1.0 Research Definition and Background

1.1 Introduction

This thesis is founded upon the universal and prevailing human urge to seek one particular mineral that exists throughout the world naturally in various forms. The variety of different methods developed and adapted to achieve successful salt extraction is testament to the powerful significance of this mineral for thousands of years. Investigating the origins of acquiring salt, ranging from simple to more complex extraction techniques, and the many facets of salt consumption, is fascinating. Delving deeper, this search can also involve addressing some fundamental and important human development and evolutionary issues. This includes the origins of agriculture and, as suggested by some sources (**1.4.1**), (Denton 1984; 2005) even the very survival of the human species. Although salt consumption has become somewhat of a social taboo in the UK in modern times due to excessive intake, this does not alter the fact that the human body has a basic biological *need* for salt in order to function. This in turn could arguably be linked to an instinctive human *want* for salt within the body in order to survive. How influential this basic biological requirement is within the development of salt-production and consumption is a subject of great debate, especially when the equally important cultural element of human behaviour is thrown in for good measure.

There is evidence for salt extraction and production all over the world, dating from at least the Neolithic period across Europe (Nenquin 1961; Chapman *et al.* 2001; Weller 2002; Erdoğu *et al.* 2003). Although variable in nature, the methods developed to retrieve salt can be surprisingly similar across time and space. For example, some of the clay equipment used to extract salt from the sea within the Late Classic period in the Belize region of Peru (McKillop 2002) , is extraordinarily similar to the equipment used in Iron Age Britain.

Salt has played a huge variety of roles throughout time and in different cultures (Hathaway 2008) leading to a variety of cultural norms as well as more specific practical roles such as meat preservation (Allen 2004; Maltby 2006). Cultural 'markers' have included the inclusion of salt within superstitions (Roud 2006), folklore, symbolic practices and taboos (Borić and Stefanović 2004), which is unsurprising when considering the long history of salt production and consumption in many areas of the world. Uses of salt include: food preservation, antiseptic, strengthening clay (before firing), taste additive and biological fulfilment amongst many others. We only need to look to the many sayings that still exist within the English language to observe ways in which salt acts as a cultural marker. Phrases such as 'Salt of the Earth', 'Take with a Pinch of Salt' and 'Worth their Salt' are all still in use today and are vestiges of the symbolic nature of salt's ability to convey a multitude of meanings. The long history of salt-production has also often led to the incorporation of words for salt (most commonly within Indo-European languages) into place names across the world (Falileyev 2011).

It has often been commented upon that those who study salt, incorporating all avenues of research from the biological sciences to historical and archaeological studies, are very passionate about their subject. This is of course true of most research; however, the study of salt offers something quite unique. Whichever path is taken, it inevitably leads into a massive subject area which is surprisingly wide ranging and applicable to so much of our studies of past and present cultural behaviour. Humans and salt have had a tempestuous relationship for many, many years, and it is subsequently easy to become engrossed by it and discover it to be particularly thought provoking.

The course taken by this thesis leads the reader through a particular time in the prehistory and history of Britain when the production of salt becomes particularly evident in the archaeological record. The thesis focuses upon one particular type of site, which was primarily concerned with the crystallisation of salt from seawater, either directly or indirectly (techniques are explored further in Chapter **4.0**).

The study area incorporates a large proportion of southern Britain, where many sites have been discovered since the early 20th century. An attempt to contextualise these sites and fully explore their individual nature has not previously been attempted and this thesis addresses this. The evidence will be placed alongside the already flourishing and extensive research carried out in the Fenlands (Lincolnshire, Norfolk and Cambridgeshire) and Essex, where the presence of extensive salt production is particularly well known and well researched (**1.6.5**).

The production of salt cannot be divorced from consumption behaviour, including distribution and trade practices, and, although this research project is primarily concerned with the production sites, aspects of their place in the wider contemporary context will also be explored.

The main themes covered in this chapter are listed in Table 1.1.

Table 1.1 Key Themes in Chapter 1.0

Key Themes	Aims and Objectives of this research project
	Consideration of issues potentially impacting this research including modern perception of salt consumption
	Main techniques for the production of salt in modern and ancient periods
	An overview of the earliest evidence for salt exploitation, including potential catalysts for the human relationship with salt
	Archaeological character of early salt-production including associated features and equipment
	Overview of previous archaeological studies into prehistoric and Roman salt-production in Europe
	Overview of current popular areas for salt studies in Britain: Significance of the Fenlands and Essex
	Regional overview of Iron Age and Roman salt-production in southern Britain (study area)

This chapter explores the significance of the contemporary research context of salt-production studies, including modern perception of salt consumption. The properties of salt, and methods of producing it from various natural resources are outlined.

The archaeological character of prehistoric and Roman salt-production sites in Britain is outlined, including definitions of the main stages of production. Finally, the archaeological background of prehistoric and Roman salt-production in Europe will be presented, including an overview of the study area.

Chapter **2.0** provides the methodology used to complete this research project, whilst Chapter **3.0** provides a summary of the core data collected. Chapter **4.0** focuses upon the methods of production, as well as defining and describing the stages of salt-production as evidenced in the archaeological record. Chapters **5.0-6.0** provide regional evaluations from Kent and Somerset respectively, which will explore key themes and the character of salt-production in more detail within two important areas of production. Chapter **7.0** provides a contextual discussion of the study area. This includes an overview of chronological and technological trends including some shared technological trends with France, modes of salt-production (modes of organisation) and the overall significance of salt-production in the study area and beyond. Chapter **8.0** provides a brief conclusion, and suggestions for further research, as well as an evaluation of the approaches used to assess and interpret the dataset.

1.2 Aim and Objectives

This research project aims to investigate the archaeological evidence for the production of salt from seawater in the Iron Age and Romano-British periods (700BC-450AD). It will assess the significance of these sites within the wider chronological and regional context of southern Britain.

1.2.1 Study Area

The study area incorporates the areas defined by the modern county boundaries of Somerset (including the Unitary Authority of North Somerset), Devon, Cornwall, Dorset, Isle of Wight, Hampshire, West Sussex, East Sussex and Kent. The eastern extent of the study area was naturally provided by the Thames Estuary forming the boundary between Kent and Essex. The western extent of the study is defined as North Somerset, encompassing the eastern side of the Bristol Channel.

This area of southern Britain is also split into two general regions which will be referred to during this thesis; these are the 'South-West' and 'South-East'. Somerset, Devon, Cornwall and Dorset are in the South-West, while Hampshire, Isle of Wight, West Sussex, East Sussex and Kent are in the South East. County and governmental boundaries have been used for ease of definition and presentation of results. However, it is important to remember that they are *modern* arbitrary boundaries and do not necessarily reflect any boundaries in place during the Iron Age and Romano-British periods.

The study area incorporates a variety of different environments and topography, some of which are more conducive to salt-production than others. All of the counties concerned have, to differing extents, coastlines. Although the study area incorporates a substantial coastline, thus having huge *potential* for containing evidence for sites exploiting seawater for salt, not *all* areas will contain sites.

1.2.2 Summary of Research Methodology

Research has predominantly involved a desk-based collection of published and unpublished literature, as well as a small, carefully targeted, programme of archaeological fieldwork. The project aims firstly to consolidate current knowledge of salt-production sites from previous studies, and then create the research dataset which is held in a database specifically designed for this research project. The database uses criteria that will help clarify and define site character, and then once the primary data results are presented in Chapter **3.0**, the following chapters will then explore the results in detail, and build up a detailed picture of the significance of salt-production within the Iron Age and Roman periods in the study area. Comparisons will be made between the character of salt-production in the study area, with other key areas of Britain.

1.2.3 Overview of Chronological Periods

This thesis focuses upon a particularly dynamic and interesting period of time encompassing the span between c.700BC to AD450, where there is evidence that salt-production significantly increased. The transition between the Iron Age and Romano-British period is a period of great personal interest as it represents a wrestle between old and new identities, and potential for great change in technologies and production processes, including salt-production. This period appears to represent almost a Golden Age for the ancient tradition of salt-production in Britain, before it significantly changed in nature after the 4th century AD. Therefore the 'window' of study was limited to these two periods, in order to gain a detailed overview into the emergence and development of the salt industry and its birth within Britain, and understand the impact of social and demographic change on such an important production process. After this time, there is a significant change in archaeological visibility, as well as technology, including technique, as the industry entered into another phase of its development, before growing into the extensive industry it is more famous for, in the Medieval to Post-Medieval periods.

The general phasing and chronology referred to for the Early to Late Iron Age and the Early to Late Romano-British periods are provided in Table 1.2. The term 'Romano-British' in comparison to 'Roman' is the preferred term for this period and will be used throughout this research project.

Table 1.2 Phasing and chronology referred to for the Iron Age and Romano-British period of Britain

Phase	Iron Age	Romano-British
Early	c.700BC-400BC	c.AD50-AD150
Middle	c.400BC-100BC	c.AD150AD-AD300
Late	c.100BC-AD50	c.AD300AD-AD450

There are five main research objectives and these are listed below:

1. Ascertaining the nature and extent of the salt-production process

This involves investigating and deconstructing the archaeological evidence into pre-defined feature and material culture types. These types will then be used to reconstruct techniques of salt-production through all stages of the process. This information will be predominantly obtained from the collection of data from literature. In certain cases sites were visited to add information to the dataset and excavation archives were consulted, including data or relevant artefacts where appropriate.

2. Evaluating the location of sites within the modern and ancient landscape

This involves interpreting the location of sites as recorded using grid references in the database and plotted onto digital mapping software. The purpose of this is to establish where different types of sites (as defined by the first objective) exist, and to gain a better understanding of preferred topographies. This also enables the investigation of geographical relationships between sites.

3. Contextual assessment of the evidence through time

This involves exploring the significance of the overall results within the overall contemporary and historical context of Iron Age and Roman southern England and allows investigation of the role that salt-production played in these periods. As attested to above, it also allows for exploration into how the impact of the new Roman presence in southern Britain after AD43 potentially affected the technology and mechanisms of production and consumption.

4. Regional evaluation of key areas of activity (case studies)

This is an integral part of this research project and involves assessing sites by location and identifying key areas of activity, particularly areas of clustered sites. These key areas provide an opportunity to explore salt-production sites in more detail. Comparisons will be made be between these areas and these will be used to consider the significance of salt-production both within the study area and in other parts of the UK. For the purposes of this study, modern perception of territorial and tribal boundaries will not be considered. The issue of defining ancient territorial boundaries is complex, and therefore it has been decided that attempting to ‘align’ the data to this would detract from the importance of the sites in their own right. The evidence will be assessed purely within the framework of regional diversity as evidenced by the archaeological evidence alone.

5. Developing an innovative approach to the study of salt-production

The sites included within this study have had a variety of different archaeological investigations applied to them. This can include anything from desk-based research to invasive excavation. This research will evaluate previous forms of investigation and consider the impact they have had on interpretations about the nature and extent of salt-production. It will be shown that, if approached in a new, structured and informed manner, new information can be gained about this particularly poorly understood subject area.

Key themes throughout this thesis will include the identification of particular technologies and evidence of technique, as well as any trends and diversity across sites, and well as evidence of the organisation and use of space.

1.3 Contemporary Research Context

In 2005, 'How are Things? A Philosophical Experiment' was translated and published in English (Pol-Droit 2005). This book represents a personal exploration by the author into how he interacts with and experiences everyday objects in his everyday life (examples being an umbrella and a street lamp). He notes the effect he himself has on objects, and the effect they have on him. The chapters are separated into different emotional reactions: 'Astonishment', 'Trial' and 'Error', 'Panic' and 'Calm'. We are all constantly surrounded by objects or things, and as archaeologists, are constantly seeking out the way in which past people interacted with these artefacts, or 'material culture' that we discover in the ground. This thesis seeks to explore the distinctive 'objects' that were used in the production of salt.

There are two particularly interesting and relevant points that Pol-Droit raises in this book. Firstly, he shows what can happen when the same amount of time and focus on the study of 'everyday' things from the past is applied to the present. What is particularly poignant within Pol-Droit's work in the context of this thesis, are his observations on the lack of a salt cellar at his table whilst eating lunch. This discourse is presented under the sub-heading of 'Astonishment' and his thoughts offer a suitable starting point for this thesis:

> I register that the salad lacks salt; but the salt cellar is not on the table. Normally it should be on the table, which is why I notice it is not there, in its usual place, hovering, in the background. Being available, while knowing how to make itself discreet. Its job is simply to be there. Just in case. On the off-chance. (Pol-Droit 2005: 43)

This account perfectly encapsulates the modern attitude to salt, at least in the western world. It has just always been there, easy to obtain, 'hovering' in the background to be used as and when it is required. Salt in modern times is mass-produced using modern technology, enabling a constant and abundant supply. Salt *appears* to have always just been there, easily and readily obtained, 'a commodity' functioning discreetly in the background, with no particular significance other than to serve a practical function.

We have in the UK, abundant natural rock salt deposits and are surrounded by an eternal source of salt in the sea. A common reaction to this research project when presented at conferences has been along the line of 'surely salt-production is easy and simple to achieve'. This is not surprising as at ‘face value’ it apparently just involves simple evaporation to extract the salt, with little time, effort or more importantly, skill involved.

Consequently some may question why the study of early salt producing techniques and sites as a whole would be worthwhile. The existence of early salt-production sites in Europe and beyond has been known for some time; clearly people have been producing salt for millennia, indeed, 'why wouldn’t they?' Laszlo, at the beginning of his book on salt perfectly summaries this common opinion:

> This book focuses on salt, a chemical that to us has become very mundane.
> (Laszlo 2001: 22)

Ironically the very nature and success of salt within our civilisation, playing a role discreetly and consistently in the background of our everyday lives, is no doubt the reason for the relatively little amount of attention it has received in archaeological research. That is not to say that the history of salt has not received any attention. There is literature by authors with a real passion for the history of salt. However, it does appear that early UK coastal salt-production sites, especially along areas on the southern coast, are generally viewed as mundane, insignificant, liminal and even peripheral places. These places were apparently used for a simple task, an almost abstract process exploiting a 'natural resource', playing out in the background, insignificant, without thought, without meaning. This crucial view and its impact upon our understanding of early salt-production will be discussed in more detail later on in this thesis.

Just to make matters worse, salt has often been under extreme scrutiny all over the world, especially over the last decade, as research has demonstrated significant negative health effects of consuming salt too highly in the diet. The British Government (mainly through the 'British Food Standards Agency') has invested particularly heavily in advertising the health problems of consuming too much salt.

One of the most recent British Government campaigns (2004) portrayed a particularly harrowing picture of the perils of high salt consumption. Figure 1.1 was retrieved from a press office release archive. (Salt Manufacturer's Association 2004) and encapsulates modern attitudes to salt perfectly. The somewhat distressing cartoon depicts two slugs in the domestic bliss of their kitchen and narrates a sad story.

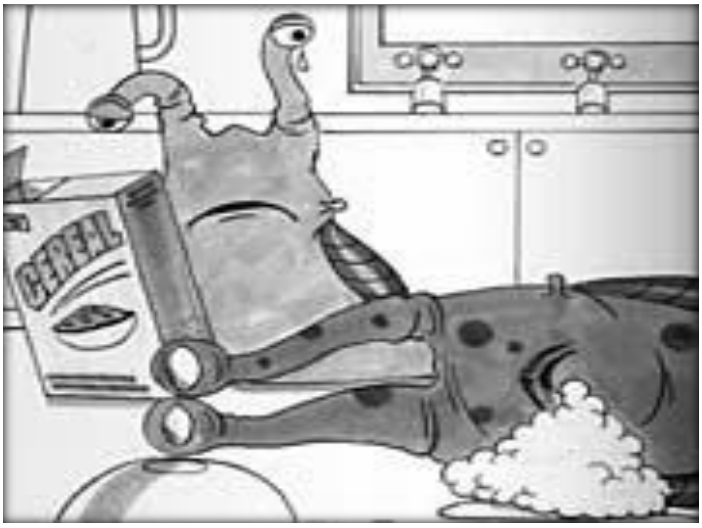


Figure 1.1 British Food Standards Agency salt warning avert using slugs (Salt Manufacturer's Association 2004)

The slug to the top left is shedding a tear, no doubt at the horrible demise of its partner, slung across the table, foaming at the mouth and presumably meeting a fatal end. In its distress the surviving slug is examining the cereal packet to try and ascertain what happened. Alas, the culprit is revealed; the cereal contained too much salt. This series of absurd, yet quite powerful adverts, unsurprisingly resulted in a shower of complaints from British salt producers, headed by the British Salt Manufacturer's Association.

Through this, salt had been pulled from the comfortable, consistent and faithfully serving position in the background into the limelight, but unfortunately with a somewhat negative image. How unfortunate that something that has played an integral and multi-faceted role in most societies for millennia, has been revealed as a discreet killer. The on-going bad publicity combined with increased public awareness, has proved to be a catalyst for the steady decline in direct consumption of salt within the diet, for example the adding of salt during cooking to enhance the flavour of a dish. However, despite the negativity, salt is still popular as a taste additive, especially amongst circles of gourmet chefs and in cultures where salt has long heavily been used in food dishes (for example in the Mediterranean, particularly in Italy).

> Fashionable people are now divided into two camps. One is passionate about being healthy and eating less salt, the other is passionate about salt.
> (Kurlansky 2002: 442)

At a time in history when there is a general movement towards 'taking things back to basics', people are moving more and more towards traditional, simple and organic or traditional ways of obtaining natural ingredients for foodstuffs. Salt has not been excluded from this. Most modern table salt is mass-produced using modern techniques from natural rock salt deposits underground or, to a lesser degree, salt extracted from the sea. It is also common to add extra ingredients to cheaper ‘table salts’, including 'free flowing agents' to stop it from becoming too solid, as well as fluoride and iodine.

In contrast to this, there is a good market for more 'organic' or traditionally-made salt; this is often marketed on its visual attributes and natural chemical content.

Salt comes in a variety of grades and qualities, and in many attractive shades other than white, including pink. Ironically the most expensive coloured salts are not white because they contain *more* impurities ranging from simple dirt, to magnesium sulphate. Even with the market for ‘superior’ salt, Kurlansky states that there has been a steady decline in direct salt consumption since the 19th century, and estimates that modern Europeans now consume about half the amount of salt (Kurlansky 2002: 404). However, even if the direct consumption of salt within the diet continues to fall there will always be a market for salt. It can also be used in many other ways that do not actually involve ingesting it. Salt is predominantly produced for the chemical industry, for which there are thousands of uses (Highley *et al.* 2006).

Salt also has perceived properties that can enhance an individual's health and beauty. For instance 'bath salts' are often used for relaxing and cleansing and trips to the coast were recommended for many years to 'breathe in the fresh salty air'. There is even an underground sanatorium 210ft deep within a disused chamber of the famous Wieliczka Salt Mine in Poland. Individuals who suffer from severe breathing difficulties such as asthma go there in order to improve their lung capacity. It is considered that the underground 'pure' salty air in this mine greatly eases breathing problems; there is even a basketball court for exercise.

This section has provided a brief overview of the erratic role that salt has within our modern lives, and has highlighted current perceptions of this mineral, providing the modern context in which this research has been produced. This reflective process is considered essential within this subject area as strong modern perceptions can easily have the potential to influence our ability to maintain a more objective interpretation of the archaeological evidence. It is a particularly poignant time to be studying the history of salt-production and consumption.

1.4 Development of the Human Relationship with Salt and the Exploiting of Natural Sources of Salt

Salt (NaCl) occurs naturally throughout the world in a variety of locations and in two basic forms; solid or within a solution, and is commonly composed of 39.32% sodium and 60.66% chlorine.

The methods used to exploit the various natural sources will have depended on many factors, including the most important; location and source type, as well as the knowledge base, traditions and behaviour of the community.

Firstly and simply, there had to be a source of salt that was accessible by people in order to exploit it. Secondly, the nature of the salt and the type of source are also clearly important. However, it is also essential not to overlook the cultural elements that would come into play. Not every potential source of salt was exploited, far from it. If a group has access to a salt source and chose to exploit it, they would have to think through how this would be achieved. Decisions as to whether they would exploit it would be closely linked with other activities and the motivations of the individuals or communities involved.

The exploitation of salt sources developed over millennia, from exploiting naturally occurring salt in solid/crystal form) to the development of techniques that could be used to artificially produce salt. Before outlining the most common techniques used to crystallise salt from solution, this section will explore the beginnings of this human relationship and experimentation with salt. This is in order to contextualise the prehistoric and Roman techniques of salt-production, which is a significant focus of this research project.

1.4.1 Earliest Origins: 'Need' versus 'Want'

The human body *needs* salt in order to function and it could therefore be speculated that this biological requirement was the driving force behind people first exploiting and consuming salt. There has been some considerable debate as to why people first began to seek salt and an overview will be provided here.

1.4.1.1 A Salt Tie? Developing a Relationship with Salt

Where and when are the origins of the long term human relationship with salt? When did salt enter our diets in such a noticeable way?

There are two issues here: a human's biological *need* for salt (sodium in particular), in order for the body to function and the *want* for salt as a personal/individual or general cultural *choice*.

There has been much speculation on the earliest origins of salt procurement and consumption, with differing opinions based upon either scientific or cultural grounding. What we *do* know is that at some point in prehistory, people chose to start producing supplementary salt; i.e. salt that was not gained naturally, for example, from meat and outcrops of solid or naturally crystallised salt, commonly known as 'salt licks'.

The *requirement* for supplementary salt most likely first arose with the movement of hunter-gathering groups into agricultural practice and the domestication of animals. Chapman's work on Neolithic salt-production sites in Moldavia, speculated that the origins of at least an 'experimentation' with salt probably occurred even earlier within the Palaeolithic (Chapman *et al.* 2001). However, identifying archaeological evidence that it is definately attributable to salt exploitation is very difficult to identify on these early sites.

It appears that most authors, who have speculated upon the origins of salt procurement, attribute it to a period in the Later Neolithic, when people were beginning to develop farming practice (Kurlansky 2002; Visser 2005). This was a period that saw great change, innovation, and clear evidence for people taking more control over their natural environment.

It is likely that the preliminary *urge* to produce salt at this time was based more upon the fact that people were now beginning to manage and domesticate animals, with salt playing an integral role within husbandry practice.

Visser explains how humans may have developed a close relationship with salt during the domestication of cattle by creating integral relationships; using an analogy with the traditional ‘salt tie’ between reindeer herders and their animals:

> Cattle may originally have been taught when very young that they could get their salt from men. They would then range freely in search of pasture. Their "owners" needed only to visit them occasionally in the field with gifts of salt to remind them that they were no longer wild. Men could then proceed to take advantage of the relationship. (Visser 2005: 106)

Many domesticated animals love the taste of salt and will rapidly consume salt licks. Therefore this may well be a feasible idea, especially in areas where perhaps animals did not have access to natural salt sources. With the domestication of animals came the ability for greater control for slaughtering animals at specific periods during the year, with the option to preserve meat for longer term consumption requirements. It was likely at this time that ways of preserving meat were explored, including the techniques of smoking and/or curing with salt.

> …increased sedentism would have led to an interest in methods of food preservation, which would undoubtedly have included salt.
> (Chapman *et al.* 2001: 10)

The preserving properties of salt are often seen as the *most important* element for the development of salt-production and its subsequent incorporation into the diet:

> Salt, primarily because of its supreme importance in the preservation of food, has been an integral part of the north European economy since prehistory.
> (Gilman *et al.* 1998: 1)

Another important use would be to fulfil supplementary requirements for stock in areas where there were no natural salt licks or general low levels within the natural environment, as it is today with modern cattle (Nenquin 1961; Pryor 1999; Chapman *et al.* 2001). Livestock can require a larger amount of salt intake compared to humans. This can be up to five times the amount for a horse, and even as much as ten times the amount for cattle (Kurlansky 2002: 10). Nenquin (1961: 140) estimates that a horse needs roughly 50g of salt a day, whilst a cow needs nearly 100g. This of course would vary dependant on their size and environment.

The introduction of agriculture may also have led to the need for salt as a taste additive because of a *lack* of meat. It has been suggested that the high consumption of bland plant-based foodstuffs led to a need for supplementary salt intake, as salt was usually acquired from meat. Also bland foodstuffs may have required flavouring to make them more palatable.

> Only much later, in Neolithic times, when the food became richer in carbohydrates at the expense of butcher's meat, did the human organism ask for a supplement of salt as much. (Nenquin 1961: 11)

1.4.1.2 A Growing Taste for Salt?

Work has also been carried out on the development of the human 'taste' for salt. Denton (1984: 80) refers to earlier work by Meneely, in which he suggested that it was difficult to dissociate the *need* and the *want* of salt. Meneely suggested that humans first used salt to preserve food, and then subsequently acquired a lasting taste for salt from the time of agricultural innovation. Thus 'want' followed 'need'.

Although a valid point, there are many problems within this theory that need to be considered, the main one being the consequences of individual or group choice.

Gouletquer (1974: 2) makes the point that people managed for many years without salt, emphasising that groups in many areas of Europe during the Palaeolithic and Mesolithic lived far from obvious sources of salt. He further suggests that enough salt could have been gained from eating meat and plants, or indeed animal blood or urine (*ibid*). Essentially, he argues that some Palaeolithic groups *were* aware of salt deposits that could be exploited, they just *chose* not to (*ibid*). Nenquin also argued that people in the Palaeolithic did not seek salt, using the argument that no evidence for salt exploitation earlier than the Neolithic could be found during his extensive research:

> For this study practically no data could be found for Palaeolithic or Mesolithic times, and this can be explained first of all by the very low density of population in these periods, and also because the diet of a hunter-fisher does not demand free salt. (Nenquin 1961: 11)

By 'free salt' Nenquin presumably refers to salt that was acquired by artificial means. However, Nenquin's research was largely based upon salt-production evidenced by ceramic material. However, earlier pre-ceramic groups could have used less archaeologically visible techniques (such as the use of organic materials).

The issue of whether sufficient salt could be supplied by diet alone, was further explored by Adshead, who along with Gouletquer, also supported the view that sufficient salt could be obtained from the diet, especially if people were following a largely carnivore diet, as meat is a good source of salt:

> …so long as his or her diet contains sufficient meat, fish or even insects, there is no physiological necessity for a human being to ingest any additional salt.
> (Adshead 1992: 7)

However, Adshead then goes onto argue that animals and humans following a herbivore diet would have needed to seek supplementary salt because most salt is gained from meat consumption.

1.4.1.3 Exploration and Experimentation

As highlighted by Gouletquer (1974) and Chapman (2001), it is likely that early human groups did know where they could access salt. The most likely earliest areas for salt exploitation would have been areas where salt has crystallised naturally and in a visible location (salt licks). These are most likely to occur in caves or clay beds with a particularly high salt content, or indeed coastal areas where salt had naturally evaporated from the sea on rocks due to a hot climate.

Denton (1984: 54) investigated the behaviour of carnivores and herbivores towards acquiring and consuming salt from these natural licks. He observed that it was the herbivores that actively sought the salt licks, and carnivores did not appear to follow suit. However, carnivores did focus upon salt licks and trails leading to them, to hunt the animals seeking the salt (*ibid*). It is conceivable that humans first utilised these natural salt licks because these areas acted as rich hunting grounds. In time, people could have started to mimic the animals eating salt, perhaps due to symbolic reasons; wanting to take on a more animalistic appearance.

In the case of early exploitation of salt springs in Moldavia, it was proposed that 'prehistoric man first exploited salt water, and only later naturally re-crystallised salt, in the proximity of the salt springs' (Alexianu *et al.* 2011a: 17).

Most explanations behind early salt-production ascribe a particular motivation to this task; people needed salt biologically, people needed salt for their cattle, people wanted salt to preserve food. However, this assumes that people already understood the properties of salt before exploiting it. A very viable alternative view is that people were generally curious about this mineral and therefore started slowly exploring it. Chapman adopts this viewpoint, approaching the situation from that of salt 'experimentation' (Chapman *et al.* 2001). It is suggested that experimentation with salt would have led to the gradual discovery of the mineral properties.

Chapman suggests that three key properties would have been identified (Table 1.3).

Table 1.3 Three suggested key discoveries resulting from early salt experimentation (Chapman *et al.* 2001: 10)

Three Key Salt Properties	**1**	A flavouring in cooking
	2	A medium of preservation
	3	A way of improving human and animal physiology and therefore health and condition

This work also suggests that the third property would have perhaps taken longer to understand. People could have eventually observed that animals utilising salt licks were in better condition for example. Thus, in this case, experimentation would have led to the recognition of physiological benefits after the immediate, practical uses for salt for taste and preservation. Carter (1975) also argues that taste and the preservation properties of salt were the catalyst for salt-production rather than a biological need:

> Man, except perhaps in the most exceptional circumstances, has no physiological need to add extra salt to his diet. His widespread efforts to prepare salt, and its value as a commodity, must therefore arise from his taste for salt as a condiment and preservation of food. (Carter 1975: 13)

This was taken further by Tekol (2006), suggesting that longer term consumption of salt could even lead to addiction.

1.4.1.4 Environmental Determinism and Biological Requirement Versus Cultural Choice

Whatever the case, whether ‘want’ followed ‘need’, or vice-versa, or whether they were one and the same, it remains that certain circumstances enabled people to develop a strong relationship with salt. There could have been many reasons for this, but it is likely to have been a mixture of ‘need’ and ‘want’, which grew more intense and *some* societies (not all), chose to incorporate salt into many aspects of their lives.

The two threads of investigation here, as with many other archaeological studies, seem to contrast between environmental determinism and cultural choice, i.e salt availability/intake dictated by environment and salt intake influenced by decisions/choice based in cultural beliefs. Denton (1984) emphasises the environmental factors, with the need for salt by animals and humans being dependant on environmental circumstances. This can include diet (carnivore versus herbivore), population pressure, the amount of salt naturally available, individual changes such as illness or pregnancy, and the climate (hot or cold).

Denton even goes on to say that not only did early humans develop a *salt appetite*, but by seeking salt instinctively, humans were actively (whether consciously or unconsciously) preserving their very survival. He sees salt consumption as so crucial that it played an integral part of human evolution.

> There is an emphasis in relevant historical records on a human preoccupation with salt. Sometimes this may amount to a craving and people may endure great hardships and take risks to obtain it. The situation is conspicuously different from that with other condiments, and this would appear to be clearly related to the fact that sodium is a critical element in the body. (Denton 1984: 89)

We cannot assume however, that people requiring extra salt in the past because of deficiency in the normal diet, instinctively knew they needed it as a supplement to their diet. However, salt deficiency can cause negative physical symptoms, and it seems likely that the problems caused by salt deficiency would have been observed. The degree to which humans were able to satisfy their nutritional needs by developing an appetite for certain minerals is difficult to ascertain. It seems likely that this was very much embedded in individual and perhaps cultural choice. Surprisingly, after many scientific experiments on the biological need for salt (mainly in animals), Adshead concludes:

> The consumption of salt…is problematic. It is a fact of culture rather than nature. (Adshead 1992: 7)

Boyd (2002) also supports this view, suggesting that caution should be taken when discussing the 'nutritional status of prehistoric food resources' as most people general fail to consider that :

> ...food practices are more often than not socially and culturally sanctioned, and in some cases may actually run counter to 'rational' concerns about people's health and bodily well-being... (Boyd 2002: 144)

However, in comparison, Laszlo believes in a more instinctive reaction based on biological need:

> …salt deficiency induces a feeling of need and a compulsion to satisfy it. This *innate need is not cultural.* Moreover, it contrasts with thirst in that it is not immediately perceived, which can become dangerous… (emphasis added)
> (Laszlo 2001: 96-97)

In early studies into group migrations, some people even suggested that these large scale movements were based upon an overwhelming human need to seek salt as part of an 'extreme salt hunger' (Nenquin 1961: 140).

If we downplay the importance of environmental determinism, we could argue that salt consumption, could have been a part of the everyday traditional behaviour and actions of a social group. This ‘socially embedded behaviour’ is of particular interest when studying Iron Age and Romano-British salt-production.

Thurmond (2006) is keen to point out that salt was probably acting as an agent of a 'more civilized life'. Thurmond is also keen to separate the study of ancient salt consumption from modern consumption habits:

> …the debate about how much salt is essential today should be totally divorced from discussions of consumption in antiquity... (Thurmond 2006: 235)

Perhaps we do tend to place too much emphasis on the biological aspects of salt consumption, as we are so aware of these in modern times. However, as Adshead (1992) pointed out, the cultural elements of production and consumption cannot be ignored.

Whatever the motivations, salt became incorporated into the lives of prehistoric communities throughout the world, and it is not surprising that the role of salt became more varied through time. This includes its incorporation into a variety of symbolic roles (Hathaway 2008), as well as producing surplus amounts for exchange and trade as it became more popular. It is also important to consider here that there is ethnographic evidence for salt taboos within some communities and that we should not assume that salt was consumed by all individuals or cultures in the past (Kurlansky 2002).

Therefore, there is no simple explanation for the reasons why salt was first consumed as a supplement; it could have been a mixture of environmental, biological and cultural factors.

1.5 Crystallising Salt from Solution

Salt occurs abundantly in vast amounts of seawater covering this planet, although salinity levels vary dependant on location. On average, the sea contains about 3.5-3.7% salt (Gilman *et al.* 1998), of which Fawn (1986) speculates that about 2.5% is sodium chloride. These salinity levels can vary depending on the topography of the coast and the presence of freshwater rivers. Areas of enclosed water such as estuaries and inland brine springs are generally thought to be the most fruitful areas to produce salt as the salinity level can be much higher (Gilman *et al.* 1998). In both these areas, this can increase to as much as 8% (Rapp 2002: 220; Fielding and Fielding 2006: 6). However freshwater rivers feeding into an estuary can act to dilute the salt concentration in areas near to their mouths. Therefore even a single enclosed area of water can be sensitive to localised variations in salinity levels.

However, the proximity of fresh water could be useful when producing salt, as it could potentially be used to cleanse salt of impurities. Pliny makes reference to fresh water in conjunction with salt-production sites but does not detail why this is the case:

> Of artificial salt there are various kinds. The usual one, and the most plentiful, is made in salt pools by running into them seawater not without streams of fresh water... (Jones 1963: 31.39.81)

Pliny then goes on to make a particular mention that fresh water was not used when salt was produced in Crete (*ibid*).

Salt can also occur in solution through the natural or artificial formation of underground brine lakes, formed either by ground water naturally leaching solid buried salt deposits or by artificially pumping water into deposits to create underground brine lakes.

1.5.1 Producing Salt from Seawater

Many techniques of production have been developed all over the world. An overview of the main methods used to extract salt directly or indirectly from seawater, are shown in Table 1.4. The techniques relevant to this research project are highlighted.

Table 1.4 Methods of exploiting and producing salt

Source	Method of retrieval or extraction		Physical Remains
Seawater	Open Pan	Condensing and evaporating salt from seawater, salt lakes, or springs using *natural sunlight only*	Settling/Evaporation Tanks/Ponds/Pans
	Open Pan and Artificial Heating	Condensing and evaporating salt from seawater, salt lakes, or springs *using natural sunlight and artificial heat*	Open Pans/Hearths/ Clay or Metal Vessels/ Debris Mounds, Debris Layers or Pits
Peat/ Plants	Leaching/ Washing/ Burning/ Evaporation	Process involving the burning of saltmarsh plants, soils, silts and peats, and then filtering/washing the ash with saltwater to produce a concentrated brine which is then artificially heated	Hearths/Clay or Metal Vessels/Debris Mounds, Layers or Pits. Burnt organic matter
Soil/Silt Plants		Process involving washing of soil formed in the beds of dried salt lakes, producing a brine which is then artificially heated	Hearths/Clay or Metal Vessels/Debris Mounds/Silt Mounds or Layers

Although the process of producing salt from plant materials and silts (Leaching) is not directly exploiting seawater, this is a common technique in areas of costal saltmarsh where there is frequent inundation from the sea, usually in estuaries or marshes fed by tidal rivers. It is also probable, that the ashes were washed with seawater to aid in the concentration of brine.

Potentially, this indirect technique could have been used in the study area to produce salt, as well as directly extracting salt from seawater. The two techniques would potentially leave very similar archaeological remains, and this is explored further in this research project.

1.5.2 Crystallising Salt from Brine

Evaporating salt directly from brine produced from seawater has been the most common technique of salt-production throughout Europe until modern times. This technique is still used in many places in the world, including France, the Bahamas, USA, Japan and Australia (Kurlansky 2002) and within the UK (Malden Saltworks, Essex), but on a smaller scale (in terms of output) than mining.

Table 1.5 The three main components of seawater (Gilman *et al.* 1998: 3)

<table>
<tr><td rowspan="6">Main Components of Seawater</td><td>1</td><td colspan="3">Sand and silt particles</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Salts that have a limited solubility which includes:</td><td>i</td><td>Calcium</td></tr>
<tr><td>ii</td><td>Magnesium carbonates</td></tr>
<tr><td>iii</td><td>Calcium sulphate</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Highly Soluble salts which can include:</td><td>i</td><td>‘Epsom Salt’: potassium chloride</td></tr>
<tr><td>ii</td><td>‘Glauber Salt’: sodium, calcium and magnesium sulphates</td></tr>
</table>

In the work carried out on the UK Salt Industry on behalf of English Heritage, three main components (other than sodium chloride) were identified as naturally occurring (at different levels dependant on location) in seawater (Table 1.5).

Briggs (2008) provides average percentages for mineral occurrence in the sea (Table 1.6). This provides a useful overview of the many different minerals that can be found within seawater and has implications when attempting to retrieve sodium chloride.

Table 1.6 Average percentage of solids in seawater (Briggs 2008)

Mineral	Average (%) within seawater
Sodium chloride	77
Magnesium chloride	10
Magnesium sulphate	5
Calcium sulphate	3
Potassium sulphate	3
Magnesium bromide	Trace
Calcium carbonate	Trace

It is also these mineral components that can result in a bitter taste, if not removed during the production. With this in mind, it is also useful to explore the order in which these minerals 'materialise' during the evaporation of seawater.

According to Rapp (2002), there is a natural order of salt evaporation (Table 1.7). Fawn estimates that after about 90% of the brine has evaporated, sodium chloride will crystallise, and after about 97% evaporation, the remaining salts will crystallise (Fawn 1986: 35). A well-known and simple traditional method for testing whether brine is concentrated enough for further crystallisation, is to float a medium-sized egg within it. If the egg floats to the top then the brine is sufficiently concentrated.

Table 1.7 The natural order of salt evaporation (Rapp 2002: 220)

Natural Order of Salt Evaporation	1	Calcium carbonate
	2	Calcium sulphate
	3	**Sodium chloride**
	4	Potassium magnesium chloride

Sodium chloride is consistently the most abundant mineral. However, due to the variations in mineral levels within different locations of the sea, Rapp considers that some areas would not have been suitable for salt-production. Rainfall for example affects water salinity, as it dilutes seawater. The Blackwater Estuary of Essex is particularly good for salt-production as there is a high salt content within the water due to a very low average rainfall (Tooley 2006).

Other minerals/solids that are listed as being within seawater other than sodium chloride are often referred to as 'bitterns'; this is especially true of magnesium chloride, which has a bitter taste. From the medieval period at least, these bitterns were commonly removed during the evaporation process. In the 18th century, Brownrigg (1748) writes:

> The marine bittern is a ponderous liquor, exceeding clear, and almost colourless as pure water, whereas bittern drawn from some salt springs is of a brownish colour. (Brownrigg 1748: 62)

This liquor was often described as being a dark red colour, Brownrigg (*ibid*) goes on to describe the process of removing bittern during the act of artificial evaporation within lead pans. Much of the bittern formed a residue on the bottom of the pans, which was usually left to accumulate over three or four uses as it also contained valuable salt. After this time it was said that the residue should be removed, or it would start to pollute the salt (making it taste too bitter).

In the modern Sea-Salt Works at Maldon, Essex, the brine is boiled in large stainless steel containers, and before producing the salt crystals, the water is quickly heated to produce a 'froth' called 'leese', which appears on the surface and is removed using specially made rakes (Tooley 2006). The leese represents the bitterns and impurities present within the water and in this case it is removed before the sodium chloride crystallises. Once the leese is removed, the brine is left to simmer under a controlled temperature for up to 16 hours and the salt crystals are then removed.

It is generally assumed that bitterns have always been removed from salt to make it more palatable. However, this really is a matter of taste and caution should be taken when making this assumption and applying it to earlier salt-production. Late 20th century tribes of central Africa, were observed consuming vegetable salts, or '*sel de cendres'*; salt which is obtained by burning 'particular plants'. This salt tasted somewhat like common sodium chloride but has the bitter after-taste of potassium salts. However, the tribe members preferred this bitter tasting salt even though they had access to 'purer' sodium chloride (Denton 1984: 87). When we talk of salt-production, it may well have been more than just the 'pure' sodium chloride that was produced.

Lastly, there would also be some insoluble sediments and substances such as plant matter, sand, silt and mud to remove, which would presumably require a filtering process from seawater. Similarly, the burning of salt-impregnated marsh plants, soils or peat, would involve a filtering process to gain a cleaner brine from the ash.

Some Iron Age and Romano-British sites in Britain have evidence for ponds, tanks or reservoirs, which are thought to have been used to aid in the settling of these sediments and substances, as well as aiding in the concentration of brine.

1.5.3 Natural Solar Evaporation: Open Pan Traditional ‘Salinas’

The easiest way to obtain salt from seawater is through solar evaporation; this can be achieved by creating a man-made system to channel the water into special ponds (also described sometimes as 'pans' or 'pickle ponds' (Thurmond 2006: 242), or it can simply involve retrieving salt that has naturally crystallised in the sun on the edges of lakes or coastlines.

The Roman scholar Pliny, dedicated 32 verses to salt within Book XXXI of the encyclopaedic *Naturalis Historia* (Natural History) written in the late 1st century AD (Jones 1963: 31.39.73-105). Amongst discussions on different types of salt, locations for natural salt and its medicinal qualities, Pliny makes frequent reference to salt that is created naturally by solar evaporation. Pliny refers to salt in two main ways; artificial or native, with two agencies; condensation or drying up of water. Condensation mainly appears to refer to salt that naturally crystallises on the edge of the sea left by tide action; whilst drying of water literally refers to salt lakes that dry up in the summer.

Pliny seems to describe salt made by the creation of pools where sea water was fed as 'artificial', even though no artificial heat was used to create the salt. This technique of salt-production has been popular in the Mediterranean ever since this time. However, there has been a rapid decline relatively recently (discussed below).

Traditional open pan salt-production mainly involves the creation of 'ponds' or 'pans' on coastal fringes or inland salt springs often known as ‘Salinas’ in the Mediterranean (Figure 1.2). The Latin term *'salinae'* was commonly used to define coastal salt-production sites in Ancient Rome. However, this could also include mine sites, which can cause some confusion, (Ørsted 1998: 22). The term became synonymous over time with not only the production site, but also the economic infrastructure around these sites including roads (Morère Molinero 2011), as can be seen in the ‘Via Salaria’ road still running through Rome to this day. Most ancient and traditional salt works in Italy and across the Meditteranean, include open large ponds (or pans) that are filled with seawater using natural or man-made inlets.

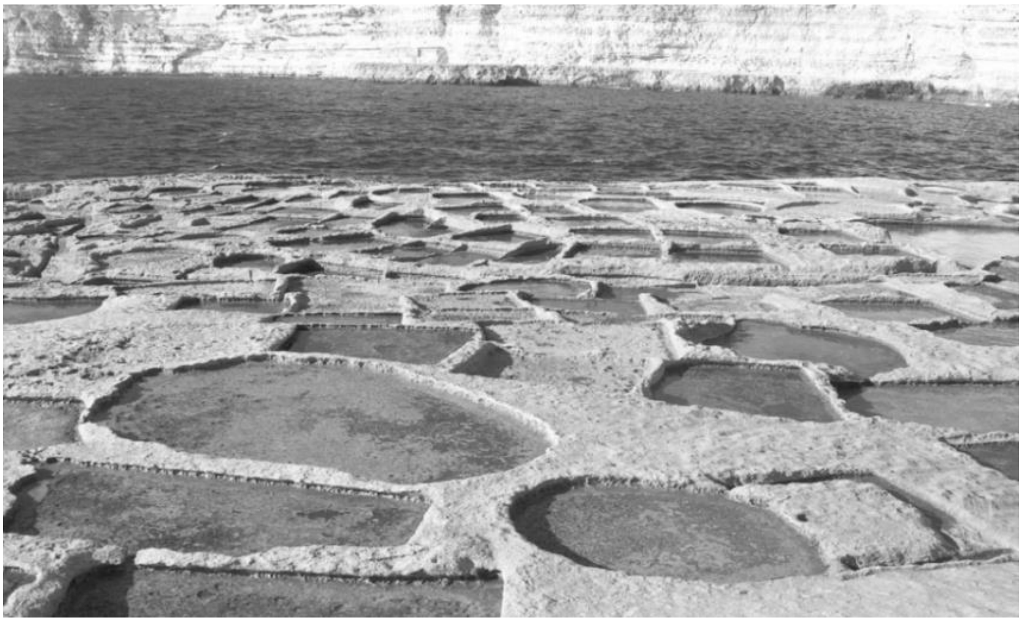


Figure 1.2 View of solar evaporation ponds in Gozo, Malta (Harry Manley: 2003)

Once supplied with sufficient saltwater, the channel can then be shut off until the pans require a refill. Once filled, the pans can be left in the natural sunlight to evaporate the saltwater into a solution of brine and settled sediments such as sand. Salt made from purely solar evaporation is often referred to as 'bay salt' (Holden and Hudson 1981) or 'sun salt' (Gouletquer 1974: 12). Often this involves groups of pools which can vary greatly in size that can either be used singularly or in a sequence. The latter technique is often referred to as 'successive pan evaporation', and involves transferring the brine over different pans to allow for a purer salt to be produced (Thurmond 2006: 241-242).

This method was thought to have been used first by the Chinese in c.800 BC, staying localised until about two centuries later when the technique spread to areas of Europe during the Iron Age and Roman periods (Adshead 1992: 49-50).

1.5.4 Partial or Complete Artificial Evaporation

> Brine boiling offers the quickest means of evaporation…but this does not account for the time spent acquiring fuel. Solar evaporation does not require fuel but may take days or weeks to accomplish and is limited to geographic areas with high evaporation and little precipitation. (Akridge 2008: 1461)

An extension of this technique is to apply artificial heat to partially concentrated seawater or brine from a salt spring, and is essential if the local climate does not support full solar evaporation, like that in Britain. Pliny only makes brief reference to the use of artificial heat to crystallise salt from water from a salt spring (Jones 1963: 31.39.82).

The seawater is partially concentrated in the sun, and then transferred to a vessel for artificial heating and evaporation. The vessel can vary greatly in size and can be made of either clay or metal. Clay was predominantly used in Europe from at least the early Bronze Age until the introduction of lead pans, in the Roman period. The lead pans were replaced by iron pans in the medieval and post-medieval periods. The clay vessels (often cylindrical or rectangular in shape) are often referred to as 'briquetage'. The technique of using such containers is sometimes referred to as the 'pot process' (Fielding 2005a: 11). Metal salt producing vessels are also often referred to as 'salt pans', which can cause some confusion as this term is also used to describe the open solar salt works in the Mediterranean.

Britain only has one operating sea-salt works remaining, in Maldon, Essex, where modern pumping and artificial evaporation equipment is used including vacuum containers (Tooley 2006). Figure 1.3 shows this process before the introduction of modern techniques (18th-early 19th century) at Lymington, a well-known area of medieval and post-medieval coastal salt working in Hampshire.

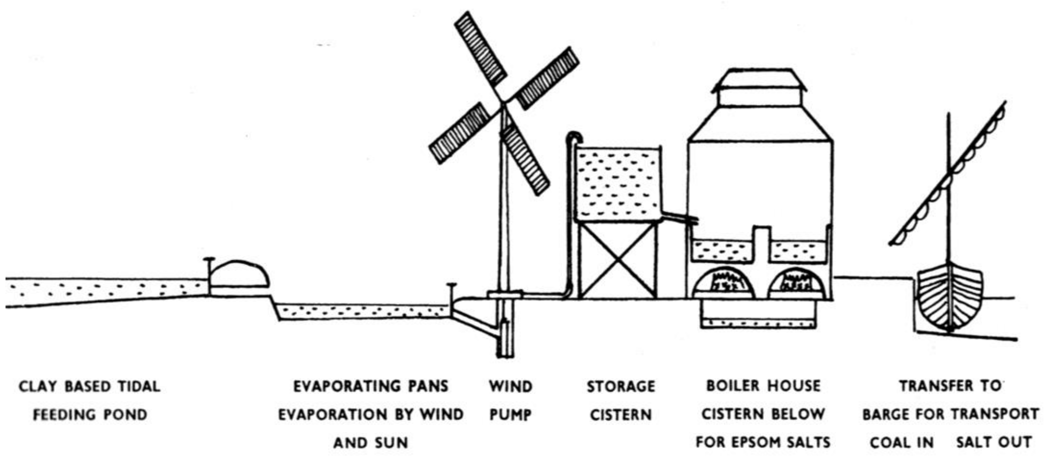


Figure 1.3 A diagram of the method of salt-production used during the post-medieval period in Lymington, Hampshire (Lloyd 1967: 9)

The last traditional open pan salt works utilising a salt spring in Britain was the Lion Salt Works of Cheshire. Dating from the Victorian period, the works closed in 1986. These works pumped brine to the surface using shafts and wells, and the brine was stored in a large tank (capacity for 30,000 gallons) before being moved to iron evaporating pans within wooden buildings around the site (Fielding 2005b).

Traditional open pan and/or artificial heating is still used in modern times. However, the number of these sites still in existence is declining significantly.

The process known as 'leeching' or 'sleeching' has been less commonly used in Europe, but does involve similar natural and artificial evaporation of the brine, as stated earlier.

This technique is commonly used to obtain salt in Africa, where soil remaining from ancient salt lakes is washed to produce a brine and extract salt through evaporation (Gouletquer 1975; Connah 1996). Similarly, in some coastal areas, salt can also be obtained from saltmarsh material and seaweed, by burning the material, washing the ashes, which produce a brine, which is the evaporated similarly to brine obtained from seawater (Fielding and Fielding 2006).

1.5.5 The 'Briquetage' or 'Pot Process' Technique

The archaeological remains of this particular technique provide the basis for this thesis. It is generally thought that this technique involved a combination of firstly employing solar evaporation to concentrate seawater into brine, artificially heating the brine to crystallise the salt (due to a colder climate) and finally drying the salt. Based upon the archaeological evidence from the Lincolnshire Fens (Chowne 2001; Lane and Morris 2001) and Essex (De Brisay 1978; Fawn 1986; Fawn *et al.* 1990) it has been extrapolated that this was the main technique for producing salt throughout Britain during the Iron Age and Romano-British periods.

It is generally accepted that salt-production in Britain was probably carried out seasonally, exploiting the summer months, between May and October, when the temperature would be best suited to support partial solar evaporation (Bradley 1975; Darvill 1987; DeRoche 1997; Gurney 1986). It is often thought that this process was repeated throughout the summer between other activities (Figure 1.4). Thus the seawater could be partially concentrated and sediments left to settle in open ponds or tanks in the natural sun whilst other activities were carried out and then further processed using artificial heat when convenient.

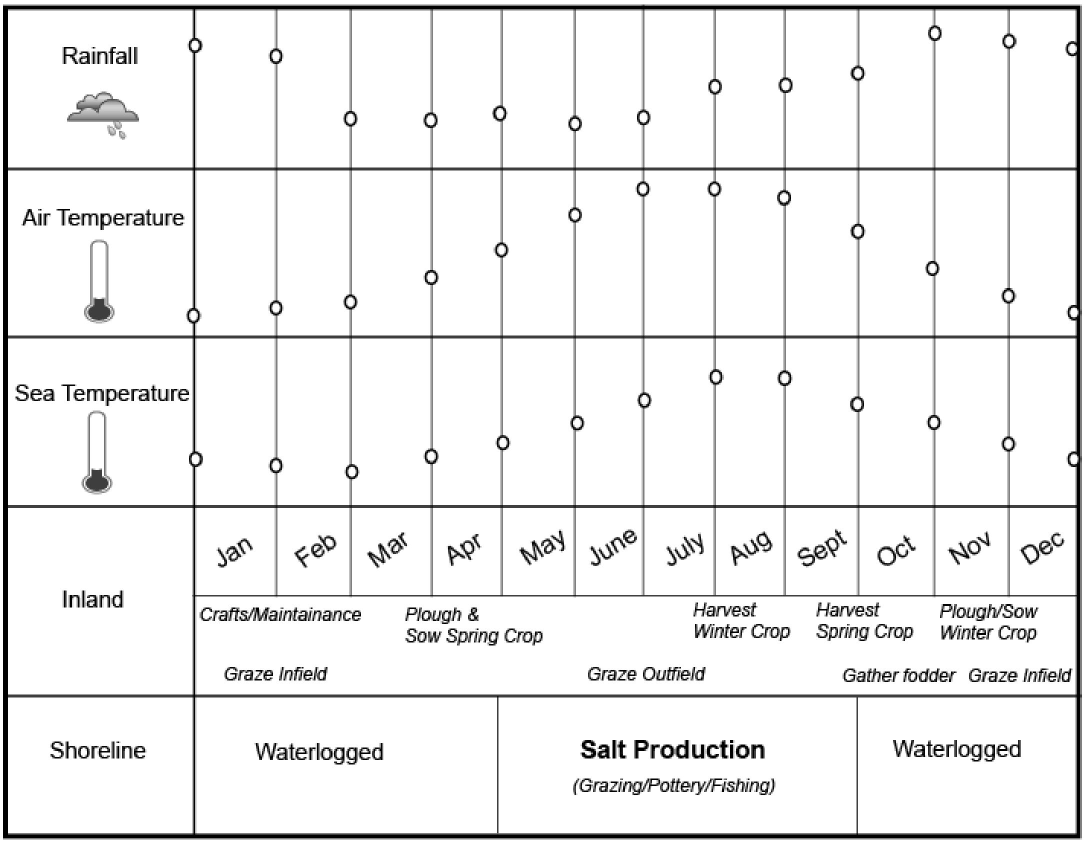


Figure 1.4 Seasonal diagram of agriculture and coastal salt-production (Redrawn from Bradley 1975: 22)

However, Riehm (1961: 186) offers a different scenario, suggesting that the saltwater was left to evaporate naturally and concentrate during the summer months within ‘flat sunpans’, perhaps with light roofs to protect them. Then in the autumn the crust of salt, and most of the clay lining it was adhered to, was loosened and placed within a fire, using the original ‘saltpan’ or settling/evaporation tank, as a makeshift hearth.

Riehm suggests that this ‘roasted/ clay and salt mixture was then broken up and put into a boiling container. Then brine was added to the mixture to draw out the salt within the clay matrix’ (*ibid*). The baked clay residue could then be discarded, and the salt solution heated to obtain the salt (*ibid*: 186-187). This scenario would also explain the porous nature of many containers observed within salt-production sites. If the ‘solution’ was indeed more ‘solid’ in nature the container would not absorb it so readily. The addition of salt into the clay matrix of tanks could also have provided a natural ‘cleanser ‘for the salt; the clay potentially absorbing some of the bitter salts.

Nenquin (1961: 123) also describes an alternative technique that could have been employed for the production of salt at this time. This technique involves waiting for a low tide when salt would crystallise naturally on the surface of sand. The sand could then be gathered up and placed within a wooden or ceramic container with a perforated base. He then suggested that these containers were lined with straw, which could act as a filter for the sand and other debris such as shells. The brine solution could then be poured into other vessels and evaporated; this apparently would produce a much purer salt. Further to this the salt could then be refined again by mixing the solution with fresh water and re-crystallising the salt.

1.5.5.1 Briquetage

The pot process involves the use of ceramic vessels for the full to partial evaporation of saltwater or brine to produce salt. This could include the use of normal everyday ‘domestic’ pottery. However, on many sites, specialist equipment called ‘briquetage’ has often been used. The term originates from the Seille Valley in north-west France (Fawn *et al*. 1990; Gouletquer 1974; Olivier and Kovacik 2006) and was used to describe the deposits of burnt clay and ashes’, found there (Gouletquer 1974: 13). It was first used in 1764 and was eventually adopted throughout Europe (*ibid*). Over time, the original meaning of the term has altered. It is generally now used more specifically, to describe the vessels and supports that were used in the salt-production process, as well as more rarely, clay hearth debris also. Gouletquer noted this variation and sought to preserve its original more 'holistic' meaning, incorporating all debris from production:

> …briquetage is used to describe the technique of salt making with baked clay not only the sites left after the salt-making process has finished. The last meaning accorded to the word in some parts of Europe-pieces of burnt clay pots, vessels or other implements or fragments-should not be used, because it is too precise. (Gouletquer 1974: 13)

Dr Elaine Morris, who has worked the most extensively on this material within the UK and provided many new important insights into briquetage distribution, also supports the view that the term should be used in a holistically:

> …the term briquetage…is taken to mean not only the ceramic equipment (troughs, supports, clips etc.), but also the fragmented debris of hearths/ovens, used in the processing of sea salt. (Lane and Morris 2001: 8)

The use of the term remains quite ambiguous, dependant on individual preference. For example the definition of briquetage as given by the MDA Object Type Thesaurus (online) is very specific, referring only to vessels and a form of support called a 'fire-bar':

> A collective name for the pans and fire bars used in the making of salt through evaporation. (English Heritage 2006a)

This inconsistency can cause confusion when attempting to quantify, describe and compare briquetage assemblages and this issue will be discussed in more detail later. Briquetage forms can be surprisingly similar across Europe, a point observed by Nenquin:

> It is sometimes very difficult to distinguish between the briquetage from Halle…and that from Lorraine or the Red Hills in England. Everywhere we find the same badly fired cylinders, the same evaporation-pans, the same heaps of waste-material. (Nenquin 1961: 156)

Most recognisable briquetage forms consist of containers and supports. Different containers could also be used to heat water in order to extract, dry and store salt and the supports were used to hold containers over a source of heat.

In many parts of Europe, early Iron Age forms of briquetage combined these two elements (Figure 1.5). The container and support were originally one object, as seen in France, Germany and Poland (De Brisay 1981: 37; Kleinmann 1975: 46; Riehm 1961: 184).

The change in forms is particularly clear in Germany (mainly based on evidence from the Halle area). The forms consist of (top left to right on Figure 1.5): a goblet, a narrow chalice, a pointed vessel on hollow pointed 'cone' pedestal and a vessel on a pedestal.

In some areas the forms then became separated into containers and supports as can be seen in the examples from a site next to the banks of the river Saale in Germany, where great quantities of Iron Age briquetage have been found since the late 19th century. Most of the forms consist of the 'chalice' like objects (Figure 1.5). However, there were also small 'largish impermeable vessels' (Riehm 1961: 183) that appear to have been supported by a separate pedestal.

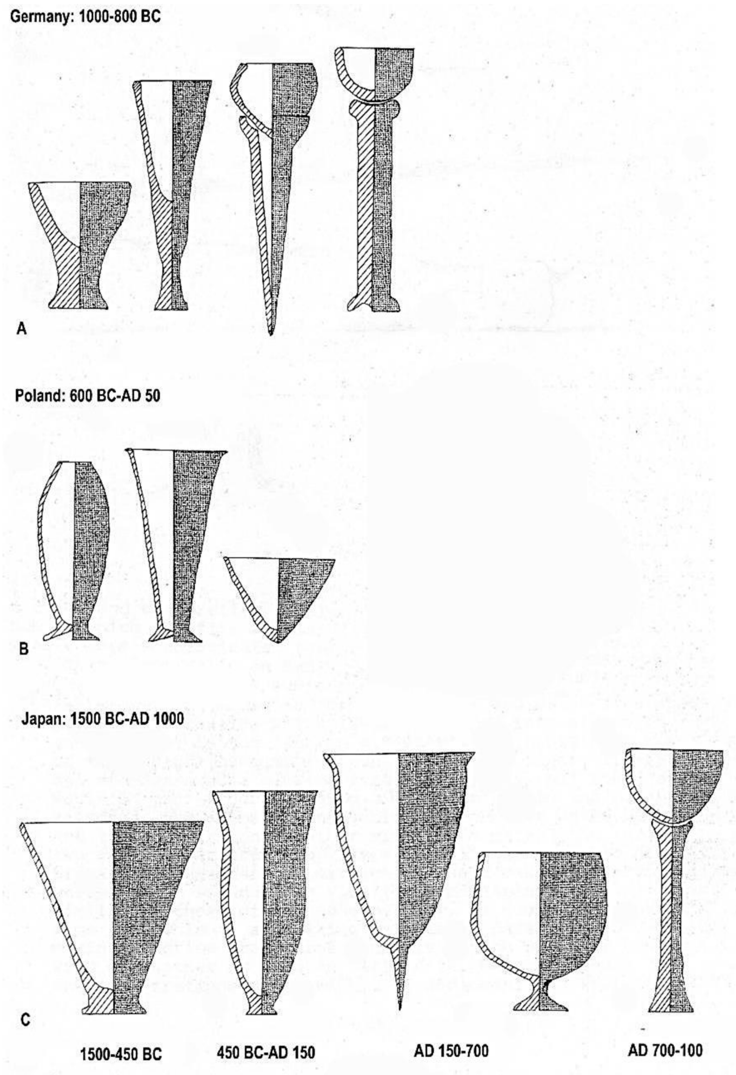


Figure 1.5 Development of briquetage 'crystallising vessels' in Germany, Poland and Japan (Adapted from De Brisay 1981: 37)

Experiments were carried out to see how these different forms functioned. It was found that the chalice type objects were not suitable for boiling brine, being too porous to withstand any great heat. However, the reconstructed larger vessels (not illustrated), although still porous could withstand greater heat and were found to be better containers for boiling , if brine was added constantly until the salt began to crystallise (*ibid*).

The recognition that all of the different forms were very uniform in size supported the view that the moulds were made to a standard size of salt cake mould. Experiments showed that the best heat for drying salt was between 60º and 70º C. At a temperature greater than this the salt blistered and lost its structural integrity.

Thus the chalice-type forms were interpreted as salt cake moulds. Very similar chalice forms were still in use during the 20th century in Manga, Africa (Figure 1.6). However, in this instance these vessels were used to heat brine rather than dry salt, the brine being obtained from the leaching of salt-impregnated soil (Gouletquer 1975).

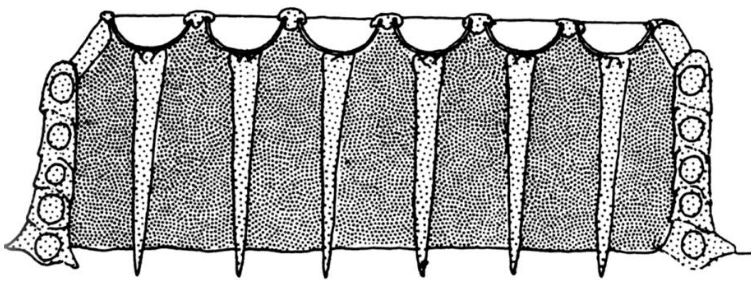


Figure 1.6 Cross section of a kiln used to produce salt, still in use within Manga, Niger, in the mid-20th century, using pointed pedestals and small round vessels (Adapted from Gouletquer 1975: 50)

By the time briquetage becomes recognisable in the archaeological record of Britain (Middle Bronze Age), the supports and container vessels had become separated.

In the Bronze Age it appears that small single ‘pedestal’ supports were used within a hearth to support a single container, as seen at Tetney, Lincolnshire (Figure 1.7) and Brean Down, Somerset (Bell 1990). By the Iron Age, the evidence suggests that more than one support was used to hold vessels (perhaps due to the vessels becoming larger) over a hearth.

The study of salt-production in prehistory and the Roman period is dominated by the study of briquetage. The very presence of briquetage on a site is often the main and only form of evidence to suggest that salt working has taken place and in the case of some UK inland sites, possible evidence for the distribution of salt.

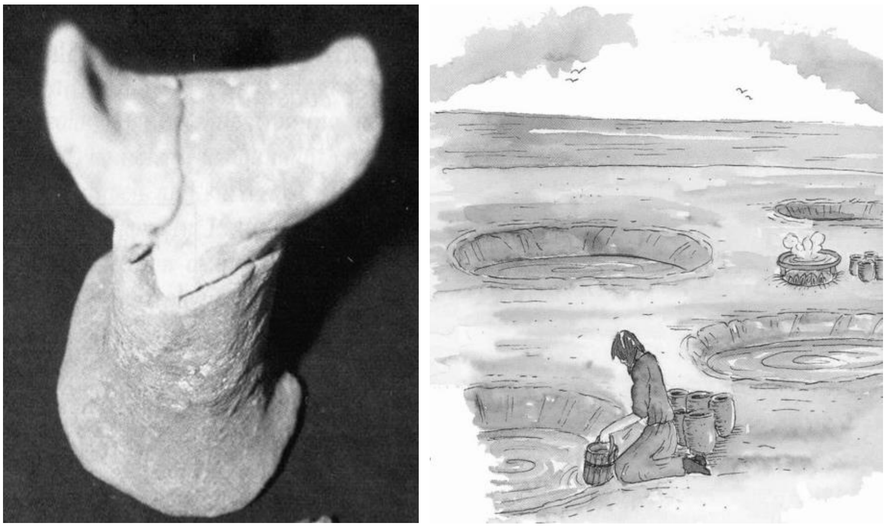


Figure 1.7 Left: Single briquetage pedestal from the Bronze Age site at Tetney, Lincolnshire (Palmer-Brown 1993: 136) Right: Artist's impression of a Bronze Age salt -production site at Tetney (Pryor 1997: 38)

Gouletquer refers to salt-production sites using briquetage as 'briquetages' and heavily focuses on this technique as a classification of a site with little emphasis on the associated features also required (Gouletquer 1974: 7). Van den Broeke (1995) highlighted the problems of employing a briquetage-dominated viewpoint, especially where there are no associated salt-production features present.

> …as a result of the absence of the finished product itself, the briquetage forms the most important guide-fossil to prehistoric salt-winning from brine-boiling… (Nenquin 1961: 76)

He came to the conclusion, based upon his work on the Iron Age sea salt trade in the Lower Rhine area, that:

> …the presence of solid briquetage at a site does not necessarily mean that salt was actually produced at that site. (Van den Broeke 1995: 149)

In Britain, there is evidence for the location of briquetage outside the production sites, predominantly in the Iron Age, and two authors in particular (Morris, 1985 1994a and b, 1996 and Kinory 2012) have attempted to reconstruct distribution networks for salt, based upon the location of these finds. Kinory (2012) in particular, assessed the original evidence provided by Morris, and new finds since this time. She concluded that, despite these limited examples of briquetage used for transport, that most salt in prehistoric Britain was in fact transported in '…containers which are archaeologically invisible'.

Despite its ubiquity, briquetage can be difficult to recognise and identify. There is not a universal typology for briquetage forms even when there are diagnostic sherds present. These fragments of coarse clay can easily be misinterpreted as general fired or baked clay, daub or even ceramic building material. Another major concern with this particular material type is that when it does survive well as recognisable, diagnostic elements, it can closely resemble pottery production kiln furniture. Indeed, both processes required 'quantities of clay for kiln furniture, oven linings or brine-evaporation vessels' (Swan 1984: 49).

One of the main issues when attempting to identify briquetage is that of fragmentation. It is often so fragmented that it renders any identification of diagnostic sherds impossible. Briquetage is therefore notoriously difficult to analyse. It can be elusive and mysterious and often does not give up its presence easily, nor the site from which it originates. However, the associated features used in conjunction with briquetage are even less understood.

> It is probably not generally appreciated that while finds of briquetage from salt production sites have been recorded in large numbers during field survey… we actually know very little about these sites due to lack of excavation. (Gurney 1999: 60)

1.5.5.2 Associated Archaeological Features

The associated features are generally sorted into event types related to techniques of production (Gilman *et al.* 1998; Lane and Morris 2001), and these are outlined below (Table 1.8). The tables have been reproduced from a preliminary assessment of salt-production sites by English Heritage (Gilman *et al.* 1998).

Table 1.8 Events and associated feature types from a complete salt-production site (Gilman *et al.*, 1998: 12 and 16

Event	General Feature Description
Water Management	Features associated with providing seawater to a site and aiding sediment settling or partial solar evaporation
Artificial Evaporation	Variety of hearth and oven structures; some enclosed and some open; some using direct heat and some using indirect heat
Debris Deposition	Mounds or layers created from the debris of salt-production including briquetage, ash and burnt clay
Working Area and General Miscellaneous	General areas of activity-non specific such as clay spreads (possible working areas) and unidentified ditches and gullies

The first stage outlined here is **'Water Management'** (Table 1.9).

Table 1.9 Status of prehistoric and Roman water management features (Gilman *et al.* 1998: 12 and 16)

Feature	Description and Status	
	Prehistoric	Roman
Solar Evaporation Pans	If they existed, remain totally unknown. Many will have been destroyed by marine erosion in the past, others may lie buried beneath the later alluvium	Poorly known, many will have been destroyed by marine erosion in the past, others may lie buried beneath later alluvium
Brine Storage Tanks	No information is known from the majority of sites. Some sites, however, have produced evidence of clay-lined pits which may have served this function	Little information from the majority of sites, some Red-Hill sites however have produced clay-lined pits which may have served this function

This event involves features associated with the collection of seawater to be evaporated on-site. Features typically consist of clay-lined features used to aid the settling of sediments and/or the partial solar evaporation of seawater to produce brine (Figure 1.8).

This can also include either natural or human-made channels to provide saltwater to the site and reservoirs to store saltwater. Of all the events, it is likely that the remains of this one are less likely to preserve as they would have been the nearest features to the coastline. Briquetage is not associated with this event, but is associated with the other three.

Figure 1.8 Excavation of a Red Hill at Peldon, Essex. Brine tank on the left, small hearth on the right (Fawn *et al.* 1990: Plate 4: Appendices)

The second stage is the **'Artificial Evaporation'** event (Table 1.10).

Table 1.10 Status of prehistoric and Roman artificial heating features (Gilman *et al.* 1998: 12 and 16)

Feature	Description and Status	
	Prehistoric	Roman
Brine Hearths	A handful of brine hearths are known; most recorded examples are long and rectangular, less than 2m long and usually about 0.5-0.6 wide. They are lined with clay (or stones), one end is closed, the other opens into a stokehole. In no case is the superstructure preserved or even inferable. Usually they occur singly, though pairs are also known	A few dozen brine hearths are known, most recorded examples are long and rectangular, less than 2m long and usually about 0.5-0.6 wide. They are lined with clay (or stones), one end is closed, the other opens into a stokehole. In no case is the superstructure preserved or even inferable. Usually they occur singly, though pairs are also known. Some oval brine hearths are also known from some south Essex Red Hills. Brine hearths seem to have been periodically dismantled after use, thus accounting for their scarcity

This involves the use of heat to produce and dry salt from brine using usually large rectangular or circular briquetage containers, which were supported with a variety of different types of briquetage supports. The features associated with this event mainly include hearths (above and below ground), which can be open or enclosed (Figure 1.9).

The hearths above ground that are not enclosed (hereafter referred to as ‘open’) are less likely to preserve compared with enclosed hearths within the ground, as they are not as structurally strong and would be more easily lost to erosion or plough damage.

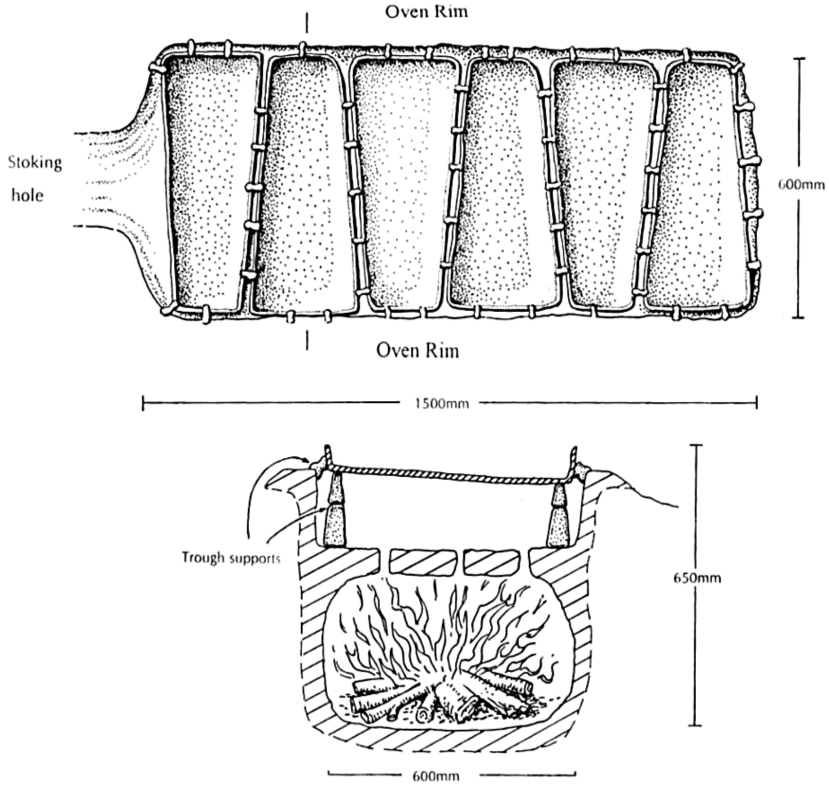


Figure 1.9 Reconstruction of an enclosed clay lined hearth with briquetage, Ingoldmells, Lincolnshire (Lane and Morris 2001: 421)

The third stage is the **‘Debris Deposition’** event (Table 1.11).

Table 1.11 Status of prehistoric and Roman debris mounds (Gilman *et al.* 1998: 12 and 16)

Feature	Description and Status	
	Prehistoric	Roman
Mound (waste)	Deposits of varying thickness and extent of clay, ash and other burnt material, containing briquetage. May overlie, underlie or contain other structural components. Ash deposits in and around the waste heap may indicate the length of use of the site. These may be the only trace of a site visible on the surface	

This term was used to describe all of the debris created by salt-production, which mainly consists of burnt fuel ash and briquetage remains. This debris can be deposited in a variety of ways and this can provide an insight into site management practices.

The fourth category describes the 'General Features' which can occur within a salt-production site such as hard surfaces created to work upon, or structures created in order to provide shelter (Table 1.12).

Table 1.12 Status of prehistoric and Roman working areas and structures features (Gilman *et al.* 1998: 12 and 16)

Feature	Description and Status	
	Prehistoric	Roman
Working Floors	Flat level areas, several square metres in extent, of clay, fragments of fired clay and ash trampled into a surface. This formed a hard-standing for the salt-production activity. Rarely recorded, though may be represented by scatters of briquetage found loose on foreshores	Flat level areas, several square metres in extent, of clay, fragments of fired clay and ash trampled into a surface. This formed a hard-standing for the salt-production activity. Rarely recorded properly
Walls	Some fired clay walls have been found on some sites. These may have been part of the hearth superstructure. Alternatively they may be parts of buildings associated with the salterns, which suffered a fire as the result of an industrial incident	In a few cases low fired clay walls have been found around hearths and some distance from them. Their function is unknown, but may be part of the hearth superstructure, though some may be accidentally-burnt wattle buildings
Other Structures	One may suspect that a whole range of other structures should be related to salt-production sites. In our present state of knowledge they remain totally unknown	

This category is a more ambiguous as it refers to a multitude of general features that are less well-understood and studied.

1.6 Archaeological Background and Wider Studies of Salt-Production across Europe

1.6.1 Earliest Archaeological Evidence for Salt-Production in Europe

As discussed in **1.4**, it is probable that the earliest human experimentations with salt-production have left little archaeological trace. Initial efforts to obtain salt would have accessed natural sources of crystallised salt, which would not require a production process that would leave archaeological traces. Even when hearths and artefacts such as pottery were used for salt-production, they may have been, multi-functional. It has been shown in ethnographic studies (Alexianu *et al.* 2011b) that many people have employed ‘generic’ tools and hearths to produce salt, even in modern times.

This includes evidence for Neolithic salt-production. Examples include evidence from Spain, where rock salt was scraped from natural outcrops using stone axes (Weller 2002) and Central Anatolia (Erdoğu *et al.* 2003), where salt springs and lakes were exploited (Chapman *et al.* 2001; Cavruc and Harding 2011; Lazarovici and Lazarovici 2011). In all these cases salt-production is more evidenced by general human occupation debris associated with salt sources as opposed to specific technologies.

Most salt-production sites from the Bronze Age onwards are known either by excavating salt mines, or predominantly by the discovery of briquetage by salt springs, lakes and coastlines, indicating that the ‘pot process’ of evaporating brine and/or drying salt had taken place. Therefore these sites are easier to identify based upon these archaeologically visible attributes.

1.6.2 The Growth of Salt-Production Sites across Europe from the Bronze Age. The Work of Jacques Nenquin and Pierre Gouletquer

Much of this section will be based upon the dissertation completed by Jacques Nenquin, (1961) and the work of Pierre Gouletquer, who also researched the early development of salt-production in Europe (Gouletquer 1974). Nenquin was one of the first academics to carry out research into salt-production in Europe, producing a detailed overview which provided an excellent base for future researchers. Within his extensive work, Nenquin compiled gazetteers of sites across Europe, including a series of distribution maps (Figures 1.10-1.11 and 1.13-1.14).

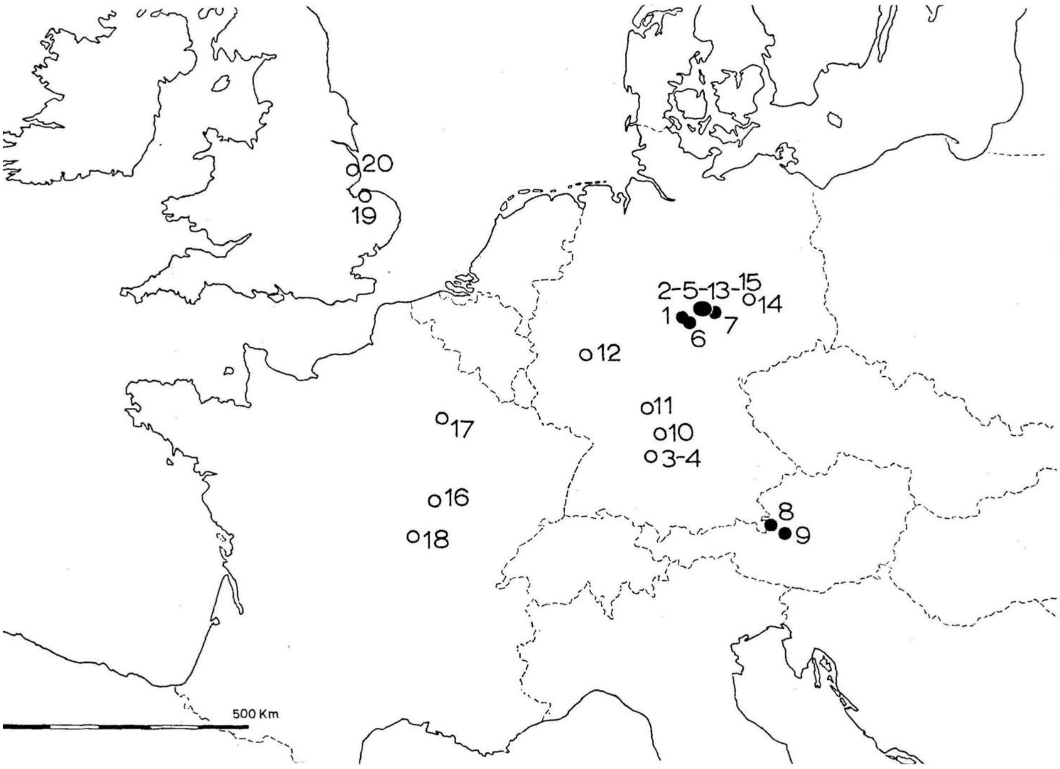
Within his maps, Nenquin makes the distinction between ‘Probable’ and ‘Certain’ sites and he also outlines some general salt-production areas, such as the Morbihan area of France, Lincolnshire and Essex.

1.6.2.1 Bronze Age Salt-Production Sites

Nenquin's Map II (Figure 1.10) plots 20 Bronze Age salt-production sites, of which 10 are 'Probable', and 10 are 'Certain'.

Only two sites are plotted for the UK, at Botany Bay and Saltfleet. More sites have since been located, revealing that salt was produced from at least the Middle Bronze Age in Britain.

Examples include a well-preserved Middle Bronze Age site at Brean Down, Somerset (Bell 1990), and Later Bronze Age sites at Tetney (Palmer-Brown 1993) and Billingborough, Lincolnshire (Chowne 2001), and South Woodham, Essex (Wilkinson and Murphy 1986).



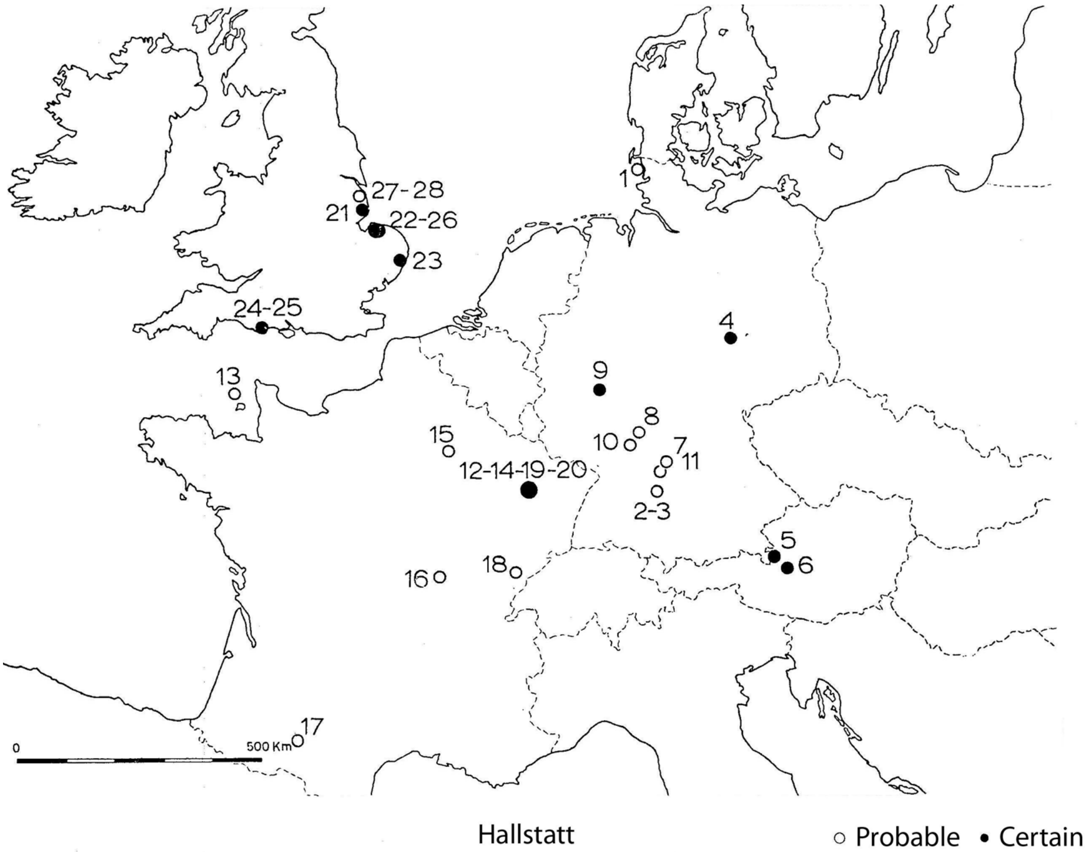
Bronze Age ○ Probable • Certain

1. Auleben 2. Dederstedt 3. Dörtel 4. Eichenau 5. Erdeborn 6. Frankenhausen
7. Halle-Giebichenstein 8. Hallein 9. Hallstatt 10. Kirchberg 11. Mergentheim
12. Nauheim13. Quenstedt 14. Schelieben 15. Stedten 16. Fontaines Salées
17. Montmert 18. Pougues les Eaux 19. Botany Bay 20. Saltfleet

Figure 1.10 Distribution map of Bronze Age salt-production sites in Europe (Adapted from Nenquin 1961: 'Map II')

1.6.2.2 Late Bronze Age-Early/Middle Iron Age Salt-Production Sites (Halstatt)

As is apparent in the maps shown in Figures 1.11-1.12, there is an increase in salt-production sites recorded during this period across Western Europe, including Britain. This includes the major mine site at Halstatt, Austria (6) and the major inland spring production site in the Seille Valley, France (19).



1. Amrum 2. Dörtel 3. Eichenau 4. Halle-Giebichenstein 5. Hallein 6. Hallstatt 7. Kirchberg 8. Mergentheim 9. Nauheim 10. Niedernahll 11. Oberlimpurg 12. Bourthecourt 13. Guernsey 14. Marsal 15. Montmert 16. St Honoré les Bains 17. Salies du Salat 18. Salins 19. Seille 20. Vic 21. Addlethorpe 22. Botany Bay, Weeting 23. Brantham Hall Farm 24. Gaulter Gap 25. Kimmeridge 26. Runcton Holme 27. Saltfleet 28. Thorpe

Figure 1.11 Distribution map of Halstatt (Late Bronze Age-Middle Iron Age) salt-production sites in Europe (Adapted from Nenquin 1961: 'Map III')

The sites recorded in England were exclusively those exploiting saltwater sources on the coast or inland marshes. For the Halstatt period in particular, Nenquin plots *c*.11 'Probable' and *c*.17 'Certain' sites including eight 'Certain' sites within the UK, mainly in the Fenland and Essex, as well as two in the Isle of Purbeck, Dorset

(Figure 1.11). The latter are the earliest that Nenquin plots within the study area of this research.

The Seille Valley, France (Figures 1.11: 19 and 1.12), represents a particularly intensive area of salt-production from salt springs. Since Nenquin's study (1961), further archaeological investigation of this area have revealed substantial deposits of briquetage and uniquely large evaporation hearths (Olivier and Kovacik 2006).

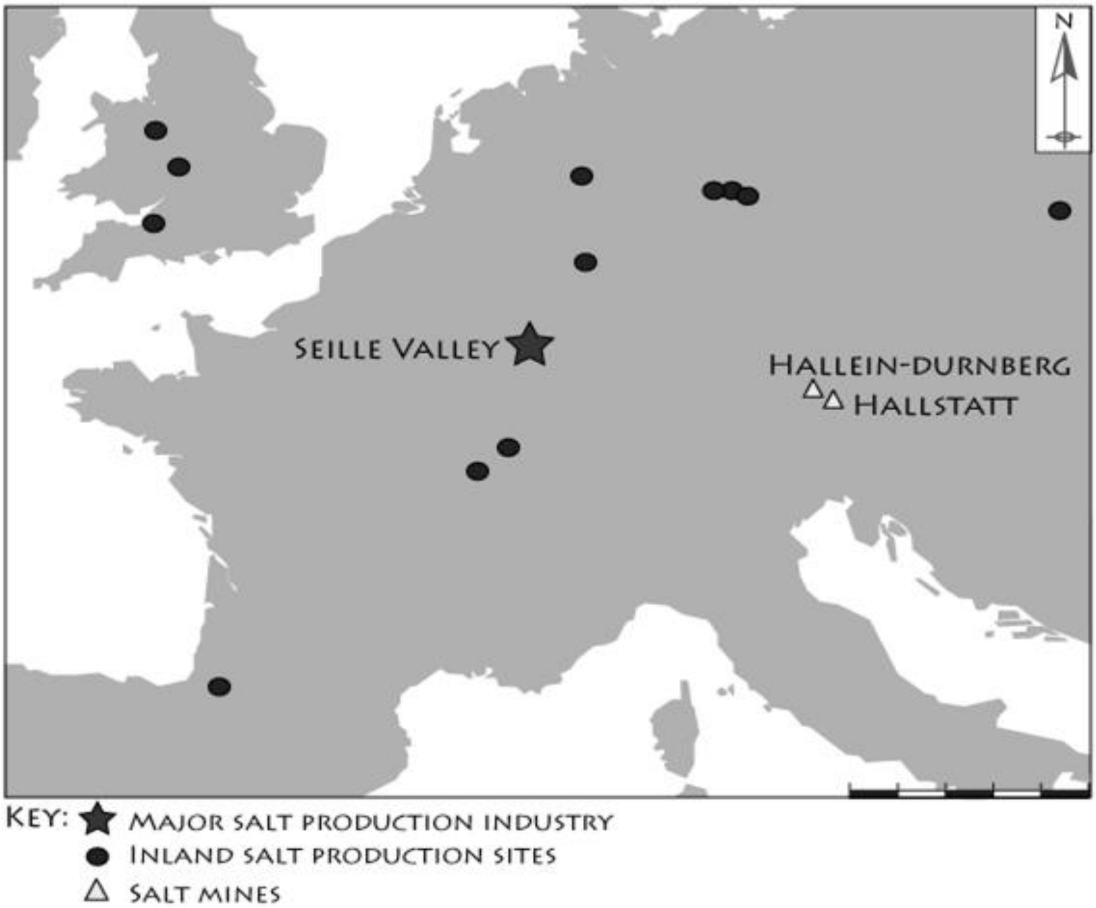


Figure 1.12 Recent map showing 'European Salt Production Centres: c.2000BC-750BC' (note that most coastal areas of Britain are not shown in this map), (Riddiford 2010: Available from: http://www.seillevalley.com/BronzeAgeSaltMap.htm)

The start date for salt-production at this site can now be potentially put back into the Middle Bronze Age (Riddiford 2009). The site was then used until early in the 1st century BC (Olivier and Kovacik 2006). Based upon new excavations, it has been proposed that this site was *the* major site of industrial salt-production in Europe before the 1st century A.D (Figure 1.12). Figure 1.12 is only depicting inland salt-production sites, and therefore only shows the salt spring exploitation sites in Cheshire and Worcestershire which were apparently active in this earlier period, indicated by the discovery of VCP containers (Morris 1985; 1994). However, presumably the lower point is linked to the inland mound sites in the Central Somerset Levels, which have been dated to much later in the Romano-British period. The Somerset mound sites will be explored in detail in Chapter **6.0**.

1.6.2.3 Late Iron Age Salt-Production Sites (La Tène)

In the Later Iron Age Nenquin (1961) suggested that many new sites appeared across Europe (Figure 1.13). This included a series of new coastal sites across the south west of France, the Netherlands and eastern Britain. This included new sites in Britain, which are plotted in the regions covered by the Fens and Essex (Figure 1.13).

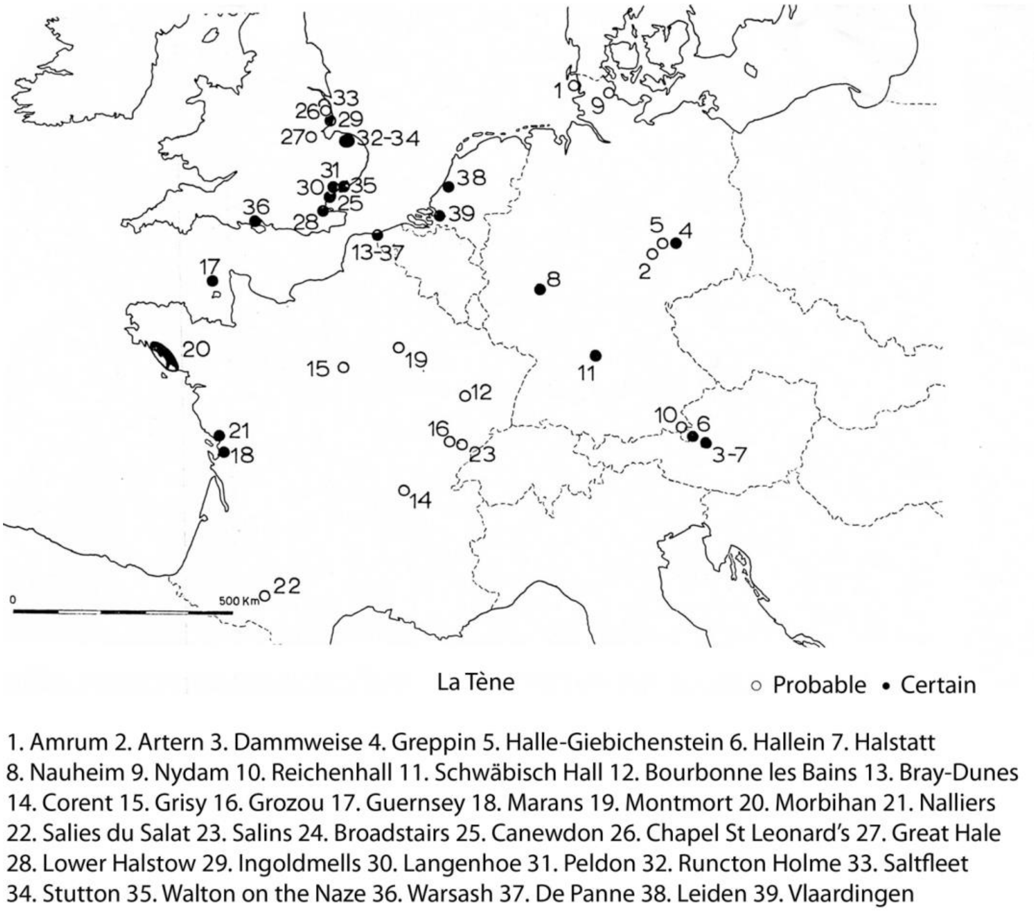
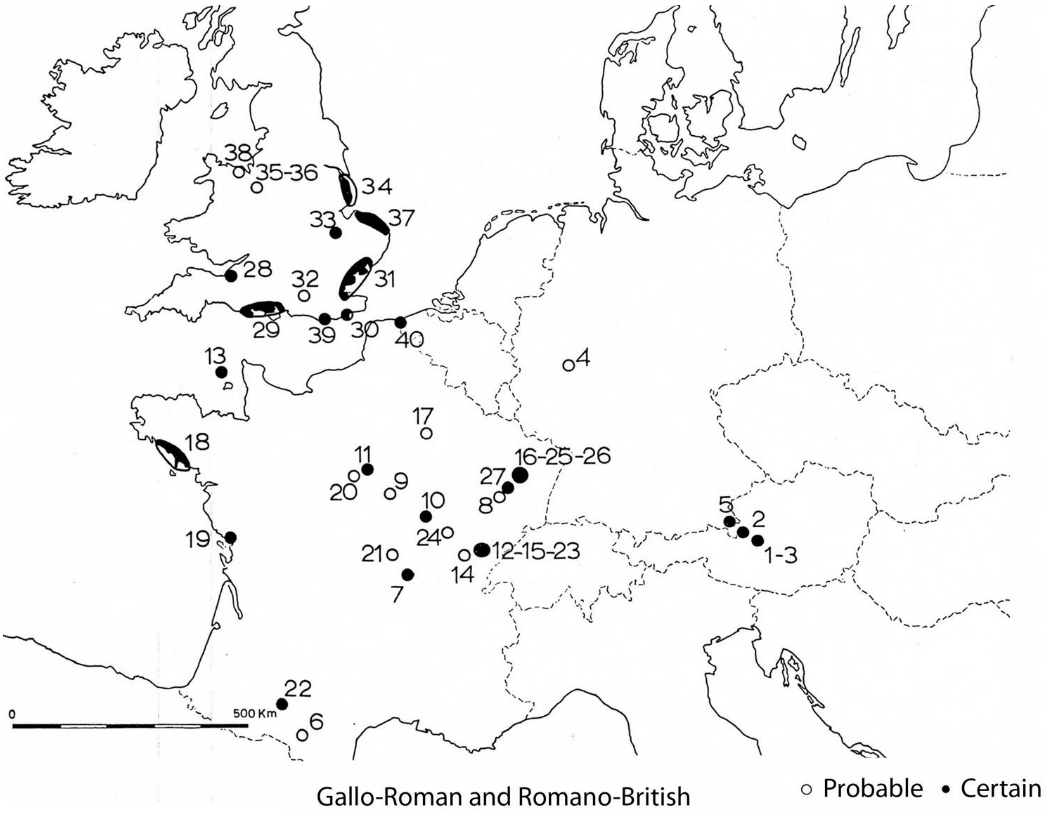


Figure 1.13 Distribution map of La Tène (Late Iron Age) salt-production sites in Europe (Adapted from Nenquin 1961: 'Map IV')

In terms of the research study area, three new sites are suggested; one at Warsash, Hampshire (36) and two in Kent (25 and 28).

1.6.2.4 Roman Salt-Production Sites

Nenquin (1961) showed that many Late Iron Age sites continued into the Early Roman period and also that many more sites began during this time (Figure 1.14).



1. Dammweise 2. Hallein 3. Halstatt 4. Nauheim 5. Reichenhall 6. Ax 7. Bourbon Lacey
8. Bourbonne les Bains 9. Foissy 10. Fontaines Salées 11. Grisy 12. Grozou 13. Guernsey
14. Lons le Saunier 15. Maizières 16. Marsal 17. Montmort 18. Morbihan 19. Nalliers 20. Saclay
21. St Honoré les Bains 22. Salies du Salat 23. Salins 24. Santenay 25. Seille 26. Vic 27. Vittel
28. Brue district 29. Dorset sites 30. Dymchurch 31. Essex-Kent sites 32. Farnham 33. Fens
34. Lincolnshire sites 35. Kinderton 36. Nantwich 37. Norfolk sites 38. Prestatyn 39. Seaford
40. De Panne

Figure 1.14 Distribution map of Gallo-Roman and Romano-British salt- production sites in Europe. (Adapted from Nenquin 1961: 'Map V')

He suggested that in this period, coastal salt-production sites in the Netherlands ended, but some coastal sites in France continued. Nenquin also included the extensive site within the Seille Valley, France. Subsequent fieldwork has shown the site actually originated in the Later Iron Age (Olivier and Kovacik 2006).

Nenquin noted general areas of Romano-British salt-production, including the well-established sites in Lincolnshire, Norfolk and Essex. He also showed areas of salt-production in Somerset and the inland brine springs of Cheshire. Sites reappear in the Poole Harbour/Isle of Purbeck area of Dorset and new sites are shown at Seaford, East Sussex, and in the area of Dymchurch, Kent.

The new sites in the Cheshire area (Figure 1.14) are at Kinderton (35) and Nantwich. Subsequently, investigation has revealed further sites at Droitwich and Upwich (Hurst 1997), Middlewich (Bestwick 1975; Williams and Reid 2008) and elsewhere (Fielding 2005a). Many of these sites have evidence for Iron Age origins and salt from the Droitwich area was distributed in distinctive pottery containers (VCP) during the middle-Late Iron Age (Morris 1985; Matthews 1999).

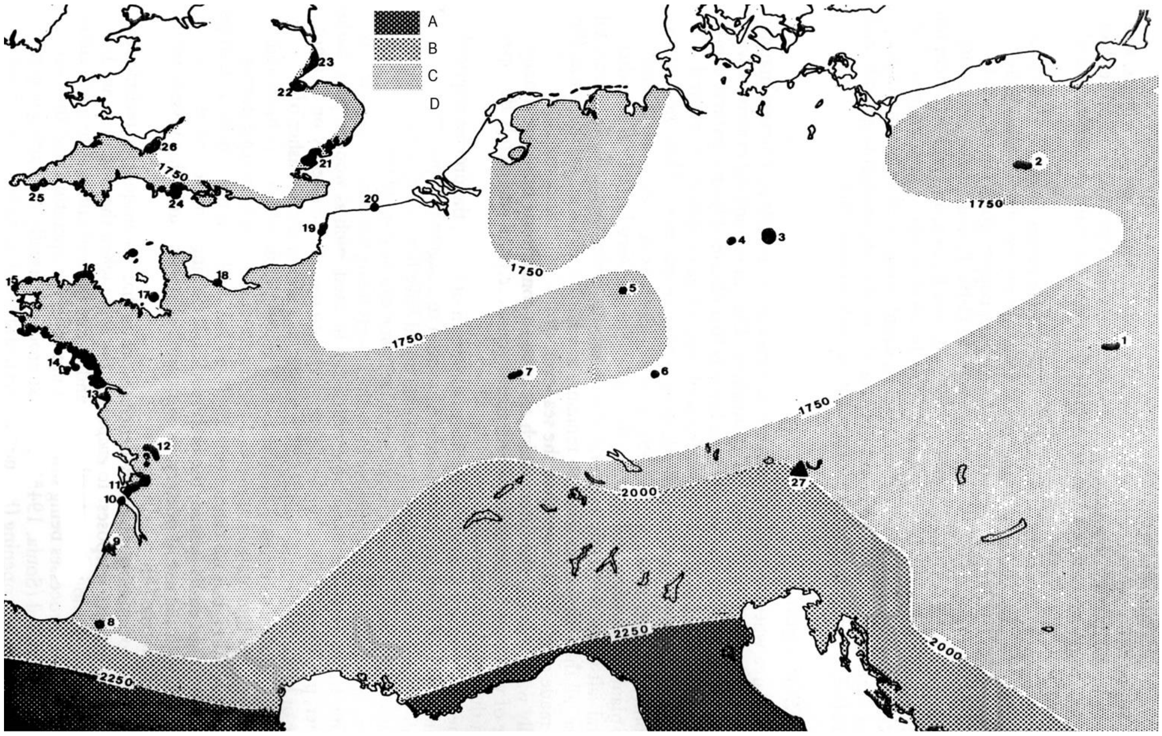
Nenquin did not plot any sites for Cornwall, Devon or West Sussex, although he still concluded that of all the areas in Europe he had researched, Britain topped the list for the number of salt-production sites 'with a certified total of 106 sites' (Nenquin 1961: 157). He also pointed out that this was an underestimate because of the amount of the Red Hills that had been lost to erosion.

1.6.3 Overview of Prehistoric and Roman Salt-Production Sites in Europe

Thirteen years after Nenquin's publication, Pierre Gouletquer (1974) published a paper on the development of salt-production in prehistoric and Roman Europe. Like Nenquin, Gouletquer provided an overview of techniques and also produced a European distribution map (only showing sites using briquetage), (Figure 1.15).

This map includes sites in Somerset (26: Roman) and Dorset (24). However, salt-production in Dorset is shown to date to the Late Iron Age (La Tène) only. Another surprising omission is that no Kent sites are represented, despite sites known to be there at the time of his research. However, the Roman salt-production site at Trebarveth, Cornwall is shown.

The map also shows the average amount of sunlight hours per year for different areas. Gouletquer placed much more emphasis on climate and technique and therefore this map was created in order to show the importance of these two factors.



A. More than 2,250 hours per year
B. Between 2,250 and 2,000 hours per year
C. Between 2,000 and 1,750 hours per year
D. Less than 1,750 hours per year

1.	Little Poland Group	(Neolithic and Hallstatt)
2.	Poland and Kouiavia	(Hallstatt)
3-4.	Saale Valley Group	(Late Bronze Age and Hallstatt)
5.	Bad-Nauheim	(La Tene)
6.	Schwabisch-Hall	(Hallstatt)
7.	Seille Valley Group	(Halstatt)
8.	Salies-de-Bearn Group	(Late Bronze Age or Early Hallstatt and Roman)
9.	Le Pylat	(Unknown)
10.	Soulac	(Hallstatt and La Tene)
11.	Aunis and Saintonge Group	(Hallstatt and La Tene)
12.	Vendee Group	(La Tene)
13-14.	South Brittany Group	(La Tene)
15.	Beg-ar-Vir	(Roman)
16-17.	Tregor and Channel Islands Group	(La Tene)
18.	Lion-sur-Mer	(Late Hallstatt or La Tene)
19.	Etaples Group	(Hallstatt and La Tene)
20.	La Panne	(Hallstatt)
21.	Essex Group	(La Tene and Roman)
22.	Fenlands Group	(La Tene and Roman)
23.	Lincolnshire Group	(La Tene and Roman)
24.	Dorset Group	(La Tene)
25.	Trebarveth	(Roman)
26.	Somerset Group	(Roman)
27.	Hallstatt Salt Mines	(Hallstatt)

Figure 1.15 Map of prehistoric and Roman salt-production (briquetage) sites in Europe showing hours of sunshine (Adapted from Gouletquer 1974: 4)

Riddiford's (2009) recent map (Figure 1.16) shows even more salt-production areas in Europe appearing during the Iron Age, especially in the extensive spread of coastal sites across the north-western coast of France, and the southern and eastern coasts of Britain.

This map provides more detail about the general spread of sites in Britain and includes many areas not included by Nenquin and Gouletquer's maps, including Cornwall and Sussex. However, the shaded areas are still very generic as they were used to provide the general wider context to a discussion specifically on the salt industry in the Seille Valley, France.

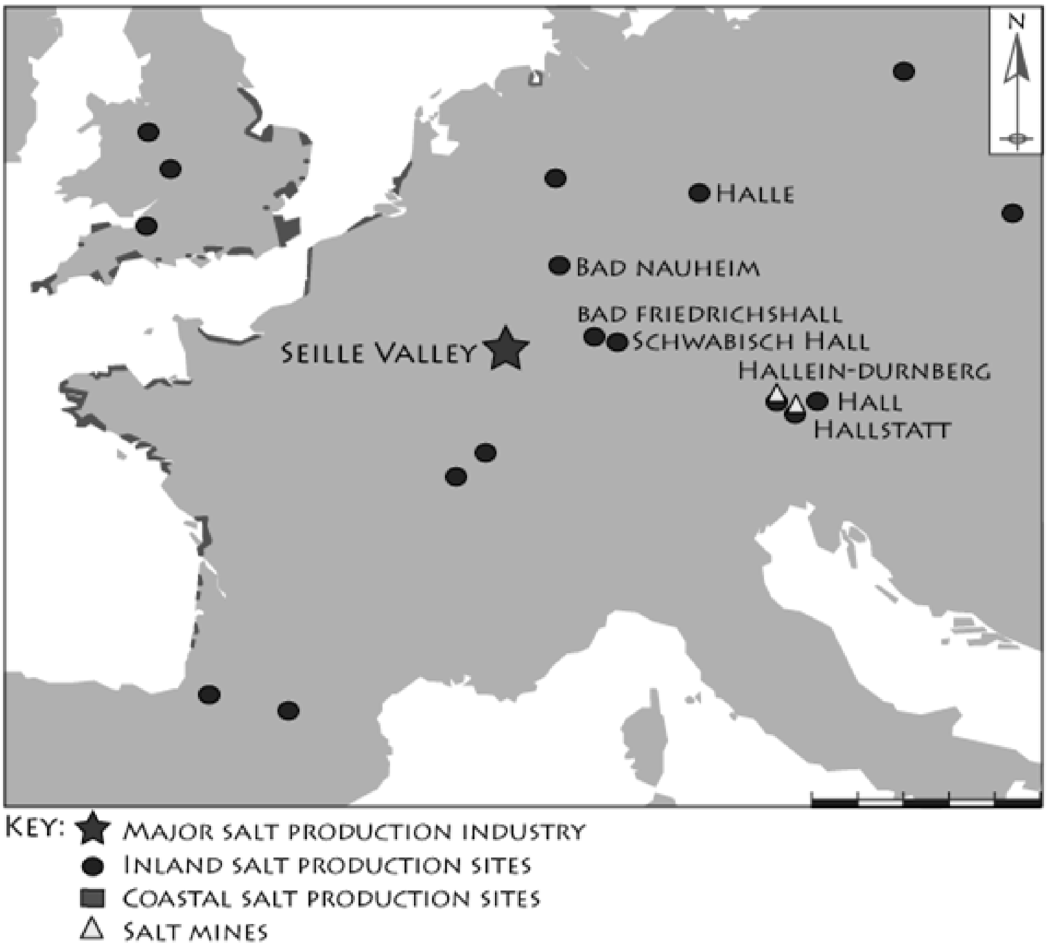


Figure 1.16 Recent map showing 'European Salt Production Centres: c.750BC-AD50' (Riddiford 2010: http://seillevalley.com/IronAgeSaltMap.htm)

All the maps show a considerable increase of salt-production sites during the Iron Age (especially Later Iron Age) and Early Roman period across Europe. However, none of the maps show details for sites in the Middle-Late Roman period, therefore showing how little understood salt-production after the Early Roman period is overall.

1.6.4 Studies of Iron Age and Roman Salt-Production in Britain

Nenquin recognised that there was a considerable increase in sites within Britain during the Early Romano-British period particularly in Essex:

> …it is a fact that a chronological agreement exists between the date of the invasions in S-E. England, and the remarkable increase in the number of salt-industry sites in the same region. (Nenquin 1961: 153)

He went on to speculate that this was the result of an 'urgent need' for salt due to the 'continuously growing population of Romanized Britain', (Nenquin 1961: 129). In his work on the transformation of coastal wetlands, Rippon (2000a, 2000b, 2000c) addresses salt-production in Roman Britain in more detail, by providing a map which shows areas of salt-production in the Early and Late Romano-British periods within Britain (Figure 1.17).

The map shows that there was a decrease in sites in the Later Romano-British period, with only two areas of the study area remaining active: the Central Somerset Levels and Poole Harbour, Dorset. Again, no sites in Cornwall or Devon are shown in either of the maps.

Most maps depicting salt-production sites in Europe, and specifically in Britain are providing a generic overview of popular areas, often with little detailed investigation of the nature of the archaeological evidence. Nenquin (1961) was the first author to attempt to represent sites on a slightly more individual level as opposed to general production areas.

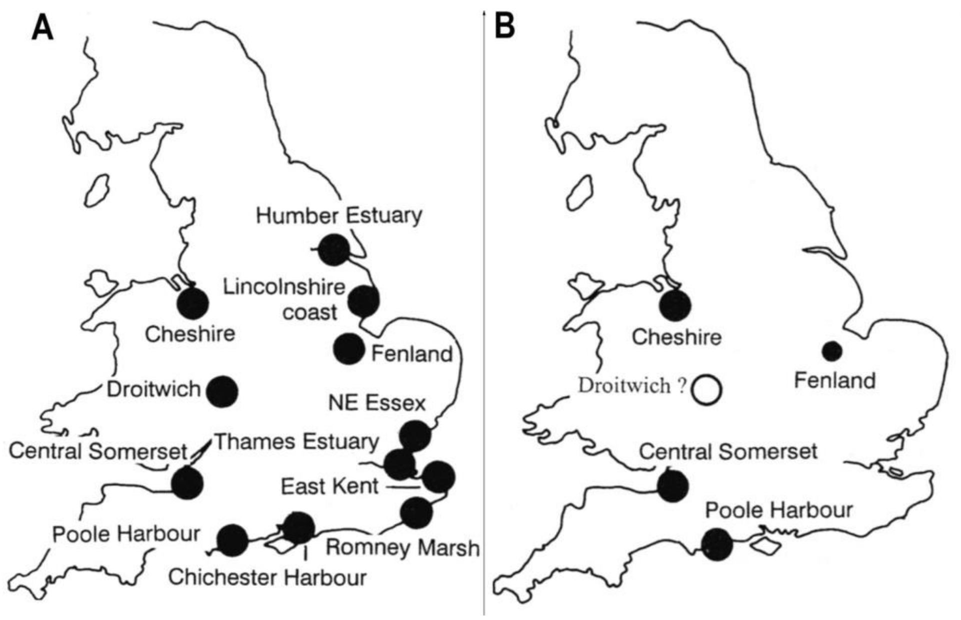


Figure 1.17 Map showing the main areas of salt-production in Britain. A: Early Romano-British period B: Late Romano British (Adapted from Rippon 2000c: 97)

Most studies of salt-production in Britain have been heavily focused upon specific regions of Britain.

1.6.5 A Review of Key Studies of Coastal Salt-Production Sites in Britain

Most literature on early salt-production specifically within Britain has focused upon Essex and, to a lesser degree, the Fenlands. Figure 1.18 provides a good example, with the word 'salt' (highlighted in yellow), shown only within the Essex, Norfolk and Lincolnshire areas.

Figure 1.18 Map of Roman Britain (Adated from Frere 1991: xvi : yellow emphasis added to highlight 'SALT')

Whilst compiling the literature review for this thesis, it was noted that a commonly cited source within most discussions involving early salt-production, was the proceedings from the 1974 conference: 'SALT: The Study of an Ancient Industry', held at the University of Essex (De Brisay and Evans 1975). Papers in this volume synthesised and discussed data on salt-production sites from different periods, and countries all over the world.

1.6.5.1 The Famous Essex Red Hills

It was apt that the 1974 Salt Conference was held in Essex, as this location provided the base for the growth of research into Bronze Age-Romano-British salt-production. Salt-production in Essex appears to have started on a small scale in the Bronze Age, continuing and increasing through the Iron Age into the Romano-British period, but with most sites abandoned by the end of the second century AD (Rippon 2000c: 139).

This area is famous for a distinctive type of salt-production site that has long been the subject of debate amongst those people living among them; and these are locally termed, the 'Red Hills' (Figure 1.19).

These 'Red Hills' are spread across the coastline of Essex (Figure 1.19); they consist of burnt mounds made up of a deep red silt. They have long been thought to have been associated with salt-production (De Brisay 1975; Fawn *et al.* 1990). This term first appeared in print when Henry Stopes published his excavations of these mounds (Stopes 1879). He indicated that the term 'Red Hills' had been used for many years by the local people. The term is now synonymous with many salt-production sites in Essex and is generally used to refer to whole sites as well as the actual debris mounds themselves.

Due to their high visibility and local interest, the Red Hills became a focus of archaeological work as early as 1906. As a result a 'Red Hills Exploration Committee' was formed by the Society of Antiquaries (Riehm 1961: 181) and the committee oversaw several excavations (Figure 1.20) over the following decades.

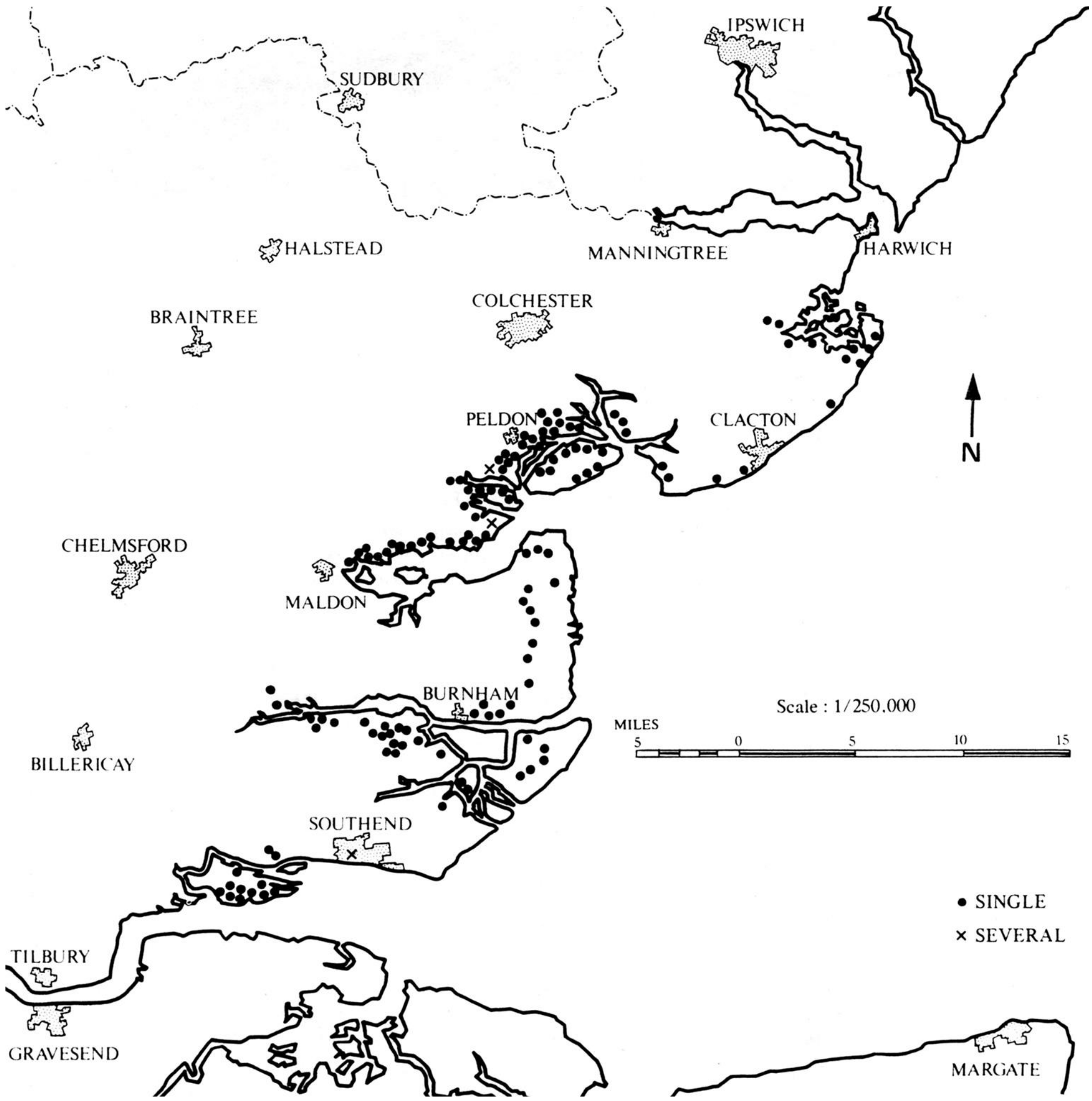


Figure 1.19 Distribution map of Red Hill sites in Essex (De Brisay 1975: 5)

Much of the best published archaeological investigation was undertaken during the 1970's and 1980's by Mrs Kay De Brisay (Figure 1.20), (De Brisay 1985; 1978; 1981; De Brisay and Evans 1975) and Mr James Fawn (Fawn 1986; 1994; Fawn *et al*. 1990) both avid enthusiasts for these particular sites. De Brisay did a particularly good job of writing about the details of these sites, with many observations on small but important aspects of these sites, especially when it came to the briquetage forms used. Fawn built on this work and his book 'The Red Hills of Essex: Salt-making in Antiquity', provides the best synthesis on the sites to this date (Fawn *et al.* 1990).

The work carried out in Essex has helped to define the archaeology of an Iron Age and Romano-British coastal salt-production site, as well as understanding the technology and techniques employed. It was a result of excavating these sites that distinct features within defined working areas were fully recognised, including settling tanks and different hearth types.

Figure 1.20 Excavation of a salt-production site at Peldon, Essex, 1973. Mrs Kay de Brisay is the central figure in the pink (Fawn *et al.* 1990: Plate 1)

Both Fawn (1994) and De Brisay (1978, 1981) also observed distinct types of briquetage that were similar to other areas of Europe and Fawn created and developed a detailed typology (Figure 1.21).

Fawn (1986) listed 298 sites, then later, 300 (Fawn *et al.* 1990) and finally, this increased to at least 400 (Fawn 1994). By 2008, about 408 sites and/or finds specifically associated with salt-production recorded in the Essex Historic Environment Record, demonstrating the decrease of Red Hill investigation by this time.

The pioneering work in Essex inspired further research and fieldwork in other areas of Britain and indeed Europe. Due to the amount of work that has been carried out there, many have assumed that Essex was the most important area for salt-production in the Later Iron Age and Romano-British periods, as emphasised in both the work of Gouletquer (1974) and Nenquin (1961):

> ...we know in fact, thanks to the evidence of the Red Hills, that it was precisely the South-East coast of England which was the most important salt-producing area of the country in Romano-British times. (Nenquin 1961: 153)

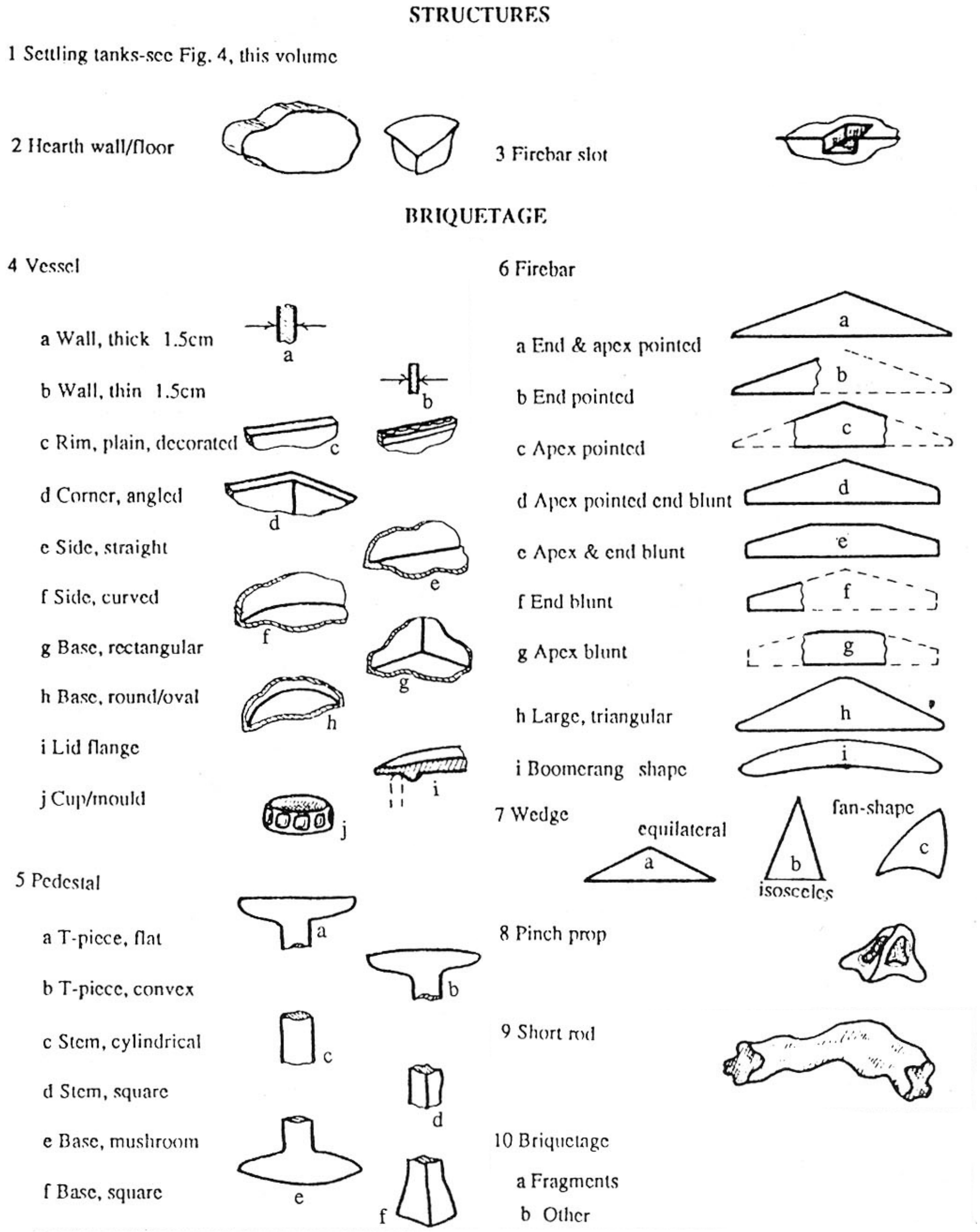


Figure 1.21 Essex Red Hill Briquetage Typology (Adapted from Fawn *et al.* 1990: 69)

However, many more sites have been discovered elsewhere in Britain in the last 20 years that could perhaps challenge this view. It is also important to note that only a very small percentage (perhaps as little as 5-10%) of the estimated number of sites in Essex have actually been the subject of systematic (published) archaeological excavation. Although this research project will not be re-examining the Essex evidence in detail, it will form a basis for comparison with the areas under detailed scrutiny.

1.6.5.2 Research in the Lincolnshire and Fenland area

There has also been substantial fieldwork and research on salt-production sites in the Fenlands, particularly Lincolnshire (Figure 1.22), (Baker 1975; Chowne 2001; Lane 2005a, 2005b, 2005c) especially in recent times. It was the Fenland sites that provided the inspiration behind the extensive work of Jacques Nenquin (Nenquin 1961). The work of Dr Elaine Morris (University of Southampton) and Tom Lane (Archaeological Project Services) has particularly contributed to current understanding of salt-production in this area of Britain.

Research in this area has included the formation of the 'Fenlands Management Project/Fenlands Survey' which has contributed significant data (Crowson *et al.* 2000). Much of the more recent work in Lincolnshire has been carried out by archaeological contractors as a result of PPG16.

Salt-production in this area appears to have been predominantly carried out during the Iron Age period, although some sites were still in use in the 3rd/4th centuries AD (Lane and Morris 2001).

This has included the extensive six hectare excavation of a well preserved c.2nd Century AD salt-production site at Wygate Park, Spalding, with associated settlement, copper and bronze working evidence (Wood 2007).

In 2001 (Lane and Morris 2001), *c*.300 sites were thought to be associated with salt-production in the Fenlands, most of which are in Lincolnshire, and by 2008, *c*.398 salt-production sites and/or finds specifically associated with salt-production were recorded within the Lincolnshire Historic Environment Record.

Of particular significance was the publication of ' A Millennium of Saltmaking: Prehistoric and Romano-British Salt-production in the Fenland' (Lane and Morris 2001). The combination of Tom Lane's extensive experience of excavating these sites in a commercial context, with the specialist knowledge of briquetage by Dr Morris in an academic context, has resulted in excellent research and discussion, culminating in this large and significant volume.

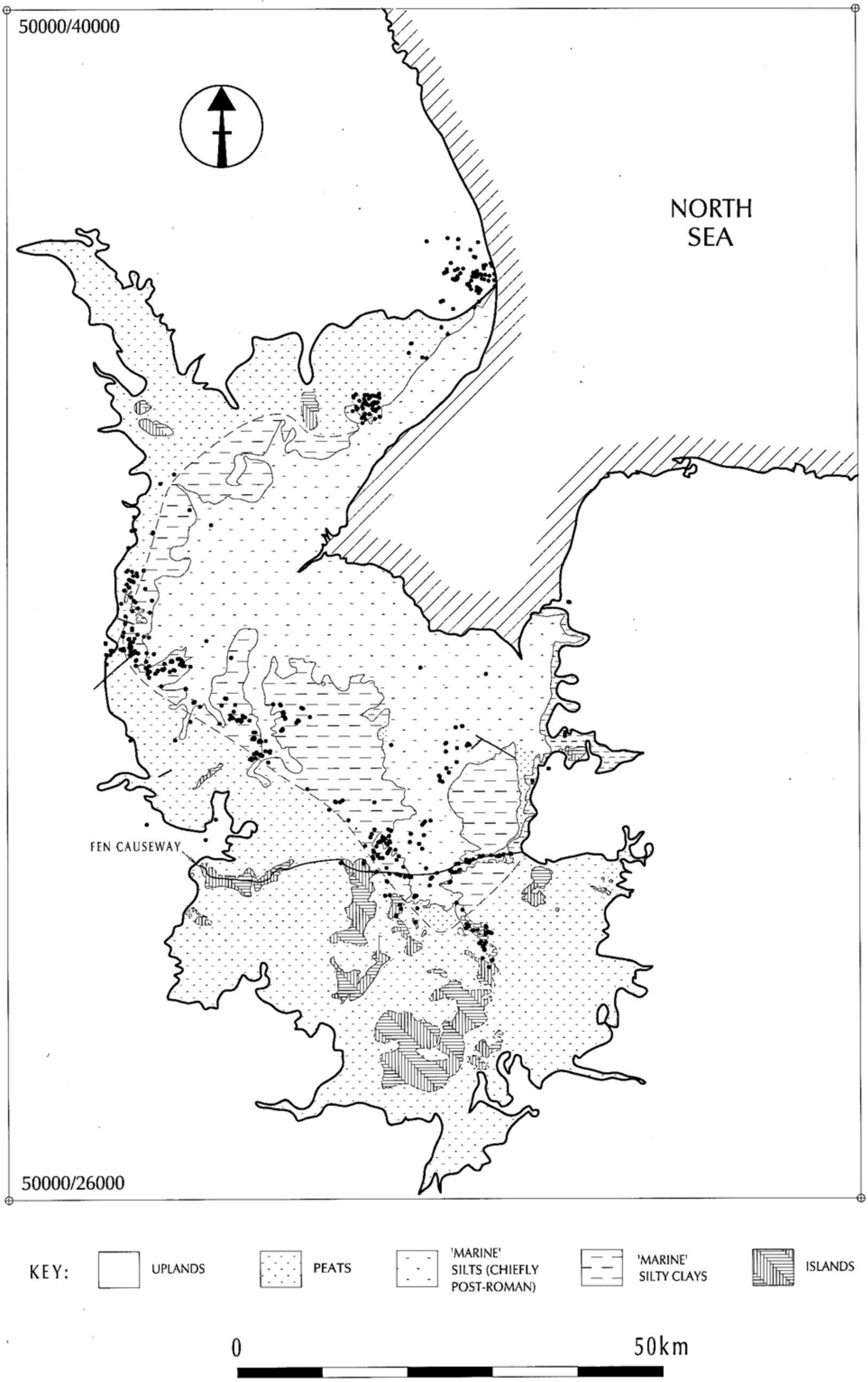


Figure 1.22 Distribution of Iron Age and Roman-British 'salterns' in the Fenland area and contemporary landscape (Lane and Morris 2001: 7)

This publication remains the most useful, detailed and up to date guide for salt-production in the Fens, and also provides insightful discussion about the significance of salt-production across Britain in general. As a result, this work has provided the basis for the feature type and briquetage identification carried out for this project.

In contrast to Essex where many of the sites have been damaged by substantial coastal erosion, sites in the Fenland area are much better preserved in general due to land reclamation. As a result, their location has been tentatively used to plot former Iron Age and Romano-British coastlines (Simmons 1980).

1.7 An Overview of the Study Area: Somerset to Kent

The research study area encompasses the southern most part Britain which is bordered to the east by the River Thames, Surrey, Greater London and Essex, and in the west by Wiltshire and Gloucestershire. The study area is focused upon the southern coast of Britain, but also includes the extensive inland waterscape of the Somerset Levels (Figure 1.23).

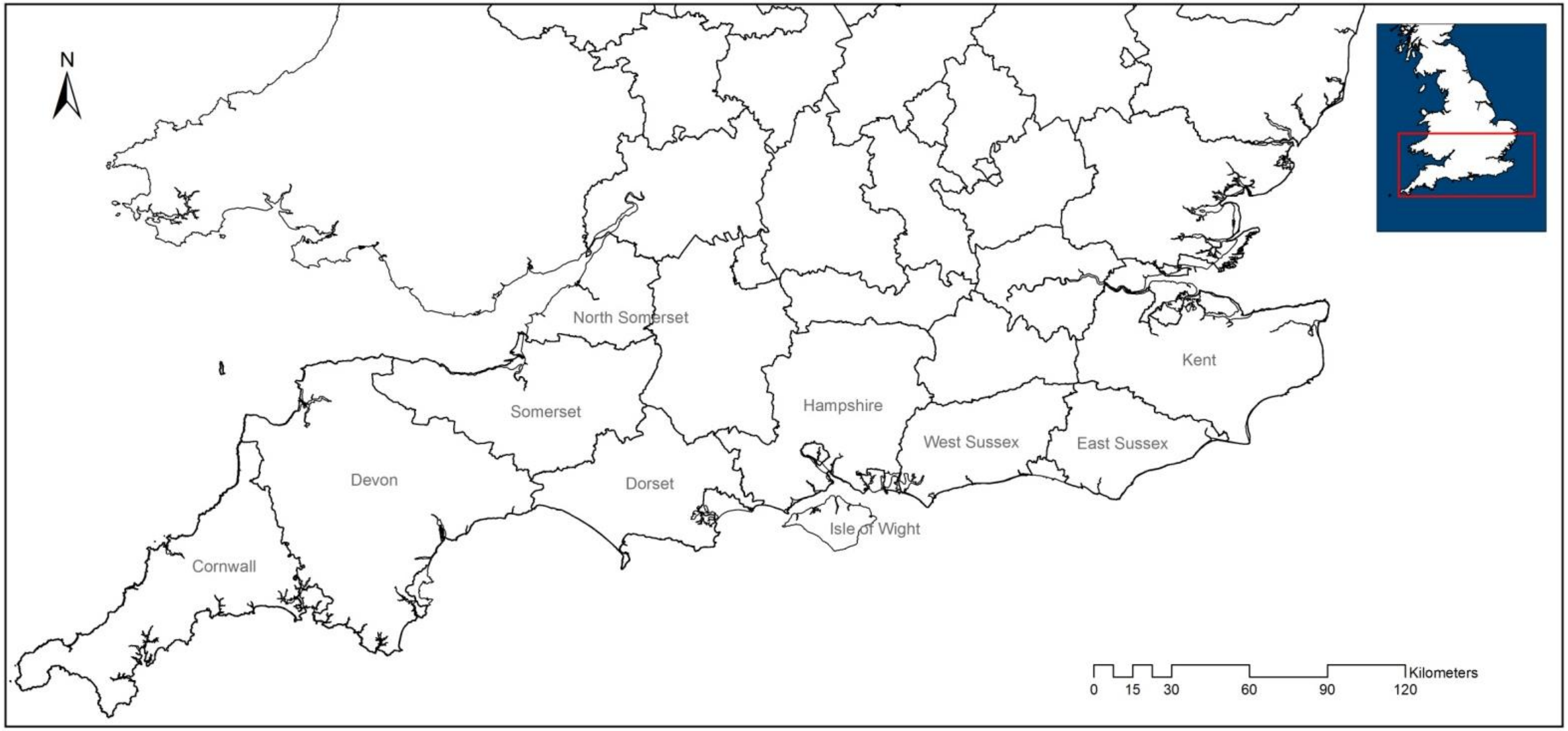


Figure 1.23 Map of the study area showing modern county boundaries (Ordnance Survey Map Data© Crown Copyright/Database Right 2011

1.7.1 Somerset

Somerset has received a great deal of archaeological attention in recent times. However, despite this, and the presence of substantial quantities of debris mounds (many of which were exposed during more recent canalisation of the River Hunstpill), which appear to be related to salt-production, there is relatively little published literature on salt-production in Somerset.

Many of these mounds remain in the landscape of the Central Somerset Levels as subtle earthworks, and therefore these have provided the focus for archaeological study and investigation in the Central Somerset Levels.

Bullied (1914) was the first to survey these mounds and noted that they appeared to be associated with pottery and salt-production. Since then, discussion of these mounds and generally of salt-production in Somerset has been somewhat limited, to inclusion within more general discussions of Romano-British activity within Somerset. However, the work of Leech, Rippon and Brunning especially, on more general evidence for exploitation of the Somerset Levels, including consideration of Romano-British salt-production, has provided significant contributions to further understanding the significance and nature of salt-production in Somerset (Leech 1981; Rippon 2000a, 2000b, 2000c, 2006; Brunning 2006).

Leech was also the first to professionally investigate and record briquetage findspots (Leech 1977), and also plotted the distribution of the mound sites as well as the briquetage findspots (Figure 1.24). His work also included the sectioning of a large briquetage debris mound (Leech *et al.* 1983). This revealed new and important insights into the nature of technology used in salt-production, as well as significant evidence that a working area had been created within a debris mound, suggesting that other mounds in the area could also be similar in nature.

Since then, work specifically focusing upon investigating the mounds further, has been carried out by Brunning and Grove (Grove 1996; Grove and Brunning 1998; Brunning and Farr-Cox 2006). Grove provided a much needed up to date survey of the state and nature of some the mounds (Grove, 1996), proving that many were disappearing from view.

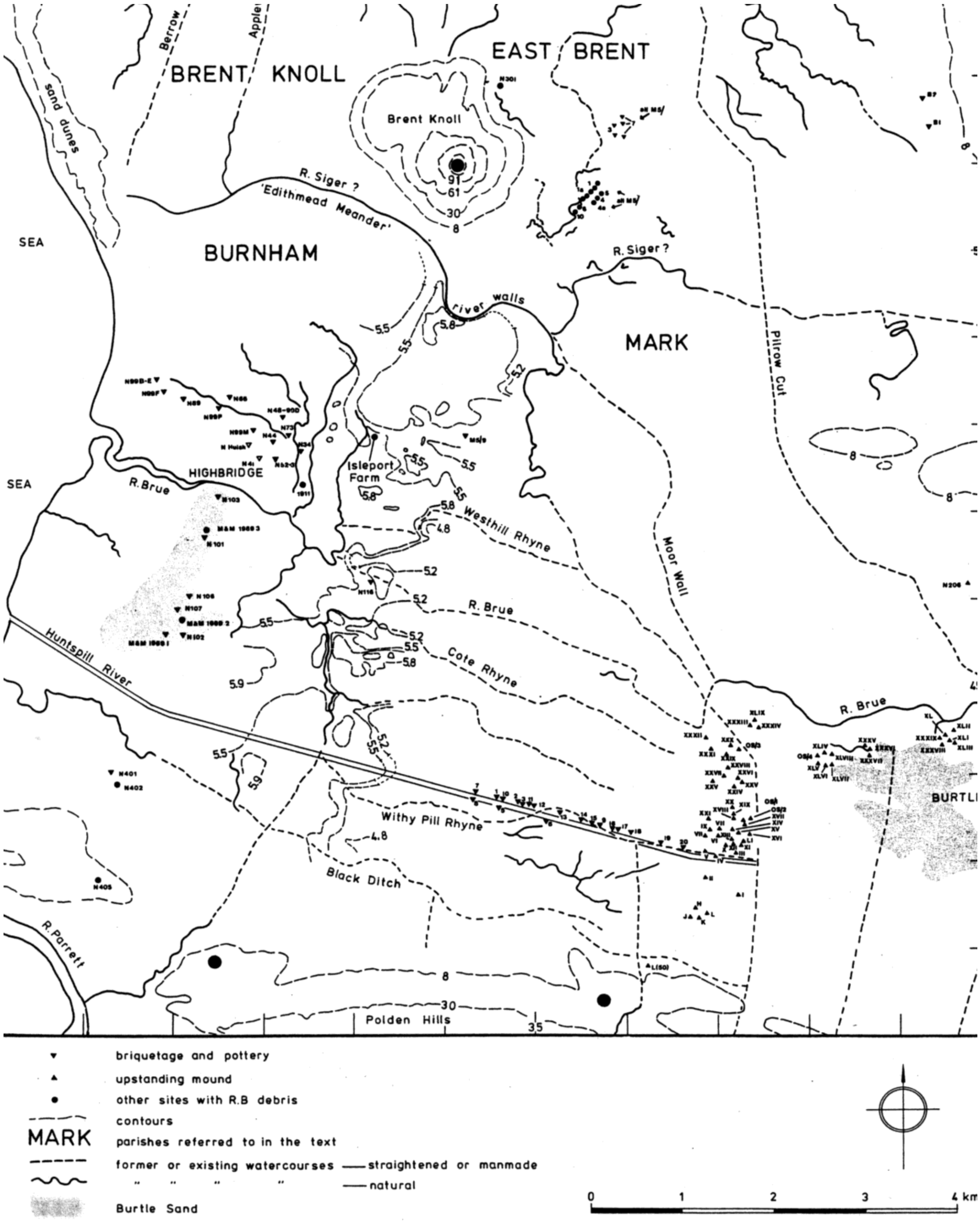


Figure 1.24 Distribution map of Romano-British sites in the Somerset Levels, with 'briquetage and pottery' sites (Leech 1981: 22)

At least 68 mounds were known to the east of Gold Corner (an area near the pumping station on the River Huntspill) at this time (Grove and Brunning 1998). However the overall total quantity of mounds remains unclear. Brunning has plotted the distribution of sites and exploring them using LIDAR data (Brunning and Farr-Cox 2006), which is discussed further in Chapter **6.0**. He has also carried out an excavation of a second debris mound (remains largely unpublished, but some information can be found in: Brunning 2006). Technology revealed during this excavation, was also used to carry out some experimental salt-production (Brunning 2006).

Outside of this mound area in the Central Somerset Levels, and except for the general overviews provided by Rippon and Leech, there is very little specific literature about the nature of salt-production across the whole of Somerset (including North Somerset). This is with the exception of a short journal article, providing an overview of the Romano-British Somerset Salt Industry (Grove and Brunning 1998).

1.7.2 Devon, Cornwall and Dorset

There is little published evidence for early salt-production within Devon. This could be a true representation or could indicate that sites are yet to be found, or indeed have been lost to erosion. Cornwall equally has limited evidence.

However, there are two Romano-British sites which are well preserved and published; Trebarveth (Peacock 1969) and Carngoon Bank (Mcavoy *et al.* 1980). Carngoon Bank appears to have been particularly long-lived, with evidence for continued use throughout the Romano-British period, especially in the 3rd-4th centuries, and carries on into the 6th century (Gilman *et al.* 1998: 15).

The literature for Dorset is dominated by the evidence for Iron Age and Romano-British salt-production in Poole Harbour (Figure 1.25) and the Isle of Purbeck, Dorset, (Calkin 1948, Sunter and Woodward 1987; Cox and Hearne 1991). Sites at Poole Harbour, Isle of Purbeck and one at Wyke Regis (also see Bailey 1962) were discussed in a paper given at the Essex Salt Conference (Farrar 1975). Farrar explored the economics of salt-production in Poole Harbour; stating:

> It is not clear to what extent salt-boiling was practised in Dorset as a specialized industry rather than as one of a number of seasonal activities in a balanced community. (Farrar 1975: 15)

Much of the evidence within the Harbour was revealed during the Wytch Farm excavations (ahead of oil extraction), with extensive amounts of material recorded (Cox and Hearne 1991).

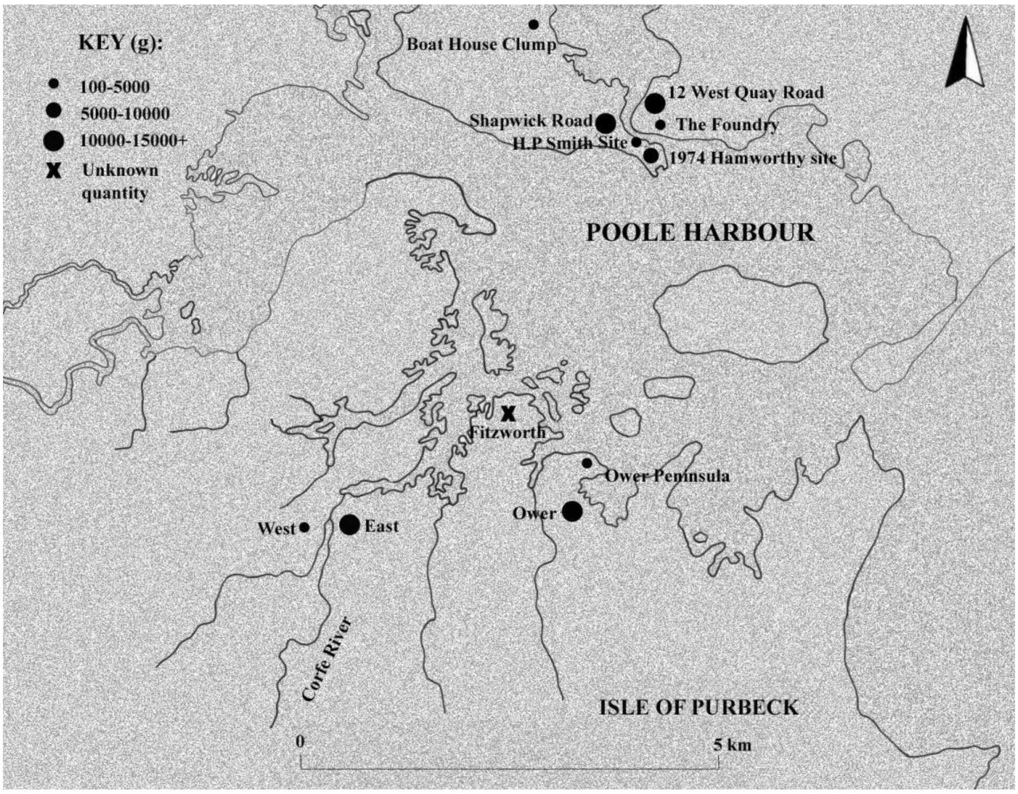


Figure 1.25 Sites with evidence for briquetage and salt-production within Poole Harbour, Dorset (Hathaway 2004b: 77)

Recent research has added to the work carried out in the 20th century, with well-preserved sites revealed in Poole and Hamworthy as part of building development work (Bellamy 2001a, 2001b, 2003a, 2003b, 2004a, 2004b; Hathaway 2004b, 2005b; Jarvis 1986a, 1986b).

1.7.3 Hampshire and Sussex

Most of the published evidence for Iron Age and Romano-British salt-production in Hampshire occurs in the Solent (Southampton Water), (Fox 1937; Hughes 1973) and Portsmouth and Langstone Harbours (Figure 1.26). These areas have been subject to piecemeal investigation over the years.

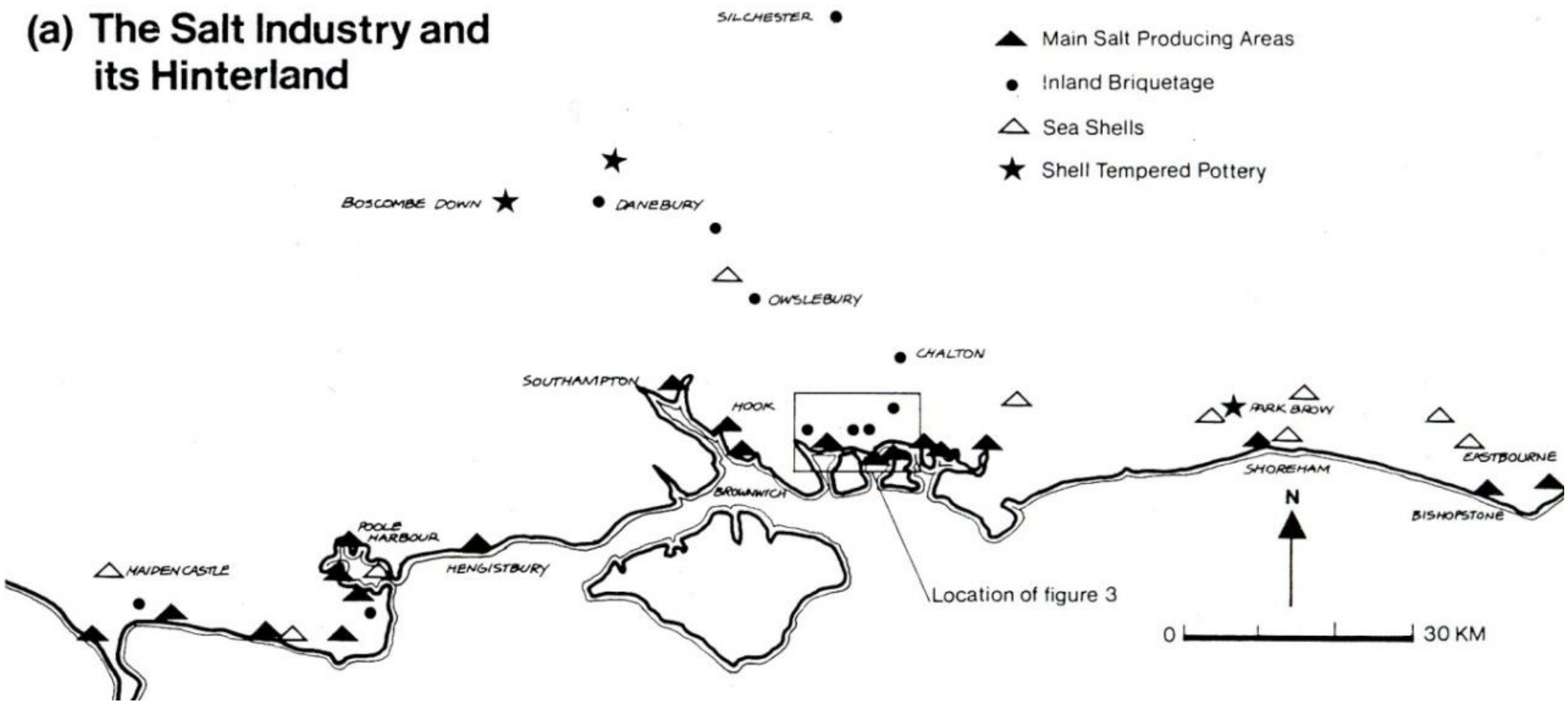


Figure 1.26 Map of salt producing areas and settlements in Dorset, Hampshire and Sussex (Bradley 1975: 21)

A larger inter-tidal survey within Langstone Harbour revealed surprisingly limited evidence for salt-production, showing that previously noted sites had suffered a great deal of erosion (Allen 2000).

The best known site in Hampshire is a Late Iron Age site at Hook, within a cluster of sites situated on the eastern edge of Southampton Water (Fox 1937). This site revealed evidence for features and artefacts associated with salt-production.

A paper given at the Essex Salt Conference discussed the evidence for salt-production and settlements in Hampshire and Sussex (Bradley 1975), (Figure 1.26). This paper still provides the main source of reference for salt-production within this area.

Early work at Chidham, within Chichester Harbour, West Sussex, revealed a large early Romano-British salt-production site (Bradley 1992). This provides the best example of a well preserved site from Sussex. This is also the only site in the area of the harbours where it was possible to carry out assessment of the spatial relationship between features and briquetage spreads.

1.7.4 Isle of Wight

The Isle of Wight also has evidence for early salt-production, the main site being an early Romano-British cliff-top site at Redcliff (Tomalin 1989). Unpublished observations of briquetage scatters have also been reported from other areas of the island. The evidence has not received much attention and is in great need of further research.

1.7.5 Kent

Kent has received greater focus than other counties in the study area as it is adjacent to the famous 'Red Hills' of Essex and traditionally similarities have been sought. There are a large number of Romano-British sites in Kent (Figure 1.27), (as highlighted by Gilman *et al.* 1998: 14-15) with two particularly well documented sites in Cooling (1^{st} to 3^{rd} centuries AD), (Miles 2004) and Cliffe (1^{st}-2^{nd} centuries AD) (Miles 1968), which have both been the subject of systematic excavation.

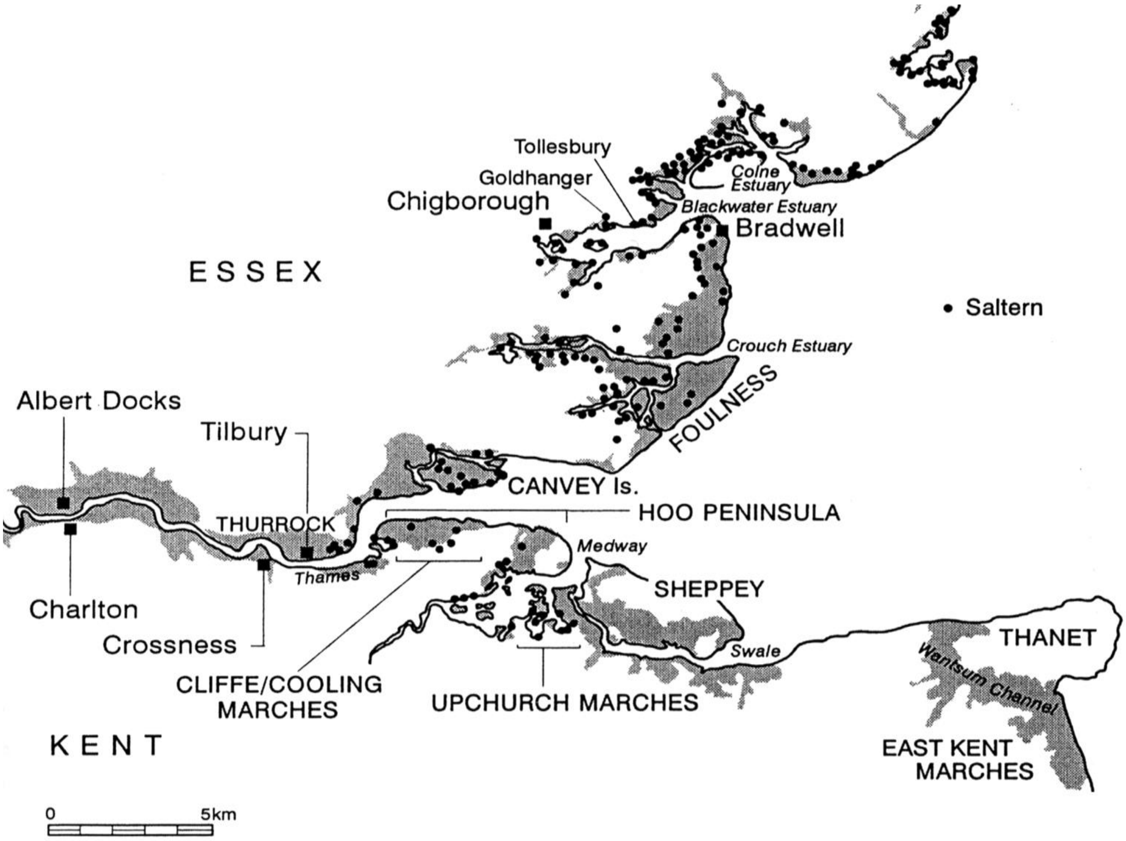


Figure 1.27 A map showing the distribution of Romano-British salt-production sites in northern Kent and Essex in 2000 (Adapted from Rippon 2000c: 61).

Kent salt-production sites have been recognised for some time and were included within a paper on the Roman industry within marsh areas of Kent (Miles and Syddell 1969) and within a paper given at the Essex Salt Conference (Miles 1975).

North Kent and the Medway Estuary have been the main areas of focus, probably due to their close proximity with Essex. These areas have been the subject of relatively large amounts of archaeological survey and fieldwork, much of which has shown the presence of extensive salt-production activity (Detsicas 1984; Jackson 1992; 2003; Miles 1965; Rippon 2000c; Topping and Swan 1995; Wessex Archaeology 1992). North Kent has also been the focus of a recent English Heritage ‘Rapid Coastal Zone Assessment’ (Wessex Archaeology 2000b, 2002b, 2004a, 2005, 2006).

Although most work has predominantly focused on the North Kent area (Figure 1.27) there are also a handful of sites distributed along the rest of the Kent coast (Detsicas 1984; Kinnes *et al.* 1998) and also within the south-west area of

Romney Marsh. Romney Marsh has also been the subject of archaeological survey and fieldwork (Reeves 1992), which has shown general scatters of associated surface material, indicating the presence of hidden sites.

Excavations ahead of quarry extraction pits (gravel) have yielded two important sites in particular, the first being Scotney Court (Philp and Willson 1984; Reeves 1992; Barber 1998) and the second within Lydd Quarry (Priestley-Bell 2002; 2006b; 2006a).

1.8 Overview

This chapter has presented the following information:

- Aims and Objectives of this Research Project
- Modern negative perceptions towards salt consumption
- The complex relationship between humans and salt
- The possible origins of the earliest human exploitation of salt
- Techniques for crystallising salt from seawater directly/indirectly
- Development of salt-production using 'briquetage' as equipment to produce salt in prehistoric and Roman Europe
- Archaeological remains associated with prehistoric and Romano-British salt-production
- Previous studies of salt-production in Britain
- Definition of the research study area
- Background of Iron Age and Romano-British salt-production in the study area

The aim and objectives of this research fully address the nature of salt-production within southern Britain, and will allow for the exploration into the significance of production in the UK as a whole. This research will contribute significantly to this subject area.

People have been consuming salt for millennia and this chapter has discussed the significance of this by exploring the earliest origins of salt procurement and consumption. The origins of salt-production would be different across the world, dependant on many environmental and cultural factors.

Exploring the issue of 'want' versus 'need' has shown that the history of salt-consumption is heavily embedded in both biological and cultural behaviours and it is impossible to truly separate these in reality. However, the development of a 'human taste' for salt provided an interesting discourse on the process of innovation and experimentation in our past. Salt became such an integral part of our lives that this naturally led to the identification of not only numerous practical properties, but also symbolic.

As has been outlined, there are many natural sources of salt in the world and there are various ways that salt can be procured. There are clearly a number of techniques that have been developed and adapted throughout history in order to retrieve salt from a variety of different locations. The different methods outlined here all have their own set of requirements; as well as time and skill needed. Much is dependent on the type of salt source available to people which would directly affect the way the salt could be extracted.

When discussing the occurrence of natural salt in the Roman world, Thurmond points out the main differences between the sources and effort required to produce salt. Salt was mainly available from either rock salt deposits or from brine springs and the sea and therefore required different processes of production. Rock salt; as Thurmond points out; often occurs in more 'remote' and inaccessible places' so was therefore more difficult to get to, but required little subsequent processing 'if we discount the extraction' (Thurmond 2006: 238-239).

However, this source could easily be over-exploited and all accessible salt removed over time, therefore the source is exhaustible. In comparison, sea salt is 'readily accessible' but does require processing, unlike rock salt, to make it 'palatable'. Its availability is of course dependant on salinity levels, but it is an inexhaustible source (Thurmond 2006: 239).

Both processes however, can result in the production of many different types of salt which will look and taste different, a point which is often over-looked when approaching this subject. Sea-salt production using purely solar evaporation is often seen as an efficient way of producing salt, as it involves using 'free energy' and relatively little human effort or involvement. However, natural salt pans or pools require much human attention in order to maintain them, as well as constantly turning them over by removing salt and adding more brine. If people want salt, they have clearly developed many techniques to do this, all of which required skill and knowledge.

Archaeological evidence for the earliest salt-production activity in Europe has shown that not all sites have obvious or generic identifiable features and equipment. Therefore potentially, salt has been produced since much earlier in prehistory, and although evidence currently only points to Bronze Age origins for Britain, it is possible that it was far earlier.

The development of salt-production through the study of archaeological site distribution was outlined including the important work of Nenquin and Gouletquer, as well as De Brisay and Fawn in the British salt-production studies.

Essex and Lincolnshire have played a core role in the development of studies into salt-production, but there are clearly other areas of Britain that are also key to understanding the wider picture of salt-production. Although there has been little attempt to synthesise or contextualise the sites within southern Britain, there have been positive initiatives in recent years to address the nature of and risk to all coastal archaeology. This is most evidenced in the English Heritage assessment report outlined in **1.5.5.2**.