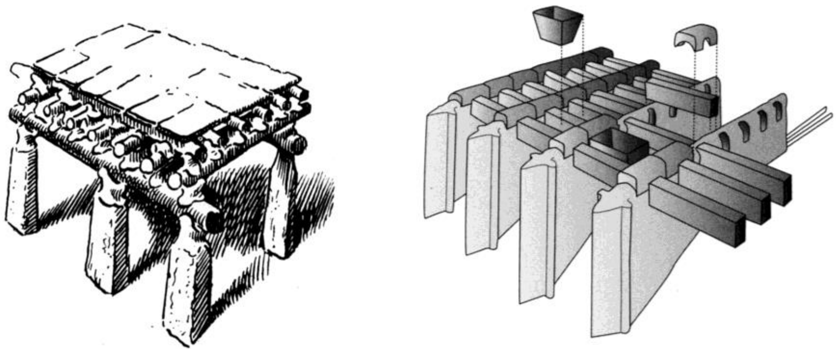

Figure 4.45 Left: Reconstruction for grid-type briquetage formation used in the Seille region of France in the Later Iron Age-Early Romano periods (Smith 1918: 41) Right: More recent reconstruction of grill furnaces from the same area (Daire, 2003: 37)

The grid could either be constructed on the ground surface or within a shallow cut which would leave little trace archaeologically. The divided linear hearth Site 229 is also similar to forms used in France (Daire, 2003). The significance of this technological link to France is further discussed in **7.4.2.**

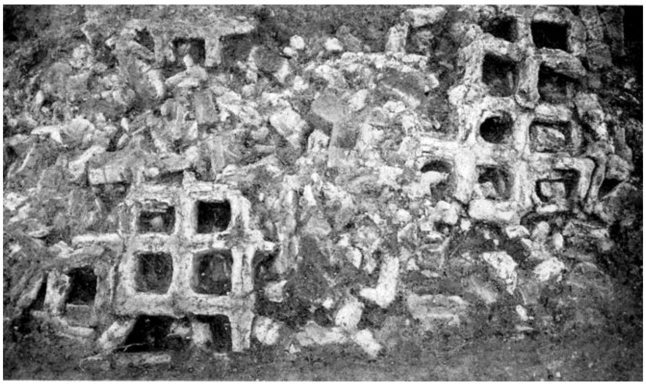

Figure 4.46 A collapsed briquetage grid system from a Roman salt–production site in France (Daire 2003: 70)

Portable Hearths in the Medway Estuary? Sites 42, 44, 57, 59, 61 and 311

Evidence for burnt linear features has been recorded within some areas around the Medway Estuary (Jackson, 1992). These appear to have been curved or straight and could be the remains of hearths. Associated with some of these areas are forms of briquetage known as ‘Slotted Lumps’ (Figure 4.47). This form was used to create Type 3’ in the study area Slab Typology (Figure 3.56) and only exists in Kent. The lumps have one smooth curved side, whilst the other side has small briquetage slabs embedded within it in a row placed vertically.

Figure 4.47 Slotted lump containing four broken briquetage slabs (Author: 2007)

The reconstruction (Figure 4.48) shows how the lumps could have been used in association with burnt surface features identified across some sites.

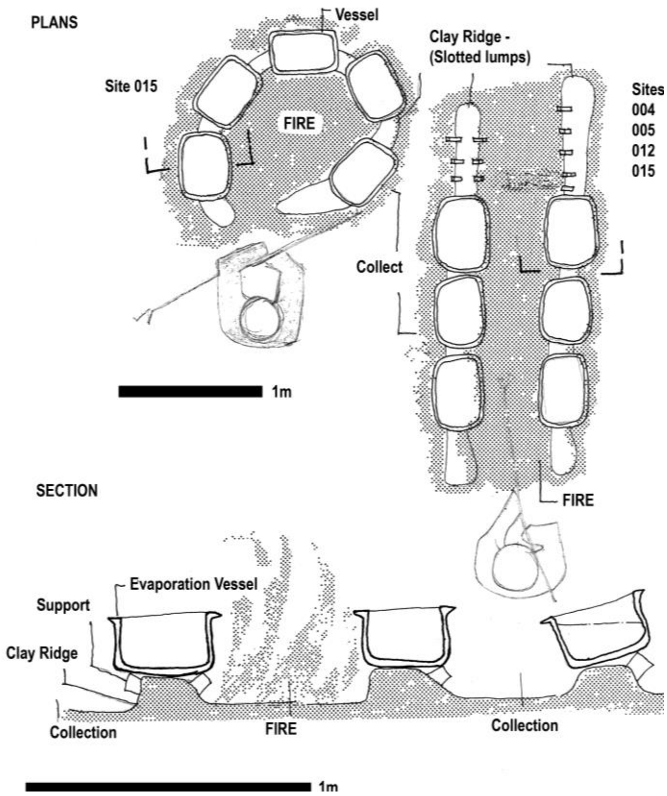

Figure 4.48 Reconstructions of how the slotted lump material could have been used in the Medway Estuary, Kent (Adapted from Ian Jackson: Personal Archives)

The lumps would have acted as hearth lining and the embedded slabs would have acted as supports. This innovation is discussed further in **5.3.2.3**.

4.6.1.6 Ovens

Chambered or twin ovens have been commonly identified in Essex (Figure 4.49), but were not common in the study area and, due to their poor preservation, are difficult to reconstruct in detail. Twelve potential examples were recorded, most of which were poorly described and could alternatively have been truncated hearths (see confidence rating in Table 10.1.16).

Ovens are defined here as hearths with evidence for superstructure, which can often include flues and stokeholes.

Figure 4.49 An example of oven structures with flues and chambers at Leigh Beck, Essex (Fawn *et al.* 1990: Plate 5)

Site 212: Redhill Battery, Isle of Wight

Site 212 is one of the few known Iron Age-Roman salt-production sites within the Isle of Wight. It had evidence for a ditch/gully hearth (Figure 4.50) with a stokehole and a feature thought to represent a clay-domed oven within the terminus (Tomalin 1989).

The dome appeared to be represented by a large clay bowl with a hole in the centre (Figure 4.51) and significantly, was constructed in the same fabric as local briquetage (*ibid*).

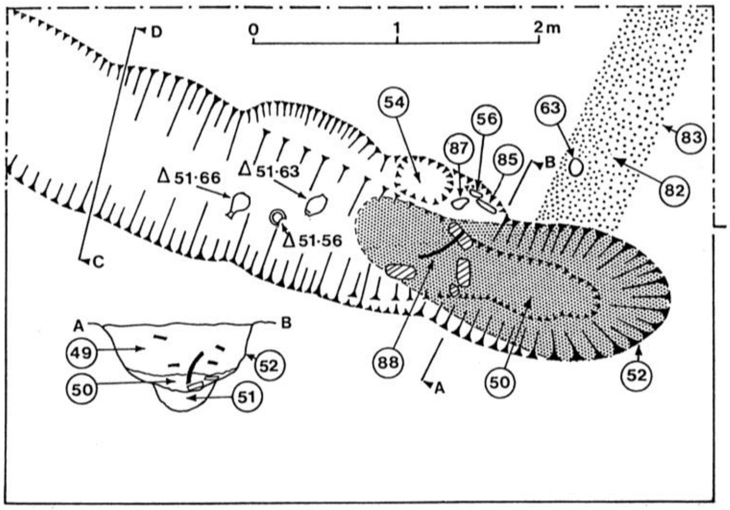

Figure 4.50 Plan of the gully (52) associated with salt-production activity at Site 212. The shaded area represents the area containing briquetage fragments, the dotted linear feature is a probable Neolithic gully (Tomalin, 1980: 113)

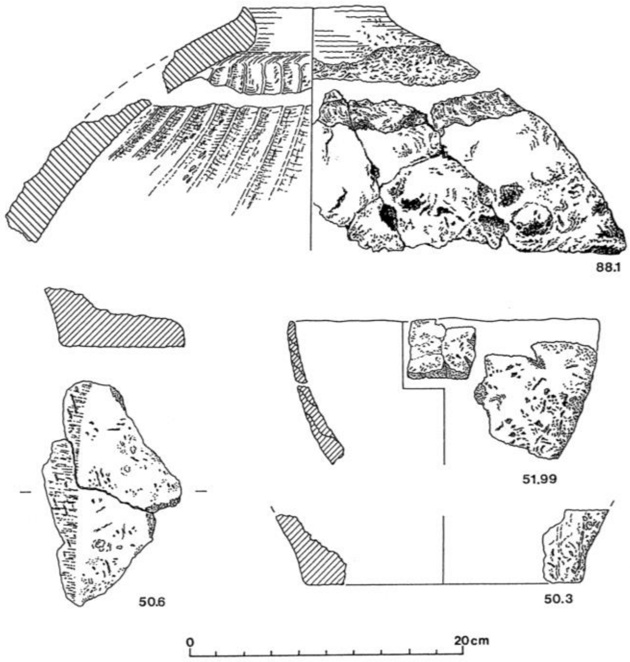

Figure 4.51 Remains of a 'domed briquetage structure' (88.1) and container fragments (50.3, 50.6 and 51) from the gully (Tomalin, 1989: 114)

If this feature does indeed represent a domed oven used in salt-production, it is unique in the study area. The feature closely resembles a small, updraft Romano-British pottery kiln (Swan, 1984) and therefore could suggest the sharing of technological features used in pottery production.

If this was a closed oven, then access to the containers during brine evaporation (which was essential) would only have been possible if there were gaps in the wall, or if the dome was portable. It is therefore instead possible, that the large bowl represents a vessel with the hole in the base to filter salt-impregnated organic material or wash salt during the salt-production process. In this case the ditch/gully would have been simply an enclosed hearth.

Of potential interest is that there are examples of Neolithic domed ovens used to produce salt in north-east Bulgaria (6^{th}-5^{th} millennia BC), (Nikolov 2011). These substantial thick ovens, were constructed with two entrances to provide access and allow draft to circulate and were used in conjunction with wide, shallow flat based bowls containing brine (*ibid*), similar in form to the bowls used within this site (Figure 4.51).

Although it is considered that most of the hearths in the study area were simply set within the ground with no covering structures as expected in an oven (this is mostly evidenced in a lack of stokeholes), it is proposed by Brunning that hearths in the Central Somerset Levels were set above the ground with raised walls and no cover (Brunning 2006). This is based upon the hearth in Figure 4.39 and suggestions that some hearths in the Essex Red Hills were also raised (Fawn *et al.* 1990). This is considered further in **6.0**.

4.6.1.7 Enclosed Hearths/Working Areas Associated with Structures and Buildings

Light Structures or Windbreaks

Sites 212, 221, 261 and 308: Salt Working Ivor Westmore 2, Isle of Wight (Late Iron Age-Early Romano-British), Site 261, Hengistbury Head, Dorset (Late Iron Age), Site 231, Hamworthy, Dorset (Late Iron Age) and Sites 30 and 90 in North Kent (Early Roman)

Evidence for temporary structures and windbreaks have been identified on two sites in the Isle of Wight (Sites 212 and 221) as well as Dorset (Site 261) and Kent (Site 308). It is plausible that more sites employed temporary structures; however small stake holes can easily be overlooked on archaeological sites.

Site 90: Funton Creek, Kent

As well as well-preserved hearths, this Romano-British site also had evidence for temporary structures or windbreaks. One of the hearths was recorded as having two small ash-filled holes on its southern end. These probably represent stake-holes that contained the burnt remains of wood.

Site 30: Cooling, Kent

As stated earlier, one of the working areas in this site (*c*.3rd century AD phase: Figure 4.18) was associated with the remains of four chalk 'piers' around the hearth. The piers are large and seem very elaborate for covering a single small salt-production hearth. It is possible that they formed part of a larger site that was not excavated and perhaps were used as a base for a wooden structure. This is discussed further in **5.0**.

Buildings/Permanent Structures

Sites 14 and15, Cornwall, Site 34, Upchurch, Kent and Sites 216, 225 and 231 Poole Harbour, Dorset

There are eleven examples (from eight sites: Sites 14, 15, 30, 32, 34, 39, 216 and 225) of permanent rectangular/sub-rectangular buildings associated with salt-production. Five examples will be outlined here; a timber structure in Upchurch in Kent (Site 34), and four stone buildings from Cornwall (Sites 14-15) and Poole Harbour, Dorset (Sites 216 and 225).

Site 231: Hamworthy, Dorset

There was also one example of circular Iron Age huts associated with a salt-production site, at Site 231 in Hamworthy, Dorset (Figure 4.11). Whether these huts served as storage areas or housing is unclear. However, it is possible that this site represents a Late Iron Age industry focused settlement, similar to activity at Ower across the harbour to the south.

Site 34: Upchurch, Kent

This 2nd century AD site has revealed evidence for substantial timber remains as well as lighter structures. The relationship between the building and salt-production is uncertain and the buildings could have served as storage areas.

Site 14: Carngoon Bank, Cornwall

This site consisted of a small occupation area on a cliff top dated to the Romano-British period (Mcavoy *et al.* 1980).

It included a sub-rectangular stone building, enclosing a sub-rectangular hearth with associated briquetage (Figure 4.52). There were several phases of activity within the building. The first phase contained ten pits and a sub-rectangular hearth. The hearth was clay lined and contained charcoal and ash.

The clay lining was only slightly burnt (Mcavoy *et al.* 1980), either suggesting the use of low temperatures or that a stokehole may have been used. No briquetage was found within the hearth but was recorded in the vicinity. Forms across this site consisted exclusively of containers, one fragment of which was found to have a pierced rim (Cornwall Historic Environment Record).

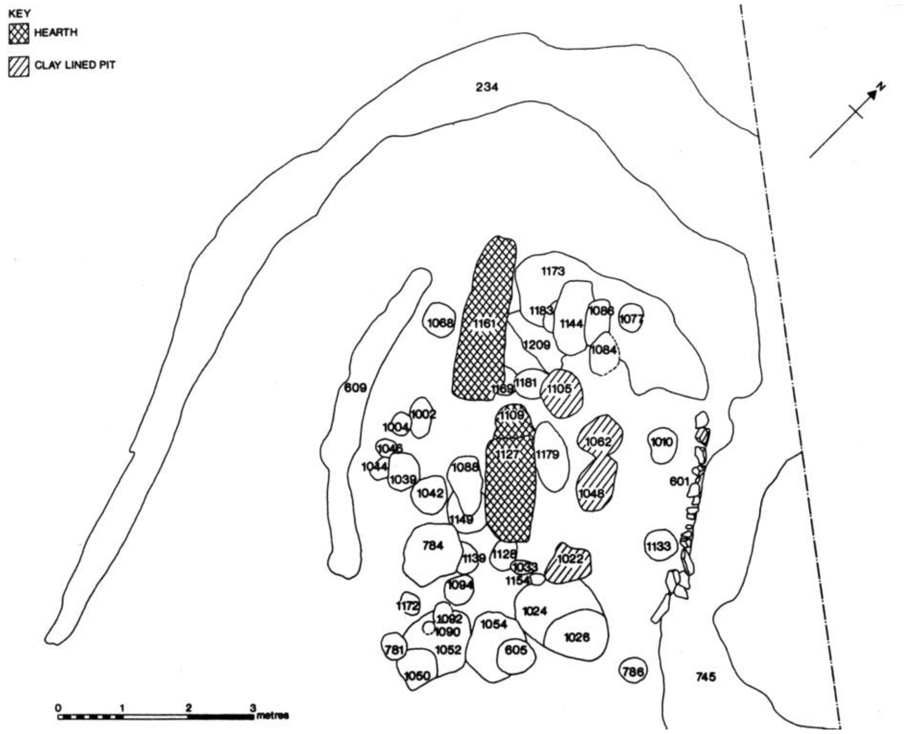

Figure 4.52 Carngoon Bank (Site 14) Structure 63 and phases I and II. Site 14 (Mcavoy *et al*, 1980: 39)

The pits probably functioned as clay and water storage areas. A later hearth was also associated with pits within the building. Outside the building was an oval pit, which was thought to have been a larger water reservoir. After disuse this pit was filled with a large quantity of briquetage. Upslope from this feature was a large surface spread of briquetage debris and it is possible this was to provide a hard standing or yard outside the building. Sealing this spread were some briquetage debris mounds.

Site 15: Trebarveth, Cornwall

This site (Figure 4.53) also consisted of a Romano-British building containing a salt-production working area in the interior including a briquetage assemblage comprised of containers only (Peacock 1969).

The circular stone building contained two hearths or ovens at the centre of the interior with associated pits (Figure 4.54). The hearths again represent different periods of activity. The first hearth was built into an oblong hollow and lined at the base and sides with stones.

Figure 4.53 Trebarveth (Site 15), Cornwall showing the site eroding on the cliff edge (Cornwall Historic Environment Record Archive 2009)

The floor had been raised and the chamber underneath the floor contained a dark fill with very fragmented briquetage.

The clay base of this chamber was heavily burnt in comparison to the raised stone floor, suggesting a small fire was set but did not involve flames actually touching the stones. There were two probable clay storage pits and two adjoined pits for water storage.

The second hearth was also stone-lined with a raised floor and was slightly longer than the first (1.6m v 1m in length). The northern end of this hearth was capped by a large oblong boulder. There were layers of burnt debris representing clearing out of both hearths. In terms of debris deposition, this site appeared to be much less organised than Carngoon Bank with briquetage debris spread across the building. No definite evidence for briquetage deposition outside the building was found.

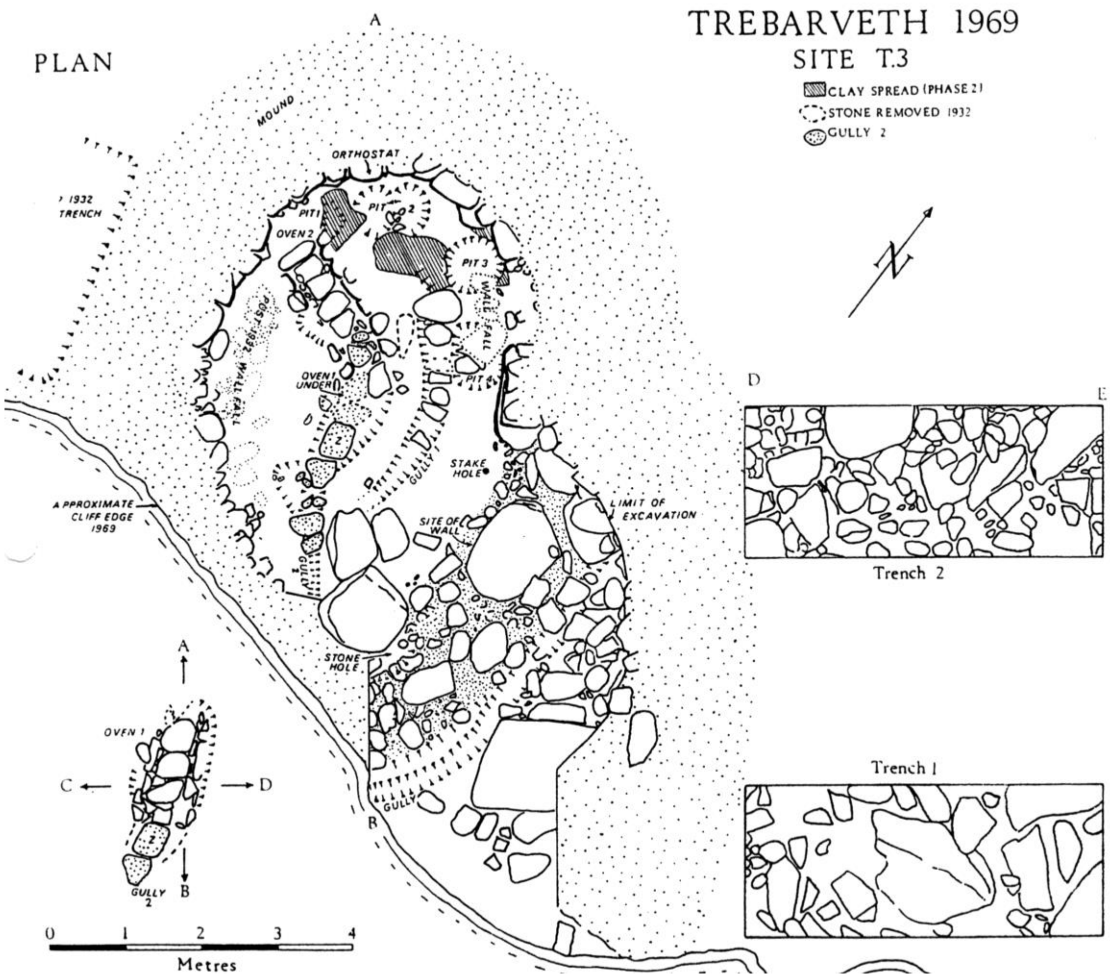

Figure 4.54 Plan of Trebarveth, Site 15 (Peacock, 1969:53)

Sites 14 and 15 are very similar. They both have restricted briquetage forms with a lack of supports (predominantly simple flat-based, slab-built containers), (Peacock, 1969:57). They both represent areas where salt was produced indoors. This would potentially have allowed for production to extend beyond the traditional summer period.

Site 216: Rope Lake Hole, Isle of Purbeck, Dorset

This site was a large Iron Age and Romano-British settlement complex with areas of industrial activity (Woodward 1987b).

Although the site had been badly damaged and is heavily truncated, Romano-British salt-production was evidenced by large briquetage spreads (Figure 4.55).

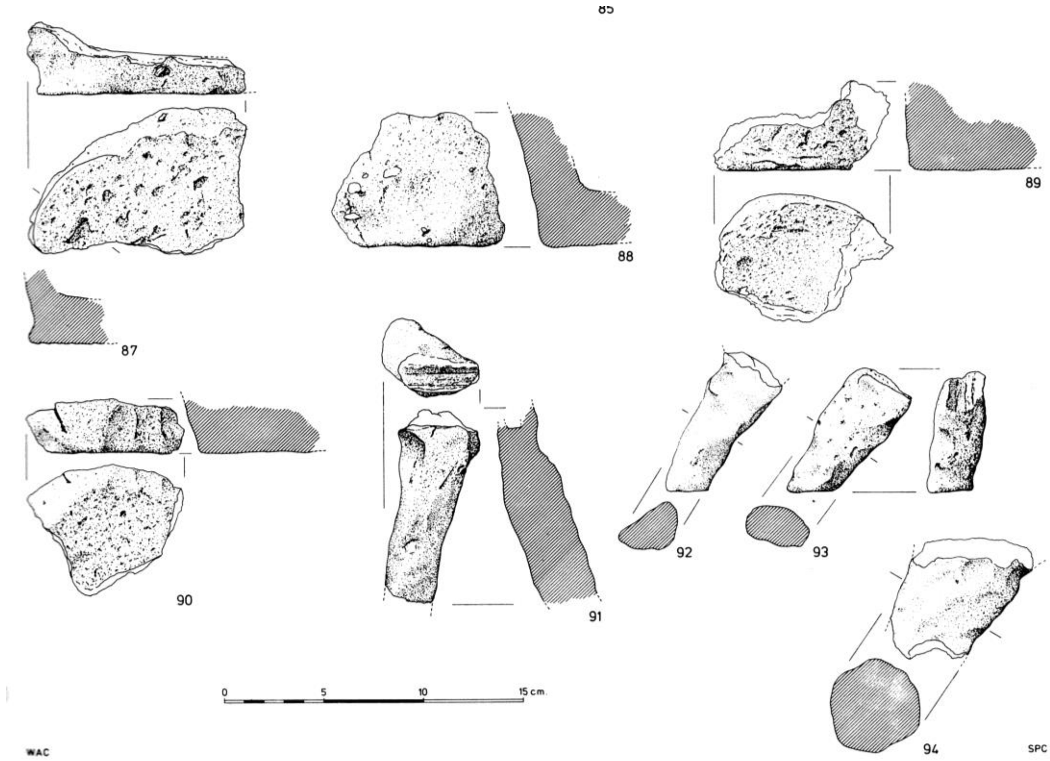

Figure 4.55 Briquetage: 84-90 thick rectangular brine evaporation containers; 91-94 pedestal supports from Rope Lake Hole (Site 216), (Hawkes, 1987: 159)

The briquetage included containers and pedestal supports (Figure 4.56). As at Site 14, briquetage debris had been used to create yard surfaces and floors for rectangular stone buildings (Figure 4.56).

The large quantity of briquetage around the edge of the building and some inside, suggests that the building contained an enclosed hearth for salt-production. However no definite hearths were located during the limited excavations.

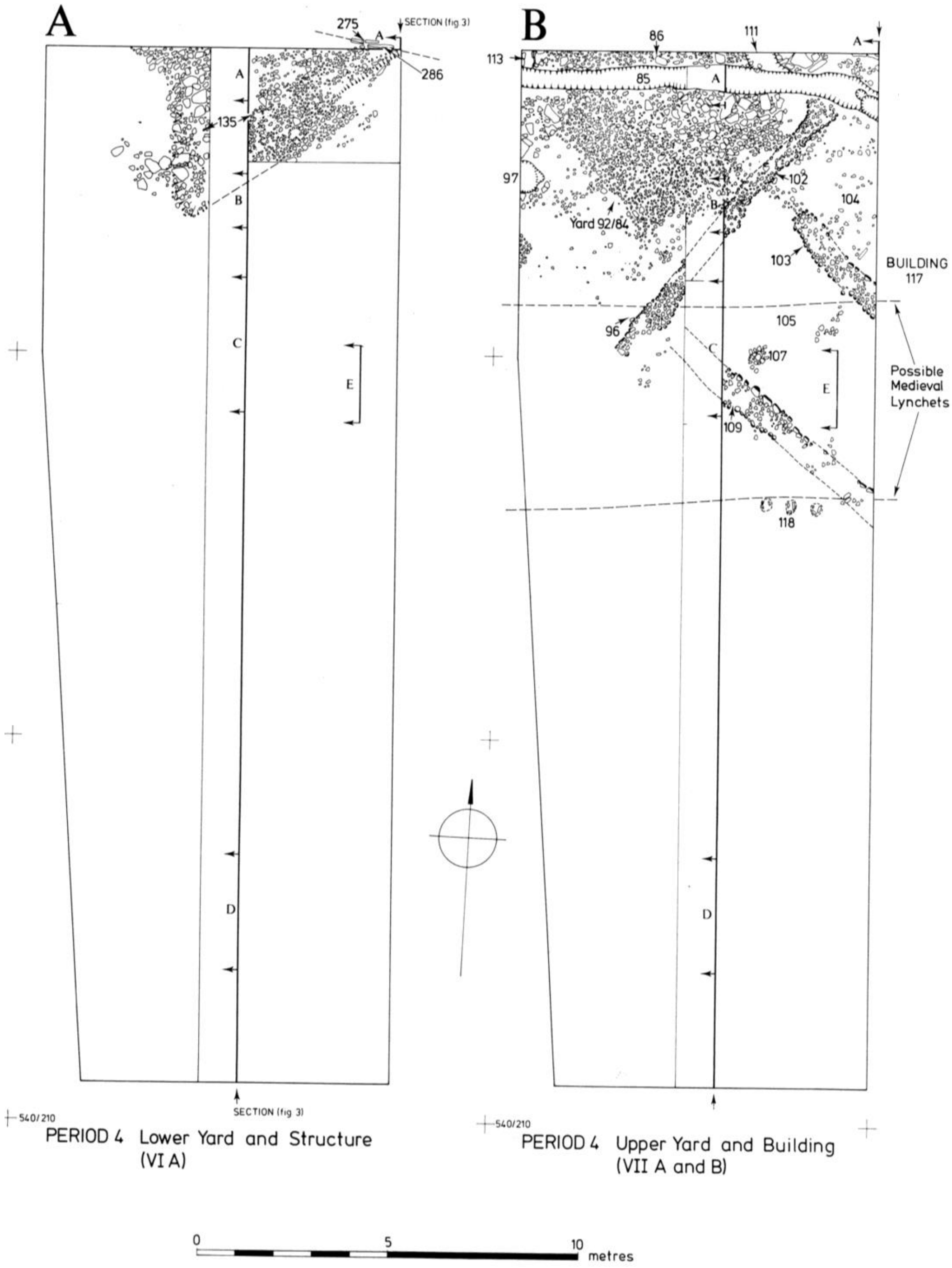

Figure 4.56 Plans showing Romano-British activity (Phase 4) at Site 216. Briquetage and shale made up some of the 'lower yard' surface (135) (Plan A) and was associated with the internal area of building 117 Plan B). Both internal areas 104 and 105 had briquetage on the floors (Plan B). (Woodward 1987b: 140)

Site 225: Ower, Poole Harbour, Dorset

This site represents another Later Iron Age and Romano-British settlement complex with stone-built rectangular buildings and areas of pottery, shale and salt-production (Woodward 1987a). One building had evidence for internal salt-production (Figure 4.57).

Figure 4.57 Plan of building 707 with 'drier' 708 at Ower, Poole Harbour (Site 225) (Woodward 1987a: 55)

The later phases of this building were associated with extensive layers of briquetage. This building was one of a small group of buildings arranged around a yard.

It was originally interpreted as a 'BB1 pottery-making settlement' (Woodward 1987a: 57). One of the internal features of the building was described as a 'corn or fish drier, (Figure 4.57: Feature 708). This feature originally had a superstructure, which had collapsed in the centre. This feature was bowl-shaped with an attached flue constructed from local heathstone and limestone. Within it, was a base layer of charcoal, above which was a layer of fragmented briquetage and burnt clay. This material was interpreted as '…probably derived from the lining and walling of the drier' (Woodward 1987a: 61).

More briquetage or possible kiln furniture was observed across the 'mouth of the drier' in the form of a 'long 'tongue' shaped piece which was interpreted as '…perhaps… a surviving piece of the dryer's floor' (*ibid* 61).

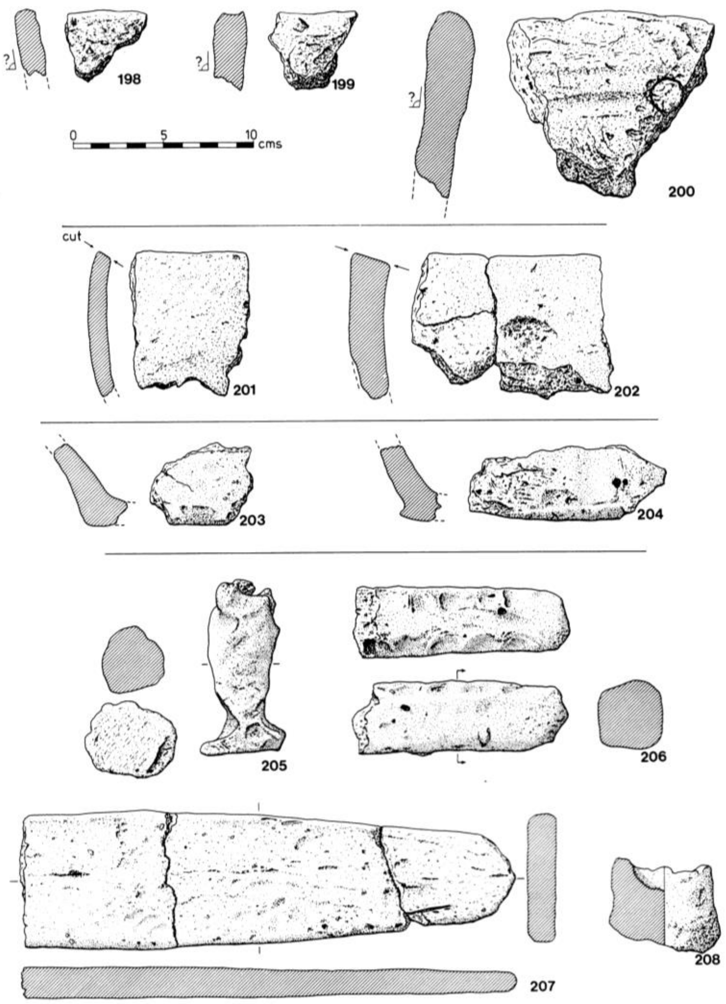

Figure 4.58 Briquetage from Site 225 (not to scale) Note the two different forms of container; the cylindrical cut edge container (201-202) and the thicker evaporation containers (198-200, 203-204) (Woodward 1987a: 93)

However, environmental samples taken from the feature showed a lack of carbonised grain, thus not providing strong support that the feature was a corn drier. There also was relatively little general domestic/occupation debris within the hut, whereas a large amount of briquetage debris was recorded. Just outside the hut was a larger concentration of briquetage debris forming an associated yard surface (Figures 4.57-4.58).

It seems more plausible that Building 707 at Ower, at least in the last stages of its lifecycle, was used for salt-production. Although raised floors are often associated with corn driers, most corn-driers are Y-shaped or T-shaped in form (Russell and Laycock 2010) and not bowl-shaped. The presence of briquetage within the 'drier' plus the briquetage debris inside and outside the building, strongly suggests that the feature was in fact an enclosed hearth with stokehole (Indirect Heat) used for artificial brine evaporation and/or drying of salt.

Briquetage forms mainly consisted of round or sub-rectangular containers. Hand-squeezed squat pedestals (Figure 4.58: 205) were also found, as well as bar supports.

Behind Closed Doors: A Note about the Significance of Salt-Production Carried within Buildings or Structures

Evidence for salt-production carried out within buildings clearly raises some interesting issues. Producing salt inside would surely have been more labour intensive in terms of creating artificial heated conditions. However, there must have been a valid reason for choosing to produce salt in this manner.

The clearest explanation is that by taking the process indoors, it was easier to control and it could be carried out all year round. Perhaps the indoor sites on the Cornish coast and in South Dorset were responding to higher demands for salt.

The significance of buildings on these sites, and evidence for domestic versus non-domestic activity evidenced on these sites is explored further in **7.0**.

4.6.1.8 Open Hearths (Direct Heat)

Open hearths are recorded archaeologically as simple levelled raw clay spreads, on Red Hill sites in Essex (De Brisay 1975), Lincolnshire (Lane and Morris 2001) and Dorset (Hathaway 2004b). At Osea Road, Essex, circular imprints from briquetage supports were observed on a clay spread used as a hearth (De Brisay 1975: 6). It is believed, based upon the research in Essex and Lincolnshire, that salt-production sites often have separate hearths for crystallising and for drying salt. The open hearths are therefore predominantly viewed as representing features for the drying salt.

A total of 23 **Open Hearths (Direct Heat)** were recorded across 17 sites during this study (Table 10.1.16). This was the most uncertain of the hearth/oven categories as most of these features were very damaged.

This feature type includes simple shallow burnt clay areas that were on the ground surface. However, these may also include the remains of more elaborate enclosed hearths that have been badly truncated with little more than the base surviving. Although associated with briquetage, some of these areas may have been domestic cooking hearths or the bases of bonfire kilns for producing the briquetage. Given these problems with identification and interpretation, it is estimated here that potentially only about a quarter of these features actually represent true 'Open Hearths'.

The third stage of salt-production (drying salt), therefore is the most difficult to identify and is only likely to be observed on sites that have been subject to large open area excavations. There are however, a few instances of Open Hearths that do merit discussion. These are 'Clay Platforms or Floors' that appear to have been used as surface hearths. It is assumed they functioned for the drying of salt, but it remains a possibility that they were also used to concentrate brine.

4.6.1.9 Clay Platforms (Possible Open Hearths)

Site 11: Hook, Warsash, Hampshire

This site has had very limited archaeological investigation (Fox 1937; Welsh 1985) but was found to contain earthworks and clay platforms (Figure 4.59) associated with disturbed briquetage (Figure 4.60).

Welsh (1985) made a sketch of the visible archaeological features (Figure 4.60). Two square platforms were observed by Welsh (one as large as c.30m). Fox had also previously observed a similar feature before the construction of a gold course (but apparently more oblong in shape).

Although no definite hearths were located, both authors observed that briquetage was embedded within these clay platforms. This is supported by finds of flat clay with impressions of square bars within them (Figure 4.59: ii).

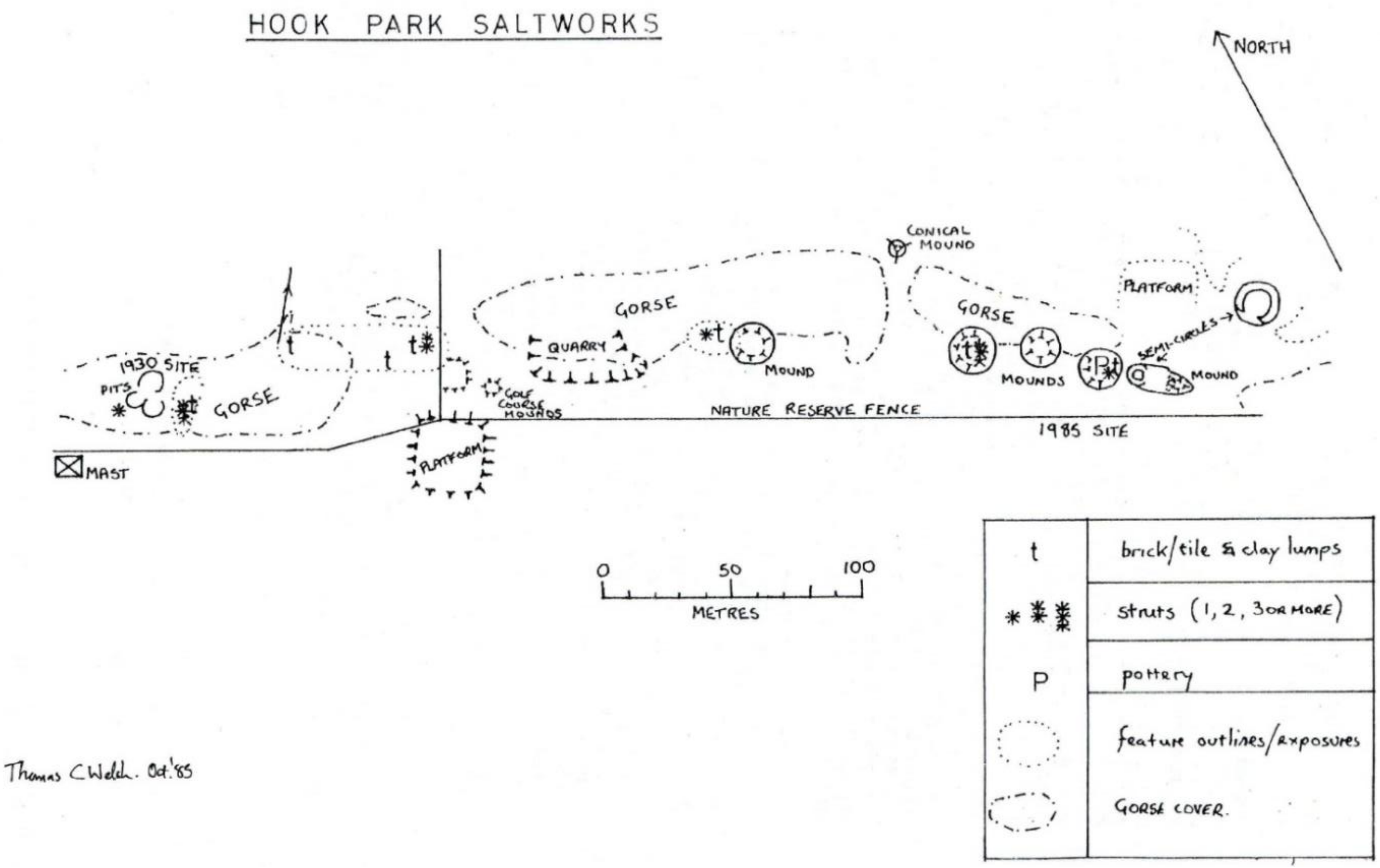

Figure 4.59 Hook Park Site Plan sketch (Welsh 1985)

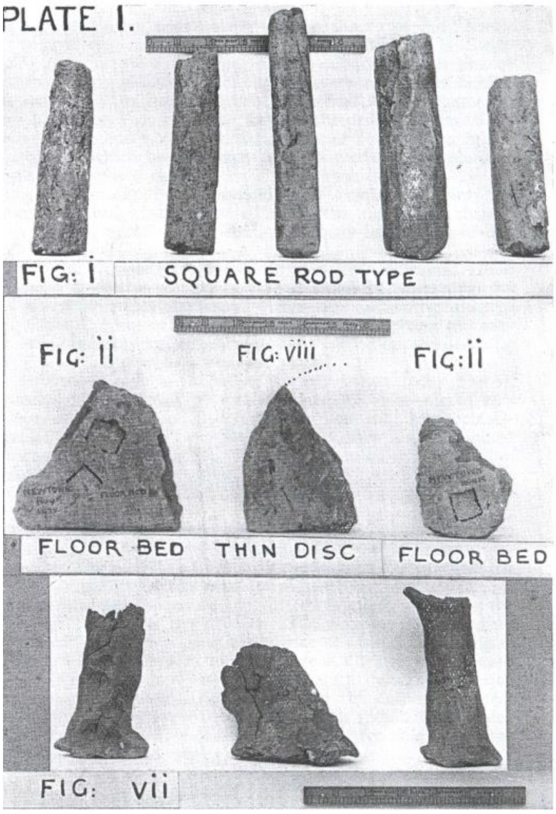

Figure 4.60 Briquetage from Hook (Site 11), (Fox 1937: Plate 1)

This therefore suggests that the clay platforms may have been used as open hearths, for both the evaporation of brine and drying salt. The briquetage was particularly well made and robust. Both bars and pedestals were present, but it is not known whether they were contemporary as all the finds were unstratified. There were no obvious container fragments in the limited assemblage.

At least four other sites (Sites 243, 266, 296 and 311) also have evidence for the use of clay platforms.

The evidence from Site 266 at Shipstal, Poole Harbour (Dorset Historic Environment Record) is very limited due to inadequate recording, but it appears that a large, thick burnt clay surface was found associated with briquetage:

> …But if Trebarveth and Wyke Regis teach us to look for flued ovens where there are no props and for simple hearths or floors where props are present, we can look with renewed interest at Shipstal on the shores of Poole Harbour where H.P Smith, in a trial excavation in the early thirties which he did not follow up, found a floor of fired clay associated with briquetage, which he thought was debris from a pottery-kiln. This is exactly the kind of thing we might expect on a site yielding props, and perhaps one day before it is too late we shall see a sufficiently large area at one of these sites stripped by excavation. (Farrar 1975: 20)

Site 243: Saltern, Portsmouth, Hampshire

Lying relatively close to Site 11, is another Late Iron Age site (Site 243) which also appeared to contain a rectangular platform described as a possible 'working area' (Portsmouth UA Historic Environment Record). This clay platform, however, was only c.4.9m x 3m in size.

Site 296: Ebber Rocks, Cornwall

Although this site had not been fully assessed at the time of data collection, a metre thick clay platform with small indentations within it was observed (Cornwall Historic Environment Record staff *pers comm*.). Briquetage container fragments were also found, some of which were within the fills of the holes. Although no pedestals had been found, it is possible that the small holes were areas where briquetage pedestals had been secured upright. Alternatively, they could be stakeholes for a temporary structure such as a windbreak.

Site 311: Slayhills Marsh, North Kent

The final site (Site 311) is dated to the Romano-British period (Upchurch Archaeological Research Group 1999). It consisted of an area of firm clay merging into a mudflat slope. Substantial areas of salt-production forming working floors with portable briquetage (including slotted lumps) were observed. It is possible that the floors were created in order to provide a hard base on which the slotted lumps were placed to create an enclosed hearth on the surface.

4.6.2 An Overview of Stages 2 and 3 in the Dataset

This section has reviewed the different types of 'heating structure' that were used during the Iron Age and Romano-British period. Most structures employed briquetage supports which held one or more containers (clay or lead). There is evidence from some sites for the use of simple shallow hearths and limited basic briquetage forms, whilst others produced more elaborate hearths and briquetage. Ultimately the more elaborate the hearth, the easier the heat and temperature could be controlled, in turn ensuring better quality salt crystals were produced.

Larger hearths that were able to heat multiple brine containers at one time (Figure 4.61) could clearly produce more salt compared to a small basic hearth that could only heat one container.

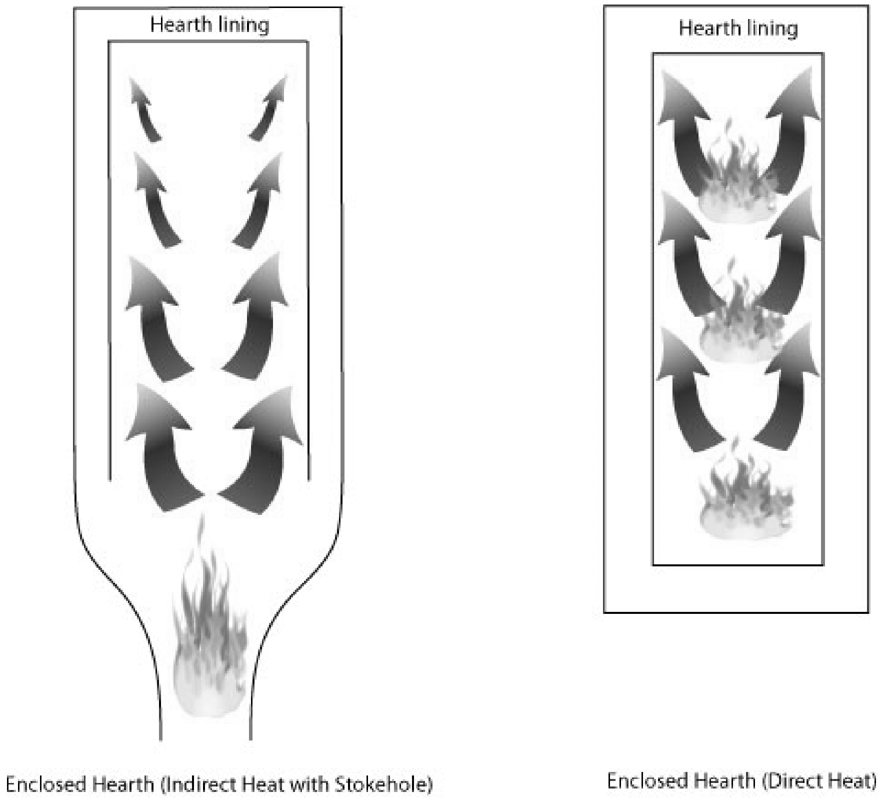

Figure 4.61 Diagram showing the main two enclosed hearth types and the method of heat distribution

However, the more containers used meant that more effort and time was spent monitoring the process and moving brine between containers so that none dried out. The type of larger enclosed hearths (Figure 4.61) used would also impact upon this process.

When using a simple enclosed hearth with direct heat, the fire would cover nearly all the base of the hearth enabling all the containers to be heated consistently. However if an enclosed hearth with a stokehole (indirect heat) was used, the hottest area would have been directly next to the stokehole and fire. This would have led to inconsistent heating of the containers, with those closest to the stokehole drying out first. This effect was observed by the author during experimental salt-production in Lincolnshire during a salt conference in 2006 (Report 10.2.1: Photograph 23). In an attempt to stop the first container drying out too quickly, brine was transferred from the end container to the front in a cycle which proved successful (Figure 4.62).

In contrast, if only one container was heated at a time, the brine could be closely monitored and the heat and brine levels adjusted as necessary. At Lydd Quarry (Site 82) most if not all of the small hearths could only have heated single containers. Perhaps in this case, many individuals made salt simultaneously, all being individually responsible for the salt produced from a single hearth.

Figure 4.62 Multiple containers (Fenland Type) over an enclosed hearth, brine was transferred between containers as required to stop the containers from drying out (Author: 2006)

As has been suggested previously, the would have been a very close relationship between the types of hearth and briquetage used. They had to work together and, for example, if bars were used in a horizontal position across the tops of hearths, then clearly the bars would need to be of an appropriate length to achieve this. Pedestal height would also be linked to hearth height. If the containers were too low down within a hearth, access would have been difficult. It is therefore possible that at sites with briquetage, but with no revealed hearths, that the hearth type could be inferred by the briquetage, and indeed, vice-versa.

4.6.3 Inferring ‘Missing Links’: Relationship between Hearths and Briquetage

Although the use of hearths with briquetage to produce and dry salt crystals is clear, there are still many salt-production sites where briquetage was located with no associated features. Is it possible that these briquetage assemblages can provide more information than simply indicating salt-production took place in the vicinity?

There are three main ways in which links between briquetage and heating structures can be made and that involves observing briquetage supports in three ways:

1. Presence of stabiliser briquetage forms including spacers and pinch-props
2. External surface appearance of briquetage support
3. The form and dimensions of briquetage support

As stated earlier, for a hearth to have held multiple containers, small stabilisers were required to hold the containers over the supports. These forms include ‘Structural’ briquetage; in the form of Types 1-2 (Figure 3.61).

Simply the presence of one of these forms within a briquetage assemblage, indicates that multiple containers were in use, which means the hearth was probably linear or rectangular/sub-rectangular in shape.

Different colouration on the exterior of briquetage supports can be indicative of whether the support was exposed directly to fire, which could be used to infer the use of a directly heated hearth versus an indirectly heated hearth/oven.

The difficulty in interpreting differences in surface colouration is determining whether they occurred during firing or from subsequent use. Little is known about the creation of briquetage and it probably varied greatly between sites and individual producers. If, for example, simple bonfire or clamp kilns were used to create briquetage, this can leave a clouded effect on the surface due to differences in oxygen levels and the proximity of other clay objects within the kiln (observed by the author during experiments).

However, the identification of certain ‘salt colours’ on the surfaces of some briquetage has been attested (Lane and Morris 2001). Buff yellow and pale lavender surface colouration on some briquetage supports have been observed on assemblages from Lincolnshire and are thought to be the result of a reaction between salt, heat and baked clay (*ibid*). These colours therefore can be used as a useful tool to identify briquetage and confirm that this material was indeed used in salt-production.

The form of the briquetage support can also be used to infer hearth type as their position within a hearth or oven could affect their height and width. With these factors in mind, it is possible that briquetage supports could preserve evidence of how they were created and used.

4.6.3.1 Briquetage Pedestals

Pedestals can be very informative about technological choice and hearth types. The first example comes from Lydd Quarry, Kent (Site 82). The majority of rounded pedestals from this site have clear exterior markings which indicate that they were used close to, or within, a source of direct heat (Figure 4.63).

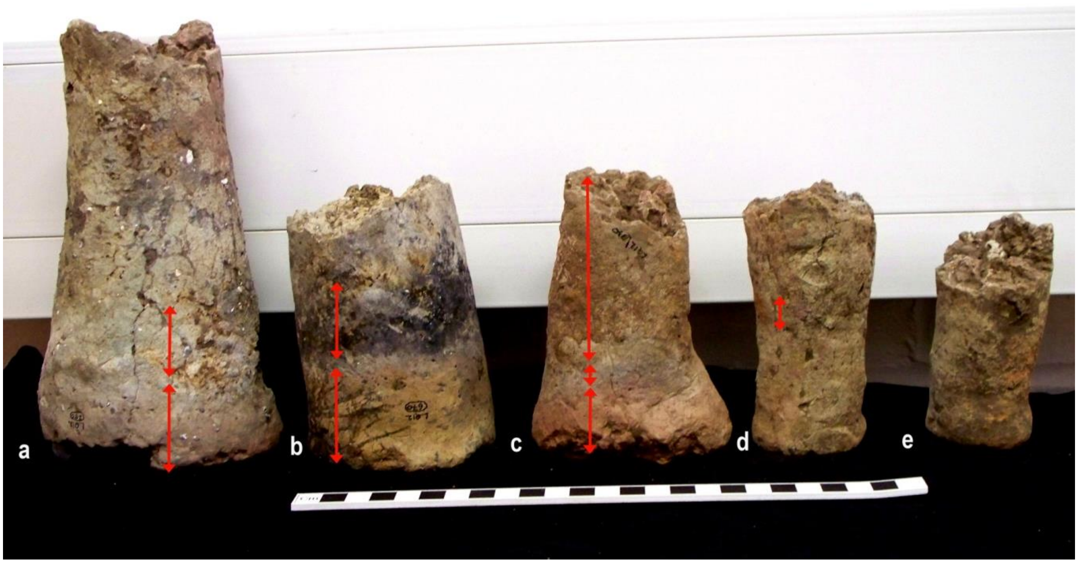

Figure 4.63 Briquetage pedestals from Lydd Quarry, Romney Marsh, Kent (Site 82) showing zones of banding on the exterior as a result of differential heat exposure during use (Author: 2008)

Fortunately, this site has revealed evidence for rounded pedestals *in-situ* within small circular hearths (Figures 4.24 and 4.26).

It is also possible to infer this through observations of some of the support exteriors. These examples have the bases of pedestals embedded within the hearth base. Either the pedestals were inserted into the hearth lining whilst it was still wet, or they became fused to the base with the heat of the fire.

All of the pedestals shown in Figure 4.63 have been subjected to direct heat, as a result of being placed directly within a hearth base, as evidenced in the colour banding and darkened areas of fabric. The difference in lower banding is probably the result of resting within a layer of fuel, whilst the upper areas would have been exposed to great heat, but were not directly resting within the fire.

It is likely that the height of pedestals was linked to the depth of hearths as the position of the container above the supports, was important when heating brine. If the container was too high it would not receive enough heat, if too low it would receive too much heat and make access to the container difficult.

In contrast to the pedestals in Figure 4.63, similar briquetage pedestal support forms used at Site 213 are homogenous in surface appearance with no banding or evidence for application of heat (Figure 4.64).

Figure 4.64 Rounded pedestal supports from Shapwick Road, Hamworthy (Type 2) (Site 213), (Author:2004)

They are usually a pale buff orange colour with a soft powdery fabric and have not been exposed to direct heat, as they lack discolouration. These pedestals show little evidence for actual use (Figure 4.64), suggesting they were never placed directly within a fire in the base of an enclosed hearth (direct heat).

Experimental archaeology in 2006 (Report 10.2.1) showed that during attempts at traditional salt-production using rounded clay pedestals, they became discoloured on the surface after use within the base of a directly heated enclosed hearth (Figure 4.65).

Figure 4.65 Reconstructed pedestals used during attempts at traditional salt-production in Lincolnshire. The pedestals were used within an enclosed hearth and although distant from direct heat still had surface clouding and areas with surface crystallised salt (Author: 2006)

Many of the Site 213 (Shapwick Road, Poole Harbour) pedestals were found in association with a deep, enclosed rectangular hearth with no stokehole, therefore using direct heat. Given the depth of the hearth, the pedestals would have been too short to safely support a container supporting the theory that they were not used inside the hearth. Therefore, the most plausible explanation is that they were placed in rows along each side of the hearth. This would have created a rather delicate balancing act when supporting containers above the hearth.

This was unexpected as it might have been quicker for the container to be within the hotter area inside the hearth. However, this may account for why the hearth was so deep. Presumably the fire would have been set within the hearth, and being so enclosed and deep, would have been able to reach higher temperatures, therefore being able to heat the container held above.

Similarly, the Late Romano-British salt-production site at Middleton, Norfolk revealed an enclosed hearth with *in-situ* pedestal bases embedded in rows on the top of the hearth lining, (Figure 7.15), (Lane and Morris, 2001).

Although the examples illustrated here were found in association with hearth features, it provides a basis upon which to interpret briquetage pedestals that are not found in association with a hearth.

4.6.3.2 Briquetage Bars

Some examples of unstratified bars with extensive evidence of use were discovered amongst material from briquetage debris mounds and river floors (River Huntspill) in the Central Somerset Levels (Figure 4.66).

Figure 4.66 Bar fragments found within the River Huntspill after being eroded from nearby briquetage debris mounds (Author: 2008)

The colours observed on the surface of these organically tempered bars included whites, beiges, lilacs and greys, pinks and darker and lighter shades of orange/red.

It is probable that the natural fabric colour was cream, matching local clays (Figure 4.66: lower ends of bars **b** and **c**). These probably indicate parts of the bar that were covered during use within an enclosed hearth. However, whether bars were used in the vertical or horizontal position is a subject of debate.

Some sites in the Fenlands with similar bars were assumed to have been used in the vertical position (Lane and Morris 2001: 371). Bars of similar dimensions and attributes to those in Somerset were also found at an inland Romano-British salt-production site at King Street, Middlewich, Cheshire (Williams and Reid 2008: 164). Similar colouration was also observed and the cream sections were thought to represent the ends of bars embedded upright within a rectangular enclosed hearth. Figure 4.67 illustrates a possible reconstruction of how bars were used in the upright position. The use of bars in the upright position is also supported by the square impression of bars found on the clay material from a platform at Hook, Hampshire (Site 11).

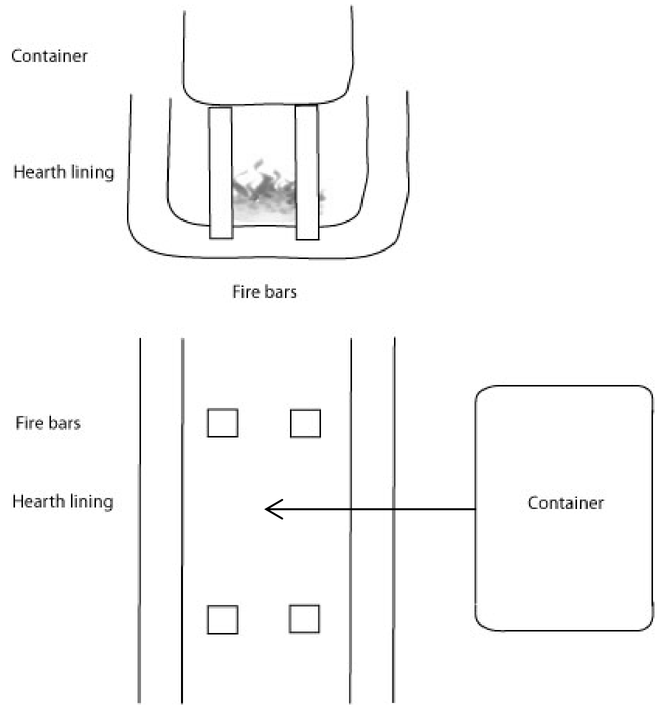

Figure 4.67 Reconstruction of briquetage support bars being used in the upright position

The form of the bars also potentially indicates the positions in which they were used. Nearly all the bars found within the study area were rectangular and approximately the same thickness from end to end. However, there were four sites in Kent (Site 30, 32, 42 and 312) that used triangular bars, commonly seen in the Red Hill sites of Essex (De Brisay 1975; 1981).

This difference in form could simply be attributed to individual choice of form based on *aesthetic preference*. However, the triangular bars were made specifically to be used in the *horizontal position*. Most weight and therefore stress is placed upon the centre of the bar when supporting a container. Therefore the triangular bars were made thicker in their central point to support the heavy containers filled with brine (Figure 4.68).

Definite evidence that a bar was used in the horizontal position was found inEssex where the bar impression was preserved in the sides of an enclosed hearth (Figure 4.68: bottom).

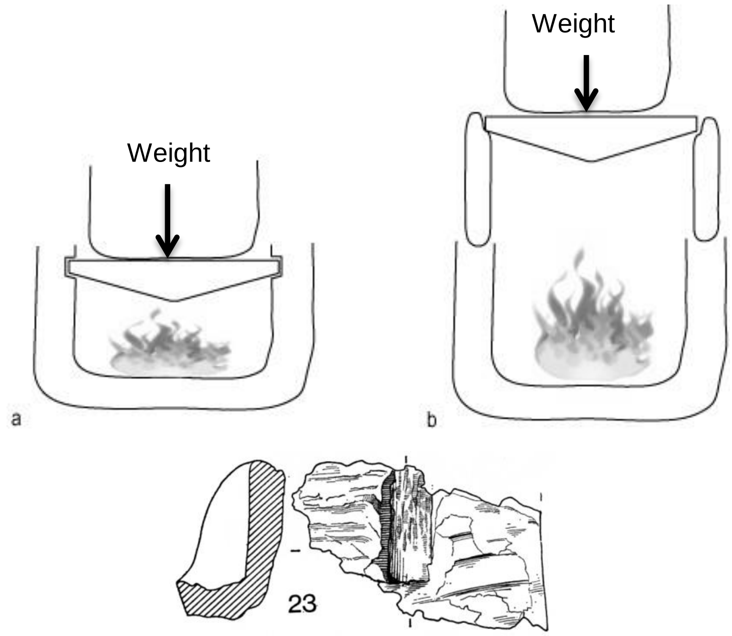

Figure 4.68 Top: Reconstruction of the use of triangular briquetage support bars in Essex showing that the bar would only work with the triangular point facing downwards Bottom: Example of the lining of a salt-production hearth with the impression of a horizontal impressed support bar (Adapted from De Brisay 1978: 47)

Triangular bars were ideal for supporting heavier briquetage containers in the horizontal position. However the bars within the study area were mainly rectangular and straight which could suggest that in most cases they were used in the upright position.

However, similar long, rectangular bars used in pottery production are known to have been used in the horizontal position. It is likely therefore that the bars could be used in either positions as required.

In Somerset, the exterior colouration on one particular bar (Bar b) does suggest that at least in this case, the bar had been used in the horizontal position (Figure 4.69).

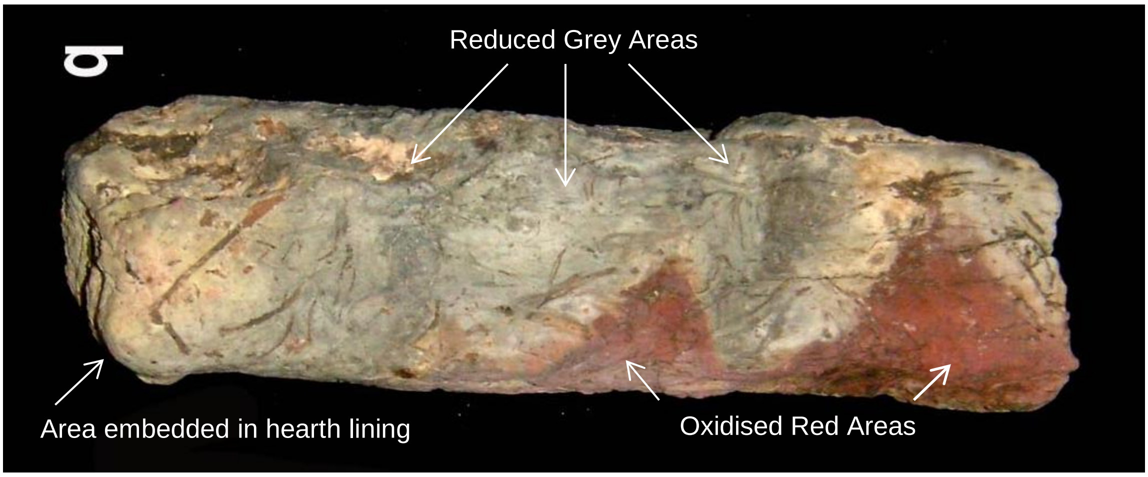

Figure 4.69 A close up of the surface markings on Bar b (unstratified from the River Huntspill) (Author: 2008)

This bar has particularly distinct wavy markings on one surface; the grey area represents a reduced area (heated with little oxygen), and the red an oxidised area. This suggests that the grey areas were parts of the bar that were covered whilst heat was applied *during its use*. This could have occurred whilst the bar was being used in the horizontal position with slabs or other bars laid over the top in angled rows. However it is difficult to visualise how this would have worked in terms of producing salt over a hearth and an alternative explanation for the markings may have to be sought.

Unfortunately no complete bars were found to verify whether the other end of the bar also had evidence for being embedded. The strong likelihood that lead containers were used on many sites within the Somerset Levels poses other issues. Lead has a low melting point and therefore the container would need to be sufficiently distant from direct fire to stop it melting.

Therefore, if the bars were used horizontally (as reconstructed in Figure 4.70), they would need to be embedded within a deeper hearth (as seen in Site 166) to maintain sufficient distance between the heat source and container. Also if the bar was used upright it would need to be long enough to reach well clear of the fire.

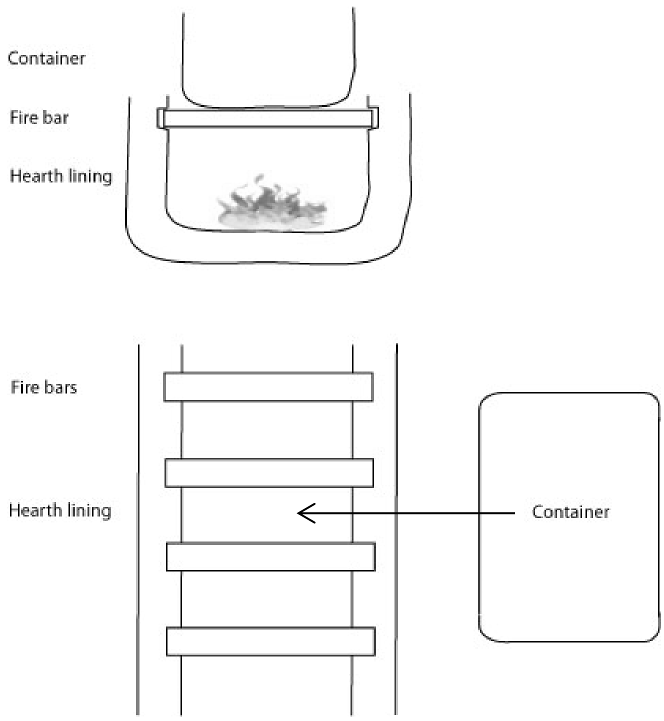

Figure 4.70 Reconstruction of briquetage support bars being used in the horizontal position

Many bars found within the Somerset Levels (**6.0**) also had evidence for vitrification in their centres as a result of being exposed to great heat. Although this could have been caused by spanning a hearth horizontally, it is more likely to occur if the bars were directly placed within the hearth fire, either used alone or with slabs above. This not only infers that the bars were probably used in the vertical position, but also that enclosed hearths using the direct heat method were used in Somerset, as supported by the archaeological evidence.

4.6.3.3 Chemical Analysis of Briquetage

There is one final method that could be used to certainly ascertain whether briquetage has been used in salt-production and could even potentially inform on its position within a hearth.

This involves chemical analysis of briquetage fabric to determine and compare salt content (specifically sodium (Na) and potassium (K)). This has only been carried out formally on one site within the study area at a Romano-British salt mound east of Cornmoor Farm, East Huntspill (Site 198), (Leech *et al.* 1983).

Table 4.5 Results of chemical analysis for sodium and potassium of briquetage, pot and burnt clay (Adapted from Leech *et al.* 1983: 78)

Test Sample	No. of Samples	Water Extract		Acid Extract	
		Na+ppm	K+ppm	Na+ppm	K+ppm
Pedestal from hearth	4	2-3	2-3	45-50	55-64
Slab from burnt layer	6	2-3	2-3	145-1000	60-70
Slab from burnt layer	6	2-3	1-2	150-900	60-118
Unburnt layer material	-	3-4	1-2	2-3	7-8
Bar from burnt zone	4	2-3	3-4	60-75	60-65
Unburnt zone	2	2-3	2-3	2-3	2-3
Peat Ash	2	2-3	1-2	6-7	7-8
Pot sherd unstratified	2	2-3	2-3	2-3	2-3

As shown earlier, this site consisted of a debris mound containing burnt layers and hearths. Samples were taken from briquetage, a pot sherd and general burnt layers (Table 4.5).

The samples were dissolved in acid provided the clearest results for evidence of direct contact with brine (both sodium and potassium). All briquetage supports had very high values. Most slabs had higher sodium (Na) and potassium (K) levels than pedestals and bars, indicating that the slabs had closer contact with brine. This supports the theory that the supports lay beneath the slabs which held containers, brine probably spilt from the containers onto the slabs.

Figure 4.71 Salt covering all the hearth lining after the hearth had been used to produce salt during a day of traditional salt-production (Author: 2006)

Salt-production experiments in Lincolnshire using similar hearths and briquetage indicated salt adhered to everything including the hearth lining (Figure 4.71).

4.6.4 Potential Use of Organic Artefacts in the Production of Salt (Stages 2 and 3)

Thus far, discussion on the methods of salt-production has focused predominantly upon the use of clay briquetage containers (and later lead containers). However, there is also potential for the use of organic artefacts to have been used in the processing of salt.

Although many archaeological investigations now commonly take environmental samples to identify organic material, it is still rare that organic artefacts survive due to the lack of suitable anaerobic conditions.

Although there is more likelihood for the preservation of organic artefacts on peaty, clay wet coastal or marsh sites where salt-production sites are often found, it is still possible that heavy briquetage within the waste deposition areas could have crushed more delicate objects such as basketry.

Therefore, often the only evidence for the use of organic material during salt-production is in the voids left within organic tempered briquetage after the material such as seeds and grass was burnt away during creation and use. However, as show in **4.3.1** (Figure 4.2), occasionally the impressions of wooden planks/surfaces can be observed on the exterior surface of briquetage containers. The potential for organic artefacts to have been used in the processing of salt on some sites, is further explored below.

4.6.5 Processing Salt to Taste and Look Good: Absence of Evidence or Evidence of Absence?

As stated in **1.5.2,** when producing salt from solution it is common for the salt to contain bitterns that greatly impacts the taste if not removed. As shown in the outlining of Techniques I-III (Figures 4.6-4.7), there was the option for further processing the salt to improve the taste and to remove more impurities/bitterns.

However currently there is currently little archaeological evidence to support that this took place.

Ethnographic examples of traditional salt-production in Africa have shown that basket containers were often used to sieve salt for impurities. Basketry was also traditionally used to contain wet salt for drying and in some areas to transport salt for trade. Wooden bowls to store salt were also used. (Alexander 1975; Sutton 1981; Connah 1991; Matshetshe 2001).

Figure 4.72 A sketch of an individual in Africa washing salt in a large basket to remove impurities (Adapted from Gouletquer 1975: 50)

Basketry was mainly used to filter salt in order to make the salt look and taste appropriate to cultural preferences. For example in Manga, Niger, ethnographic observations made in the 1970's revealed that large baskets (Figure 4.72) were commonly used to process the impurities from wet salt by washing it with fresh water (Gouletquer 1975).

It does seem probable that at least some salt-production sites in the study area could have employed this or similar techniques to remove impurities. The salt could either have been washed with brine or freshwater.

For example some sites may have specialised in producing salt for use primarily for the preservation of meat whilst others may have produced salt for the use as a condiment to be added to food (Hathaway 2008). These different uses may have influenced the size, type and quality of salt crystals produced.

When salt crystallisation takes place, if not removed, the magnesium salts will also crystallise and form part of the overall finished product. The consequences of this is that the magnesium salts are particularly susceptible to absorbing humidity from the air, which not only results in a bitter taste but also means the salt is more susceptible to becoming damp (Nenquin 1961). Therefore it was probably considered important to remove the ‘bitterns’ from the salt, if not for just improving taste, but also to stop the salt absorbing more moisture once it had been dried on-site.

In Kibiro, East Africa (Connah 1996), a system of filtering was used to process salt from the soils of ancient dried salt lakes. This originally employed organic vessels, and later metal and plastic containers. This process could have been similar to the processing of salt-impregnated marsh material as suggested in Technique III.

This has been speculated for Middle Iron Age salt-production at Red Hills in Stanford Wharf, Thames Estuary, Essex where recent excavations revealed insight into the technique of salt-production in this area (Biddulph *et al.* 2012). Environmental examples revealed evidence for the processing of marsh plants for salt (Hunter 2012). It was suggested that this was achieved in a similar way to Technique III, but with the addition of baskets hanging above the tanks in order to hold the burnt material, which was washed through with brine (Biddulph *et al.* 2012), (Figure 6.50).

There is also ethnographic evidence for the removal of moisture from salt in order to improve the taste using organic materials in Mexico (Ceja Acosta 2011). This involves filtering the salt through a colander to remove moisture, and then leaving it on a draining board to dry further for several hours (Ceja Acosta 2011: 41). After this, the salt was hung in small sacks above the brine evaporation hearth to completely dry out using the rising heat generated by the hearth (*ibid*). It is possible that some of the evidence for temporary structures near hearths on sites in the study area (**4.6.1.7**) could represent areas where salt could be hung and dried in sacks or filtered.

The Somerset Levels are particularly rich with natural resources for the creation of basketry and a large fragment of basket was recovered beneath a Romano-British briquetage mound (Site 166) at the River Huntspill (Figure 4.73). Due to this close association with a salt-production site, it was speculated that the basket formed part of a container used either within the salt-production process or to transport salt (Grove and Brunning 1998).

Figure 4.73 Basketry preserved underneath a briquetage mound in the Somerset Levels at Site 166 (Brunning 2006: 21)

Although only identified on one site, it is possible that further excavations would reveal more basketry and further potential evidence to support the use of organic artefacts in salt-production.

The second potential example for evidence of the filtering process was discovered at another Romano-British salt-production site in 12 West Quay Road, Poole, Dorset (Site 215). Amongst fragments of rectangular plain briquetage containers and pedestals was an unusual decorated fragment with a perforated base (Figure 4.74).

This container was unusually shallow (barely 1cm deep), decorated and had holes within the base made before firing.

There are two possible interpretations; that it had a specific function within the salt-production process or that it had a completely different function as an object and was simply made from the same fabric as briquetage.

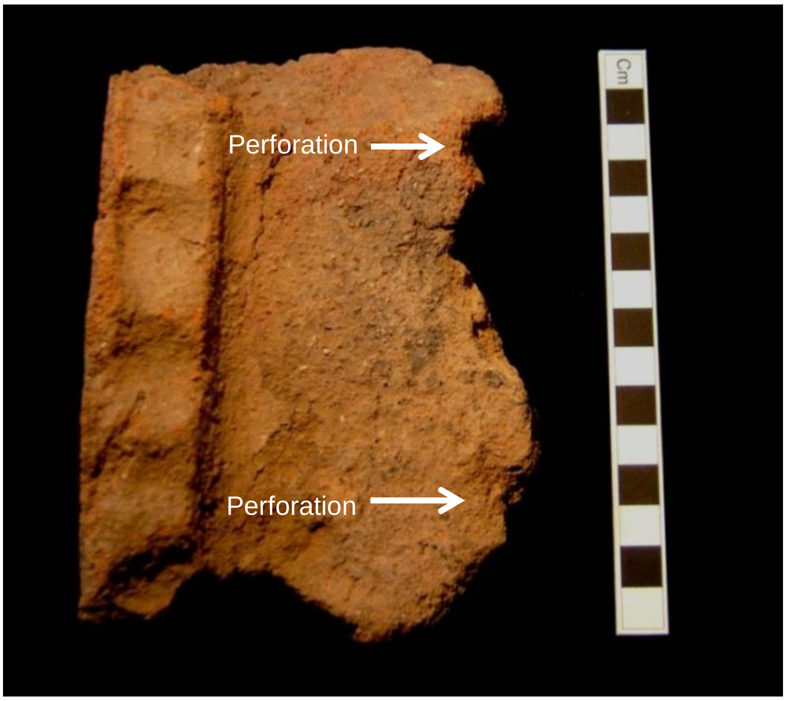

Figure 4.74 Early Romano-British perforated and decorated fragment of briquetage container from 12 West Quay Road, Poole, Dorset (Site 215) (Author: 2009)

It has been suggested that it was perhaps a container used for the cooking of fish (Jacqui Wood *pers. comm.* 2006). However, given its close association with salt-production hearths and briquetage, it is more likely that it was used to filter wet salt for impurities. This is also supported by similarly decorated briquetage containers with pie-curst decoration (*with* and without *perforations*) which have been found in Essex (De Brisay 1975; 1978: 49). Of interest is that De Brisay (*ibid*) considered the 'meticulous attention to detail' evidenced in the creation of decorated Essex briquetage, inferred small-scale production, presumably inferring that there was more time, to decorate briquetage if there was less time pressure to produce salt.

Except for this possible evidence for processing salt using organic remains, there is no definite evidence in the archaeological record that impurities were removed from salt for taste and appearance. The most common method of removing impurities is to carefully heat the brine so that the 'leese' containing the 'bitterns' rises to the top as froth and can be removed *before* salt crystals are formed. This method would not leave any archaeological trace.

4.7 Stage 4: Debris Deposition

Salt-production produces significant amounts of waste. This can include large amounts of briquetage as well as fuel ash/fuel slag, burnt soil, dismantled hearth linings, organic and domestic debris.

The most enduring signature of an Iron Age and Romano-British salt-production site is the presence of briquetage. Therefore, as expected, this was the most 'archaeologically visible' stage, with 210 debris deposition *features* occurring within 154 of the 276 sites (Figures 3.31 and 4.75).

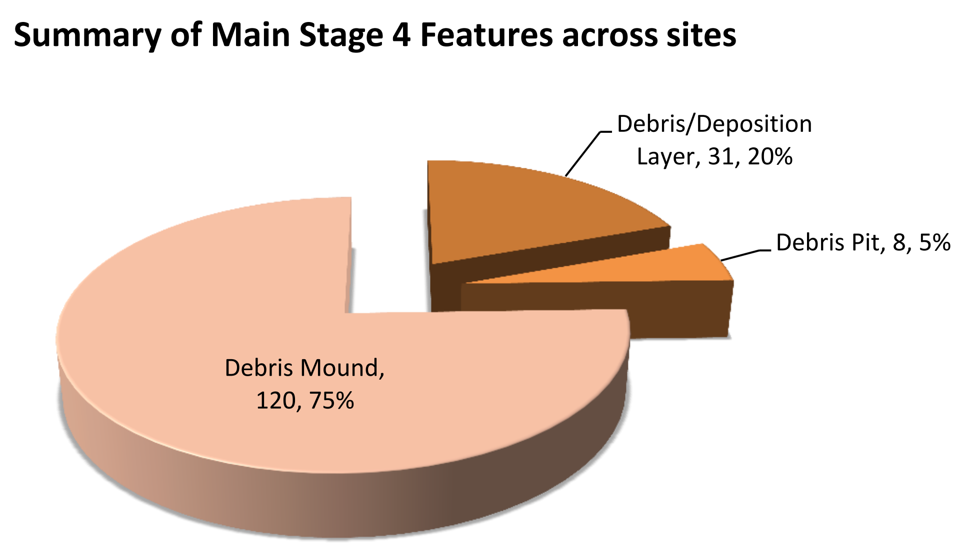

Figure 4.75 Percentage of the three main features created for the deposition of debris from salt-production across sites (Total=154 sites, some sites contained multiple types)

Briquetage appears in most cases to have been produced in large quantities as it was easily worn and broken during use, and possibly had to be broken during use. This, combined with hearth debris, would have required periodical disposal inside and around the edges of a site.

It would make sense that, in most cases, debris was dumped outside the main working area to prevent obstruction of movement and access to hearths and tanks. It is also probable that temporary small dumps of briquetage were created inside the working area during salt-production. Then, periodically, the waste could have been moved to larger dumps (either buried or on the ground surface as layers or as heaped mounds) in the vicinity. This would have greatly depended on the scale of salt-production, the overall size of the site and the local topography and land-use. For example, if a salt-production site was located at some distance from domestic living areas, it could easily create a large area to dump debris without obstructing other activities. If salt was produced in the vicinity of occupation areas, the dumping of debris would have required more careful management.

The ways in which debris was managed would need to be considered at the start of salt-production, especially if carried out on a large scale. Even the most well managed sites would have had small fragments of briquetage scattered around the salt-production area, perhaps trampled into the ground through the movement of people. Briquetage would also have broken whilst being used and therefore have entered the hearth area from where it could be removed later.

The way in which debris was managed can potentially provide a great deal of information about the way a site was organised. Evidence for large areas of dumping away from the site could suggest that there was a pre-determined plan for waste disposal.

Larger salt-production sites could have altered the surrounding landscape significantly by accumulating large quantities over time.

Studying the deposition of debris as well as the location of features can provide a holistic overview for the use of space by individuals and communities working on and organising the site. Whether debris was deposited within or at the edges of a site would have greatly affected the routes taken when walking around and using the site.

Clearly there are a variety of features available for the deposition of debris generated from salt-production. Figure 4.75 contains the three most common, formal and managed methods of deposition (debris deposited within other features such as hearths and tanks are not counted in this category).

The most common method of deposition observed was the formation of 'Debris Mounds' (75%). The majority of debris mounds in the study area occur in the Central Somerset Levels (Figures 4.77). However some have also been found in the Isle of Purbeck, Dorset (Figure 4.78) as well as North Kent (Figure 4.18). Mounds are also commonly employed in Essex (Fawn *et al.* 1990) and some areas of Lincolnshire, (Figure 4.76), (Simmons 1975; Lane and Morris 2001). These mounds consisted of debris such as briquetage and charcoal.

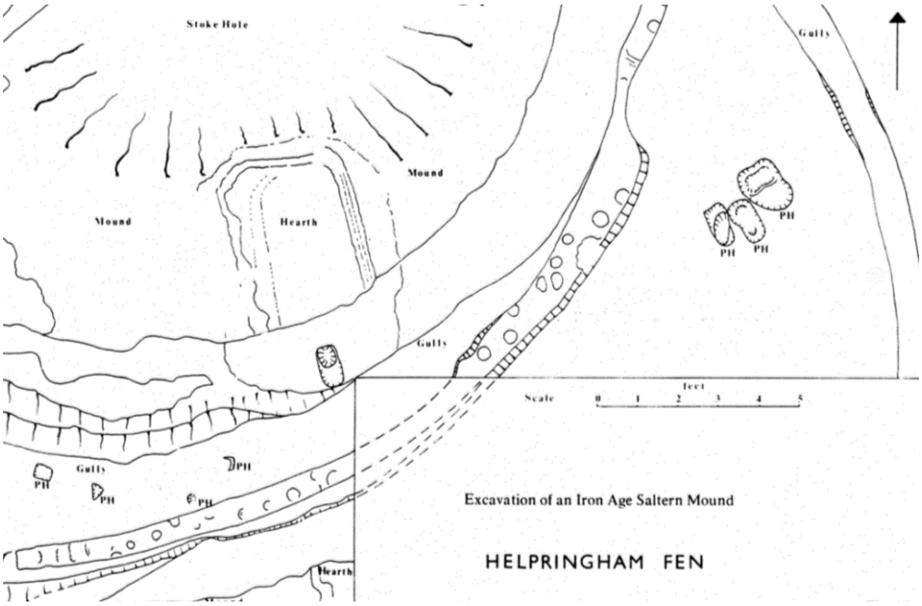

Figure 4.76 A Late Iron Age salt-production site with debris mound at Helpringham Fen, Lincolnshire (Simmons 1975: 33)

One example of a relatively well-preserved large debris mound outside of Somerset can be found on the clifftops of the Isle of Purbeck (Hobarrow Bay, Site 214). This mound, originally one of a series of debris mounds that have now been lost to the sea, is itself eroding away on the cliff edge (Figure 4.78).

Figure 4.77 Left: Site 155 (a scheduled debris mound) facing north (Neil Tinkley: 2008) Right: Site 108 in section, facing west towards Woolavington Bridge showing the stratigraphy of briquetage (red) and burnt charcoal layers (black) (Author: 2008)

Figure 4.78 View of the mound at Site 214 (Author: 2004)

The spreading of debris over large areas of the ground (Debris/Deposition Spread/Layer) was the second most common method of formal debris deposition (20%), (Figure 4.75).

Many salt-production sites are first identified when these large spreads of briquetage are discovered during excavation. These spreads are often on the outer perimeters of the main working areas. However, some have also been found within the site and even integrated into floors. This would be useful in areas that were particularly wet or low lying as briquetage would form solid working floors and drier areas to walk upon.

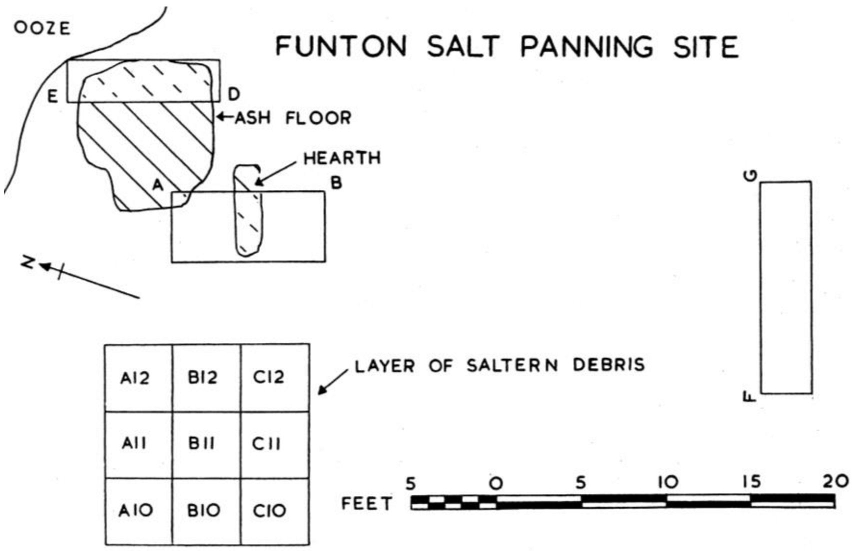

Figure 4.79 Plan for Site 32 at Funton, Kent (Miles, 1965: 262)

Figure 4.80 Left: Briquetage layer exposed at Upton Park, Poole Harbour at Site 218 (Poole Museum Service Archive) Middle: A disturbed buried briquetage deposit near Site 227 Right: Briquetage fragments scattered around the base of a tree, disturbed by root action in the same area as Site 227 (Author: 2009)

This was probably the case on a low lying coastal site at Site 32, at Funton, Kent (Figure 4.79) where briquetage and hearth debris surface layers were observed within the main working area.

The spreading of briquetage on the ground was particularly prevalent along the edges of Poole Harbour, Dorset where it drastically altered the visual landscape in areas around the Arne Peninsula and Upton Park (Holes Bay), (Figure 4.80: left). Scatters of briquetage can still be seen on the ground surface in parts of the Arne Peninsula (Figure 4.80: middle and right).

Depositing briquetage within pits was also identified across eight sites (c.5%), (Figure 4.75). The use of pits for general waste is commonly seen in many domestic and industrial archaeological sites in many periods.

It was very common to use hearths as deposition pits after they had ceased to be used and this often confirms that the hearths were associated with salt-production. Although not separately quantified, most hearths filled with briquetage appear to represent an act of final deposition symbolising the end of a hearth's use for salt-production.

4.7.1 Briquetage Lifecycle

Briquetage has a potentially variable lifecycle in terms of the way in which it was originally created and used (Primary Consumption) as well as any secondary use (Secondary Consumption) and disposal (Figure 4.81).

As stated earlier, briquetage containers are nearly always highly fragmented due to use or deliberate breakage. Ethnographic parallels from Soconusco, Mexico, have shown that the average lifespan of a pot used to heat brine was 3-4 days (Ceja Acosta 2011: 41) when producing loose salt. In production of loose salt, each family exploiting a salt spring for the season would use on average between 12-20 vessels (*ibid*).

However, if solid salt was being formed (i.e the creation of salt blocks from loose crystals) (known as '*samo*' locally), the container had to be broken in order to retrieve the salt (*ibid*). Importantly, this meant that a strategy had to be put into place for salt-production, as the creation of salt blocks required more investment in pot manufacture. It is possible that this distinction was made in Iron Age/Roman salt-production, and would clearly have impacted preparations before production and involved different levels of investment.

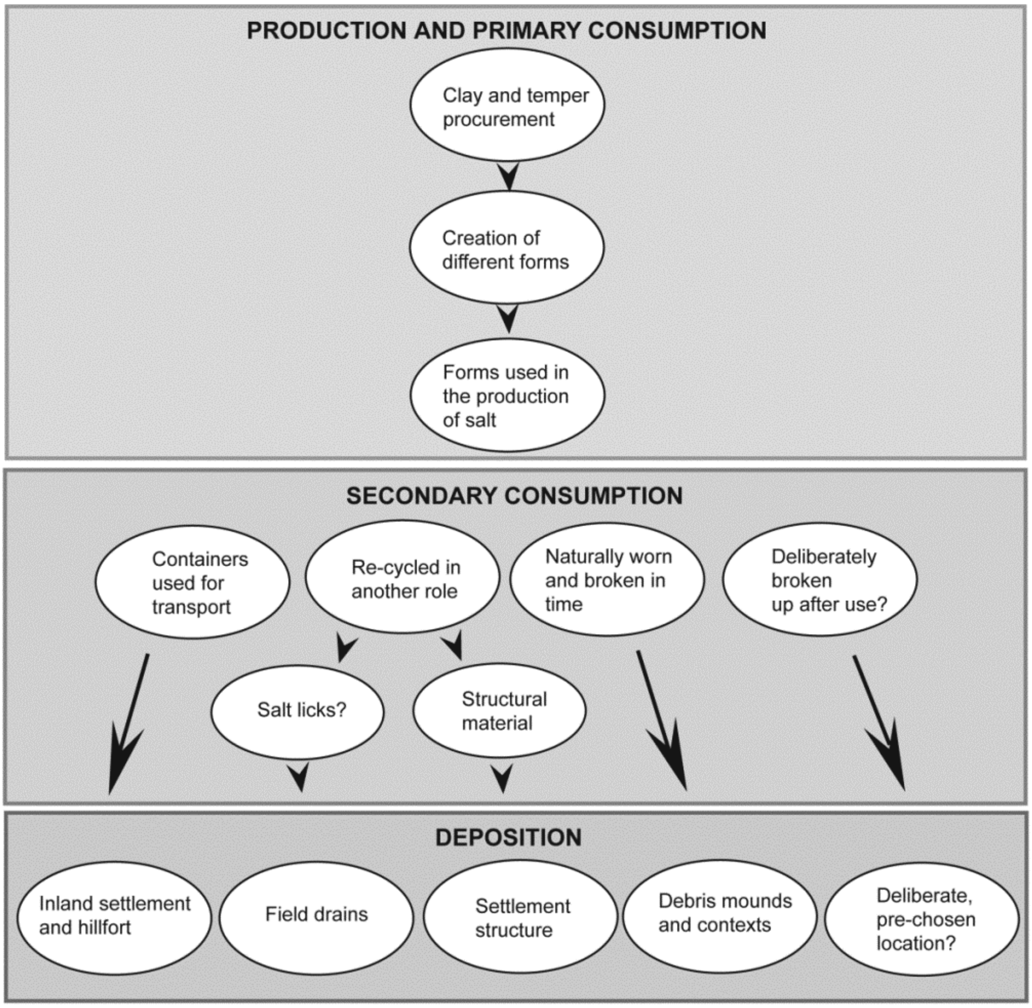

Figure 4.81 Lifecycle of briquetage (Hathaway 2008: 50)

The end of the lifecycle was mostly linked to the way in which waste was managed and organised. There were at least eight different methods for the deposition of briquetage and other waste (Figure 4.82).

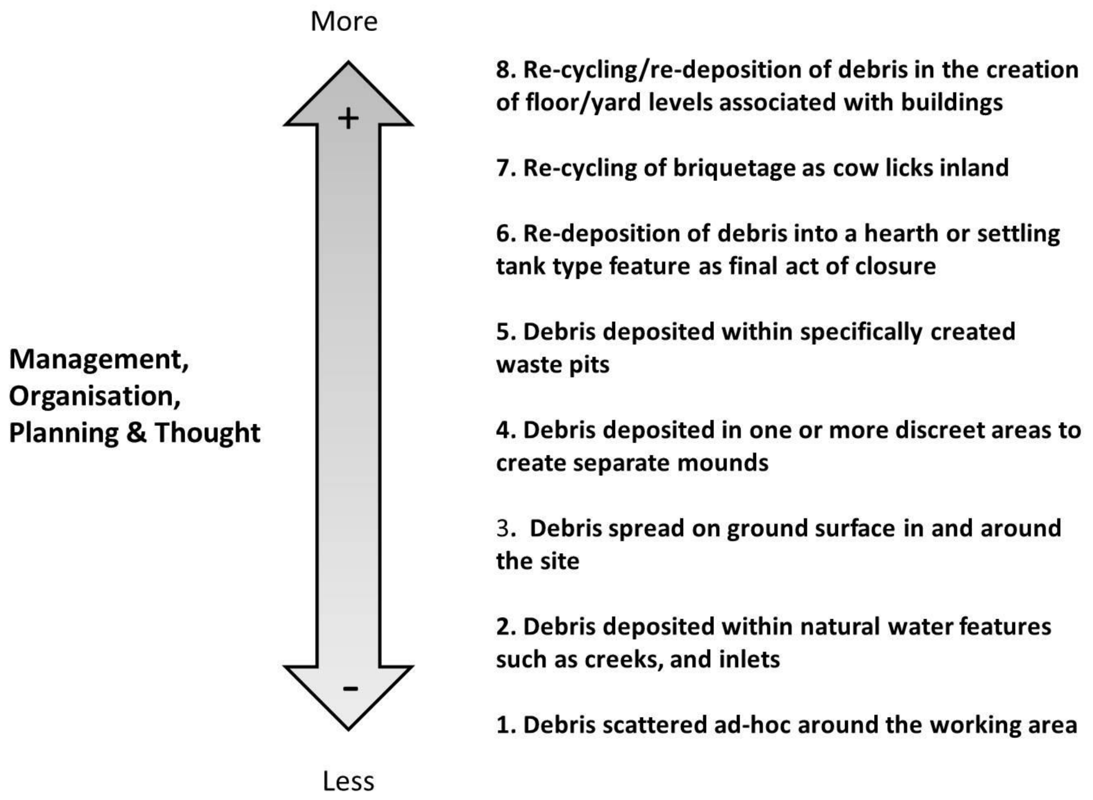

Figure 4.82 A list of some of the main methods that could have been used to dispose of briquetage and general salt-production waste with most 'casual' at the bottom

Method 1 is the most casual and the easiest of deposition methods as it simply required broken briquetage to be thrown to one side as required. This briquetage and other debris was then gradually was trampled into the ground.

Method 2 involved the deposition of briquetage into nearby areas of water including the sea. This could be achieved by simply throwing debris into the water. Alternatively, briquetage could have been transported in larger quantities from the site into the water periodically. This option was probably used on many smaller sites as a quick method to dispose of waste, but could have had implications for water access over time if debris accumulated in large quantities. This method is not easy to identify archaeologically and has only really been seen on a large scale in Kent, in particular at Site 30 at Cooling and to a degree at Site 82 (Lydd Quarry).

Site 30 was particularly prolific in waste deposition as pottery was being produced at the same time as salt in the Romano-British period. Large mounds and dumps caused areas of the river to silt and greatly reduced access to the site and to the water sources. At Lydd, briquetage debris was frequently dumped within the natural channels occurring within the gravel, which also would have silted up many seawater inlets.

This either suggests that individuals were not organised, and basically ‘messy’, or that they knew that they would be exhausting these areas quickly and would be shortly moving to another site. Perhaps, salt-production on the site was short and intense. Focus could have been purely upon producing large quantities of salt in the shortest amount of time possible.

Method 3 involves the depositing of debris in spread/s predominantly around the exterior of the site, but also within the site in some instances. These surface spreads probably represent multiple dumps of debris created over many seasons of production. The size of these spreads reveals the history of salt-producing areas, with the large spreads frequently revealed during groundworks around Poole Harbour for example, providing testimony to the many decades of production.

It is probable that sites with a long tradition of producing would have simply added to the spreads each year. A bonus to creating spreads within the main working area was that hardstandings were formed which could provide solid and stable working floors, especially in areas of marsh and wetland.

It is possible that in some areas like Poole Harbour, briquetage would have needed to be moved elsewhere during the formation of settlements. There is no evidence to suggest the creation of large central and concentrated mounds of debris in this area, which means that spreading the material would have probably been at increasing distances from the working areas as time progressed. Each new season would have required decisions to be made as to whether to keep dumping debris in the same space or to start a new ‘dump’.

Method 4 created one or more separate discreet debris mounds and was slightly more elaborate. Creating mounds would have meant that by stacking the briquetage upwards, rather than sideways, there would have been less restriction to site access. It was also ideal for sites that contained many small salt-producing working, as each could create their own mound.

The presence of discreet debris mounds could suggest short-term use of a site. This is because sites which were used over long periods of time would probably have merged smaller discreet mounds into larger spreads to accommodate the waste.

In the Somerset Levels, the mound distribution clearly suggests a systematic and well-planned management of space. The ground surface in the Levels when wet resembles a large sponge and can make access difficult. Therefore it would have made sense to create large areas of dry hardstanding, upon which people could move and work with more ease.

In this case, small mounds were created from debris, leaving large areas of ground free, and providing small working areas and hardstandings as needed. In some areas these mounds were so heavily used, that the briquetage literally sank into the peat, thus providing a way in which the same mound could be built up again. This is discussed further in **6.0**.

Method 5 involved the excavation of pits that were either originally used for storage and then filled with waste, or were created specifically for the burial of waste. This discreet method of debris deposition also hid it from view. It did however, require effort to excavate the pits and plan their locations. The use of pits could also suggest the following:

1. **Pits with no apparent spreads or mounds:** Small-scale salt-production where pits were enough to accommodate most waste debris
2. **Pits associated with spreads and mounds:** The pits represent a small scale salt-production site that has grown in size and scale over time requiring more substantial waste management
3. **Pits associated with spreads and mounds:** A site coming to the end of its lifecycle where all other options of disposal have been exhausted and small pits were excavated to dispose of the last briquetage before the site was abandoned

Method 6 involved the filling of working features such as hearths and tanks with briquetage perhaps when the features were replaced by others.

However, in most instances where briquetage has been used to fill salt-production features, the features still have an intact lining and structural integrity suggesting they were still usable. This therefore raises the question as to whether this was a practical act or whether there were more complex reasons.

One possibility is that at the end of each season of salt-production, the features were deliberately filled with briquetage and hearth material such as charcoal to protect them until the following season.

Another possibility is that briquetage was deliberately deposited within a feature to symbolise the closure of a site, rather than simply abandonment of the feature.

Methods 7 and **8** are more concerned with the physical properties of briquetage and the re-cycling of this material *after* its preliminary use in salt-production and *after* its original deposition.

Buildings associated with salt-production in Cornwall and South Dorset were found to have briquetage incorporated into floors and external yard surfaces. It is also possible that briquetage could have been crushed and re-used within mortars for building or that fragments could have been re-used as cow licks. However, no specific evidence for this has been found.

4.8 Overview of Iron Age and Romano-British Salt-Production Techniques within the Study Area

The various techniques available to salt producers were outlined in **1.5**. The choice of technique is dependent on the type of natural resource being exploited.

As described in **1.5**, for locations with a colder climate such as Britain, producing salt involved at least partial artificial evaporation of brine using a hearth or oven. The various stages of salt-production have been presented within this chapter.

Three main techniques available to Iron Age and Romano-British salt producers were presented in Figures 4.6-4.7 (Techniques I-III). There were some elements of the salt-production process that were essential (boxes with solid outlines) and other elements that were optional or non-essential (boxes with dashed outlines). All three shared the option for the further processing of salt in order to improve taste/and or remove further impurities such as bittern. However, whether this happened remains speculative and currently evidence is predominantly based upon ethnographic examples.

The most commonly known technique (Technique I) as indicated by archaeological evidence for producing salt in Britain from seawater in prehistory and the Roman period was to concentrate seawater using partial solar and then artificial heat to crystallise the salt.

The simplest way of concentrating seawater was to create a clay lined tank, or cut a tank into thick clay, and then leave the salt water to settle, whilst the sun slowly evaporated the water. As shown in Figure 4.6, the concentrated brine could then be added to a vessel, placed over a hearth and slowly heated to produce a wet salt 'sludge'. On most sites, this would have been the main method used for salt-production.

It has been suggested that perhaps too much emphasis has been placed on the incorporation of solar evaporation in Iron Age and Romano-British salt-production given the climate (Biddulph *et al.* 2012). However, even if tanks were not intentionally used for solar evaporation, they still would have greatly aided the settling of sediments and impurities before artificial brine evaporation.

Techniques I-II are essentially the same process as described above, with the addition of the optional periodic event of removing and roasting clay tank linings in Stage 1 (Figure 4.6). This process could potentially be carried out with a single tank, although presumably there would have been a slight delay in salt-production whilst that tank was re-lined. Therefore more than one tank present within a working area would be preferable.

Technique III (Figure 4.7) is the most complex. This involves obtaining brine *indirectly* from the sea, by processing (burning and washing) salt-impregnated organic matter gathered from the coastal environs. This method is often referred to as 'sleeching' (Nenquin 1961) or 'leaching'. This technique is less commonly evidenced in the study area, but was potentially been used in some form within the Somerset Levels (discussed further in **6.6.3**).

The main difference in Stage 1, was whether the organic material was burned within a hearth (Figure 4.7: Technique III a) or within a tank (Figure 4.7: Technique III b). The idea of placing this material within a hearth to 'double-up' as fuel for a hearth fire for artificial brine concentration was presented by Biddulph *et al* (2012).

If the organic material was *suitable to maintain a continuous low heat*, then to use it as a fuel would be an efficient method of utilising the heat generated, as opposed to the burning of material within a tank. The main difference between the two options (hearth versus tank) was that only the latter involved the burning of the tank.

However, the clay lining of tanks would also be baked if the option of roasting the lining to obtain salt was carried out in all the three techniques. Therefore baked clay tanks do not immediately indicate which technique was used. Tanks fired during the burning of organic materials, could have continued to be used for saltwater storage and brine concentration as needed.

Therefore it is not surprising that archaeologically, both Techniques II and III would potentially appear identical as both involve the heating/roasting/firing of tanks and the frequent or periodic removal of tank linings. The archaeological remains could also depend upon which stage of the Stage 1 cycle that the site was completing when abandoned.

At least two sites in Kent (Sites 62 and 90), and one in South Dorset (Site 228) had potential evidence for burnt tanks, and they could have represented examples of tanks that were being regularly used to burn organic material. In the case of Site 228, this is the probable explanation because presumably, if the tanks were being roasted to provide salt from the lining, the lining would have been removed before the site was abandoned.

The case at site 62 is slightly different. As stated earlier, it was unclear as to whether the tanks were hearths, identification was made difficult due to the features in the site being cut directly into natural clay (Figures 4.31 and 4.83).

Therefore they did not require additional lining. If the two large features were tanks, at least at some point in their use, then presumably, this would have meant that the option of roasting the tank linings was not possible.

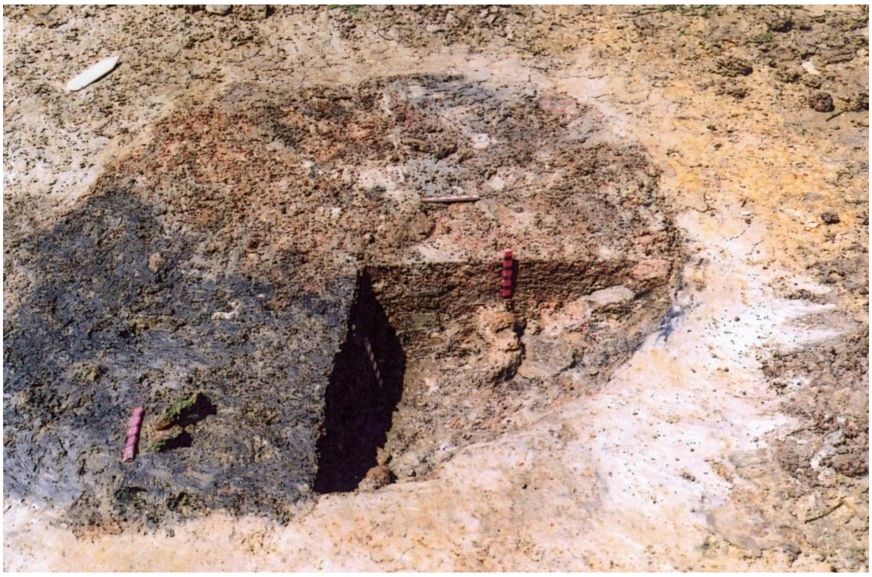

Figure 4.83 Section of one of a pair of joined tanks at Site 62, Medway Estuary, Kent

It is probable that on some sites, one of the final acts before the season ended, was to remove the tank linings for the final time to extract the salt. There would have been little point in re-lining the tank until the next season of salt-production (or if at all if the site was not re-used).

This would result in the tank, archaeologically, appearing to be a simple cut feature, as without the lining, there would be little to ascertain function. At least one certain example of brine tanks with no clay lining were discovered at Site 166 in the Central Somerset Levels, (Brunning *pers comm*). At least two of the tanks had been cut into peat just outside the parameters of the mound. Therefore, it is probable, that their linings had been removed to obtain the salt before the site ceased was abandoned.

Tanks with removed linings may be linked to the presence of apparently ambitious scoops or hollows within a site associated with salt-production, even if indirectly. For example, there were several shallow 'charcoal-filled pits' within Site 229 at Corfe River, Poole Harbour (Cox and Hearne 1991: 40). Their function was uncertain, although a possible interpretation of charcoal roasting pits was given.

Given this new insight into tank use, and this site's association with salt-production, it is probable that some or all of these features could have represented water management tanks (Figure 4.84).

Figure 4.84 Probable water management tank for salt-production with the lining removed for roasting at Site 229: East of Corfe River, Dorset (Cox and Hearne 1991: 40)

Investigating evidence for the processing of tank linings (Technique II) could perhaps look into the waste material from this process. Perhaps more chemical analysis of debris content in the future, combined with experimental archaeology, could identify this process more certainly.

One final potential form of evidence is in the presence of perforated briquetage containers and possibly, slabs. In Nenquin's (1961) description of 'sleeching' he mentions the use of perforated containers that acted as filters:

> … the salt crystallises naturally on the surface of sand/stone etc. When gaining the salt through sand, it would inevitably be mixed up with shells etc so the whole thing was thrown into a wooden or ceramic container with a perforated base… containers were lined with straw which acted as a filter then the brine solution was poured into other vessels and evaporated, this apparently would produce a much purer salt. The salt could then be refined again by mixing the solution with fresh water and re-crystallising the salt. (Nenquin: 1961: 123)

As stated earlier, perforated slabs have been noted on some salt-production sites and the presence of a perforated flat container at Site 215 in Poole Harbour (Figure 4.74) could be linked to this technique. It is also plausible however, that perforated slabs/containers were used to process broken up, roasted and crushed tank lining.

4.9 Overview

The main outcomes of this chapter are listed below:

- There were many considerations required when deciding to produce salt
- There was more than one technique used to produce salt
- Each site had its own narrative and own set of unique 'lifecycles'
- There are four main stages of salt-production
- The infrastructure of each site was dependent upon not only environmental conditions, but also the technological knowledge of salt producers, as well as the scale of production
- Enclosed Hearths (Direct Heat) were the most commonly employed hearth type in the study area, but there were a variety of potential combustion structures that could have been used, including more 'alternative hearths'
- Briquetage can be used to infer much about technological choice and hearth type, even if there is no preserving feature evidence in a site
- Features and briquetage have their own individual lifecycles
- The lifecycle of briquetage can potentially reach beyond the production site
- Re-cycling was employed on some sites

This chapter has considered the many factors that were involved in the planning and running of a salt-production site. This can include a variety of feature and briquetage forms. Considering the biographies and lifecycles of a site is the most informative approach to understanding these sites further.

The following two chapters (**5.0-6.0**) explore the choices made by salt producers further, on a regional basis.