Historic England

Pre-industrial Salterns

Introductions to Heritage Assets

Summary

Historic England's Introductions to Heritage Assets (IHAs) are accessible, authoritative, illustrated summaries of what we know about specific types of archaeological site, building, landscape or marine asset. Typically they deal with subjects which have previously lacked such a published summary, either because the literature is dauntingly voluminous, or alternatively where little has been written. Most often it is the latter, and many IHAs bring understanding of site or building types which are neglected or little understood.

This IHA provides an introduction to pre-industrial salterns. Salterns, or 'salt works', are places where crystalline salt was extracted from salt water - either sea water, or brine from inland springs. Salt production follows a process of evaporation until crystals of sodium chloride are precipitated from sea-water or inland brine. Descriptions of the asset type as well as its development and associations, along with a brief chronology, are included. A list of in-depth sources on the topic is suggested for further reading.

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Front cover
An aerial photograph from 1946 showing the pattern of saltern mounds, some in pasture, others ploughed flat, in the parishes of Marshchapel and North Coates, Lincolnshire. The small rectangular markings on some of the upstanding mounds may be the outlines of former workshops (saltcotes).

Introduction

The preservation of food has always been a vital matter, whether to offset seasonal shortages, or to allow for shipment and trade. Prior to the introduction of canning and artificial refrigeration there were only three principal ways of keeping perishable goods: drying, smoking and salting.

Salt (sodium chloride) is a naturally occurring substance, but it requires specific processes to amass qualities in a pure and useable form. In Britain, organised production dates back to the Bronze Age around 1200 BC, at least. It developed through the Iron Age into the Romano-British period, where distribution increased geographically and it was either produced directly on the coast, within marsh areas, or, by the Late Iron Age/Early Romano-British period, inland.

Development and technological innovation continued into the medieval and post-medieval periods, at differing scales according to the level of demand. The basic processes for producing salt remained much the same, however technology changed significantly after the Romano-British period, when larger-scale production meant a more factory-like production level.

Hearths which were used to heat brine, and settling tanks used to let the sediments of seawater settle for example, grew significantly in size from the medieval period and were often covered by this stage for more control and protection from the elements. The process then often became modernised, and more sophisticated into the 19th and 20th centuries, with centralised industrial processes.

Although they do not survive in large quantities, there are still traditional coastal salt works in operation in the Mediterranean that in the main still only use traditional techniques. Long dependence on this method of preservation may explain the modern taste for salt in the human diet, above and beyond levels which are naturally absorbed from food or indeed required for healthy living.

The importance of salt within earlier economies can hardly be overstated. It was essential for the maintenance of life, and also for commerce. In addition to preserving food (most notably fish, but also meat and some vegetables) salt also plays an essential role in bread-making and in the manufacture of butter and cheese.

Salt-fish, principally herring caught from the Baltic and North Sea, was one of Britain's most important trading commodities in the medieval period and later. Unsurprisingly, evidence of salt-making is often found in the vicinity of the major fishing ports.

Beyond foodstuffs, salt was vital to some tanning and cloth dying processes, and was widely used in medieval and later times for glazing ceramic vessels to make them waterproof. Salts other than sodium chloride, such as Epsom Salt (magnesium sulphate) or Glauber Salt (sodium sulphate) found increasing value in post-medieval chemical industries, although they were initially removed simply because they interfered with the quality and taste of the white salt.

Such an essential product inevitably attracted taxation. Salt taxes were raised by James I in 1603 and again in 1694 to support William III's wars, and they continued to be enforced, with many amendments and only minor interruptions, until 1825, when its disproportionate effects on the poor (who could afford less fresh food) were finally recognised and the acts repealed.

Salterns, or 'salt works', are places where crystalline salt was extracted from salt water - either sea water, or brine from inland springs - using the processes described below. Coastal salterns, in all periods, were attracted to areas with the highest saline concentration, avoiding deep waters and regions diluted by rivers and high rainfall, and often exploiting small inlets and tidal marshlands which were subject to natural evaporation. Early inland salterns were drawn to the highly saline springs which issued from the Triassic salt beds along the western side of England between Cumbria and Somerset – in particular those beneath Cheshire and northern Shropshire, and centred around Droitwich in Worcestershire.

Figure 1
A solar evaporation system, or salina, in operation near Udapi on the Malabar coast, southern India.

1 Description

Salt production follows a process of evaporation until crystals of sodium chloride are precipitated from sea-water or inland brine. In sunnier climates, around the Mediterranean or along the Indian coast, for example, salt has long been produced by the natural evaporation of sea water in shallow artificial lagoons or *salinas* (see Figure 1). Although this method alone could rarely have been relied upon to produce salt crystals in Britain, solar evaporation was traditionally employed to concentrate the brine in early stages of the process.

'Sunworks', as such operations were called from the 16th century onward, involved a series of shallow solar pans, often set behind a sea bank and fed through a sluice-gate at high tide. A series of shallow pans dating to the Romano-British period at Lydd Quarry, Kent, were also found to contain evidence for sluice gates, indicating that this technique dated to at least this period in this country. After the sea-water had been allowed to settle, it was tapped off into a second lower pan, and then a third, allowing time for evaporation at each stage until a strong solution was achieved, drawn off and stored in brine tanks to await the final heating process (see Figure 2).

An alternative approach, known to have been used from at least the medieval period, and probably even earlier, involved washing salt-impregnated sand. This process, known as *'sleeching'* on the Cumbrian/Lancashire coast, and *'muldefang'* in Lincolnshire, took salt-caked sand from the spring tide line and placed it in a trench or *'kinch'* along with sea water. The resulting solution was then tapped and stored as above, whilst the de-salted sands were thrown away and the *kinch* refilled.

Having achieved a strong enough brine (the specific gravity of which could be tested by floating an egg) the next step was to extract the salt. The simplest way to do this was to heat the brine slowly in a metal or ceramic pot, scooping out the crystals as they formed on the surface of the water and on the sides of the container, without allowing the pot to boil dry and contaminate the pure salt with other chlorides and sulphates (known as bittern or bitters).

Figure 2
Georgius Agricola's idealised view of a sunworks in De Res Metallica (1559).

This basic method of settling, naturally evaporating then artificially heating salt water to obtain crystal salt, has been in use in Britain since at least the middle Bronze Age. It is still used in Britain's two remaining coastal salt works, on Anglesey and at Maldon in Essex. This is termed the 'open pan process' to distinguish it from the 'vacuum pan' system which was invented in the early 20th century and still operates on a vast scale in England's modern inland salt works.

Wide, shallow, circular, triangular and rectangular flat-based fired-clay vessels were used to artificially heat brine in prehistory and the Roman period. Lead containers were introduced in the Roman period, used on some larger-scale production sites, and remained in use throughout the medieval period, until replaced by riveted iron which was better able to withstand the heat of coal fires. The containers were placed over a hearth and the temperature was carefully controlled so as to produce a slow heated brine which then facilitated the growth of well-formed crystals. In the Bronze and earlier Iron Age, simple small single hearths were used with single clay containers, however by the Late Iron Age and into the Roman period, hearths developed into larger deeper features, which could then hold several containers at once, some with horizontal flue fed by a fire at one end (see Figure 3).

Figure 3
Agricola's depiction of open pan working.

Salt crystallised out of the brine in different forms depending on heat (faster boiling gave finer crystals) and could be graded according to purpose. Insoluble salts, such as magnesium carbonate and calcium sulphate, formed as pan scale on the surface of the container. The level of impurities left in salt can alter the colour and taste, usually the extremely soluble 'bitters' were left behind in solution, to be discarded or treated as a source of useful chemicals. The final stage in the process was to drain off any remaining liquor, dry the salt, and prepare it for storage or shipment.

Inland salterns operated in much the same way as those on the coast, although, being more concentrated to begin with, their brine rarely required the preliminary stages of solar evaporation. Instead, the inland industry developed ever more complex means of tapping into underground supplies, saw greater industrial centralisation in the medieval period and the earliest uses of mechanised power.

The third and final method of salt manufacture was by purifying supplies produced elsewhere. In the 16th and 17th centuries, impure salts imported from French and Cape Verde sunworks were dissolved and reprocessed (using the same open-pan technique) at a number of east coast salterns. Once rock salt began to be mined, initially in Cheshire in 1670, this too was treated and refined in the same way.

2 Chronology

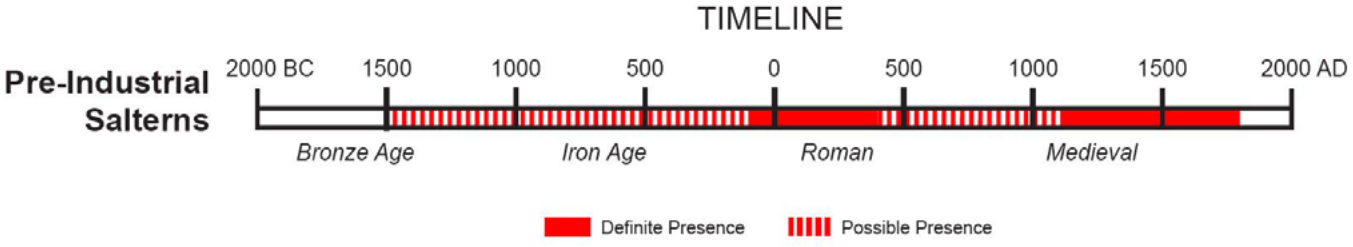
In all likelihood salt-gathering and salt-making predate any archaeological information currently available in Britain. The earliest actual evidence for deliberate manufacture has been found at South Woodham Ferrers, Essex, dating from the middle-late Bronze Age (1412-1130 BC); and a handful of other, slightly later sites have been discovered in Lincolnshire, Somerset and Kent. The early Iron Age is better represented, with a larger number of sites known in Lincolnshire, East Anglia and along the south coast, but this was followed by explosive growth in the last century or so before the Roman invasion of AD 43.

The numerous 'red-hills' on the ancient coastlines of Essex are one reflection of this, but growth is equally visible all around the Wash basin, in Kent, along the Sussex-Hampshire-Dorset coast and across the Somerset levels - indeed wherever the climatic conditions were suitable and there were good existing trade networks - continuing and expanding in the Roman-British period.

The inland salt workings in Worcestershire can be traced back to the 6th to 5th century BC, and a similar massive expansion occurred here, in Cheshire and in Shropshire, in the late Iron Age and Roman periods when several specialised centres (e.g. the Roman settlements at Middlewich and Droitwich, both known as *Salinae*, or 'salt town') were established.

Less is known about post-Roman and Anglo-Saxon salterns, although Bede mentions the inland salt springs and there is some evidence for coastal works in 8th to 10th century charters. In the 11th century over 1,195 *salinas*, mostly in Sussex, Kent, Norfolk and Lincolnshire, are recorded in the Domesday Book, which also provides the earliest proper record of salt works in the three Cheshire 'wich' towns - Middlewich, Northwich and Nantwich – the term 'wich' denoting a brine spring or well. There is considerable documentary and field evidence for coastal and inland saltworking in the medieval period. The Lincolnshire coastal industry was decimated by the Great Flood of 1571. By this time other areas had already experienced a long decline in the face of foreign imports, although some continued to thrive, especially on the north-east and north-west coasts, buoyed up by local fishing industries, by advances in the use of iron for pans and coal for fuel, and by the need to reprocess poor quality foreign salt.

Increased mechanisation, from wind pumps to crushing mills, allowed some coastal sites to remain competitive in the post-medieval period, but the major technological advances occurred at inland works, entwined as they were with other industries and served by roads, canals and railways. The last great technical innovation, the vacuum evaporator, was introduced in 1906. This coincided with the amalgamation of major producers into a single cartel (the Salt Union) and the final demise of all but a few artisan producers of open-pan salt.



3 Development of the Asset Type

Due to their nature, most earlier salterns were located on the coast, and with changes in climate and sea-level since, they are often poorly preserved, and it is likely there were many more sites in existence that will never be known. However, where well-preserved prehistoric sites have been excavated, single shallow brine hearths with an associated small settling tank lined with clay or with stone, have been found (Tetney Lock, Billingborough Fen, Lincolnshire). Tetney revealed multiple small shallow hearths and settling tanks located across a large area.

There are some very well-preserved Late Iron Age and Roman salterns that have been excavated, often revealing large complexes of features, such as at Lydd Quarry, Kent, and within the Central Somerset Levels, where larger hearths with sets of larger settling tanks have been found. However, the most enduring evidence for a prehistoric-Roman saltern is in the waste products from salt production, in the form of often very large amounts of 'briquetage'.

Briquetage is the term given to the fired-clay containers used to crystalize and dry salt, and there are detailed typologies in existence, the best being in the Fenlands. As part of the production process, these containers were systematically broken up, forming sometimes substantial layers or mounds of these broken clay containers. Field-walking surveys often identify the location of salterns from the presence of surface scatters of disturbed briquetage, such as in the Romney Marsh and Somerset Levels.

Excavated early sites have provided occasional hints of the other expected elements - such as leats, solar evaporation pans, brine storage tanks and working floors - although these are better represented in the coastal salterns of the late Iron Age, Roman and medieval periods.

A principal element of both earlier and later coastal works are waste layers and mounds: deposits of discarded silts, sands, ash, pottery and briquetage the growth of which may indicate the longevity of the operation and may also seal and preserve earlier structural components. The most striking of these are perhaps the 'Red Hills' found in Essex and less frequently in Suffolk: accumulations (now frequently ploughed flat) of burnt, reddened earth containing masses of Roman briquetage (Figure 4).

There are also well-preserved examples of Late Iron Age and Roman briquetage waste mounds in the Central Somerset Levels. The examples in Essex have been the subject of archaeological investigations since the early years of the 20th century. Waste mounds are also indicative of later coastal salterns, particularly those featuring the discarded sands and silts from the sleeching or muldefang process. Some of the most impressive examples of these, standing up to 6 m high and 20 m across, are to be found along the North Lincolnshire coast, between Grimsby and Mablethorpe (see cover), although here, as elsewhere, the majority have been reduced by later ploughing, and remain visible only from the air.

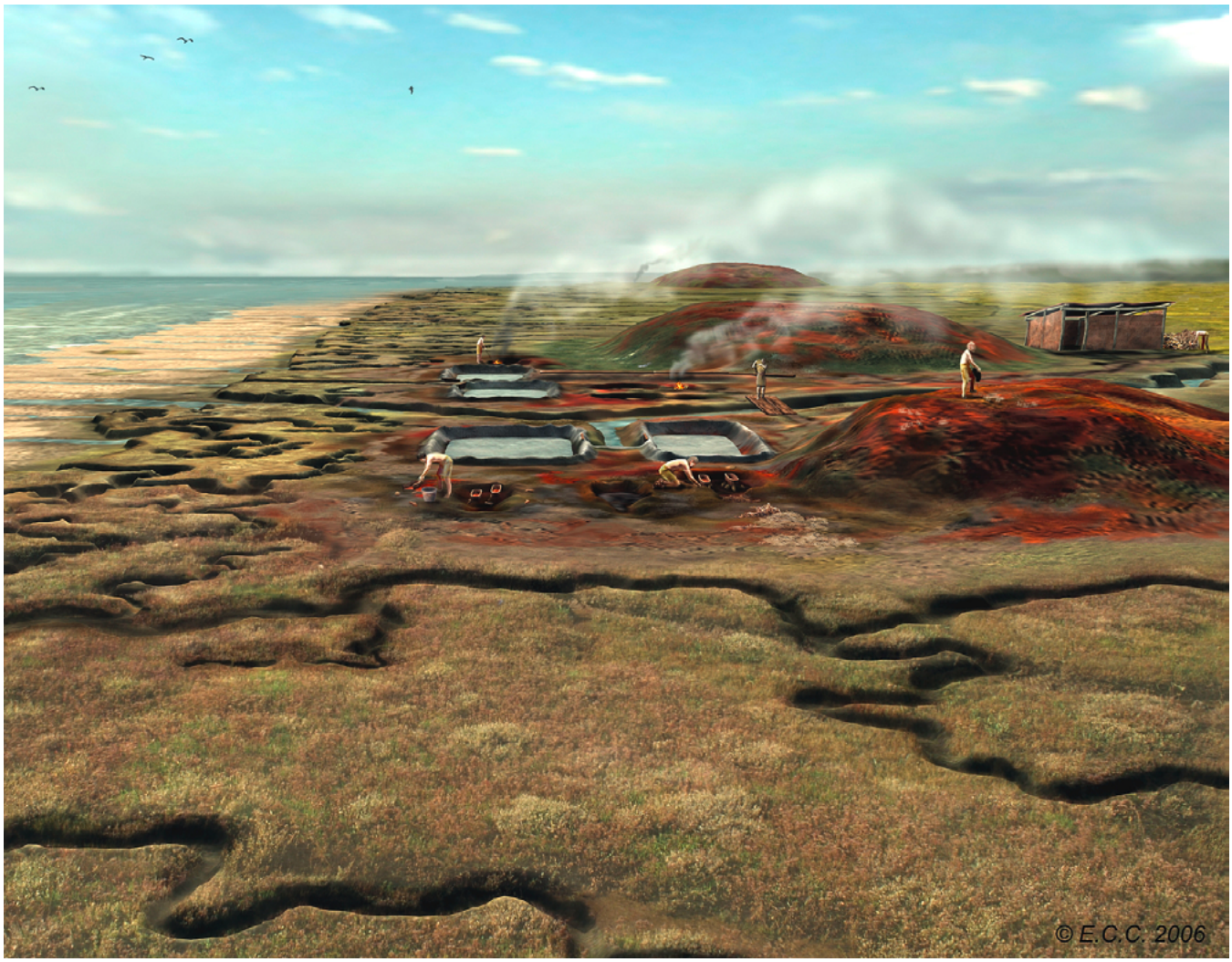


Figure 4
A reconstruction by Roger Massey-Ryan of Romano-British salterns in operation (forming 'red-hills' in the process) along the Essex coast, based on excavated on Canvey Island in the 1960s.

Other features of the later coastal industry include, sluices, large kinches or sleech pans (which might be rectangular or, in Cumbria for example, circular and sometimes embanked), and traces of buildings: workshops (or 'coates'), hot-houses for drying the final product and sheds for storage. The archaeological evidence for early inland saltworks bears many similarities to that seen on the coast, such as the clay- and stake-lined brine tanks, brine hearths and briquetage common to the late Iron Age industry in Droitwich.

Unlike the more seasonally active coastal salterns, however, production around inland brine springs was more concerted, intensive and organised, such that complicated means developed to pipe or channel brine to different workshops fed by a common source. In the medieval and later periods permanent structures, 'wich houses' and the like, were constructed to contain furnaces and ready supplies of brine in tubs or pits; great wooden troughs used for this purpose in Nantwich were known as 'ships'. It was in these areas that industrialisation took hold at a comparatively early stage, increasing the scale of production and adding steam power for crushing mills and pumps.

4 Associations

Salterns may be associated with a wide range of settlement forms – towns, villages, hamlets or farmsteads – depending on their location and date. Some inland salterns operated in urban contexts in Roman, medieval and later periods, whilst coastal salterns are either found in isolated locations, distant from any settlement, and operated only at certain times of year or near trade and production hubs such as within Poole Harbour, Dorset.

In some cases, links to the parent settlement might be reflected in trackways, and perhaps by the demarcation of fields and other boundaries indicating rights and property. Trackways, together with causeways and bridges, were needed to import fuel and export the finished product (in the West Midlands, Anglo-Saxon charters and place-name evidence has been combined to reveal an extensive network of 'saltways' – long distance trading routes - emanating from Droitwich), unless shipment was taken immediately by sea, in which case small wharves or larger harbours and ports may be closely associated.

The process of acquiring fuels for salt manufacture may also have left a mark in the landscape, whether in the form of peat cuttings (turbaries), coal mines or place-names associated with coppice woodland. Evidence for peat cutting has been found underneath a Roman waste briquetage mound in the Central Somerset Levels for example.

Coastal salterns often form components of complicated, historically dynamic landscapes. A common relationship is found with medieval and later sea walls. Some salterns would be established on the shoreline forward of these barriers, whilst others might be placed to the rear, to benefit from their protection while maintaining a seawater supply via elaborate systems of leats and sluices.

In other cases salterns have been left stranded and abandoned by the forward progress of land reclamation, which was itself sometimes (as in many places around the Wash) initiated by the outpouring of waste from the salt industry. Many existing farmsteads and indeed some medieval churches along the Lincolnshire and East Anglian coast are built on mounds of dry land created from saltern waste. The positions of stranded or inundated coastal salterns, such as the Roman 'Red Hills' of Essex, can provide an important indication of the extent and direction of coastal change through time, whether caused by deliberate actions, natural processes or a combination of the two.

5 Further Reading

The Salt Industry by Andrew and Annelise Fielding (2006), provides a concise, well-illustrated and highly informative guide to the subject, and includes a listing of interesting places to visit. A broader perspective is provided by Mark Kurlansky's *Salt: A World History* (2002).

In the late 1990s Historic England commissioned a comprehensive overview of the distribution, character and chronology of the salt industry, and the significance of its archaeological remains. This report, P Gilman (ed), *The Salt Industry Step 1 Consultation Report for the Monuments Protection Programme* (1998), is available for study at the National Monuments Record (in Swindon) and in the Historic Environment Records (HER) (usually housed in the planning department) held by local authorities for all counties where salt-making forms a part of their archaeological heritage. This work, alongside southern HER records, was then used as the basis for the first systematic research into the archaeological evidence for Iron Age and Roman coastal salt-production in southern Britain: Hathaway, S J, *Making the Invisible, Visible: Iron Age and Romano-British Salt-Production in Southern Britain (*2013).

The following books and articles provide more detail of the archaeology of the salt manufacturing process and illustrate something of its lengthy development and regional diversity:

A J Fawn, K A Evans, I McMasters and G M R Davis, *The Red Hills of Essex: Salt-making in Antiquity* (1990);

T Lane and E L Morris, *A Millennium of Salt Making: Prehistoric and Romano-British Salt Production in the Fenland* (2001);

A M and A P Fielding, *Salt Works and Salinas. The Archaeology, Conservation and Recovery of Salt-making Sites and their Processes* (2005);

D M Grady, 'Medieval and Post-Medieval Salt Extraction on North-East Lincolnshire' in R H Bewley (ed), *Lincolnshire's Archaeology from the Air* (1998);

J Kinory, *Salt Production, Distribution and Use in the British Iron Age (2012).*

6 Where to Get Advice

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7 Acknowledgments

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Figures 2-3: Georgius Agricola's *De Res Metallica* (1959)

Figure 4: Reproduction courtesy of Essex County Council.

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