# Land at Greetwell Hall Farm Messingham Quarry, Manton North Lincolnshire

## Excavation Report

oxfordarchaeology east

April 2015

**Client: Andrew Josephs Associates for Sibelco UK**

OA East Report No: 1696
OASIS No: oxfordar3-207313
NGR: SE 9300 0420

Excavation Report

# Land at Greetwell Hall Farm, Messingham Quarry, Manton, North Lincolnshire

*Archaeological Excavation*

***Interim Report***

*By Graeme Clarke BSc*

*With contributions by Rachel Fosberry HNC, D.P Greenwood & Dr Gerry McDonnell*

*Editor: Richard Mortimer MCIfA*

*Illustrator: Charlotte Davies MPhil*

*Report Date: April 2015*

| | |
|---|---|
| **Report Number:** | 1696 |
| **Site Name:** | Land at Greetwell Hall Farm, Messingham Quarry, Manton, North Lincolnshire. Archaeological Excavation Interim Report |
| **HER Event No:** | MTDM |
| **Date of Works:** | January to March 2014 |
| **Client Name:** | Andrew Josephs Associates for Sibelco UK |
| **Client Ref:** | na |
| **Planning Ref:** | MIN/2009/0356 |
| **Grid Ref:** | centred on SE 9300 0420 |
| **Site Code:** | MTDM |
| **Finance Code:** | XLIMES14 |
| **Receiving Body:** | North Lincolnshire Museum Service |
| **Accession No:** | MTDM |


Prepared by: Graeme Clarke
Position: Supervisor / Project Officer
Date: April 2015

Checked by: Richard Mortimer
Position: Senior Project Manager
Date: April 2015
Signed: ..............................................


***Disclaimer***
*This document has been prepared for the titled project or named part thereof and should not be relied upon or used for any other project without an independent check being carried out as to its suitability and prior written authority of Oxford Archaeology being obtained. Oxford Archaeology accepts no responsibility or liability for the consequences of this document being used for a purpose other than the purposes for which it was commissioned. Any person/party using or relying on the document for such other purposes agrees and will by such use or reliance be taken to confirm their agreement to indemnify Oxford Archaeology for all loss or damage resulting therefrom. Oxford Archaeology accepts no responsibility or liability for this document to any party other than the person/party by whom it was commissioned.*


**Oxford Archaeology East,**
15 Trafalgar Way,
Bar Hill,
Cambridge,
CB23 8SQ

t: 01223 850500
f: 01223 850599
e: oaeast@thehumanjourney.net
w: http://thehumanjourney.net/oaeast



© Oxford Archaeology East 2011
Oxford Archaeology Limited is a Registered Charity No: 285627

## Table of Contents

## List of Figures



## List of Plates

## *Summary*

*Between the 19th January and 19th of March 2015, Oxford Archaeology East conducted an archaeological excavation on Land at Greetwell Hall Farm, Messingham Quarry, Manton, North Lincolnshire.*

*This interim report summarises the preliminary results of the excavation of Phase 3 of the proposed extension to the quarry centred on SE 9300 0420. The report also includes preliminary assessments of the ironworking slag and charcoal assemblages recovered.*

*Previous archaeological work undertaken for this phase include a desk study, surface artefact survey, geophysical survey and evaluation trenching by ASE Ltd. This work identified two accumulations of slag indicative of iron smelting. Two charcoal samples were taken for radiocarbon dating and returned Late Bronze Age/Early Iron Age date ranges of 1010-840BC and 820-590BC. A ditch was also excavated with a charcoal sample returning a Middle Iron Age date.*

*Oxford Archaeology East carried out a full excavation of the two slag accumulations and determined that they comprised similar morphology of slag type but differed in structure. The remains of an iron smelting furnace were identified in association with one of the slag accumulations which formed a plume of discarded waste material. The second slag accumulation was shown to survive solely within the disturbed topsoil with no trace of an associated furnace remaining.*

*The ditch excavated to the south during the evaluation was found to be part of a large enclosure of post-medieval date apparently emclosing a lower and previously wetter area drained by the Manton Sewer. The charcoal sample retrieved from this ditch in the trial trench evaluation is therefore considered to be residual material.*

*The excavation has demonstrated the presence of significant iron smelting remains at Messingham Quarry. These remains are important evidence for an Early Iron Age ironworking industry and economy in North Lincolnshire which was previously absent in the archaeological record. The analysis of the slag assemblage recovered will contribute greatly to our understanding of this industry.*


© Oxford Archaeology East 

# 1 Introduction

## 1.1 Location and scope of work

1.1.1 An archaeological excavation was conducted at Land at Greetwell Hall Farm, Messingham Quarry, Manton, North Lincolnshire between the 19th January and 19th March 2015 (Fig. 1).

1.1.2 This archaeological excavation was undertaken in accordance with a Mitigation Strategy (Pouncett 2009) for the project approved by Alison Williams of North Lincolnshire Unitary Council (LNUC; Planning Application MIN/2009/0356), updated by a Supplement to the approved Mitigation Strategy (Mortimer 2014) prepared by OA East.

1.1.3 The work was designed to assist in defining the character and extent of any archaeological remains within the proposed redevelopment area, in accordance with the guidelines set out in *National Planning Policy Framework* (Department for Communities and Local Government March 2012). The results will enable decisions to be made by LNUC, on behalf of the Local Planning Authority, with regard to the treatment of any archaeological remains found.

1.1.4 The site archive is currently held by OA East and will be deposited with the appropriate county stores in due course.

## 1.2 Geology and topography

1.2.1 The site comprises a plot of rough grassland resulting from intermittent pasture, ploughing and cultivation. This is part of a low lying and relatively flat expanse of grassland at approximately 20m AOD with the Lincoln Edge rising immediately to the east. This landscape has been heavily quarried for the underlying sand.

1.2.2 The underlying geology comprises Charmouth Mudstone Formation - Mudstone overlain by Sutton Sand Formation - Sand (http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html accessed 25th March 2015).

## 1.3 Archaeological and historical background

1.3.1 Manton, including the hamlet of Cleatham, is a parish immediately on the west of the Lincoln Edge in North Lincolnshire District, situated c.8km to the south of Scunthorpe. It is described as 'Malmetune' (meaning farmstead on sandy ground) in the Domesday book (http://www.domesdaybook.co.uk/lincolnshire4.html). The parish church of St Hybald's dates to the medieval period.

1.3.2 The site lies to the north of the shrunken medieval village of Manton on a flat expanse of farmed heathland described as common land when the parish was subject to an Act of Inclosure in 1829 (Lincolnshire Archives reference: MANTON PAR 01). This common land is also described as a past nesting site for thousands of black headed gulls. This may also have been the described location of a nesting site for thousands of migratory plovers whose eggs were harvested in the parish and sold as a delicacy in London (http://www.genuki.org.uk/big/eng/LIN/Manton). These activities are indicative of a wetter past environment than the relatively well drained fields encountered at the site today.

*Previous Phases of Work*

1.3.3 A desk-based assessment (Gowans & Pouncett 2009a), surface artefact survey (Gowans & Pouncett 2009b), geophysical survey (Dobson & Pouncett 2009), and trial trench evaluation (Gowans & Pouncett 2009c) for the extension of Messingham Quarry was carried out by ASE Ltd. These detail the archaeological potential of the site and should be referred to for the full background. The findings relating to Phase 3 of the scheme encompassing the present site are summarised below.

*Desk-based Assessment*

1.3.4 Two potential archaeological impacts were identified:

- a rectilinear cropmark identified from aerial photographs initially interpreted to be an Iron Age or Roman enclosure. This has been reinterpreted as a series of drainage features of post-medieval or modern date; and
- an irregular earthwork or area of disturbance identified during the course of the walkover survey.

1.3.5 Subsequent inspection by OA East of the Lincolnshire Historic Environment Record (HER) via the Heritage Gateway website (http://www.heritagegateway.org.uk) and inspection of old-maps (http://www.old-maps.co.uk) concluded that the rectilinear cropmark identified is HER 63573. This feature was noted to be bisected by Manton Sewer, the main drainage conduit for the surrounding heathland, draining southwest to the River Eau.

1.3.6 The irregular earthwork described could not be identified during the initial site visit by OA East and is considered to be pre-existing modern farming disturbance.

*Surface Artefact Survey*

1.3.7 No significant concentrations of artefacts were identified in the area of the rectilinear cropmarks or irregular earthwork. Small quantities of slag were recovered from two areas of topsoil 'cover strips'.

*Geophysical Survey*

1.3.8 A dipolar anomaly and cluster of dipolar 'spikes' thought to correspond to the site of a possible slag mound was identified at the north-western corner of the survey area. A second cluster of dipolar 'spikes' thought to correspond to a secondary dump of slag was identified approximately 50m to the west southwest of the possible slag mound. The latter cluster lay on the line of a weak positive magnetic anomaly thought to correspond to a boundary feature. Two further clusters of dipolar 'spikes' and a weak positive magnetic anomaly were also identified in the southern part of the site.

*Trial Trench Evaluation*

1.3.9 Twenty-two trenches were excavated targeting potential cropmark sites, geophysical anomalies and evaluating 'blank' spaces within the area. Significant archaeological features/deposits were recorded within three trenches. The remainder of the trenches contained either no features or post-medieval and/or modern land drains

*Trench 1*

1.3.10 An accumulation of slag was noted within the lower levels of the topsoil at the midpoint of the trench. This area was cleaned by hand and a total of c. 14kg of slag was recovered (from lower topsoil). Beneath this a consolidated mass of burnt clay and sand was encountered and another 13kg of slag collected from initial cleaning of the surface. Two samples were taken for radiocarbon dating and returned Late Bronze

Age/Early Iron Age date ranges of 1010-840BC and 820-590BC (the precise location of these sample points s unknown). Hammerscale was also recovered from samples within this layer. No further excavation of these deposits was undertaken.

***Trench 2***

1.3.11 An accumulation of slag was noted within the lower levels of the topsoil at the midpoint of the trench. This area was cleaned by hand and a total of c. 14kg of slag was recovered (from lower topsoil). A second assemblage totalling 13kg was collected from the surface of an underlying accumulation/dump of slag. A sondage (2.75m x 0.50m) was excavated through the slag heap at one edge of the trench which recovered a total of 1.1kg of slag (83 pieces) from three 10cm spits. The heap did not appear to be associated with any *in-situ* burning or subsurface features.

***Trench 4***

1.3.12 A broad but shallow ditch was excavated at the eastern end of the trench. The ditch was filled by a grey sand deposit with iron pan concretions at its surface. A radiocarbon date from charcoal within this fill returned a Middle Iron Age date.

## 1.4 Acknowledgements

1.4.1 The author would like to thank Andy Josephs Associates and Maria Cotton for commisioning the work on behalf of Sibelco Uk. Richard Mortimer managed the project and Alison Williams of North Lincolnshire Unitary Council monitored the works. The field work was supervised by the author with the assistance of Kat Nicholls, Lindsey Kemp, Lexi Scard and Daria Tsybaeva. The site survey was conducted by Dave Brown. Georectified photography of the site was conducted by Lindsey Kemp and illustrations produced by Charlotte Davies.

# 2 Aims and Methodology

## 2.1 Aims

2.1.1 The original aims of the project were set out in the Mitigation Strategy (Pouncett 2009) and updated in the Supplement to the approved Mitigation Strategy: Excavation and Watching Brief of Quarry Extension Phase 3 (Mortimer 2014). The methodology was further refined after liaising with Alison Williams of NLUC, the project's consultant Andy Josephs, the Senior Science Advisor (East Midlands) for English Heritage Jim Williams and consulting the archaeometallurgy specialist for the project Dr Gerry McDonnell following the topsoil strip revealing the first slag accumulation and furnace remains.

2.1.2 The agreed methodology for the excavation of the furnace and slag accumulations included:

- the 100% excavation of these deposits by hand in a controlled manner, in gridded squares and in spits;
- the slag to be fully recovered, weighed, and counted on site using a typology relating to the site-specific reference collection provided by Dr Gerry McDonnell;
- subsequently, a sufficient and representative sample of all slag types to be retained for analysis by the archaeometallurgy specialist;
- sub-samples to be taken in the vicinity of the furnace to examine the distribution of flake and spheroidal hammerscale;
- archaeomagnetic dating to be undertaken on the furnace if recommended by the archaeometallurgist and the archaeomagnetic specialist (Cathy Batt, Bradford University); and
- the potential for OSL dating for the furnace was considered to be low and therefore not considered further.

2.1.3 The agreed methodology for the sampling of charcoal from the furnace and slag accumulations included:

- the full recovery of all charcoal encountered;
- all charcoal recovered to be mapped by context and in the case of the slag accumulations mapped by meter grid square; and
- all charcoal collected to be assessed for species identification and potential radiocarbon dating;

2.1.4 The aims and objectives of the excavation were developed with reference to the national, regional and local frameworks, in particular English Heritage (1991 and 1997), whilst the local and regional research contexts are provided by Knight (2012).

## 2.2 Regional Research Aims

2.2.1 The previous phases of work conducted on the site by ASE Ltd revealed iron smelting remains radiocarbon dated to the 9th and 8th centuries BC (late Bronze Age period). This activity is described as a specific aim for the Regional Research framework.

2.2.2 With specific reference to the East Midlands Updated Research Agenda Knight *et al* (2012) for the Late Bronze Age and Iron Age:

- Agenda priority 4.9 (1)

How can we add to our existing knowledge of industries and crafts in this region, particularly the extraction and smelting of iron and lead, salt production and quern manufacture?; and

- Research Objective 4G

  Study the production, distribution and use of artefacts.

## 2.3 Methodology.

2.3.1 The methodology used followed that outlined in the Mitigation Strategy for the project (Pouncett 2009 & Mortimer 2014).

2.3.2 Machine excavation was carried out by a tracked 360° type excavator using a 2m wide flat bladed ditching bucket. under constant supervision of a suitably qualified and experienced archaeologist.

2.3.3 Spoil, exposed surfaces and features were scanned with a metal detector. All metal-detected and hand-collected finds were retained for inspection, other than those which were obviously modern.

2.3.4 All archaeological features and deposits were recorded using OA East's *pro-forma* sheets. Trench locations, plans and sections were recorded at appropriate scales and colour and monochrome photographs were taken of all relevant features and deposits.

2.3.5 A site-specific reference collection of the different slag types encountered was provided during a site visit by the archaeometallurgy specialist. This typology consisted of:

- Type 1 – vitrified lining;
- Type 2 – furnace slag (with charcoal impressions);
- Type 3 – slag & clay lining;
- Type 4 – tapped – flowed;
- Type 5 – tap;
- Type 6 – smelt.

2.3.6 A total of 35 bulk samples were taken from the excavation. This included the sampling of a total of 320 litres of the slag accumulation (203) and 100% of furnace **215** fills 216 & 217. These were processed by flotation at OA East's environmental processing facility at Bourn for the retrieval of charcoal. The residues were sorted for artefacts including metal rich slag, metal and ore fragments.

2.3.7 In addition, a total of ten litres per square meter of slag accumulations 203 & 204 were put through a 10mm hand sieve on site to aid the retrieval of charcoal and other artefacts.

2.3.8 Site conditions were initially cold with snow spells and latterly good with rain at times.

# 3 Results

## 3.1 Introduction

3.1.1 The excavation phase uncovered evidence for activity from the Early Iron Age, post-medieval and modern periods. Descriptions of the features identified and artefacts recovered are given in this section with full descriptions of each context presented in Appendix A. Feature locations are shown in Figures 2 & 3 with a contour survey of the site presented as Figure 4. Selected sections are given in Figure 5.

3.1.2 Very little complex stratigraphy was present on the site although some inter-cutting discrete and linear features were observed. No ceramic artefacts (pottery, brick, tile), faunal remains or flint artefacts were recovered as dating aids from any of the features encountered on the site. The chronological phasing presented below is therefore largely based on stratigraphic relationships, spatial associations and on evidence from the desk study and earlier phases of work.

3.1.3 An Archaeomagnetic Investigation was undertaken on the furnace by David Greenwood of the Archaeological Sciences department of the University of Bradford. However no samples were collected as there was no suitable *in-situ* fired material for dating (Appendix B). A preliminary assessment of the ironworking evidence recovered from the site was carried out by the project's archaeometallurgy specialist, Gerry McDonnell (Appendix C). An interim report on the environmental samples taken from the site including an inventory of all the charcoal recovered from the furnace and slag accumulations is presented as Appendix D. The radiocarbon dating certificates for two charcoal samples from this investigation are presented with the certificates from the trial trench evaluation conducted by ASE Ltd in Appendix E.

3.1.4 Three main periods of activity have been identified, these are summarised below.

- ***Period 1: Early Iron Age (c.800BC – 400BC)***

  The excavation confirmed the presence of the two slag accumulations described in the geophysical survey and trial trench evaluation of the site. The dipolar anomaly indicated in the geophysical survey was found to be an iron smelting furnace. This was associated with the slag accumulation radiocarbon dated to the Late Bronze Age/Early Iron Age during the trial trench evaluation phase. The second slag accumulation was found to be a concentration of slag within the topsoil with no apparent focus.

- ***Period 2: post-medieval (AD1500 – AD1800)***

  The eastern part of the post-medieval enclosure described in sections 1.3.4 & 1.3.5 was encountered in the southern part of the site.

- ***Period 3: modern (AD1800– present day)***

  A series of linear ditches running from east-northeast to west-southwest were found to be modern land drains.

## 3.2 Period 1: Early Iron Age (c.800BC – 400BC)

3.2.1 Slag accumulation 203 (Plate 1) comprised a complex shaped layer of mid to dark grey and brown silty sand measuring up to 15m long, 10m wide and 0.3m deep. It contained large quantities of ironworking slag and frequent charcoal inclusions.

3.2.2 This slag mound extended as a plume of material southeast from the heavily truncated remains of furnace **215** (Plate 2). The furnace had a horseshoe shape in plan, 1.27m long and 1m wide with the flat 'frontal' side of the furnace facing southeast at the head of slag mound 203. A heavily truncated cut in the underlying natural sands was observed at the base of the furnace up to 0.15m deep, with a shallow U shape profile. A small 0.61m wide section of the in-situ furnace lining (216) survived on the northwestern side up to 0.18m thick. This was overlain by a single fill (217) up to 0.15m thick that consisted mostly of slag and burnt sand with charcoal.

3.2.3 To the west-southwest topsoil spread 2 consisted of an accumulation of slag within the topsoil up to 0.2m thick. A baulk section of this topsoil (204) was hand excavated (Plate 3).

3.2.4 Both these slag accumulations were situated on a low elevated ridge extending east-northeast to west-southwest across the northern part of the site (Fig. 4). Topsoil spread 2 was situated on its western terminus.

## 3.3 Period 2: Post-medieval (AD1500 – AD1800)

***Enclosure 117***

3.3.1 This comprised part of a large ditched enclosure in the southern part of the site. Eleven sections of this ditch cut (**117**, **224**, **230**, **231**, **232**, **233**, **234**, **235**, **256**, **262** & **264**) were excavated across the ditch, measuring up to 1.5m wide and 0.45m deep, with a U shape profile. Each section contained a single fill yielding no finds.

**Ditch 236**

3.3.2 Within Enclosure 117 and parallel to its eastern side ran a smaller ditch, measuring up to 0.9m wide and 0.3m deep, with a U shape profile. Eight sections of this ditch cut (**236**, **237**, **238**, **239**, **240**, **241**, **258** & **260**) were excavated along its length. Each section contained a single fill yielding no finds.

## 3.4 Period 3: Modern (AD1800 – present day)

3.4.1 Three narrow linear cuts for land drains (**205**, **208** & **210**) were identified in the northern part of the site. These ran east-northeast to west-southwest across the excavation measuring approximately 0.7m wide with a square cut profile.

3.4.2 Two ditch cuts for more substantial land drains were also identified running east-northeast to west-southwest across the excavation. Eight sections of the northern ditch cut (**266** – **272**) adjacent to the accumulation of slag in topsoil spread 2 and baulk (204) were excavated, measuring up to 2.2m wide and 0.74m deep, with a U-shape profile and a land drain placed at the base. Each section contained a single backfill with occasional slag inclusions. The southern ditch (**242**) was excavated and measured 1.4m wide by 0.55m deep with a U shape profile and a land drain placed at the base overlain by a single backfill.

## 3.5 Undated features

3.5.1 Pit **219** (Plate 4) truncated the slag (203). It was circular in plan, measuring 0.65m in diameter by 0.12m deep, with a U shaped profile. It contained two fills with the upper deposit (221) containing occasional slag inclusions.

3.5.2 Pit **226** was circular in plan, measuring 0.65m in diameter by 0.16m deep, with a U shaped profile. It contained three fills including fill 228 containing frequent charcoal inclusions.

## 3.6 Natural features

3.6.1 An area of natural iron rich sand (218) (Plate 5) was revealed in a slight natural hollow in the northwestern corner of the site. This consisted of reddish brown sand with frequent gravel and cobble sized lumps of natural ironstone inclusions. Although indicative of the formation of bog-iron ore within such naturally occurring hollows in the local area, this deposit source was not considered by the archaeometallurgy specialist to of sufficient quality to be extracted for iron ore.

3.6.2 Four features (**202**, **222**, **280** & **282**) were found to be tree root systems with sub-circular shapes in plan and irregular profiles. These features are therefore not considered further in the subsequent discussion.

### 3.7 Finds Summary

3.7.1 Summary of all artefactual evidence.

***Ironworking slag (Appendix C)***

3.7.2 This assemblage consisted of slag from accumulations 203 & 204 and fill 217 of furnace **215**. No high metal, metal or ore fragments were recovered.

3.7.3 A total of 485.5kg of slag was recovered from slag accumulation 203. In addition, a total of 147.5kg of unstratified slag was recovered from the topsoil (200) overlying this accumulation.

3.7.4 A total of 61.5kg of slag was recovered from baulk 204 of topsoil spread 2. This hand excavated section represented an approximate 5% sample of the total footprint of the topsoil spread of slag indicated by the geophysical survey.

3.7.5 All the slag from the excavation was retained and stored at OA East. The assemblage was subject to an initial assessment of its significance by the archaeometallurgy specialist. This concluded that this iron smelting site and assemblage is of major importance in understanding the Iron Age landscape and would have been a major component of the settlement economy.

***Charcoal (Appendix D & E)***

3.7.6 Charcoal fragments were recovered from the in-situ furnace lining (216) and the overlying disuse fill (217) of furnace **215** (Fig. 5). Charcoal fragments recovered during excavation of the associated slag accumulation 203 were mapped by meter grid square with fragments also recovered from bulk samples (Fig. 3).

3.7.7 The charcoal fragments were subject to an initial assessment for their potential for speciation identification or the presence of short lived round wood twig fragments by an archaeobotanist at OA East.

3.7.8 Two samples were sent for radiocarbon dating to provide an initial assessment of the dating potential of the charcoal recovered. One consisted of a round wood twig fragment from a bulk sample taken from the slag accumulation (203), the other consisted of charcoal scraped from the in-situ furnace lining (216). The test on the twig fragment failed but the test on the charcoal from the furnace lining returned a radiocarbon dating range of 776-509BC (95.1% SUERC-59289 GU-37124).

3.7.9 Charcoal fragments were also recovered from pits **219** & **226**, enclosure **117**, ditch **236** and natural features **202** & 218,

## 4 Discussion and Conclusions

### 4.1 Early Iron Age Ironworking

4.1.1 The excavation of the two slag accumulations determined that they comprised similar morphology of slag type but differed in structure.

4.1.2 The remains of iron smelting furnace **215** were identified in association with slag forming a plume of discarded waste material. The furnace has been radiocarbon dated to 776-509BC (95.1% SUERC-59289 GU-37124).

4.1.3 The trial trench evaluation returned two radiocarbon date ranges of 1010-840BC (95.4% SUERC-22392 GU-18273) and 820-590BC from (95.4% SUERC-22401 GU-18279) charcoal recovered from a trench over the slag. The first date range is considered too early to be associated with ironworking and may therefore be discounted. The second is concurrent with the Early Iron Age and may be considered a viable result. When combined with the furnace date, this gives a date range of 776-590BC for the iron smelting activity on the site.

4.1.4 The second slag accumulation was revealed to lie solely within the disturbed topsoil with no trace of an associated furnace, heated ground or charcoal inclusions. This may represent a dump of material derived from the smelting furnace **215**. The dumping of this material may have once formed a mound at the western end of the low elevated ridge on which the smelting activity is situated and could have served as a visible mark in the landscape associated with this activity.

## 4.2 Post-medieval enclosure

4.2.1 The ditch excavated during the evaluation phase was found to be part of a large enclosure of probable post-medieval origins. This defines a lower and previously wetter area drained by Manton Sewer. The charcoal sample retrieved from this ditch during the trial trench evaluation and radiocarbon dated to the middle Iron Age is therefore considered to represent residual material.

## 4.3 Significance

4.3.1 The excavation has demonstrated the presence of significant iron smelting remains at Messingham Quarry. These remains are important evidence for an Early Iron Age ironworking industry and economy in North Lincolnshire which was previously absent in the archaeological record. The analysis of the slag assemblage recovered will contribute greatly to our understanding of this industry.

# Appendix A. Context Inventory

| Context | Cut | Period | Category | Group | Feature Type | Colour | Fine component | Coarse component | Profile |
|---|---|---|---|---|---|---|---|---|---|
| 102 | 102 | | cut | | treebole | | | | U-shape |
| 103 | 102 | | fill | | treebole | dark brownish grey | silty sand | | |
| 104 | 104 | | cut | | treebole | | | | U-shape |
| 105 | 104 | | fill | | treebole | mid brownish grey | silty sand | | |
| 108 | 108 | | cut | | treebole | | | | U-shape |
| 109 | 108 | | fill | | treebole | mid brownish grey | silty sand | | |
| 114 | 114 | | cut | | treebole | | | | U-shape |
| 115 | 114 | | fill | | treebole | mid brownish grey | sandy silt | occasional slag inclusions | |
| 116 | 114 | | fill | | treebole | dark brownish grey | silty sand | rare slag inclusions | |
| 117 | 117 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 118 | 117 | post-medieval | fill | 117 | ditch | mid grey brown | sandy silt | rare slag inclusions | |
| 200 | | | layer | | topsoil | Dark grey brown | silty sand | | |
| 201 | | | layer | | natural | light yellow orange brown | sand | | |
| 202 | 202 | | cut | | treebole | | | | irregular |
| 203 | | Late Bronze Age | layer | 203 | 'in-situ' slag mound | mid to dark brown and grey | silty sand | very frequent slag inclusions, moderate charcoal inclusions | |
| 204 | | Late Bronze Age | | 204 | slag in topsoil spread 2 | dark grey | silty sand | frequent slag inclusions | |
| 205 | 205 | modern | cut | 205 | land drain | | | | square cut |
| 206 | 205 | modern | fill | 205 | land drain | dark red brown | silty sand | | |
| 207 | 205 | modern | fill | 205 | land drain | mid grey brown | sand | | |

| Context | Cut | Period | Category | Group | Feature Type | Colour | Fine component | Coarse component | Profile |
|---|---|---|---|---|---|---|---|---|---|
| 208 | 208 | modern | cut | 205 | land drain | | | | square cut |
| 209 | 208 | modern | fill | 205 | land drain | mid grey brown | sand | | |
| 210 | 210 | modern | cut | 205 | land drain | | | | square cut |
| 211 | 210 | modern | fill | 205 | land drain | mottled grey brown | sand | | |
| 212 | 202 | | fill | | treebole | mid grey brown | sand | | |
| 213 | 202 | | fill | | treebole | dark blackish brown | silty sand | rare charcoal, rare ironstone inclusions | |
| 214 | 210 | modern | fill | 205 | land drain | mid grey brown | sand | | |
| 215 | 215 | Late Bronze Age | cut | 203 | furnace pit | | | | U-shape |
| 216 | 215 | Late Bronze Age | fill | 203 | 'in-situ' clay lining of furnace | light orange pink | sandy clay | moderate charcoal flecks | |
| 217 | 215 | Late Bronze Age | fill | 203 | disuse furnace fill | dark red brown | silty sand | slag, fired clay and charcoal inclusions | |
| 218 | | | layer | | natural 'bog-iron' hollow | reddish brown | sand | ironstone inclusions | |
| 219 | 219 | un-dated | cut | 219 | pit | | | | U-shape |
| 220 | 219 | un-dated | fill | 219 | pit | mid white yellow | clay | | |
| 221 | 219 | un-dated | fill | 219 | pit | dark blueish grey | silty sand | occasional slag inclusions | |
| 222 | 222 | | cut | | treebole | | | | irregular |
| 223 | 222 | | fill | | treebole | dark grey brown | silty sand | occasional flecks of charcoal | |
| 224 | 224 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 225 | 224 | post- | fill | 117 | ditch | mid orange brown | clayey silt | rare charcoal inclusions | |

| Context | Cut | Period | Category | Group | Feature Type | Colour | Fine component | Coarse component | Profile |
|---|---|---|---|---|---|---|---|---|---|
| | | medieval | | | | | | | |
| 226 | 226 | un-dated | cut | 226 | pit | | | | U-shape |
| 227 | 226 | un-dated | fill | 226 | pit | mid orange red | silty clay | | |
| 228 | 226 | un-dated | fill | 226 | pit | dark blueish grey | clayey silt | very frequent charcoal inclusions | |
| 229 | 226 | un-dated | fill | 226 | pit | mid brown grey | silty sand | | |
| 230 | 230 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 231 | 231 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 232 | 232 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 233 | 233 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 234 | 234 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 235 | 235 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 236 | 236 | post-medieval | cut | 236 | ditch | | | | U-shape |
| 237 | 237 | post-medieval | cut | 236 | ditch | | | | U-shape |
| 238 | 238 | post-medieval | cut | 236 | ditch | | | | U-shape |
| 239 | 239 | post-medieval | cut | 236 | ditch | | | | U-shape |
| 240 | 240 | post-medieval | cut | 236 | ditch | | | | U-shape |
| 241 | 241 | post-medieval | cut | 236 | ditch | | | | U-shape |
| 242 | 242 | modern | cut | 242 | ditched land | | | | flat based U- |

| Context | Cut | Period | Category | Group | Feature Type | Colour | Fine component | Coarse component | Profile |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | drain | | | | shape |
| 243 | 230 | post-medieval | fill | 117 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 244 | 231 | post-medieval | fill | 117 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 245 | 232 | post-medieval | fill | 117 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 246 | 233 | post-medieval | fill | 117 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 247 | 234 | post-medieval | fill | 117 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 248 | 235 | post-medieval | fill | 117 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 249 | 236 | post-medieval | fill | 236 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 250 | 237 | post-medieval | fill | 236 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 251 | 238 | post-medieval | fill | 236 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 252 | 239 | post-medieval | fill | 236 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 253 | 240 | post-medieval | | 236 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 254 | 241 | post-medieval | fill | 236 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 255 | 242 | modern | fill | 242 | ditched land drain | light brown | sand | | |
| 256 | 256 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 257 | 256 | post-medieval | fill | 117 | ditch | grey, brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 258 | 258 | post- | cut | 236 | ditch | | | | U-shape |

| Context | Cut | Period | Category | Group | Feature Type | Colour | Fine component | Coarse component | Profile |
|---|---|---|---|---|---|---|---|---|---|
| | | medieval | | | | | | | |
| 259 | 258 | post-medieval | fill | 236 | ditch | mottled grey brown, red-brown, yellow | sand | Occasional ironstone inclusions | |
| 260 | 260 | post-medieval | cut | 236 | ditch | | | | rounded V-shape |
| 261 | 260 | post-medieval | fill | 236 | ditch | dark grey brown | sand | Occasional ironstone inclusions | |
| 262 | 262 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 263 | 262 | post-medieval | fill | 117 | ditch | dark grey brown | sand | Occasional ironstone inclusions | |
| 264 | 264 | post-medieval | cut | 117 | ditch | | | | U-shape |
| 265 | 264 | post-medieval | fill | 117 | ditch | dark orange brown | sand | some lumps of red/yellow clay | |
| 266 | 266 | modern | cut | 266 | ditched land drain | | | | rounded V-shape |
| 267 | 267 | modern | cut | 266 | ditched land drain | | | | rounded V-shape |
| 268 | 268 | modern | cut | 266 | ditched land drain | | | | rounded V-shape |
| 269 | 269 | modern | cut | 266 | ditched land drain | | | | rounded V-shape |
| 270 | 270 | modern | cut | 266 | ditched land drain | | | | rounded V-shape |
| 271 | 271 | modern | cut | 266 | ditched land drain | | | | rounded V-shape |
| 272 | 272 | modern | cut | 266 | ditched land drain | | | | rounded V-shape |

| Context | Cut | Period | Category | Group | Feature Type | Colour | Fine component | Coarse component | Profile |
|---|---|---|---|---|---|---|---|---|---|
| 273 | 266 | modern | fill | 266 | ditched land drain | mid to dark yellowish brown | sand | Occasional ironstone and slag inclusions | |
| 274 | 267 | modern | fill | 266 | ditched land drain | mid to dark yellowish brown | sand | Occasional ironstone and slag inclusions | |
| 275 | 268 | modern | fill | 266 | ditched land drain | mid to dark yellowish brown | sand | Occasional ironstone and slag inclusions | |
| 276 | 269 | modern | fill | 266 | ditched land drain | mid to dark yellowish brown | sand | Occasional ironstone and slag inclusions | |
| 277 | 270 | modern | fill | 266 | ditched land drain | mid to dark yellowish brown | sand | Occasional ironstone and slag inclusions | |
| 278 | 271 | modern | fill | 266 | ditched land drain | mid to dark yellowish brown | sand | Occasional ironstone and slag inclusions | |
| 279 | 272 | modern | fill | 266 | ditched land drain | mid to dark yellowish brown | sand | Occasional ironstone and slag inclusions | |
| 280 | 280 | | cut | | tree throw | | | | irregular |
| 281 | 280 | | 281 | | tree throw | light to dark brownish grey | sand | frequent charcoal | |
| 282 | 282 | | cut | | tree throw | | | | irregular |
| 283 | 282 | | fill | | tree throw | dark grey | sand | frequent charcoal | |

# APPENDIX B. ARCHAEOMAGNETIC ANALYSIS

UNIVERSITY of BRADFORD

# ARCHAEOMAGNETIC ANALYSIS OF A POSSIBLE IRON SMELTING FURNACE, MESSINGHAM QUARRY, BRIGG ROAD, SOUTH HUMBERSIDE.

CLIENT:

RICHARD MORTIMER,

OXFORD ARCHAEOLOGY EAST

18 FEB 2015


**D.P. Greenwood & C.M. Batt**

Archaeological Sciences

University of Bradford

Bradford BD7 1DP

Tel. (01274) 233533 Email: c.m.batt@bradford.ac.uk

# Archaeomagnetic Investigation of a possible iron smelting furnace, Messingham Quarry, Brigg Road, South Humberside

D. P. Greenwood & C. M. Batt

## Summary

This report describes a site visit to carry out an archaeomagnetic investigation of a possible iron smelting furnace recorded during excavations at Messingham Quarry, Brigg Road, South Humberside. No samples were collected from feature, as there was no suitable *in situ* fired material.

An introduction to archaeomagnetic dating can be found in Appendix 1.

## Site Visit Report

A visit was made to excavations conducted by Oxford Archaeology East at Messingham Quarry, Brigg Road, South Humberside on Monday 16 Feb 2015 by David Greenwood, of Archaeological Sciences at the University of Bradford, in order to carry out an archaeomagnetic investigation of an iron smelting furnace (see figure 1).

**Figure 1: Messingham Quarry iron smelting furnace during specialist visit.**

At the time of our visit, the furnace had been largely cleared of iron smelting slag, leaving what appeared to be the front and rear of a much denuded and truncated furnace structure. On closer inspection the front of the furnace was found to be entirely composed of tap slag which, when removed, left only a heat-affected clay lump at the rear of the furnace (see figure 2). There was no evidence that any of the iron smelting furnace lining remained, and it was considered that the clay had been positioned on the outside of the furnace structure itself and had been affected due to heat radiating from the furnace walls.

**Figure 2: Heat-affected clay at rear of iron smelting furnace.**

Although the clay had been heated, as evidenced by its colour range of oranges and reds, it was very plastic, suggesting that heating was unlikely to be sufficient for it to have acquired a thermoremanent magnetisation (TRM) sufficient for archaeomagnetic dating.

An attempt was made to sample the clay using 2.5cm diameter plastic cylinders (see Appendix 1 and figure 3), however, the pressure required to insert the cylinders caused the clay to move and collapse.

It was also noted that the clay was sitting on sand, and had sand mixed in with it, thus casting some doubt on whether the clay was still *in situ* from the time it last cooled. It was also noted that the site had been subject to bioturbation from mole activity, and possibly root activity due to the shallow depth of the excavation.

**Figure 3: Fire-effected clay with trial sample cylinders, and showing collapse due to pressure required to insert cylinders.**

It was therefore not possible to take samples for archaeomagnetic investigation, as any samples retrieved would reveal a wide scatter of archaeomagnetic directions due to movement of the samples whist inserting the cylinders, and also because the material did not appear to be sufficiently heated *in situ*.

# Appendix 1: An introduction to Archaeomagnetic Dating

## Principles

Archaeomagnetic dating is a derivative dating method, based on a comparison of the ancient geomagnetic field, as recorded by archaeological materials, with a dated record of changes in the Earth's field over time in a particular geographical area. The geomagnetic field changes both in direction (declination and inclination) and in strength (intensity) and archaeomagnetic dating can be based on either changes in direction or intensity or a combination of the two. Dating by direction requires the exact position of the archaeological material in relation to the present geomagnetic field to be recorded, and so the material must be undisturbed and sampled *in situ*. Dating by intensity does not require *in situ* samples but is less precise and experimentally more difficult. The laboratory at Bradford used archaeomagnetic dating by direction.

## Suitable materials for dating

For archaeological material to be suitable for dating using magnetic direction it must contain sufficient magnetised particles and an event must have caused these particles to record the Earth's magnetic field. Many geologically derived materials e.g. soils, sediments, clays, contain sufficient magnetic minerals. There are primarily two types of archaeological events which may result in the Earth's magnetic at a particular moment being recorded by archaeological material: heating and deposition in air or water.

If materials have been heated to a sufficiently high temperature (>400°C) they may retain a thermoremanent magnetisation (TRM), which reflects the Earth's magnetic field at the time of last cooling. Suitable archaeological features would include hearths, kilns and other fired structures.

Sediments may acquire a datable detrital remanent magnetisation (DRM) from the alignment of their magnetic grains by the ambient field during deposition. Such an effect allows deposits in wells, ditches and streams to be dated. However, this aspect of archaeomagnetic dating is still under development, as factors such as bioturbation and diagenesis, can cause post-depositional disturbance of the magnetisation.

Archaeomagnetic dating can be applied to features expected to date from 1000BC to the present day, as this is the period covered by the calibration curve. However, as discussed below the precision of the date obtained will vary according to the period being dating.

## Sampling

Samples of robust fired materials are taken by attaching a 25mm flanged plastic reference button to a cleaned stable area of the feature using a fast setting epoxy resin (Clark et al. 1988). The button is levelled, using a spirit level, and held in place with a small bead of plasticine while the resin sets. The direction of north is them marked on using a magnetic compass, sun compass or gyrotheodolite and the button removed with a small part of the feature attached to it. Samples are trimmed and consolidated in the laboratory with a solution of 10% polyvinylacetate in acetone or sodium silicate solution. Sediments and friable fired materials are sampled by insertion of a 2 cm diameter plastic cylinder, onto which the direction of north is marked. Magnetometers used are sufficiently sensitive for only small samples (c. 1cm$^3$) to be required; approximately 15 samples are needed from each feature and it may be possible to select sampling location to minimise the visual impact if the feature is to be preserved.

## Laboratory measurements

In the laboratory a spinner magnetometer is used to measure the remanent magnetisation of each sample (Molyneux 1971). The measurement indicates the relative strength and direction of the magnetic field of the sample. The stability of this magnetisation is then examined by placing the sample in alternating magnetic fields of increasing strength (0–100mT) and removing the magnetisation step-by-step. The demagnetisation measurements allow removal of any less stable magnetisations acquired after the firing or depositional event, leaving the magnetisation of archaeological interest. It can also be used to indicate the magnetic mineralogy of the samples using information relating to the field required to reduce the intensity to half its original value, known as the median destructive field (MDF); higher values are indicative of harder magnetic minerals such as haematite (Sternberg et al. 1999). The results of measurements of the direction of magnetisation of a group of samples are represented on a stenographic plot, which shows declination as an angle measured clockwise from north and inclination as a distance from the perimeter.

## Statistical analysis

The magnetic directions from a number of samples expected to have the same date are combined to five a mean direction, the precision of which is defined using Fisherian statistics (Fisher 1953). The alpha-95 ($\alpha_{95}$) represents a 95% probability that the true direction lies with that cone of confidence around the observed mean direction, and would be expected to be less than 5° for dating purposes. A value larger than this indicates that the magnetic directions of the samples are scattered and therefore do not all record the same magnetic field.

Samples thought to be very different from the mean directional value are assessed using statistical tests defined by Beck (1983) and McElhinny and McFadden (2000: 92). The Beck '2-delta' test defines the samples that are located 2 angular standard deviations from the mean value. These samples are then tested using McElhinny and McFadden's equations of Cos$\theta_{95}$, if the values failed this test they could statistically be classified as lying significantly from the mean and therefore be removed from the analysis.

The stability of magnetisation of an individual samples on demagnetisation is quantified using the Stability Index (Tarling and Symons 1967). For a stable magnetisation this value would be expected to be greater than 5, a value less than this would indicate that the recorded magnetisation was not reliable for dating purposes.

## Calibration of dates

Once a stable, mean magnetic direction has been obtained this is dated by comparing it with a calibration curve showing changes in the Earth's field over time. As the variation of the Earth's magnetic field is not predictable (Batt 1997, Linford 2006), the pattern of change has to be established by independent dating typically historical records, radiocarbon or dendrochronology. The UK calibration curve is compiled from direct measurements of the field which extend back to AD1576 in Britain, and from archaeomagnetic measurements from features dated by other methods. As the geomagnetic field changes spatially, data for the calibration curve can only be drawn from within an area approximately 100km across and all magnetic directions must be corrected mathematically to a central location (Noel and Batt 1990). There is a single calibration curve for England, Scotland and Wales and directions are corrected to Meriden ($\varphi$ = 52.43° N, $\lambda$ = 1.62° W).

British archaeological dates are calibrated using the secular variation curve developed by Zananiri et al. (2007), calibrated using the RenDate programme (Lanos et al. 2005). Additional global secular variation curves can also be used, such as the ARCH3K.1 and CALS3K.3 datasets (Korte et al. 2009), calibrated using the MatLab programme developed by Pavón-Carassco *et al.* (2011). The secular variation curves differ in terms of the datasets that have been used to construct them, for example: the ARCH3K.1 curve is a global database of archaeomagnetic data only, while the CALS3K.3 curve is also a global database of magnetic data, but incorporates a combination of archaeomagnetic and lake sediment data. This results in subtly different calibrated age ranges being produced for the magnetic directions.

## Precision of dates

There are a number of factors that will influence the error margins of the dates obtained:

- Differential recording of the field by different parts of the feature
- Disturbance of the material after firing/deposition
- Uncertainties in sampling and laboratory measurements
- Error margins in the calibration curve itself
- Uncertainties in the comparison of the magnetic direction with the calibration curve
- Spatial variation of the geomagnetic field

The precision of the calibration curve varies according to the archaeological period and so the precision of the date obtained will depend on the archaeological dates. As the geomagnetic field has occasionally had the same direction at two different times, it is also possible to have two or more alternative dates for a single feature. In most cases the archaeological evidence can be used to select the most likely of these.

Given the number of different factors it is not possible to give a general range for the precision of archaeomagnetic dates but there will usually be an uncertainty of at least ±50 years. It is important to note that since the methods relies on the reliability of previously dated sites the calibration curve can be improved as more measurements become available. Features that cannot be dated or give broad age ranges now, may be datable with more precision in the future.

## Glossary of Terms

**α95** (*Alpha 95*). This is a measure of angular dispersion (in degrees), commonly used in directional statistics, which is derived from *Fisher Statistics.* It is the angular radius of a cone about the mean direction, in which the true population mean is found. There is 95% probability that the population mean lies within this range, about the mean direction (i.e. 5 chances in a 100 that the true mean direction lays outside confidence cone).

**Coercivity** (or coercive force) is the ease with which the remanent magnetisation of a grain or specimen can be reset into a new direction (i.e. *magnetised*, or demagnetised in this direction) by an applied magnetic field. This is measured in terms of the magnetic field (in millitesla, mT) required to do this. The coercivity of a mineral is strongly related to its grain size, such that smaller grains (above the super paramagnetic size threshold) need a larger magnetic field than bigger grains in order to 'demagnetise' them.

**Coercivity Spectra** A specimen remanent magnetic properties are due to a mineral (perhaps 2 or more minerals), of various grain sizes. Consequently, the magnetic field (coercive force) required to 'demagnetise' these various sized magnetic particles will also vary over a range of values. This can be quantified by the Median Destructive field– that coercivity at which 50% of the NRM has been destroyed.

**ChRM** (*Characteristic Remanent Magnetisation*). This term is used to describe what is believed to be a specimen's remanent magnetisation produced when the material was formed or last heated. The ChRM is generally (but not always) interpreted to be the last component (i.e. linear segment going through origin of the Zijderveld plot) recoverable from the demagnetisation data.

**Declination.** The angle between north and the horizontal projection of the magnetisation vector. i.e. 0° == North directed; 180° == South directed; 90° == East Directed; 270° == West directed.

**Fisher Statistics**: The commonly used statistical method of averaging 3–dimensional vectors (Butler, 1992); the 3–D equivalent of the 1–dimensional normal statistics.

**Inclination**. The angle between horizontal and the magnetisation vector, such that a downwards directed vector has positive inclination and an upwards directed vector has negative inclination.

**Magnetisation**. The magnetisation of a material is the net magnetic moment per unit volume. There are two types of magnetisation, *induced and remanent magnetisation*. The *induced magnetisation* is associated with the magnetic susceptibility, and is ONLY found and measured when materials are in a weak magnetic field. Remanent magnetisation is a 'permanent magnetisation' and is that which enables rocks to record the direction of magnetic fields at their time of formation.

**Median Destructive Field (see coercivity spectra)**.

**NRM** (*Natural Remanent Magnetisation*). The remanent magnetisation of a rock, as it is first measured, prior to laboratory treatment. This may be composed of one of more magnetisation components, perhaps acquired in different times and under different processes.

**pTRM.** When material is heated, and subsequently cooled in a magnetic field below the Curie temperature of the magnetic minerals responsible for remanence, the material will acquire a partial thermoremanent magnetisation, in the direction of the magnetic field. This is due to the fact that minerals, due to their varying grain size (and other factors), have a range of blocking temperatures.

**Remanent Magnetisation**. The magnetisation of a specimen which is permanent, and can be likened to that of a bar magnet, having a north and a south pole (i.e. has vector properties). The remanent magnetisation vector is expressed in terms of *declination*, *inclination* and magnitude. When this magnitude is expressed on a volume specific basis its units are A/m (or mA/m == $10^{-3}$ A/m), but on a mass specific basis (to allow for changes in density) its units are $Am^2 kg^{-1}$ (magnetic moment per Kg).

**TRM** *(Thermo- Remanent Magnetisation)*. That magnetisation acquired when the grain cools through its Curie temperature.

**VRM** (*Viscous Remanent Magnetisation*). Remanent magnetisation which is acquired by magnetic grains when exposed to a weak magnetic field over a period of time. This may 'overprint' the original magnetisation of the material acquired at the time of formation. The magnitude of VRM acquisition can be described by S.log (t), where S= the viscosity coefficient and t is time. S is related to the grain volume, whether it is a multidomain or single domain grain and the temperature (Butler, 1992). Generally multidomain grains acquire VRM much faster than single domain grains.

## References

Batt, C. M. (1997). The British archaeomagnetic calibration curve: an objective treatment. *Archaeometry* 39(1): 153–168.

Beck, M. E. (1983). Comment on: 'Determination of the angle of a Fisher distribution which will be exceeded with a given probability' by P.L. McFadden. *Geophysical Journal of the Royal Astrological Society* 75: 847-849.

Clark, A. J., D. H. Tarling, and Noel, M. (1988). Developments in archaeomagnetic dating in Britain. *Journal of Archaeological Science* 15(6): 645-667.

Fisher, R. A. (1953). Distribution on a sphere. *Proceedings of the Royal Society London A* 217: 295-305

Korte, M., Donadini, F., Constable, C.G., 2009. Geomagnetic field for 0–3 ka: A new series of time-varying global models. Geochemistry. Geophysics. Geosystems. 10 (6), DOI: 10.1029/2008GC002295

Lanos, P., Le Goff, M., Kovacheva, M., Schnepp, E. (2005). Hierarchial modelling of archaeomagnetic data and curve estimation by moving average technique. *Geophysics Journal International.* 160(2): 440-476.

Linford, P. (2006). *Archaeomagnetic Dating. Guidelines on producing and interpreting archaeomagnetic dates*. Swindon, English Heritage: 31.

McElhinny, M.W. and McFadden, P.L. 2000. *Palaeomagnetism: Continents and Oceans.* London: Academic Press

Molyneux, L. (1971). A complete results magnetometer for measuring the remanent magnetisation of rocks. *Geophysical Journal of the Royal Astrological Society* 24: 429-433.

Noel, M. and C. M. Batt (1990). A method for correcting geographically separated remanence directions for the purpose of archaeomagnetic dating. *Geophys. Journal Int.* 102: 753-756.

Pavòn-Carrasco, F.J., Rodríguez-González, J., Osete, M.L., Torta, J.M. 2011. A Matlab tool for archaeomagnetic dating. *Journal of Archaeological Science* 38: 408-419.

Sternberg, R. S. Lass, E., Marion, E., Katari, K., and Holbrook, M. (1999). Anomalous archaeomagnetic directions and site formation processes at archaeological sites in Israel. *Geoarchaeology* 14(5): 415-439.

Tarling, D. H. and D. T. A. Symons (1967). A stability index of remanence in palaeomagnetism. *Geophysical Journal of the Royal Astrological Society* 12: 443-448.

Zananiri, I., C. M. Batt, et al. (2007). Archaeomagnetic secular variation in the UK during the past 4000 years and its application to archaeomagnetic dating. *Physics of The Earth and Planetary Interiors* 160(2): 97-107.

## Appendix C. Archaeometallurgy Preliminary Assessment

# Preliminary Assessment of the Ironworking Evidence from Messingham, Phase 3 Lincolnshire 2015

By Dr Gerry McDonnell

## 1. Introduction

Iron production (iron smelting) and iron artefact manufacture, maintenance and repair (iron smithing) were essential crafts in early cultures. Most other crafts and industries relied on the skill of the smiths to manufacture their tools. The evidence would suggest that the iron ore was smelted in the hinterland and transported to settlements to be forged into tools and artefacts. This separation of process is dependent on part on the exploitation of the natural resources required to carry out each process. The resources required for iron smelting until the medieval period are clay for furnace construction, iron ore and charcoal for fuel. The Jurassic ridge is characterised by the presence or bedded iron ore seams, notably the Frodingham ironstone which outcrops in Scunthorpe. In the area of the site the Frodingham ironstone forms the solid geology to the west of the site, a few hundred metres to the west of the junction of Brigg Road and Kirton Road. The leaner Pectern Seam forms a very thin band of the solid geology just to the east of the eastern edge of the area designated as “Phase 4 extraction” (source http://mapapps.bgs.ac.uk/geologyofbritain /home.html).

Both seams are thin an unlikely to have been exploited, unless there is significant evidence of mining in the area. In the Iron Age and Saxon Periods the most likely source of ore would have been bog ores. Since the retreat of the ice sheets geological processes would have caused the build up of bog ores derived from the two bedded deposits in the low lying areas to the west of the ridge. The exact location of bog ore deposits cannot be determined as the deposits form where specific conditions occur, e.g. water flow rate, pH, and surface deposits. The low lying region would have supplied the clay required to build the furnaces, each furnace requiring c. 1 tonne of wet clay. Areas of managed woodland would have supplied coppice poles for charcoal production. Hence the location of smelting sites is determined to a large extent by the availability of the natural resources.

## 2. The Ironworking Evidence

The position of the site is on an elevated sand dune meaning that the ground would be drier than the surrounding lower lying landscape. The first site (Mound 1) comprised a slag heap (total (surviving) slag weight 633kg), with the remnants of a furnace. The slag was, as expected, on the downhill side of the furnace. The furnace was the base of the furnace comprising an arc of heavily oxidised fired clay, approximately 30cms internal diameter. An on-site slag reference collection was established. All hand-recovered material was ascribed to one of six types identified on site (see Table 1), in addition other slag types, not identified during the establishment of the reference collection were flagged as important slags to identify and recover, these included, iron ore, metal or metal rich slag.

The quantities of each slag type are given in Table 2, and show that the assemblage is dominated by smelting slag (Type 6). This would suggest an Iron Age or Saxon date for the site. It is reported that some high metal or metal and some possible ore were recovered in the final stages of the excavation.

| | | |
|---|---|---|
| Type 1 | vitrified lining | clay lining showing evidence of vitrification |
| Type 2 | furnace slag | slag displaying large charcoal impressions and higher viscosity, with some remnant shape of the furnace |
| Type 3 | slagged lining | clay lining with adhering silicate slag |
| Type 4 | tapped-flowed | a slag that has flowed but not achieved a free flowing temperature, hence displays some viscous-like appearance |
| Type 5 | tap | free flowing tapped slag |
| Type 6 | smelt | slag displaying large charcoal impressions and higher viscosity |

Table 1 Slag types present in the on-site reference collection

| | description | slag heap weight | unstratified | total | percentage |
|---|---|---|---|---|---|
| Type 1 | vitrified lining | 3.75 | 1.1 | 4.9 | 1 |
| Type 2 | furnace slag | 35.25 | 10.7 | 46.0 | 7 |
| Type 3 | slagged lining | 48.75 | 14.8 | 63.6 | 10 |
| Type 4 | tapped-flowed | 129.75 | 39.4 | 169.2 | 27 |
| Type 5 | tap | 45.5 | 13.8 | 59.3 | 9 |
| Type 6 | smelt | 222.5 | 67.6 | 290.1 | 46 |
| | | 485.5 | 147.5 | 633 | 100 |

Table 2 Weight and percentage of each slag type recovered from the stratified slag heap and unstratified material (weight kg)

Excavation of the second slag heap (Mound 2) produced slag but no furnace remains. The total weight of slag was small (62kg, Table 3), and may represent the tail of Mound 1 or a smaller dump from the furnace associated with Mound 1. The distribution of slag types is similar to that of Mound 1, and therefore it is reasonable to argue that it is derived from the smelting at Mound 1.

| | description | weight | percentage |
|---|---|---|---|
| Type 1 | vitrified lining | 0.3 | 0.4 |
| Type 2 | furnace slag | 6.0 | 10 |
| Type 3 | slagged lining | 4.0 | 6 |
| Type 4 | tapped-flowed | 9.0 | 15 |

| | | | |
|---|---|---|---|
| Type 5 | tap | 6.0 | 10 |
| Type 6 | smelt | 36.5 | 59 |
| | | 61.8 | 100 |

Table 3 Slag types present in Mound 2 (weight kg)

## 3. Discussion

The assessment excavation (2007-8) recovered charcoal samples from the slag mounds, which provided very early $^{14}C$ dates, i.e. pre 400BC but the stratigraphy is unclear (Gowans and Pouncett 2009). It is also noted that the charcoal in not identified nor any indication of their age is provided. The samples could derive from e.g. mature oak which would provide an incorrect date for the slag. Charcoal samples of small diameter, i.e. young timber, were recovered from the current excavation and produced a date range between 776 and 509 BC which if combined with the date obtained by Pouncett would give a range of 776-590 BC for the iron smelting activity.

There are no other confirmed Iron Age smelting sites in North Lincolnshire. However investigations along a proposed pipeline at Knaith Park (Sherlock and Cox 2009) recovered ironworking slag provisionally identified on morphological criteria by Jane Cowgill as Iron Age/Roman, but the descriptions of the slag would suggest an Iron Age or Saxon date. There are numerous finds of Iron Age date from the area known as Manton Common (Williams pers. Comm.). On the north side of the Humber Halkon (Halkon and Millet 1999, 80-95) recorded large Iron Age slag mounds in in East Yorkshire. Two $^{14}C$ dates were obtained for the site giving a date range of 600-300 BC. and there are now other Iron Age slag deposits and furnaces being excavated in the lowlands to the north of the Humber and a recent date for a site near Pocklington produced a date of 200- 100BC. These sites are in a similar geographical position as Messingham being on the ‘fen’ edge, in the best position to exploit the three natural resources of clay, ore and fuel. The earliest date for iron smelting in Britain is from the site of Broxmouth, East Lothian, Scotland in which iron ore, tapped melting slag and smithing debris were recovered from Phase 1 of the occupation of the site dated to 640-430 BC (Armit and McKenzie 2013, 18, 35-36 and McDonnell 2013 393-402).

There has been detailed study of iron artefacts from Fiskerton, Lincolnshire dated to the mid-late 1st century BC indicated the use of ferritic and phosphoric iron.(Fells 1990). Similarly the analyses of the iron tyres from the 2nd Century BC Ferry Fryston (West Yorkshire) Cart Burial indicated usage of similar alloys (Swiss and McDonnell 2007).

Iron was of major importance to the economy of Iron Age society. The quality and quantity of iron made vital contributions to the society. It underpinned other crafts and industries. Current knowledge of iron production in the Iron Age period is poor.

The quantity of iron produced by c700kg of smelting slag is dependent on two factors, the richness of the ore, i.e. the iron content, and the smelting technology. Calculations by various authors give very disparate figure and consideration must be given as to whether the calculation gives a raw metal output or finished bar. Assuming the Messingham furnace produced raw metal which was taken to the settlement for conversion to bar iron a figure of 5kg of slag generated 1kg of metal. Thus the slag represents 140kg of iron.

Although smelting sites in other parts of the country have been investigated the knowledge in North Lincolnshire is absent. Therefore the evidence from Messingham is of great importance to understanding the development of iron technology, not only in Lincolnshire but in Britain and Europe.

## 4. Conclusion

The Messingham iron smelting site is of major importance in understanding the Iron Age landscape. The quantity of iron produced would have been a major component of the settlement economy.

**References**


Armit I and McKenzie J 2013 *An Inherited Place. Broxmouth Hillfort and the South-East Scottish Iron Age* Society of Antiquaries of Scotland

Dudley, H. 1949 *Early Days in North-West Lincolnshire. A Regional Archaeology.* Scunthorpe W.H. & C.H. Caldicott G.K.

Fell, Vanessa (1990) *Pre-roman iron age metalworking tools from England and Wales: their use, technology,and archaeological context,* Durham theses, Durham University. Available at Durham E-Theses Online: http://etheses.dur.ac.uk/6610/

Gowans, E. and Pouncett, J. 2009 Land at Greetwell Hall Farm: Mesingham Quarry, Manton Trial Trench Excavations ASE Ltd Report. North Lincs Source Reports SLS Number 3855

Halkon, P. And Millett, M. 1999. *Rural Settlement and industry: Studies in the Iron Age and Roman archaeology of lowland East Yorkshire.* Leeds: Yorkshire Archaeological Report **4,** Yorkshire Archaeological Society.

McDonnell G 2013 Metallurgical and vitrified material in Armit I and McKenzie J 2013 *An Inherited Place. Broxmouth Hillfort and the South-East Scottish Iron Age* Society of Antiquaries of Scotland pp393-402

Sherlock, S. and Cox, P. 2009 *Results of archaeological evaluation by trial trenching at Knaith Park and Blyborough, Lincolnshire*. : AC archaeology Ltd doi: 10.5284/1015598, available from http://archaeologydataservice.ac.uk/archives/view/greylit/details.cfm?id=16966

Swiss A and McDonnell G 2007 Metallurgical Analysis Of The Iron Tyres From The Chariot Burial in Brown, F. Howard-Davis, C., Brennand, M., Boyle, A., Evans, T., , O'Connor, S., Spence A., Heawood, R. and Lupton, A. (Eds) *The Archaeology of the A1 (M) Darrington to Dishforth DBFO Road Scheme.* Oxford Archaeology

# Appendix D. Environmental Samples Interim Report

## A.1 Environmental samples – interim report

*By Rachel Fosberry*

A.1.1 Twenty-seven bulk samples were taken from features within the excavated areas at Land at Greetwell Hall Farm, Messingham Quarry, Manton, North Lincolnshire in order to assess the quality of preservation of plant remains and their potential to provide useful data as part of further archaeological investigations.

A.1.2 Nineteen samples were selected for an initial assessment with the aim of recovery of ecofacts suitable for radiocarbon dating (Table 4). One bucket (approximately ten litres) was processed using water flotation (using a modified Siraff three-tank system). The floating component (flot) of the samples was collected in a 0.3mm nylon mesh and the residue was washed through 10mm, 5mm, 2mm and a 0.5mm sieve. Both flot and residues were allowed to air dry. A magnet was dragged through each residue fraction prior to sorting for artefacts. The dried flots and the <2mm magnetic residues were subsequently sorted using a binocular microscope at magnifications up to x 60.

A.1.3 The residues were sorted by Lexi Scard for artefacts including metal rich slag, metal and ore fragments. Charcoal was recovered from both flots and residues in varying quantities; the greatest amount is present in the samples from slag mound 203. Individual fragments were submitted for radiocarbon dating including charcoal extracted manually from an internal layer of charcoal 'sandwiched' between two fired clay layers that made up the furnace lining 216 (Sample 27). The volume of magnetic residues is also greatest in the samples taken from mound 203 and most of the samples also contain magnetic spheroids. Spheroids are droplets of slag that are formed from hot liquid slag usually during primary smithing/consolidation of the bloom although it may be possible for the droplets to form during the smelting process.

| Sample No. | Context No. | Cut No. | Feature Type | Sample Size (L) | Volume processed (L) |
|---|---|---|---|---|---|
| 1 | 213 | 202 | Natural – Tree throw | 40 | 7 |
| 2 | 218 | N/A | Natural | 10 | 10 |
| 3 | 218 | N/A | Natural | 10 | 8 |
| 4 | 218 | N/A | Natural | 10 | 8 |
| 5 | 218 | N/A | Natural | 10 | 10 |
| 10 | 220 | 219 | Pit | 30 | 4 |
| 11 | 203 | N/A | Slag mound | 80 | 8 |
| 12 | 203 | N/A | Slag mound | 40 | 5 |
| 13 | 203 | N/A | Slag mound | 40 | 10 |
| 14 | 203 | N/A | Slag mound | 40 | 7 |
| 16 | 203 | N/A | Slag mound | 40 | 27 |
| 17 | 203 | N/A | Slag mound | 40 | 8 |
| 18 | 203 | N/A | Slag mound | 40 | 8 |
| 19 | 217 | 215 | Furnace | 80 | 9 |

| | | | | | |
|---|---|---|---|---|---|
| 22 | 228 | 226 | Pit | 20 | 6 |
| 24 | 247 | 234 | Ditch | 20 | 9 |
| 25 | 243 | 230 | Ditch | 20 | 7 |
| 26 | 250 | 237 | Ditch | 20 | 9 |
| 27 | 216 | 215 | Furnace | 20 | 8 |

Table 4: Environmental Samples from MTDM

| Context No | Grid square |
|---|---|
| 203 | 5U |
| 203 | 7E |
| 203 | 1V |
| 203 | 4F |
| 203 | 4A |
| 203 | 5K |
| 203 | 4V |
| 203 | 4Q |
| 203 | 4L |
| 203 | 4C |
| 203 | 5A |
| 203 | 4F |
| 203 | 4Q |
| 203 | 2B |
| 203 | 4S |
| 203 | 4X |
| 203 | 4I |
| 203 | 4N |
| 203 | 4D |
| 203 | 1Y |
| 203 | 1X |
| 203 | 1S |
| 203 | 1T |
| 203 | 1S |
| 203 | 1N |
| 203 | 1O |
| 203 | 1E |
| 203 | 5Y |
| 203 | 8F |
| 200 | 1S |
| 200 | 4B |
| 200 | 5T |
| 200 | 5S |

| | |
|---|---|
| 200 | 1M |
| 200 | 5X |
| 200 | 1S |
| 200 | 2W |
| 200 | 2M |
| 200 | 5G |
| 200 | 5A |
| 200 | 2P |
| 200 | 2Q |
| 200 | 5N |
| 200 | 5J |
| 200 | 2S |
| 200 | 2T |
| 200 | 2R |
| 200 | 2U |
| 200 | 2X |
| 200 | 3Q |
| 200 | 5E |
| 200 | 5H |
| 200 | 5V |

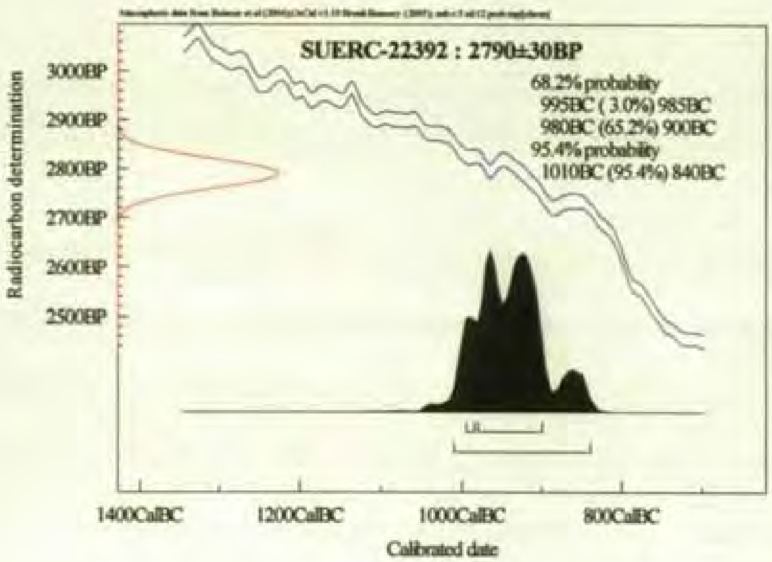
Table 5: Charcoal collected from grid squares

# Appendix E. Radiocarbon Dating Certificates

## Phase 3

### Trench 1: Slag Mound

| | |
|---|---|
| **Laboratory Code** | SUERC-22392 (GU-18273) |
| **Sample Reference** | 6 |
| **Material** | Charcoal : Unidentified |
| **$\delta^{13}C$ relative to VPDB** | -24.1 ‰ |
| **Radiocarbon Age BP** | 2790 ± 30 |




**N.B.**

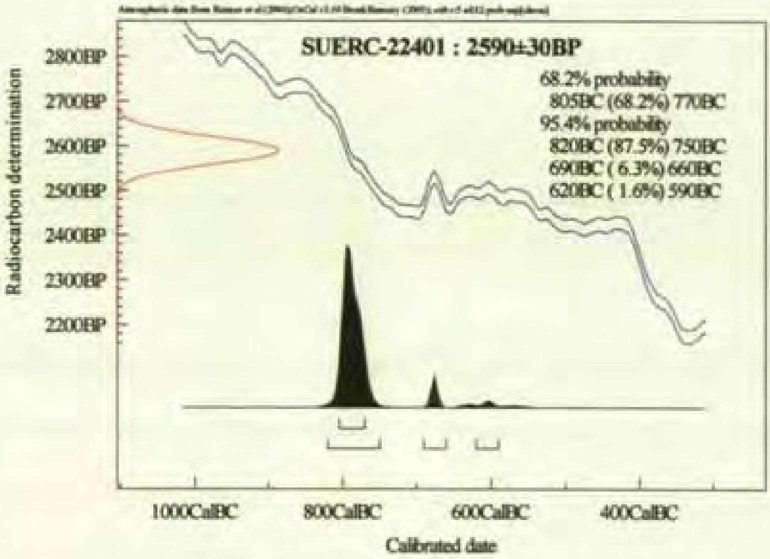
1. The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).

3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code.

## Trench 1: Slag Mound

| | |
|---|---|
| **Laboratory Code** | SUERC-22401 (GU-18279) |
| **Sample Reference** | 16 |
| **Material** | Charcoal : Unidentified |
| **$\delta^{13}C$ relative to VPDB** | -26.2 ‰ |
| **Radiocarbon Age BP** | 2590 ± 30 |




**N.B.**

1. The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).

3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code.

**Scottish Universities Environmental Research Centre**
Director: Professor R M Ellam
Rankine Avenue, Scottish Enterprise Technology Park,
East Kilbride, Glasgow G75 0QF, Scotland, UK
Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

# RADIOCARBON DATING CERTIFICATE

08 April 2015

| | |
|---|---|
| **Laboratory Code** | GU37123 |
| **Submitter** | Rachel Fosberry<br>Oxford Archaeology East<br>15 Trafalgar Way<br>Bar Hill<br>Cambs. CB23 8SQ |
| **Site Reference** | MTDM |
| **Context Reference** | 203 |
| **Sample Reference** | 18 |
| **Material** | Charcoal : cpr |
| **Result** | Failed: insufficient carbon. |

**N.B.** Any questions directed to the Radiocarbon Laboratory should quote the GU coding given above.

The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Checked and signed off by :- Date :- 08/04/2015

The University of Glasgow, charity number SC004401

The University of Edinburgh is a charitable body, registered in Scotland, with registration number SC005336

**Scottish Universities Environmental Research Centre**

Director: Professor R M Ellam

Rankine Avenue, Scottish Enterprise Technology Park,
East Kilbride, Glasgow G75 0QF, Scotland, UK
Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

# RADIOCARBON DATING CERTIFICATE

08 April 2015

| | |
|---|---|
| **Laboratory Code** | SUERC-59289 (GU37124) |
| **Submitter** | Rachel Fosberry<br>Oxford Archaeology East<br>15 Trafalgar Way<br>Bar Hill<br>Cambs. CB23 8SQ |
| **Site Reference** | MTDM |
| **Context Reference** | 216 |
| **Sample Reference** | 27 |
| **Material** | Charcoal : from furnace |
| **$\delta^{13}C$ relative to VPDB** | -27.0 ‰ |
| **Radiocarbon Age BP** | 2487 ± 29 |

**N.B.** The above $^{14}C$ age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- P Naysmith Date :- 08/04/2015

Checked and signed off by :- [signature] Date :- 08/04/2015

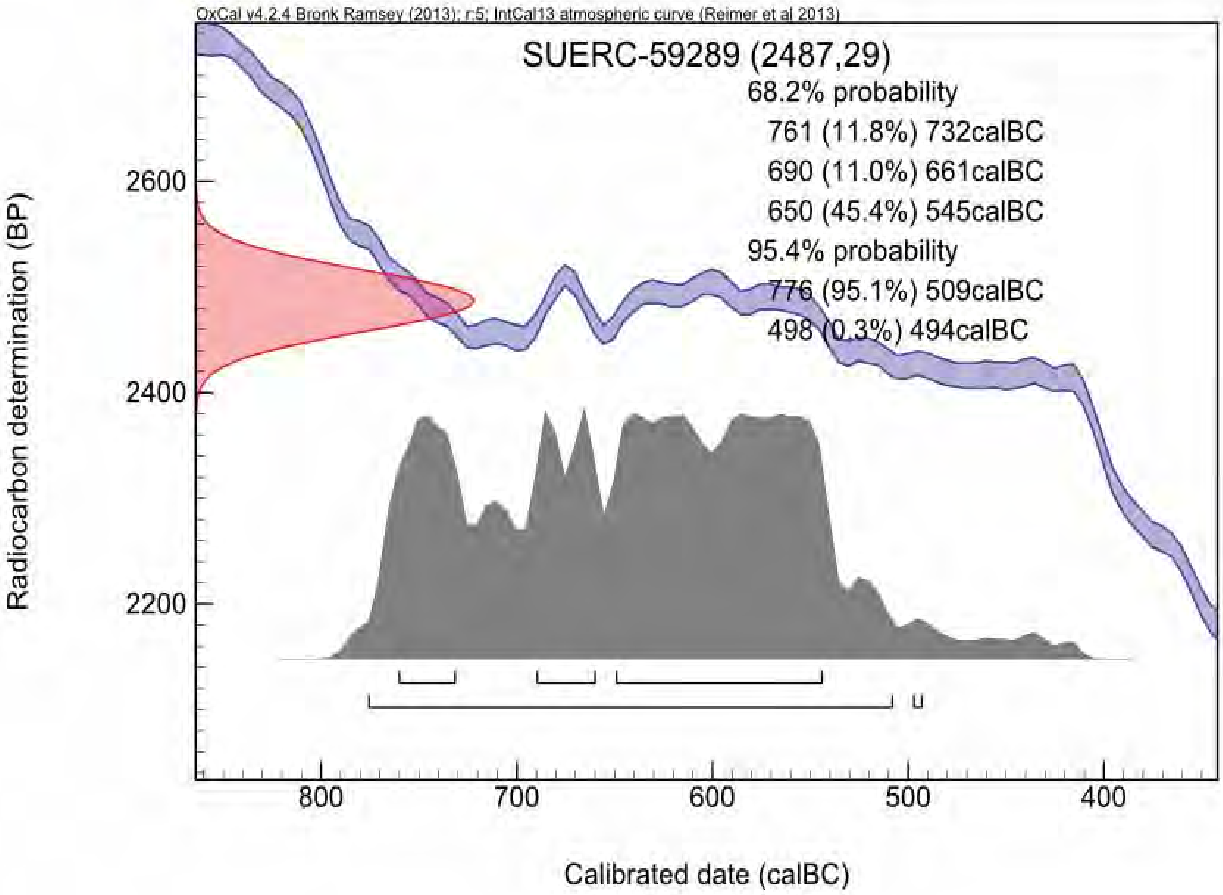
University of Glasgow

The University of Glasgow, charity number SC004401

The University of Edinburgh

The University of Edinburgh is a charitable body, registered in Scotland, with registration number SC005336

**Calibration Plot**



# Appendix F. Bibliography


| | | |
|---|---|---|
| Dobson, S & Pouncett, J | 2009 | *Land at Greetwell Hall Farm, Messingham Quarry, Manton, Geophysical Survey*. ASE Ltd, dated August 2008 (Revised March 2009) (unpublished). North Lincolnshire Museum Source Reports SLS no. 3854 |
| Gowans, E & Pouncett, J | 2009a | *Land at Greetwell Hall Farm, Messingham Quarry, Manton, Desk-Based Assessment*. ASE Ltd, dated November 2006 (Revised March 2009) (unpublished). North Lincolnshire Museum Source Reports SLS no. 3851 |
| Gowans, E & Pouncett, J | 2009b | *Land at Greetwell Hall Farm, Messingham Quarry, Manton, Surface Artefact Survey*. ASE Ltd, dated May 2007 (Revised March 2009) (unpublished). North Lincolnshire Museum Source Reports SLS no. 3853 |
| Gowans, E & Pouncett, J | 2009c | *Land at Greetwell Hall Farm, Messingham Quarry, Manton, Trial Trench Evaluation*. ASE Ltd, dated March 2009 (unpublished). North Lincolnshire Museum Source Reports SLS no. 3855 |
| Knight, D, Vyner, B & Allen, C | 2012 | *East Midlands Heritage: An Updated Research Agenda & Strategy for the Historic Environment of the East Midlands*. University of Nottingham & York Archaeological Trust |
| Mortimer, R | 2014 | *Supplement to the approved Archaeology Mitigation Strategy (2009): Excavation and Watching Brief of Quarry Extension Phase 3.* Oxford Archaeology East, dated 17th November 2014 (unpublished) |
| Paynter, S | | *Introductions to Heritage Assets. Pre-industrial Ironworks.* English Heritage |
| Pouncett, J | 2009 | *Land at Greetwell Hall Farm, Messingham Quarry, Manton, Mitigation Strategy*. ASE Ltd, dated October 2009 (unpublished) |
| | | *Centre for Archaeology Guidelines. Archaeometallurgy*. English Heritage |

## Appendix G. OASIS Report Form

All fields are required unless they are not applicable.

### *Project Details*

| | |
|---|---|
| OASIS Number | oxfordar3-207313 |
| Project Name | Land at Greetwell Hall Farm, Messingham Quarry, Manton, North Lincolnshire. Archaeological Excavation |
| Project Dates (fieldwork) Start | 19-01-2015 |
| Finish | 19-03-2015 |
| Previous Work (by OA East) | No |
| Future Work | Yes |

### Project Reference Codes

| | | | |
|---|---|---|---|
| Site Code | XLIMES14 | Planning App. No. | MIN/2009/0356 |
| HER No. | MTDM | Related HER/OASIS No. | |

### Type of Project/Techniques Used

| | |
|---|---|
| Prompt | Direction from Local Planning Authority - PPS 5 |

### *Please select all techniques used:*

| | | |
|---|---|---|
| ☐ Field Observation (periodic visits) | ☐ Part Excavation | ☐ Salvage Record |
| ☒ Full Excavation (100%) | ☐ Part Survey | ☐ Systematic Field Walking |
| ☒ Full Survey | ☐ Recorded Observation | ☐ Systematic Metal Detector Survey |
| ☒ Geophysical Survey | ☐ Remote Operated Vehicle Survey | ☐ Test Pit Survey |
| ☒ Open-Area Excavation | ☐ Salvage Excavation | ☐ Watching Brief |

### Monument Types/Significant Finds & Their Periods

List feature types using the NMR Monument Type Thesaurus and significant finds using the MDA Object type Thesaurus together with their respective periods. If no features/finds were found, please state "none".

| Monument | Period | Object | Period |
|---|---|---|---|
| Furnace, slag mound | Iron Age -800 to 43 | slag | Iron Age -800 to 43 |
| Ditch | Post Medieval 1540 to 1901 | flint artefact | Bronze Age -2.5k to -700 |
| | None | | Select period... |

### *Project Location*

| | |
|---|---|
| County | North Lincolnshire |
| District | North Lincolnshire |
| Parish | Manton |
| HER | North Lincolnshire Unitary Council |
| Study Area | 2.6ha |
| Site Address (including postcode if possible) | Land at Greetwell Hall Farm, Messingham Quarry, Manton, North Lincolnshire |
| National Grid Reference | SE 9300 0420 |

## *Project Originators*

| | |
|---|---|
| Organisation | OA EAST |
| Project Brief Originator | Alison Williams (North Lincs Unitary Council) |
| Project Design Originator | Richard Mortimer (OA East) |
| Project Manager | Richard Mortimer (OA East) |
| Supervisor | Graeme Clarke (OA East) |

## *Project Archives*

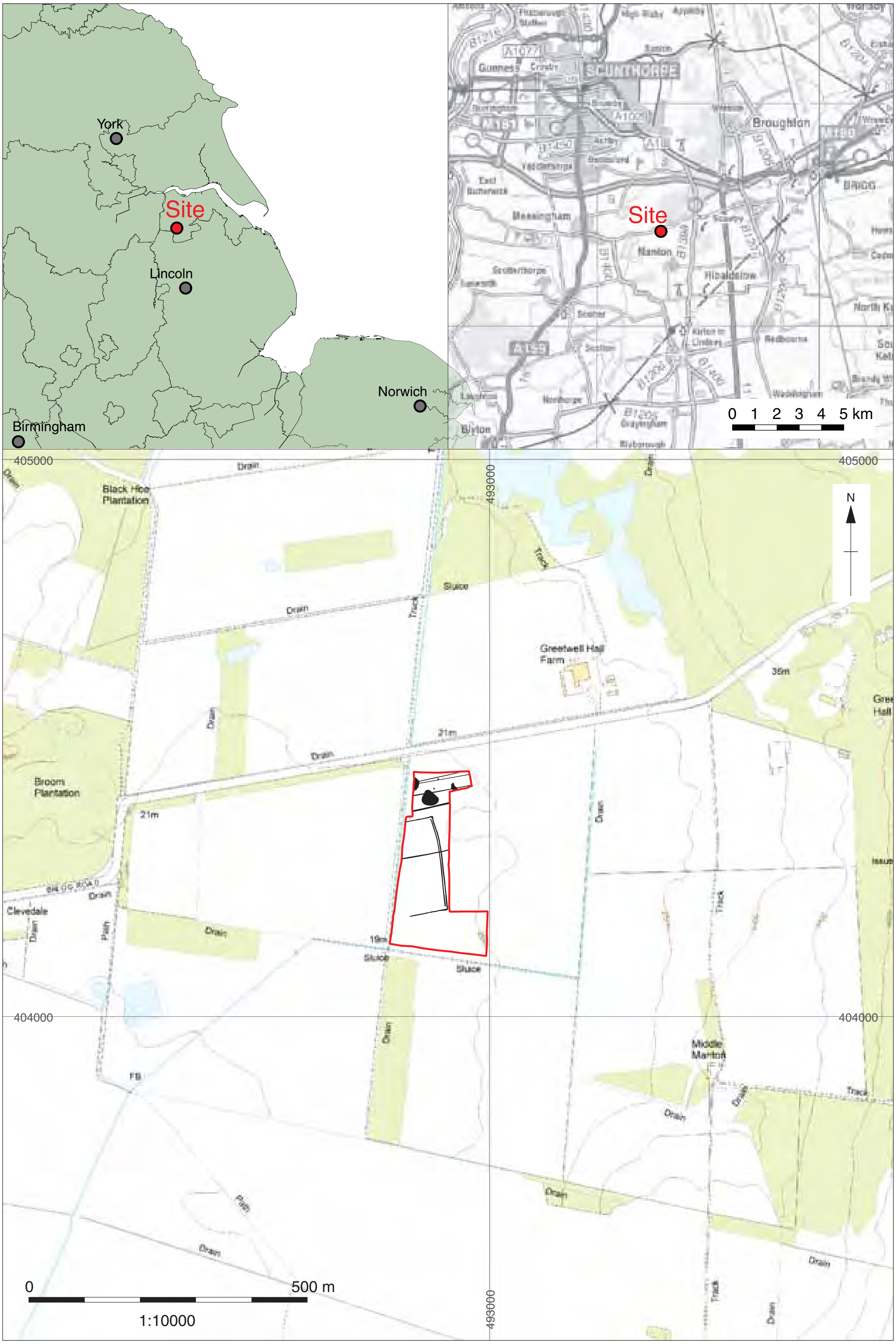
| Physical Archive | Digital Archive | Paper Archive |
|---|---|---|
| North Lincolnshire Museum Service | OA East | North Lincolnshire Museum Service |
| MTDM | XLIMES14 | MTDM |

### Archive Contents/Media

| | Physical Contents | Digital Contents | Paper Contents |
|---|---|---|---|
| Animal Bones | ☐ | ☐ | ☐ |
| Ceramics | ☐ | ☐ | ☐ |
| Environmental | ☒ | ☒ | ☐ |
| Glass | ☐ | ☐ | ☐ |
| Human Bones | ☐ | ☐ | ☐ |
| Industrial | ☐ | ☐ | ☐ |
| Leather | ☐ | ☐ | ☐ |
| Metal | ☒ | ☒ | ☒ |
| Stratigraphic | | ☐ | ☐ |
| Survey | | ☒ | ☒ |
| Textiles | ☐ | ☐ | ☐ |
| Wood | ☐ | ☐ | ☐ |
| Worked Bone | ☐ | ☐ | ☐ |
| Worked Stone/Lithic | ☒ | ☒ | ☒ |
| None | ☐ | ☐ | ☐ |
| Other | ☐ | ☐ | ☐ |

| Digital Media | Paper Media |
|---|---|
| ☒ Database | ☐ Aerial Photos |
| ☐ GIS | ☒ Context Sheet |
| ☒ Geophysics | ☐ Correspondence |
| ☒ Images | ☐ Diary |
| ☒ Illustrations | ☐ Drawing |
| ☐ Moving Image | ☐ Manuscript |
| ☐ Spreadsheets | ☐ Map |
| ☒ Survey | ☐ Matrices |
| ☒ Text | ☐ Microfilm |
| ☐ Virtual Reality | ☐ Misc. |
| | ☐ Research/Notes |
| | ☒ Photos |
| | ☒ Plans |
| | ☒ Report |
| | ☒ Sections |
| | ☒ Survey |

**Notes:**




*Contains Ordnance Survey data © Crown copyright and database right 2015. All rights reserved. Centremaps 10001998*

Figure 1: Site location showing development area (red)

© Oxford Archaeology East

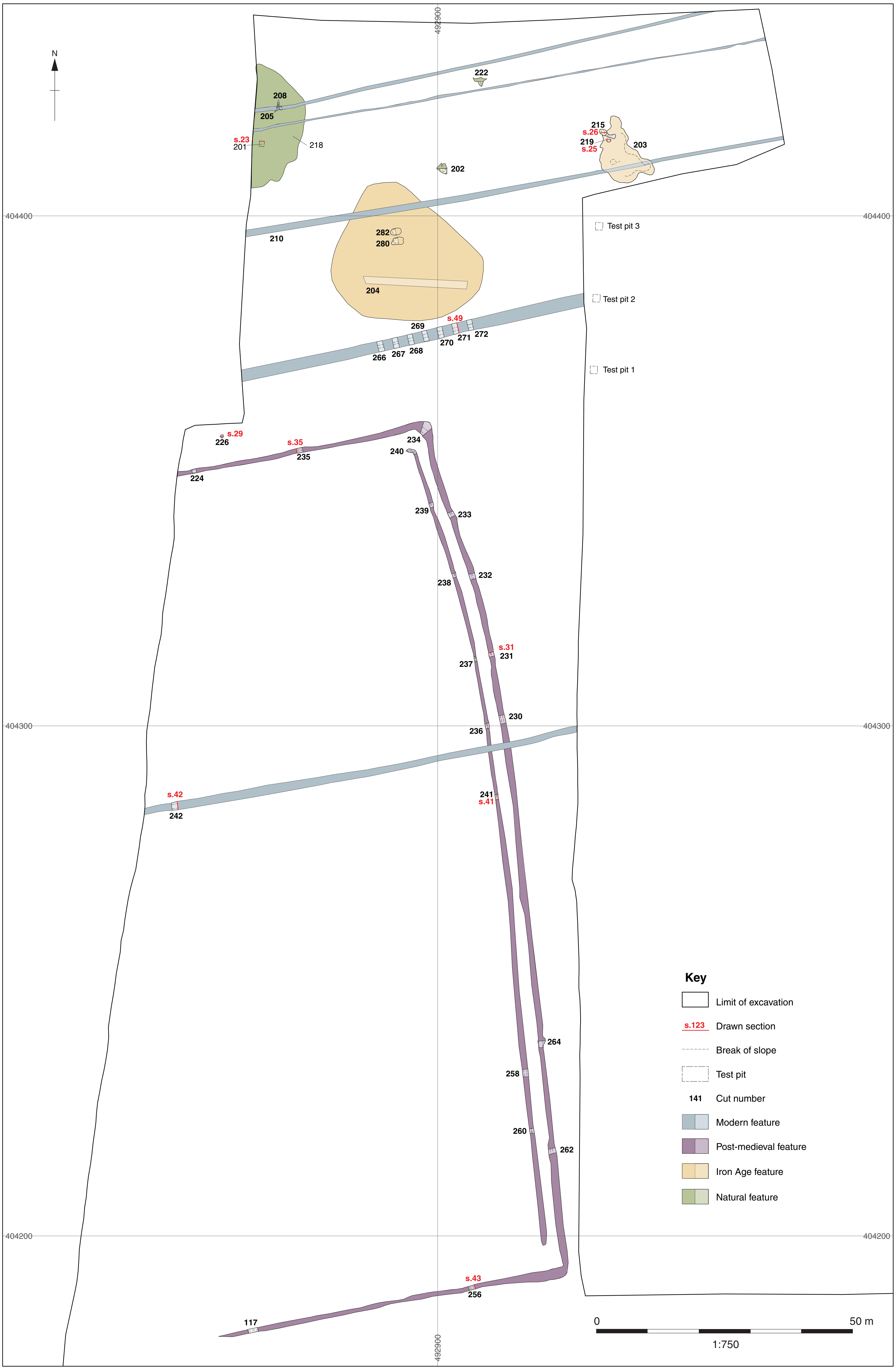



Figure 2: Site layout plan

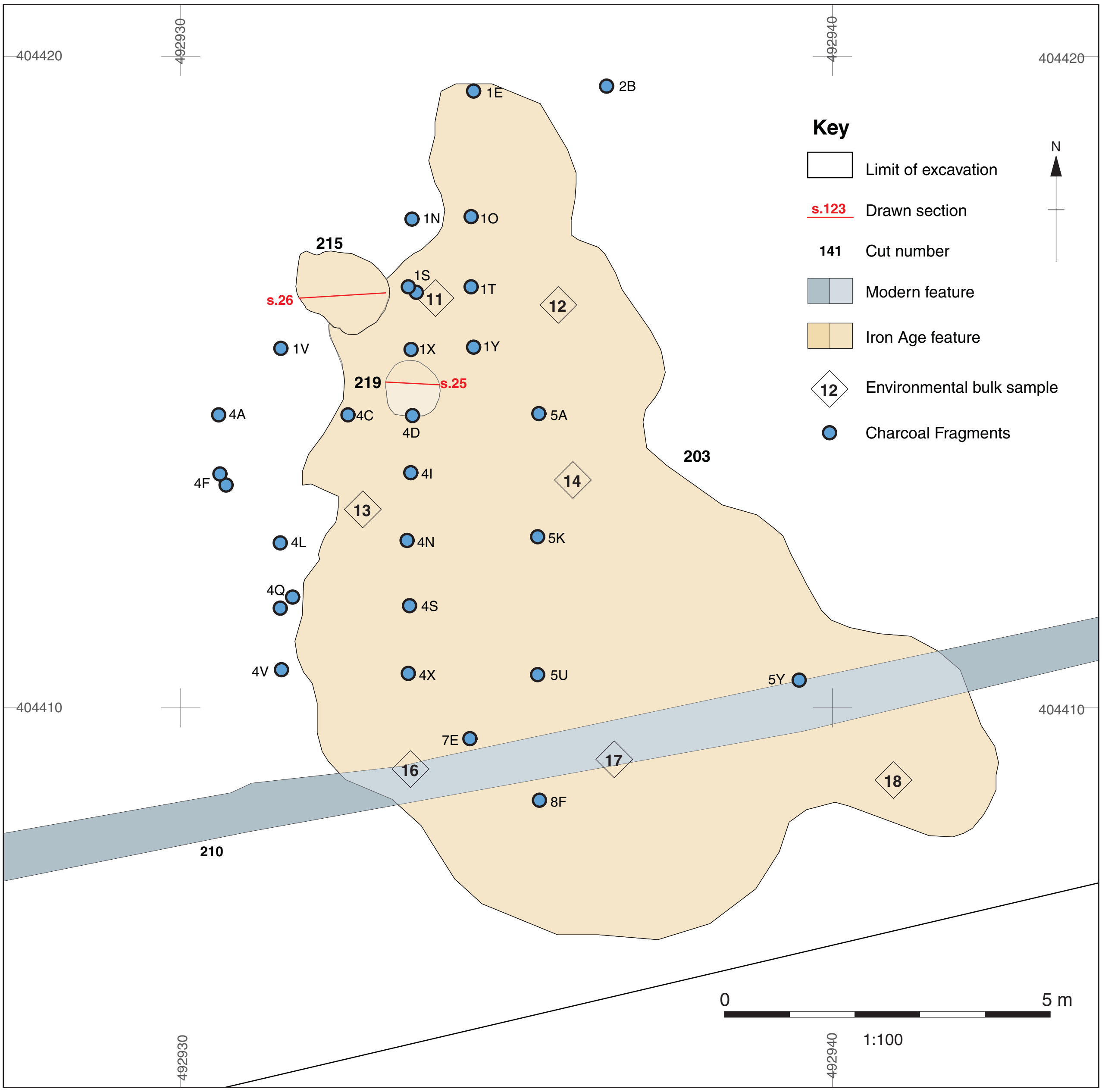



Figure 3: Plan of Furnace **215** and Slag **203**

© Oxford Archaeology East

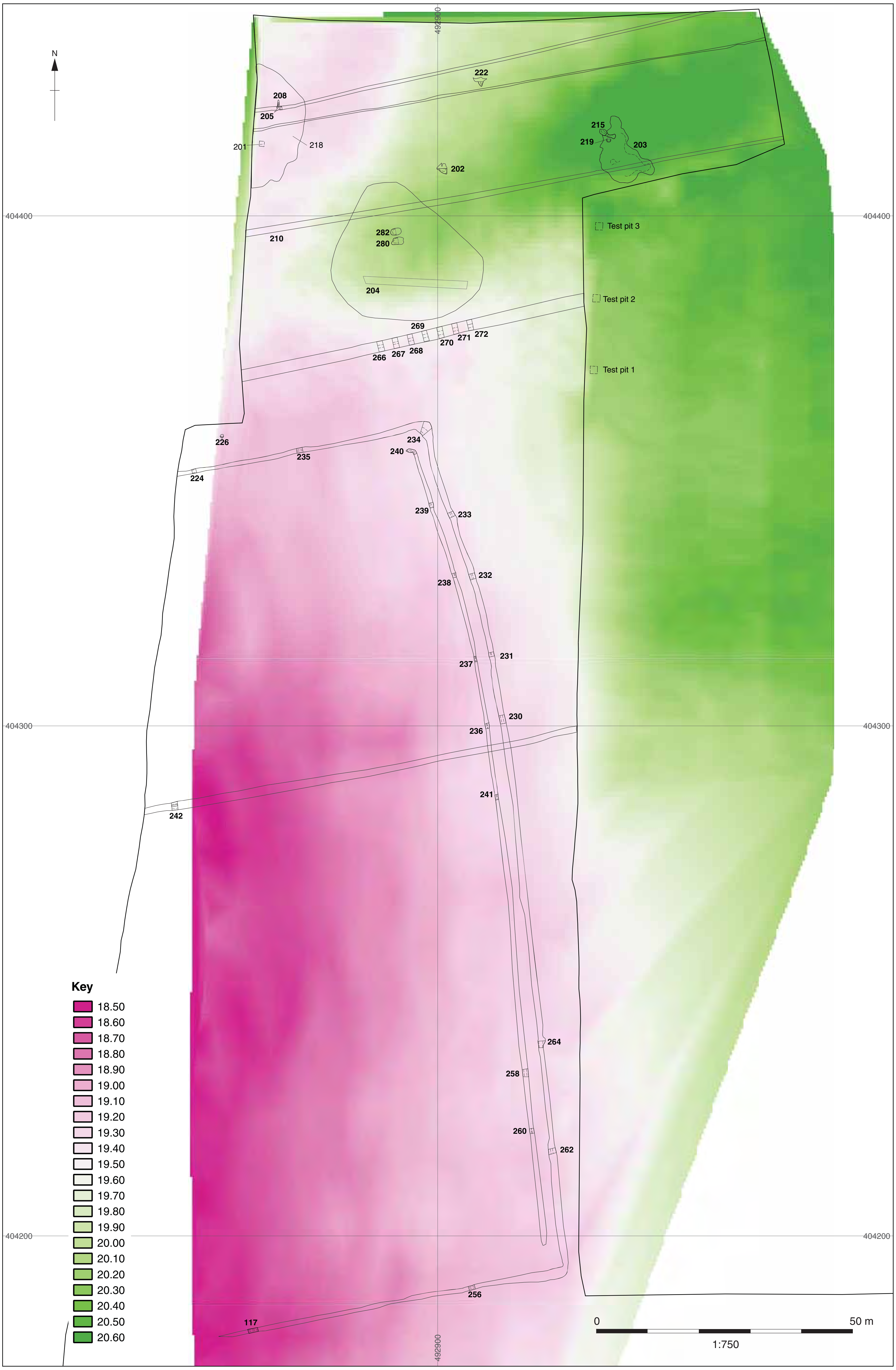



Figure 4: Site contour survey

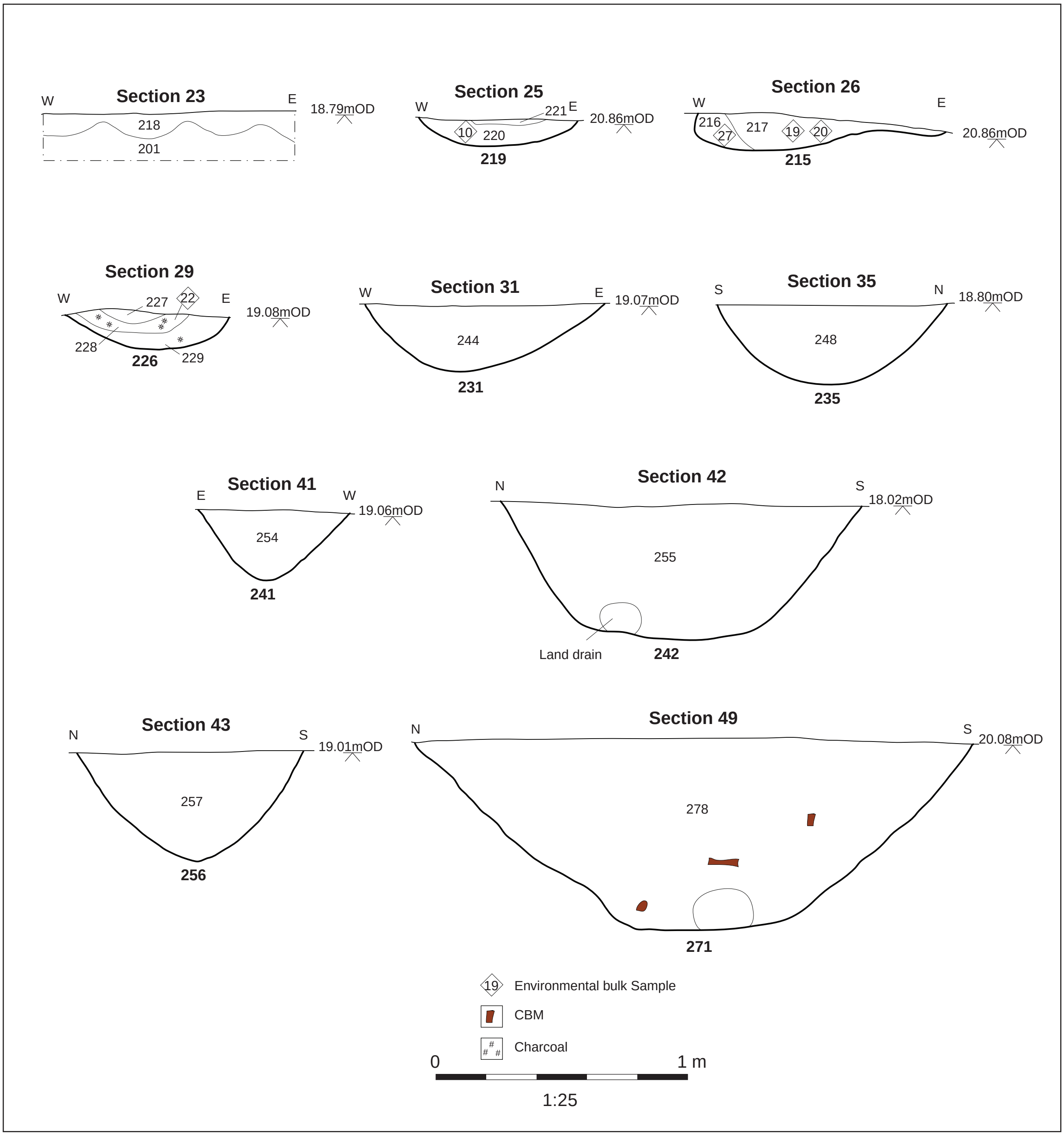



Figure 5: Selected sections

Plate 1: Pre-excavation shot of furnace **215** and slag **203**


Plate 2:  Remains of furnace **215** looking north


Plate 3: Baulk **204** of topsoil spread 2 looking southeast

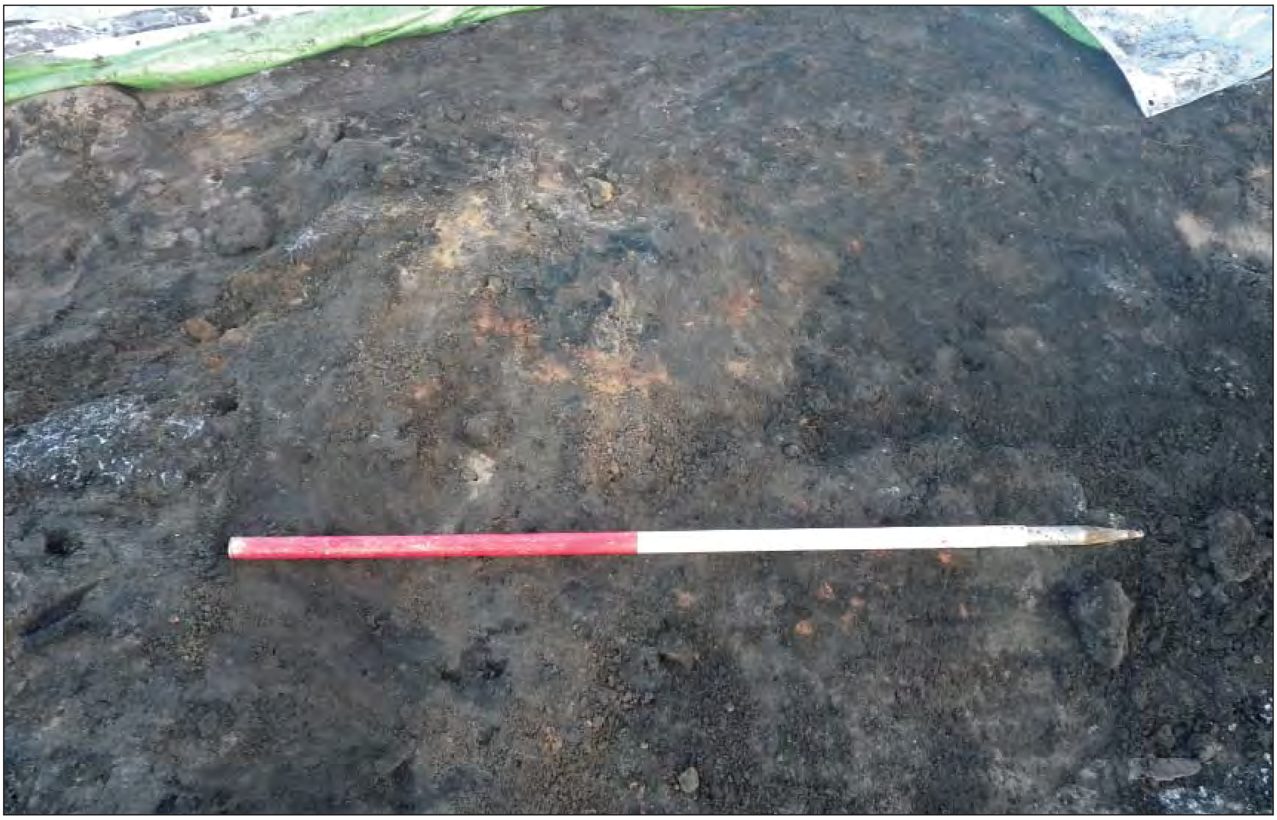


Plate 4: Pit **219** looking north


Plate 5: Bog iron hollow **218** looking southwest


Plate 6: Working shot of slag **203** excavation looking south

Plate 7: Working shot of furnace **215** excavation looking southeast

**Head Office/Registered Office/ OA South**

Janus House
Osney Mead
Oxford OX2 0ES

t: +44 (0) 1865 263 800
f: +44 (0)1865 793 496
e: info@oxfordarchaeology.com
w:http://oxfordarchaeology.com

**OA North**

Mill 3
Moor Lane
Lancaster LA1 1GF

t: +44 (0) 1524 541 000
f: +44 (0) 1524 848 606
e: oanorth@oxfordarchaeology.com
w:http://oxfordarchaeology.com

**OA East**

15 Trafalgar Way
Bar Hill
Cambridgeshire
CB23 8SQ

t: +44 (0)1223 850500
e: oaeast@oxfordarchaeology.com
w:http://oxfordarchaeology.com

**Director:** Gill Hey, BA PhD FSA MIFA
*Oxford Archaeology Ltd is a*
*Private Limited Company, N^O: 1618597*
*and a Registered Charity, N^O: 285627*