NAA

ANALYSIS

REPORT

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STAINTON QUARRY, FURNESS, CUMBRIA

prepared for

Tarmac Ltd

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ANALYSIS REPORT

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Summary

This document presents the results of a programme of analysis upon remains recorded during archaeological works carried out between 2012 and 2015 on land at Stainton Quarry, Furness, Cumbria (NGR SD 2480 7300). This report has been prepared by Northern Archaeological Associates Ltd (NAA) for Tarmac Ltd. The archaeological works were required as a condition on planning permission for extension of the workings at the quarry and comprised the excavation of five trial-trenches, a metal-detecting survey and a phase of strip, map and record excavation.

The investigated area measured approximately 0.7 hectares and was located on high ground (c.85m above Ordnance Datum (aOD)) close to the southern limit of the limestone hills of the northern Furness Peninsula. The site lay to the west of a stream that ran from Urswick Tarn to the coast via Gleaston. The limestone hills around Urswick Tarn, including Skelmore Heads and Birkrigg Common, seemed to be a focus for prehistoric burial and settlement sites; fieldwalked flint around Gleaston indicated it was the site of potentially repeated prehistoric activity. Closer to the excavated area, an earthwork enclosure and a cluster of findspots, including at least 12 stone axes (polished and rough-outs) and a polissoir, were recorded at Stone Closes in the 19th and early 20th centuries.

Archaeological features encountered during the groundworks included five pits, a posthole, part of a possible 'scoop' house and numerous burnt-out root boles. The majority of the artefacts and ecofacts were, however, recovered from charcoal-rich deposits within solution features and crevices (grykes) in one area of outcropping bedrock and the upper fills of a nearby tree-throw. These yielded a total of 1.6kg of Early Neolithic Carinated Bowls, a few sherds from a beaker, two deliberately broken polished stone axes, two large lumps of unmodified haematite, an Arran pitchstone core, a small number of flint tools and debitage, a tuff flake, and small amounts of charred grain, hazelnut shell, charcoal and burnt bone. A larger assemblage of 60 charred grains was recovered from a lone pit close to the southern limit of the excavation.

Radiocarbon dating and Bayesian modelling indicated that the majority of the associated activity was between the 40th and 35th centuries BC as well as an earlier presence during the 46th to 45th centuries. Later activity during the Chalcolithic (at 2470-2290 cal BC) and the Early Bronze Age (at 1950-1770 cal BC) was also demonstrated. Conversely, no evidence for a

*later Neolithic presence was recorded. The majority of the material was securely dated to the Early Neolithic, with pit **7** potentially providing evidence for activity into the Middle Neolithic. Lipid analysis was undertaken on 17 Carinated Bowl sherds and dairy fats were identified within nine, and plant or beeswax residues were present in one. This evidence was in line with the findings of larger studies of lipids preserved within Early Neolithic vessels, but represents the first evidence that dairying was an important component of subsistence strategies in Cumbria.*

Except for the isolated pit, all of the features and artefact-rich deposits were located close to the eastern limit of the extraction area, suggesting that the focus of Early Neolithic activity may have been beyond the investigated area. The nature of the deposits recorded within the grykes and solution features suggested that they may have been redeposited from another source, potentially an above-ground midden. Parts of this midden had seemingly slumped into natural sinkholes and were unlikely to represent any form of structured deposition.

A comparison of these deposits with similar contexts recorded at contemporary sites across Cumbria, the Irish Sea fringe and Scotland has demonstrated that the activity that produced them is most likely to have been occupational rather than ceremonial. The data recovered from Stainton Quarry has wider implications regarding the interpretation of both the nature and use of the surrounding landscape of Furness during the Early Neolithic. The combined evidence suggests higher levels of permanence of occupation, a greater reliance on domesticated resources and possibly a different topographical focus for settlement, than is currently proposed.

1.0 INTRODUCTION

1.1 This document presents the results of a programme of analysis upon remains recorded during archaeological works carried out between 2012 and 2015 on land at Stainton Quarry, in Furness, Cumbria (NGR SD 2480 7300; Fig. 1). The archaeological works were required as a condition of the planning permission for extension of the workings at the quarry. They comprised the excavation of five trial-trenches and a metal-detecting survey in 2012, and strip, map and record excavation in July and August 2015.

1.2 This document has been prepared by Northern Archaeological Associates Ltd (NAA) for Tarmac Ltd. It is informed by an Environmental Statement (ES) (Tarmac Ltd 2010), and both phases of groundworks were carried out in accordance with agreed Written Schemes of Investigation (WSI; NAA 2012; 2013a). The WSIs were submitted to Cumbria County Council Historic Environment Service (CCCHES), so that both phases of investigation constituted a scheme of works approved by the local planning authority. All archaeological works were undertaken in accordance with relevant standards, guidance and best practice published by Historic England (HE) (formerly English Heritage (EH)) (EH 2008; 2010; HE 2015; Campbell *et al.* 2011) and the Chartered Institute for Archaeologists (CIfA 2014a; 2014b; 2014c; 2014d; McKinley and Roberts 1993).

2.0 LOCATION, TOPOGRAPHY AND GEOLOGY

2.1 The investigated area (hereafter referred to as 'the site'), comprised a small block of land (c.0.7 hectares) at the centre of the current workings, to the north of Stainton with Adgarley (Fig. 1). The original local topography had been altered dramatically by quarrying, but much of this could be reconstructed from early Ordnance Survey (OS) maps (Fig. 2).

2.2 The site was located to the north and east of the brow of a low hill, close to the south-western limit of Bolton Heads. Within the excavated area, the land sloped downwards from the south-western corner (c.88.6m aOD) towards the north, but also quite dramatically to the east. The surviving ground to the south of the site continued to rise before reaching a quarried edge 130m to the south-west.

2.3 Spot heights on the First Edition OS map of 1851 (not illustrated) indicated summits to the immediate west and south of the site as well as another small hill 'Castle Haw' to the south-west (which later became Crown Quarry; Fig. 2). Also apparent was a 'waterhole' to the immediate north-west of the northern end of Trench 4 (see Figs. 2 and 3). This feature was at the head of a small valley and hence could indicate the former presence of a spring (see Wild 2003, 26). The valley (hereafter 'Stone Barrow Lane Valley') ran north-eastwards before curving towards the south-east to join a broad valley that ran from Urswick Tarn (Fig. 1) to the coast (hereafter 'Urswick Valley').

2.4 In the wider landscape, the ground to the north was undulating but gradually rose before dipping into a valley in which Standing Tarn is now located. To the north-west lay the higher ground of Bolton Heads and Little Urswick Crags that formed the western edge of Urswick Valley. To the west, a broad, gentle slope led down into a north to south aligned valley (Fig. 2), whilst the ground sloped more steeply to the south and especially the south-east downwards into Urswick Valley. This steeper slope formed a promontory upon which an enclosure comprising a stone bank was recorded in 1912 at 'Stone Closes' (Dobson 1912). The enclosure would have overlooked an area of the Urswick Valley that broadened out into a largely flat area close to Mere Tarn (Fig. 1). Within this area a concentration of early prehistoric flint was recovered in the fields close to Gleaston Castle (Evans 2008, fig. 9.17).

2.5 The site lay upon a north-east to south-west aligned limestone ridge formed by the Urswick and Park Formations (BGS 2019). Approximately 300m to the south the bedrock geology changes to the calcareous mudstone of the Alston Formation and, after a further 500m, to the Bowland Shale Formation. At Gleaston village, approximately 2.2km to the south-east of the site, the bedrock changes again to the St. Bees Sandstone Formation, which extends to the coast.

2.6 Although no drift geology is recorded within the excavated area (BGS 2019), the investigations revealed an orange-brown glacial till formed from clay, sandy silts and gravels as well as three areas of outcropping limestone. This till extends across much of the Furness Peninsula, with alluvium in some of the valleys and areas of glaciofluvial sands and gravels at the coast and around Urswick Tarn. Soils on the site were of the Crwbin Association, shallow well-drained loams, often associated with limestone pavement (SSEW 1983; Jarvis *et al.* 1984).

3.0 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

3.1 The site was subject to an Environmental Statement (Tarmac Ltd 2010). The account below includes information from the cultural heritage section of this report but is informed by the results of a survey by Dobson (1912) and a more detailed assessment of the prehistory of the Furness Peninsula by Evans (2008). The wider contemporary evidence is considered in more detail in the discussion section.

3.2 The Furness Peninsula is an important area with respect to the study of the early prehistory of not only Cumbria but also the wider northern Irish Sea 'fringe' (see Bradley *et al*. 2016, fig. 16). Much that is known about the area is due to antiquarian interest including the work of the Barrow Naturalists Field Club (Evans 2008, 120), as well as numerous findspots of prehistoric artefacts (*ibid*., fig. 9.16). More recent discoveries include an investigation of a Neolithic long cairn at Skelmore Heads (Powell 1963), fieldwalking of a significant proportion of the lowland areas (Evans 2008, fig. 9.2) and small numbers of Early Neolithic features discovered during modern developer-funded interventions at Roose Quarry (Jones 2001; OAN 2014) and Holbeck Park Avenue (OAN 2002; Evans 2018).

3.3 Of special note is a succession of collections of material from a prehistoric settlement site at Walney North End, Walney Island (Fig. 1; Cross 1938; 1939; 1942; 1946; 1947; 1949; 1950; Barnes 1955; Evans 2008, 120; Greenlane Archaeology 2015). These discoveries include large collections of lithics, finds of stone axes, hearths and shell middens as well as Bronze Age and later remains. Much of this material, however, has been only briefly reported upon and no secure dating exists.

3.4 The importance of this site was emphasised by Bradley *et al.* (2016) when it was theorised that these concentrations were associated with a possible 'maritime haven' (*ibid*., 143, fig. 11). It was suggested that Walney North End may represent a prehistoric 'beach market' (*ibid*. 125, 152), one of several that fringed the coasts of north-eastern Ireland, south-western Scotland and Cumbria (*ibid*., fig. 16). These sites may have facilitated the exchange and spread of artefacts such as Group IV polished axes, Arran pitchstone and potentially porcellanite axes, around the Irish Sea fringe.

3.5 The number of finds of polished and rough-out axes from the Furness Peninsula as a whole, along with polissoirs and grinding stones from Roose Cote near the coast and Stone Closes (adjacent to the Stainton Quarry site; Fig. 2; Table 1), has raised the possibility that axe polishing was carried out in this region during the Neolithic

(Manby 1965, 4). If the distribution of axe rough-outs discovered in Cumbria is plotted (Bradley and Edmonds 1993, fig. 7.4) the Furness Peninsula represents a clear concentration.

3.6 The most significant prehistoric site recorded in the immediate vicinity of the Stainton Quarry site was an earthwork enclosure at Stone Closes (Fig. 2, site 4) approximately 100m to the south-east (Dobson 1912). Numerous finds of stone axes (polished and rough-outs), querns, rubbing stones, a palstave, bronze ring and a pile of bloomery waste were all recovered from within its supposed circuit (see Table 1: sites 2, 3, 7, 11, 12 and 19) (*ibid.*, 281-2). The enclosure was undated and has now been removed by quarrying; the associated finds, however, suggested it may be of a Neolithic and/or Bronze Age date (Manby 1965, 4). Alternatively, it may have been the result of Iron Age or later occupation within an area of earlier activity (e.g. Evans 2008, 43).

3.7 The enclosure was conjectured to define an ancient settlement (Dobson 1912, 277), sited on a promontory and the presumed source of the numerous finds recovered. Many of the stone axes, however, were recovered from within crevices in the limestone, a pattern mirrored at Skelmore Heads near Urswick Tarn (Evans 2008, 127), where a similar earthwork enclosure was located close to the Neolithic long cairn (Powell 1963).

3.8 Assuming the deposition of the axes within the crevices at both sites was due to similar practices (see Evans 2008, 114, 127-9) and that the Skelmore long cairn and enclosure were contemporary (Evans 2008, 71), then it is possible that the Stone Closes enclosure may have been of a similar date and function. The earthwork at Skelmore Heads has been identified as a possible Neolithic 'causewayed' enclosure (Oswald *et al.* 2001, fig. 1.1, 88, 159; Hodgson and Brennand 2006, 39; Evans 2008, 71) and hence, the Stone Closes enclosure, again, if Early Neolithic in date, may have served a similar function (Evans 2008, 128). The date, and therefore the use of, the Skelmore enclosure is, however, still in question (Oswald *et al.* 2001, 88, 159), awaiting further evidence.

3.9 Causewayed enclosures are considered part of the Neolithic Carinated Bowl 'package,' that potentially arrived with a wave of immigrants (Sheridan 2010, 89), along with: the use of carinated and s-shaped pottery; new forms of stone artefact, including ground stone axes; the use of non-funerary timber structures; domesticated animals and crops; and the construction of burial monuments (*ibid.*, 95-8).

3.10 The use and function of these enclosures is, however, complex and poorly understood (Oswald *et al.* 2001, 120). There is evidence for domestic occupation at some sites (*ibid.*, 124), especially on the continent such as at Darion in Belgium (*ibid.*, fig. 5.5), while others lacking obvious structures have been interpreted differently. Alternative possible uses of these sites include places of social gatherings (Smith 1965; Oswald *et al.* 2001, 130-1), centres of manufacturing or exchange, funerary rituals or conflict (*ibid.*, 123-32). Although, it should be stated that these sites may have fulfilled a variety of functions that may have changed through time (*ibid.*, 120). The diversity of evidence also suggests that not all enclosures were used in the same way.

3.11 In the wider vicinity of the Stainton Quarry site, findspots of artefacts, as well as two possible standing stones, a small cremation cemetery and several earthwork enclosures suggested prolonged or repeated activity throughout prehistory (Table 1; Fig. 2). About 2km to the south-east of the investigated site, a concentration of lithics recovered during fieldwalking to the north of Gleaston Mill and west of Mere Tarn (Fig. 1) suggested a focus for repeated later Mesolithic and Early Neolithic activity (Evans 2008, 124-5). The lithics were located on a low rise close to a spring and the confluence of two streams in the mid-section of the Urswick Valley.

3.12 The limestone upland areas surrounding this valley were potentially foci for prehistoric burial and ceremonial activity including the Skelmore Heads long cairn to the north and a cluster of monuments on Birkrigg Common to the east (Evans 2008, 127-30). Also of interest are three cave sites (Evans 2008, 128) containing human remains and a dolmen at Tosthills to the west of Great Urswick.

Table 1: Heritage sites within 1km of the site

ID	Type	Description
1	Possible standing stone	Giggle Stone, recorded on the First Edition Ordnance Survey Map 1851. Possible standing stone
2	Findspot	A socketed celt and a palstave found in 1894. In 1903 a quantity of bloomery cinder found nearby
3	Findspot	A stone celt and querns found in 1899 and 1903
4	Enclosure	Stone Closes earthwork enclosure
5	Findspot	Axe hammer found in 1882
6	Findspot	A polished stone axe
7	Findspot	Stone celt found in 1910. Also, within a few yards a small fragment of a rubbing stone was found
8	Findspot	Saddle quern found in 1905 during draining operations
9	Cremations	An urn containing bones and a bronze implement were found during sand quarrying in 1860. A second urn, containing a smaller vessel was found two years later
10	Findspot	A Neolithic roughed-out stone axe was found in 1957
11	Findspot	In 1904, a large piece of a saddle quern of hard large-grained sandstone and a broken grinding stone were found
12	Findspot	Grit quern found at Stainton Quarry in 1901
13	Enclosures	Several enclosures some of which are rectangular, some of irregular shapes

ID	Type	Description
14	Findspot	Damaged rotary quern found at Devonshire Quarry in 1956
15	Possible standing stone	A possible standing stone that has now fallen
16	Findspot	Brown flint blade
17	Settlement	Earthworks of a possible banked enclosure and two hut circles
18	Findspot	Neolithic axe
19	Findspot	A dozen stone celts, mostly polished, some broken were found in crevices, hollows and in the turf at various dates between 1894 and 1901. Also found were a bronze ring in 1901, an upper quern stone of granite in 1903 and in 1909 a large fragment of an upper quern stone of coarse-grained grit

4.0 AIMS AND OBJECTIVES

4.1 The aims and objectives of the archaeological works are detailed in previous reporting (NAA 2012; 2013a) but in summary they were to determine whether unrecorded sub-surface archaeological remains existed within the proposed extraction area. If remains were present, the trial-trenching aimed to confirm their location, extent, nature, date and importance, so that an informed assessment of the impact could be undertaken, and a suitable mitigation strategy agreed.

4.2 A subsequent phase of works comprised archaeological monitoring of the removal of topsoil and subsoils and the investigation and recording of any archaeological remains exposed. This was designed to achieve preservation by record of those remains.

4.3 The objectives of this archaeological work were:

- to provide a detailed record of archaeological remains in advance of their loss through extraction works;
- to more fully understand the extent, nature and date of archaeological remains; the period of occupation and the relationships between the various periods of human activity;
- to recover and assess any associated structural, artefactual and environmental evidence to help inform understanding of the layout, date, function, phasing, development and economic basis of each area of activity;
- to undertake a programme of investigation that will contribute to the relevant regional research priorities;

- to prepare an illustrated assessment report followed by an analysis report on the results of the archaeological fieldwork to be deposited with the Cumbria Historic Environment Record (HER) and the National Monuments Record (NMR); and

- to publish the results in a local, regional or national journal, as appropriate within one year of the completion of the archaeological works.

4.4 Post-excavation assessment of the results of the archaeological fieldwork highlighted their regional importance (NAA 2015), and hence, further analysis was agreed upon. The aim of this analysis work (NAA 2015, 22-3) was to contribute to the following regional (Brennand 2007) and national academic debates (see Cummings and Harris 2011; Cramp *et al.* 2014; Sheridan and Pétrequin 2014) regarding the Early Neolithic:

- what forms of subsistence and land use did Early Neolithic people pursue (hunting and gathering, farming or both) and how did these vary within different regions?;

- how mobile or sedentary were people?;

- were ‘pit sites’ the truncated remains of settlement sites (or camps) or were they areas of ritual deposition (or both)?; and

- polished stone axes seem to have had extended periods of use beyond their mundane function for forest clearance, how widespread was this activity and how did it correspond with other forms of deposition?

5.0 METHODOLOGY

5.1 Full methodologies for the archaeological mitigation works are presented in previous reporting (NAA 2012; 2013a). A summary of the relevant information is presented below.

5.2 During the evaluation excavation five 50m by 2m trial-trenches were excavated within the proposed extraction area (Fig. 3). All trenches were excavated by a mechanical excavator fitted with a toothless ditching bucket; they were surveyed using GPS and the information transferred to AutoCAD software and reproduced for incorporation within this report. A metal-detecting survey was also carried out, on the surface of the field, spoil heaps and the exposed surfaces of the trenches. This survey produced a total of 35 modern finds.

5.3 During the subsequent strip, map and record investigation, the removal of overburden (topsoil and subsoil) was undertaken using a mechanical excavator fitted with a toothless ditching bucket. All soil removal was under archaeological supervision as a single phase of stripping. Mechanical excavation ceased in any areas where archaeological remains were identified by the monitoring archaeologist; thereafter, all archaeological work was undertaken by hand. The area subjected to topsoil and subsoil stripping was slightly smaller than the evaluated area (Fig. 3), hence the early prehistoric features recorded in the northern end of Trench 4 lay beyond the excavated area.

5.4 As significant archaeological finds and features were encountered a monitoring meeting was held on site with Tarmac Ltd and the Historic Environment Officer for Cumbria County Council to review the excavation sampling strategy and to establish suitable mitigation procedures for the archaeological remains uncovered. The excavation and recording of all archaeological features and deposits within the stripped area was agreed. Due to a known association with early prehistoric deposition, an investigation of an appropriate sample of the deposits within solution features and crevices (grykes) etched into the areas of exposed bedrock was also agreed.

Plate 1: Investigating the grykes in the north-western excavation area

5.5 Excavated sample sections constituted 100% of features of a potential ritual and ceremonial nature and initially a minimum of 50% sample of other features. Full excavation of some of the latter was undertaken in order to better understand the nature of discrete features and to maximise the recovery of artefacts and ecofacts. A sample of deposits within grykes and solution features etched into exposed areas of bedrock were also investigated (Plate 1). A concentration of early prehistoric artefacts was recovered from within a single area (see below) this outcrop was 100% excavated down to natural deposits and was recorded both in plan and section and in three dimensions by digital photographic modelling.

5.6 Due to the early prehistoric date of the features and artefacts encountered a high proportion (c.80) of natural features such as tree-throws and root boles exposed during stripping were investigated. This was undertaken to maximise the recovery of artefacts and the identification of often difficult to spot prehistoric deposits and/or features. A small sample of these natural features was fully recorded. A drawn record of all archaeological features was made at an appropriate scale. Sections/profiles were drawn at a scale of 1:10. Plans were drawn at a scale of 1:20. Drawings included appropriate data on levels relative to Ordnance Datum. Drawings were located within the site and the National Grid using sub-centimetre GPS (Plate 2).

Plate 2: Surveying bedrock outcrop 20 by GPS (looking south)

6.0 RESULTS

6.1 The full results of both stages of archaeological works are detailed in previous reporting (NAA 2013b; 2015). Details of the early prehistoric features recorded are presented below. Soil removal exposed till and morainic sand and gravel deposits, three areas of limestone bedrock (Fig. 3), approximately 80 natural features (e.g. root holes, boles and tree-throws), two pits (**7** and **61**) and a single posthole (**18**). After the discovery of artefacts within eroded channels and grykes associated with bedrock outcrop **20** (see below), all such features were hand-excavated in this area. A sample of the grykes and solution features in the other areas of bedrock was also excavated, but no further artefacts or charcoal-rich deposits were encountered.

6.2 Post-excavation analysis, including assessment of the pottery (Appendix E) and 10 radiocarbon dates from selected contexts (Appendix H), placed the recorded remains into five broad chronological phases. The first three phases comprised a Late Mesolithic charred hazelnut shell, and Neolithic and Chalcolithic deposits and artefacts. A fourth phase, potentially indicating at least one episode of clearance during the Early Bronze Age, was identified by a single radiocarbon date from root bole **26**. Later activity on the site was assigned to the final phase (see NAA 2013b; 2015). It should be noted that the terms Mesolithic and Neolithic have been used as chronological indicators within this report and are not meant in any way to infer strategies of subsistence, which are discussed separately. Radiocarbon dates quoted below are the modelled dates from the overall phase model (see Appendix H); uncalibrated radiocarbon ages are also quoted.

Phase I: Late Mesolithic

6.3 An area of outcropping limestone (**20**) at the eastern edge of the excavated area (Fig. 3) was the south-western end of a linear outcrop, which extended to the north-east for c.260m forming the eastern edge of Stone Barrow Lane Valley. It seemed to be a focus of deposition during the Early Neolithic (see below) but also produced a single Late Mesolithic radiocarbon date from the earliest of the artefact-rich deposits (**40**). A charred hazelnut fragment from deposit 40 returned a modelled date range of *4590-4450* cal BC (2σ; SUERC-68520, 5679±27 BP). This deposit produced numerous Early Neolithic Carinated Bowl sherds (see below), hence, the charred hazelnut shell was probably residual from earlier activity (Appendix H) suggesting a Late Mesolithic presence in the vicinity.

Phase II: Neolithic

Bedrock outcrop 20

6.4 A wide range of artefacts, including Early Neolithic pottery (Appendix E), was recovered from natural features etched into outcrop **20** (Fig. 4; Plate 3). These included sinuous shallow water-worn channels and gullies in the surface of the outcrop and vertical sub-conical holes (solution features). The latter became narrower with depth and were formed by water draining downwards through the limestone. None of these features showed any sign of being intentionally cut or altered.

6.5 The sloping surfaces of outcrop **20** were scoured by an interconnecting web of erosion gullies. A single vertical solution features (**21**) and two deeper vertical crevices (grykes A and B) were also encountered. A general sequence of an initial dark-brown silty deposit (**23**) overlain by a red-brown sandy soil (**11**, **22** and **49**), which was then sealed by topsoil (**10**) and turf (**9**), existed in the majority of these features.

Plate 3: Solution feature 21 (looking north)

6.6 The paler deposits (**23**, **11**, **22** and **49**) within the erosion gullies were generally devoid of artefacts; however, a small pitchstone core (see Appendix C) was recovered from a gully close to the western edge of the outcrop. Furthermore, 11 sherds of Early Neolithic pottery from sherd group (SG) 4 were recovered from an area of turf removed from the outcrop during cleaning. A deep solution feature (**21**) to the south-west (Plate 3) produced a further eight abraded Early Neolithic Carinated Bowl sherds (SG 6) and small amounts of charcoal.

Plate 4: Sequence of deposits within the grykes (looking north-west)

6.7 To the north-east, during topsoil removal around this bedrock outcrop, two large blocks of limestone were disturbed, exposing preserved sequences of deposits that had formed within grykes A and B (Figs 4 and 5; Plates 2 and 4). Some of these deposits (**31**, **38**, **39**, **40** and **48**) were rich in charcoal and contained Early Neolithic artefacts. Finds were also recovered during the removal of loose soil (**30**) around this area.

6.8 A complex sequence of events had occurred as a result of three small, vertical solution holes in the base of the north-west to south-east aligned gryke A (Fig. 5; Plate 5) and an extensive horizontal crack extending southwards from approximately behind deposits **40** and **48** (Plate 5). A vertical void between the rock face and the upstanding deposits indicated that this process of soil loss was potentially still ongoing.

6.9 The grykes were between 0.08m and 0.3m wide and were investigated to a depth of up to 1.1m from the outcrop surface. The earliest deposit was a natural firm red clay that produced no artefacts or ecofacts (Plate 5). The subsequent series of solution features, sinkholes, slumping and silting occurred in a complex three-dimensional pattern. These features potentially spanned an extensive time period and, although a broad sequence could be ascertained, this is likely an approximation of a more complicated series of events.

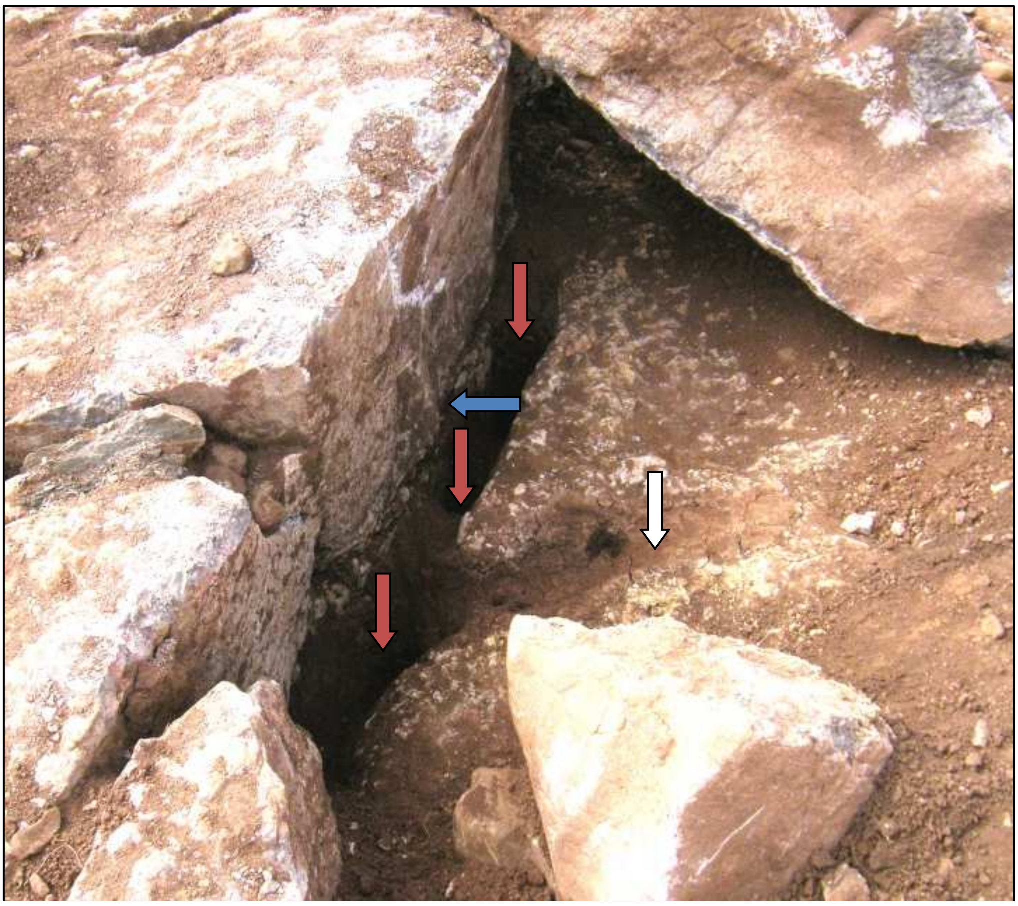

Plate 5: Natural clay and solution features in base of the grykes (looking north-west; red arrows=vertical solution features; blue=horizontal crack; white=sloping channel)

6.10 The next layer deposited was a red-brown sandy soil (**49**) that had potentially once filled the grykes to the surface. Water action had formed three vertical solution features into the clay layer in gryke A; a short, near-horizontal channel in the base of the north-east to south-west gryke B sloped downwards into the western solution feature (Plate 5). These features presumably drained water and the overlying soil (**49**) downwards, forming two sinkholes (**46** and **64**) in gryke A and a third (**63** – not illustrated) in gryke B.

6.11 At some point, the solution features became blocked and ceased to drain. Following this, a dark-brown silty deposit (**34**) formed and was overlain by naturally redeposited remnants (**66**) of deposit **49**. Neither deposit produced finds and both were very similar to the deposits (**23** and **22**) within the solution gullies recorded in the surface of the bedrock outcrop.

6.12 Following this, two darker fills (**40** and **31**) were deposited within feature **46**. The lower fill (**40**) was up to 0.10m thick and contained small amounts of oak charcoal, a hazelnut shell (see Phase I) and 55 Early Neolithic pottery sherds (SGs 18 and 19), which were mostly concentrated to the east. These sherds were not 'placed' within deposit **40** but followed the same tip lines apparent in several stones, as if they had slumped into the feature. Alternatively, successive soil loss through the solution features could have caused the sherds and stones to slump after they had been deposited.

6.13 Above fill **40** was a dark grey-brown sandy silt with lenses of dark yellow-brown material (**31**). This deposit contained five small dispersed fragments (0.8g) of burnt/cremated bone, small amounts of charcoal, a single charred grain, a polished stone axe fragment (Recorded Find (RF) 4; see Appendix D) and nine Early Neolithic pottery sherds. The pottery was mostly concentrated above the area of the sherds recovered from deposit **40** and again was aligned as if slumped into (or within) the deposit.

6.14 One sherd from each deposit (**31** and **40**) produced evidence for the processing of dairy fats (see Appendix G). The sherd from deposit **31** also produced a series of long-chain fatty acids that may have derived from a plant residue, or possibly from beeswax, although no wax esters were identified. A modelled date range of *3770-3640 cal BC* (2σ; SUERC-68516, 3888±29 BP) was obtained from a fragment of hazel charcoal from deposit **31** (Appendix H).

6.15 A fourth solution feature (**47**), potentially caused by material being eroded by water draining away through the horizontal crack behind the recorded section, was next in the sequence. This sinkhole (Fig. 5) contained two fills, the earliest of which was a 0.20m thick dark grey-brown sandy silt (**48**) with few small stones. This context produced three fragments of burnt/cremated bone (0.8g), small amounts of charcoal, a single charred wheat (*Triticum* sp.) grain and eight sherds of Early Neolithic pottery. This was overlain by a 0.50m thick deposit (**39**) of mixed dark grey-brown and mid red-brown silty soil with patches of redeposited clay. This upper deposit contained occasional large stones (some of which seemed to be heat-affected), small amounts of charcoal and moderate amounts of small stones and gravel.

6.16 Approximately 26 fragments (3.6g) of burnt/cremated bone (including cattle and possibly human – Malin Holst pers. comm.) were dispersed throughout this fill. Seven

Beaker sherds and 17 fragments of Early Neolithic pottery, mostly concentrated in the lower western portion of the fill, were also recovered. Dairy lipids were detected within two of the Early Neolithic sherds from context **39**. The wheat grain from context **48** returned a date range that was modelled to *3640-3370* cal BC (2σ; SUERC-68522, 4735±29 BP), whilst, interestingly, a fragment of hazel charcoal from the upper fill (**39**) provided a Chalcolithic (Needham *et al.* 2010, table 1) date range (see Phase III below).

6.17 The north-east to south-west aligned gryke B (Fig. 4; Plate 4) contained a mixed dark brown silty soil with patches of redder-brown material (**38**). This deposit was identical to fill **39** and produced part of an invasively retouched flint knife (Appendix A) and 10 sherds of Early Neolithic pottery (plus some crumbs).

6.18 During the initial clearing of loose soil in this area (**30**), two large lumps of unmodified haematite (RFs 2 and 3) were disturbed from the top of deposit **39** (see Appendix D) and a polished stone axe fragment (RF 1) was discovered to the immediate west of deposit **31**. Two fragments of flint debitage and six sherds of Early Neolithic pottery were recovered from above deposit **38**.

6.19 To help understand the formation processes at work within the deposits discussed above, the location of each sherd group (see Appendix E), lithic and haematite lump was plotted in plan (see Fig. 4). This exercise demonstrated that the artefacts recovered did not form a single cohesive 'placed' cache. Conversely, although the majority of the pottery groups were located close to the intersection of gryke A and gryke B, much of the other material was relatively dispersed. Importantly, the pitchstone core was potentially a background find within the general silting up of the solution features, whereas almost all of the pottery was located above the solution features.

Tree-throw 32

6.20 To the south-west of outcrop **20** (Figs 3 and 6), the fills of a tree-throw (**32**) were similarly rich in artefacts and charcoal (Plate 6), including part of a charred plank or post (sample 41AA). The lower fills (**52** overlain by **41**) of feature **32** comprised redeposited glacial till and stones (Fig. 6, section D); three small sherds of Early Neolithic pottery, moderate amounts of charcoal and five fragments of charred hazelnut shell were recovered from deposit **41**. Above this, a 0.10m thick layer of mid grey-brown silty sand (**35**) produced two retouched flint blades, three flint flakes (one utilised and one retouched), three fragments of rock crystal and 88 Early Neolithic pottery sherds. Context **35** also contained moderate amounts of charcoal and 29 fragments of charred hazelnut shell.

Plate 6: Excavating tree-throw 32 (facing north-east; outcrop 20 in background)

6.21 A single flake of Langdale tuff, a natural quartz fragment, a fragment of flint debitage and 16 sherds of Early Neolithic pottery were retrieved from the overlying mid brown-grey silty clay (**33**). This deposit also produced moderate amounts of charcoal, 35 fragments of charred hazelnut shell and two charred cereal grains. Three sherds of pottery from context **35** and one from deposit **41** contained dairy lipids. Interestingly, the majority of the pottery from deposits **33**, **35** and **41** was recovered from the same south-western area of the feature. These, however, had not been 'placed' in the deposit as, similar to the artefacts recovered from the grykes, they followed the tip lines apparent in the alignments of nearby stones.

6.22 It is most likely that deposits **35** and **33** and the upper portion of **41** represented soil and domestic refuse that had either been backfilled or had slumped into the hollow left after the tree-throw had partially infilled through natural processes. Three radiocarbon dates were measured from material recovered from each of deposits **33**, **35** and **41**. Hazelnut fragments returned date ranges that were modelled to *3790-3660* cal BC (2σ; SUERC-68517, 4959±26 BP) and *3770-3640* cal BC (2σ; SUERC-68518, 4922±29 BP) from contexts **33** and **35** respectively. A slightly earlier date range of *3940-3700* cal BC (2σ; SUERC-68521, 5012±26 BP) was modelled from a measurement from a fragment of hazel charcoal from lower fill **41**.

Pit 7

6.23 Approximately 70m to the south-west, close to the southern limit of the investigation, a single pit of a later Early or Middle Neolithic date (see Appendix H) was recorded among a cluster of root boles (Fig. 6). This pit's shape was more regular than the surrounding naturally formed features, being sub-circular with sloped sides and a small flat base (Fig. 6, section B). It contained moderate amounts of charcoal, 60 charred grains and a moderate amount of sub-angular stones, but no artefacts.

6.24 Two grains were submitted for radiocarbon dating. The date range from an emmer grain (*Triticum turgidum* ssp. *dicoccon*) was modelled to *3640-3380* cal BC (2σ; SUERC-68510, 4759±29 BP), while a barley grain (*Hordeum vulgare*) produced an earlier range of *3780-3650* cal BC (2σ; SUERC-68511, 4934±29 BP). During Bayesian modelling (Appendix H), a chi-squared test indicated that these two grains could not have 'died' in the same year; therefore, there was a moderate level of residuality within the pit fill. This could have been due to later charred grains being introduced from overlying soils via bioturbation or, more likely, earlier material being incorporated during infilling. If the latter were the case then the material could have either derived from the surrounding soil or via backfilling from an above-ground accumulation of waste, such as a midden.

Features 408, 410 and 412

6.25 During the evaluation phase of groundworks a cluster of three small features within a shallow-sided hollow (**414**), all potentially of an Early Neolithic date, were recorded at the northern end of Trench 4 (Fig 6). Two of these (**408** and **410**) extended beyond the eastern edge of the trench (Fig. 6, section F) and may have been truncated pits or postholes (Plate 7). The third feature (**412**) was potentially a small post- or stakehole. Pit **410** measured at least 0.45m wide by up to 0.25m deep and its dark fill (**409**) contained seven fragments of Early Neolithic pottery. This fill also produced 52 fragments of charred hazelnut shell and seven carbonised cereal grains including three of wheat (cf. *Triticum aestivum*) and two barley.

6.26 Feature **408** was c.0.4m wide and up to 0.15m deep and lay 0.85m to the north. Four potential packing stones remained *in situ*, and the lower 0.10m was filled with a similar material (**407**) to that in posthole **410**. The third feature, (**412**) was 0.15m in diameter and up to 0.10m deep but produced no artefacts or ecofacts.

Plate 7: Features 408, 410 and 412 (facing south-west)

6.27 These three features were recorded beyond the eastern edge of the final extraction area and lay in the base of a hollow (**414**) visible in the trench edge. This hollow was up to 0.40m deep, occupying the northernmost 3.50m of the trench, and extended beyond its northern and eastern edges. It was unclear whether this feature was naturally formed or represented part of a 'scoop' structure similar to examples recorded on Early Neolithic settlements in England (Darvill 1996, fig 6.5), Scotland (Barclay 2003, fig. 8.5; Murray and Murray 2014) and Ireland (Grogan 1996, fig. 4.4).

Phase III: Chalcolithic

6.28 The Beaker sherds recovered from the upper deposit (**39**) within gryke A were suggestive of Chalcolithic (Needham *et al.* 2010, table 1) activity in the vicinity (Appendix E). A fragment of hazel charcoal from this deposit provided a supporting modelled date range of *2470-2290* cal BC (2σ; SUERC-68519, 3888±29 BP; see Appendix H). One of the Beaker sherds was shown to contained lipids, but the presence of contaminants or low abundances of unidentified lipids meant that it was not deemed appropriate to attempt identification.

Phase IV: Early Bronze Age

6.29 Approximately 80 naturally formed root boles were investigated across the excavation area, 13 of which were recorded (Fig. 3). These comprised small oval and sub-oval features, with uneven bases, and were all filled with a dark red-brown soil containing charcoal. No artefacts were recovered from these boles which, due to their small size (up to c.1m across), were probably formed by shrubs and/or small trees. Although no *in situ* burning was apparent around these features, it is assumed that they related to at least one episode of clearance.

6.30 One of these features (**26**; Fig. 3) produced two barley grains, 20 fragments of hazelnut shell and a small assemblage of charcoal (including hazel, willow/poplar, and ash). A fragment of charred hazelnut shell from its single fill (**27**) was submitted for radiocarbon dating. This returned a modelled date range of *1960-1760* cal BC (2σ; SUERC-68515, 3532±29), indicating the charring of hazelnut shell in the vicinity during the Early Bronze Age (Needham period 3 – see Needham *et al*. 2010, table 1).

Undated features

6.31 Two further cut features, (pit **61** and posthole **18**) potentially of an early prehistoric date, were also recorded (Figs. 3 and 6). Neither produced dateable artefacts or suitable material for radiocarbon dating.

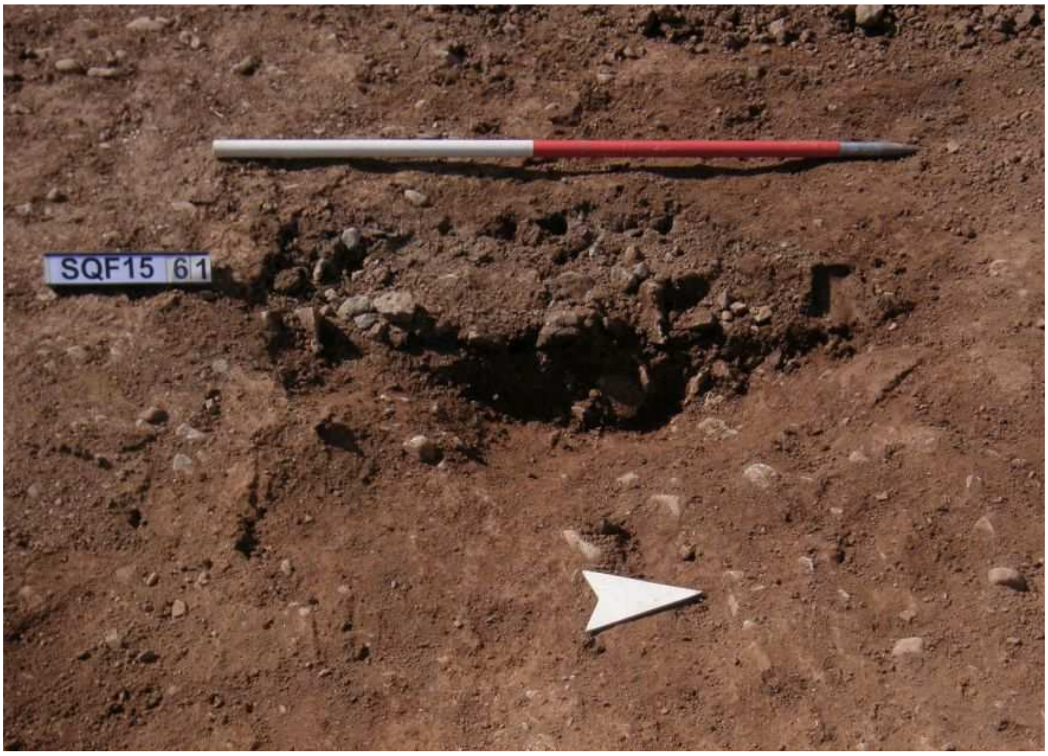

Plate 8: Pit 61

6.32 Pit **61** was in the vicinity of tree-throw **32** and outcrop **20**; it contained a large amount of angular (possibly heat-fractured) stone (Plate 8). The pit was shallow (up to 0.25m deep) with gently sloping sides and an irregular base, measuring 0.96m by 0.80m (Fig. 6, section C).

Plate 9: Posthole 18

6.33 A single posthole (**18**) was recorded beneath subsoil layer **3**, east of Trench 4 (Plate 9). It had a slightly irregular northern half with steep sides and a flat base that sloped more gently to the south, measuring approximately 0.30m by 0.55m and up to 0.20m deep. The single fill (**19**) of feature **18** was a dark reddish-brown silty clay with a small amount of moderately large sub-angular 'packing' stones. The presence of these stones and the 'classic' posthole shape of the feature indicated that it probably supported a post of some 0.20m in diameter.

7.0 DISCUSSION

Phasing, dating, residuality and the pottery

7.1 The archaeological investigations produced evidence that the site was a focus for deposition sometime during the 40th to 35th centuries BC (and possibly between the 39th and 36th centuries; Appendix H). Radiocarbon determinations also indicated an earlier presence sometime during the 46th to 45th centuries, as well as later activity during the Chalcolithic and the Early Bronze Age. Conversely, no evidence for a later Neolithic presence was recorded.

7.2 However, understanding how the Stainton Quarry dating evidence relates to the activities that produced the contexts, and the artefacts and ecofacts within, is crucial to the interpretation of the recorded remains (see the discussion on taphonomy below). It should always be remembered that archaeological contexts are rarely a snapshot of past activity (see Orton 2000, fig. 3.1; Gibson 2003, 140-1) and processes of formation and deposition are key to accurate interpretation.

7.3 It was clear during excavation that the darker deposits in pit **7**, the grykes and tree-throw **32** were different from the naturally formed lighter deposits. Most of these darker deposits contained a greater density of stones (some heat-affected), artefacts and ecofacts, as well as small lenses of charred material and redeposited natural clay. These suggested that the darker deposits were either deliberately backfilled (or dumped) into the features or had slumped into the features from above-ground piles of spoil and domestic waste (or middens).

7.4 In either scenario, and considering the range of material recovered from within them, the most likely interpretation is that the recorded contexts represented secondary (or tertiary) deposition from middens. These middens (or midden) could have derived from a nearby settlement beyond the excavated area. The presence of potentially contemporary postholes and a hollow, possibly the edge of a 'scoop house' (see below) on the very edge of the excavated area (in Trench 4), adds weight to this suggestion. Alternatively, the middens may have derived from some other activity, potentially ceremonial in nature.

7.5 The important point, however, is that there was most likely some mixing of material prior to (or during) deposition. This is a common phenomenon which is usually addressed either by assigning dating evidence as a *Terminus post quem* (TPQ) for deposition, or by statistical modelling (such as Bayesian) and careful interpretation.

7.6 At Stainton Quarry, 10 radiocarbon dates were measured from short-lived items recovered from concentrations of charred material to investigate the chronology of the macrofossils and, by inference, the deposition of the artefacts. Bayesian modelling was used to test residuality within the stratigraphical sequences as well as the different rates of deposition (see Appendix H). This modelling indicated that, in general, the dates matched the stratigraphical sequence. In addition, the span of deposition within tree-throw **32** was short, while the grykes seemed to have been infilled over some time. This matched the archaeological evidence relating to formation processes recorded on site.

7.7 Interestingly, the date from a charred grain from the mid fill (**35**) of tree-throw **32** did not seem to match the stratigraphical sequence. Additionally, the two grains from pit **7** could not have died in the same year. This was probably due to mixing prior to (or during) deposition as opposed to the dated material being intrusive. The samples were carefully selected and were not small lone abraded fragments and, therefore, were more likely to have close associations with the contexts they came from (see Waterbolk 1971). Additionally, where present, all but one of the radiocarbon dates matched the broad artefactual dating.

7.8 The evidence suggests that the artefacts from tree-throw **32** and deposits **31** and **48** (gryke A) were broadly contemporary with the charred material from the same contexts. Within the tree-throw, although there was some mixing of material prior to deposition, Bayesian modelling indicated potential rapid deposition and hence the radiocarbon dates are likely to be closely associated with the artefacts. Pit **7** was probably slightly later in date (37th to 34th centuries BC), possibly indicating that activity, including the charring of some of the grain within the pit, extended into the Middle Neolithic.

7.9 The single radiocarbon measurement that did not seem to match the artefactual dating was from a fragment of charred hazelnut shell from context **40**. Hazelnut shell is extremely robust once charred and this item is unlikely to date the pottery from that context accurately.

7.10 Bayesian modelling of the Phase II dates suggested that the pottery, polished axe fragments, the charcoal and charred grain recovered from Phase II contexts were deposited sometime between the 40th and 35th centuries BC. Additionally, the pottery from tree-throw 32 was probably deposited between the 40th and 37th centuries BC, though this may only represent a TPQ for its infilling. The Carinated Bowls from the grykes had likely TPQ's within the 38th to 37th (fill **31**) and 37th to 34th (fill **48**) centuries BC.

7.11 Importantly, the Bayesian modelling, and the suggested processes of deposition, indicate that the evidence for dairying can be assigned the same date ranges. Also, the pottery containing lipids recovered from the tree-throw potentially indicated that dairying took place sometime during the 40th to 37th centuries BC.

Environment, subsistence and permanence of place

7.12 Prehistoric remains previously recorded on the limestone ridge upon which the site was located, indicated activity during the Neolithic, Bronze Age and potentially into later prehistory (Dobson 1912; Evans 2008, 127). This area, however, was not an isolated island of occupation but was part of a wider pattern of utilisation of the varied landscapes of Furness and beyond (Evans 2008, 11).

7.13 There is not much direct data available to characterise Early Neolithic occupation within the Furness region (Evans 2008, 120). This is in part due to the small number of excavations and associated programmes of scientific dating and analysis undertaken to date. However, recent developer-funded projects, including work at Roose Quarry (Fig. 7, no. 3; Jones 2001; OAN 2014), Holbeck Park Avenue (Fig. 7, no. 4; OAN 2002; Evans 2018), Walney North End (Fig. 7, no. 2; Greenlane Archaeology 2015), Sandscale Haws (Fig. 7, no. 19; Evans and Coward 2004) and to the north-east of Stainton Quarry (Greenlane Archaeology 2012), have confirmed expectations that this region contains regionally, if not nationally, important evidence (Manby 1965, 3; Evans 2008, 118; Bradley *et al.* 2016, 143).

7.14 A combination of the antiquarian and modern evidence, as well as fieldwalking and palaeoenvironmental data (and the reconstruction of the ancient coastline), have provided a broad (if blurry) characterisation of the area during the transition into the Early Neolithic period (Hodgkinson *et al.* 2000, 35-6; Evans 2008, 118-39; Appley 2012). Pollen core evidence from Urswick Tarn (Fig. 7, no. 8; Oldfield and Statham 1963) and the Sarah Beck Valley (Fig. 7, no. 9; Appley 2012) has demonstrated minor disturbances within the extensive woodland cover prior to the more widespread changes associated with the 'elm decline'. A lack of cereal pollen and associated weed seeds, and the presence of plantain and grasses, led to the suggestion that these early clearances were for the grazing of domestic animals rather than for the cultivation of crops (Oldfield and Statham 1963; Hodgkinson *et al.* 2000, 35; Evans 2008, 126; Appley 2012, 209).

7.15 The nature of this woodland, however, was likely different upon the Furness limestone uplands than the lower-lying coastal sandstones (Spikins 1999). It has been predicted that, during the terminal Late Mesolithic (c.6000 BP; c.5000-4700 cal BC), ash-dominated woodland was present in the limestone uplands and oak predominated in coastal areas (Spikins 1999, fig. 5.17). These woodlands, however, were unlikely typified as the closed canopy forests suggested by early palynological studies (Evans 2008, 19; Simmons 2003, 23), especially in more upland areas (Simmons 2003, 43). Furthermore, the poor soil-cover (Simmons 2003, 167; Evans 2008, 125) in the limestone areas around Stainton Quarry would have supported a more open woodland than in the lowlands. Charcoal identifications at Stainton Quarry (Appendix F) complemented this evidence, with willow or poplar, oak, hazel (and possibly alder), rose-family and guelder rose being recovered from contexts likely dating to the Early Neolithic. Single fragments of birch and heather charcoal, while potentially intrusive, also suggested a presence of these species.

7.16 The coastal zone (Fig. 7) potentially included areas of wetland, fens, reed swamps, salt marshes and alder carr (Oldfield and Statham 1963; Evans 2008, 23; Appley 2012, 92). This variety of Early Neolithic habitats would have provided a diversity of potential resources within a relatively small area (the peninsula being just 13km across at its widest). However, questions regarding Early Neolithic subsistence are hampered by a dearth of well-dated evidence (Hodgkinson *et al.* 2000, 35; Hodgson and Brennand 2006, 31-2; Bishop *et al.* 2009, 77; Milner 2010, 47), issues of taphonomy (Rowley-Conwy 2000; 2004, 88; Jones and Rowley-Conwy 2007; Milner 2010, 49; Bishop *et al.* 2009, 79-82) and complex regional variability (Cooney 2007; Milner 2010, 52; Bishop *et al.* 2009, 89-90).

7.17 Prior to the excavations at Stainton Quarry and other recent developer-funded excavations (Jones 2001; OAN 2002; 2014; Evans 2018), the evidence relating to the transition to the Early Neolithic within the Furness coastal mosses was limited to antiquarian investigation, collections of fieldwalked flint and other surface finds (Evans 2008, 120-1). This situation can be paralleled with similar landscapes along the western coast of Cumbria (Hodgkinson *et al.* 2000, 155) and on the opposing side of Morecambe Bay in the Over Wyre Mosslands, especially at Pilling Moss (Fig. 8, no. 35; Middleton *et al.* 1995, 56). Due to the similarities between Late Mesolithic and Early Neolithic lithic assemblages, the actual nature of Early Neolithic activity in these areas has proved elusive (Hodgkinson *et al.* 2000, 36; Evans 2008, 31). As a result, distributions of the Neolithic 'type-fossil', the polished axe-head, have been used as a convenient, if imprecise, proxy (Hodgkinson *et al.* 2000, 36).

7.18 Along the south-western coastal strip of Cumbria, Mesolithic/Neolithic landscapes analogous to the Furness Mosses have been characterised through surface collections (Evans 2008, 126), pollen cores (Evans 2008, 23-4), the antiquarian excavations at Ehenside Tarn (Fig. 8, no. 33; Darbishire 1873; Hodgkinson *et al.* 2000, 71-4) and later investigations close to Williamson's Moss (Fig. 8, no. 34; Bonsall *et al.* 1994; Hodgkinson *et al.* 2000, 71). During the North Lancashire section of the North West Wetlands Survey (Middleton *et al.* 1995), extensive transects of pollen cores and a programme of fieldwalking undertaken across the Over Wyre peatlands complemented previously recorded Early Neolithic evidence (Sobee 1953; Middleton *et al.* 1995, 56-60). Similarities in the pollen evidence and stone tools, along with continuity in the locations of activities within these coastal mosses, led to the idea that patterns of subsistence and occupation changed little during the transition to the Early Neolithic (Hodgkinson *et al.* 2000, 152-5; Middleton *et al.* 1995, 203-4). However, it was stated that the data likely represented only a partial pattern of occupation and exploitation in these areas (Hodgkinson *et al.* 2000, 155).

7.19 With respect to national patterns, the suggestion that early farmers largely continued a 'Mesolithic way of life', utilising mainly wild resources while constantly on the move through the landscape (e.g., Thomas 1999, 29; 2008), does not stand up to a growing weight of evidence for settled agriculture (Rowley-Conwy 2004; Lancaster 2009, 46-50; Sheridan 2010, 98). Interestingly, however, Sheridan's (2010) model of a series of waves of immigrant farmers settling amongst native hunter/gatherer/fisher populations raises the likelihood that both (or indeed a variety of) subsistence strategies existed side by side during the early centuries of the transition (*ibid.*, 101).

7.20 In the Furness Peninsula, and indeed the wider Cumbrian region, few sites have provided actual evidence of Early Neolithic subsistence. As a result, the data recovered at Stainton Quarry, though limited when compared to more prolific Scottish sites, such as Warren Field (Fig. 8, no. 15; Murray *et al.* 2009) and Balbridie (Canmore no date), is not inconsequential. This dearth of evidence should not, however, be considered evidence of an absence (Sagan 1995, 213). Cumbria as a whole suffers from a lack of large-scale open-area excavation. Furthermore, as prehistoric remains are often invisible to commercial prospecting techniques (especially low-density trial-trenching; see Hey and Lacey 2001, 58-9), the evidence recovered to date is almost certainly unrepresentative of past activity.

7.21 A total of 121 fragments of charred hazelnut shell, 70 cereal grains and eight fragments (1.6g) of indeterminate bone were recovered from the Phase II contexts recorded at Stainton Quarry. These items comprise little more than a couple of handfuls of fragments but represent the largest Early Neolithic palaeobotanical assemblage recovered from Furness, and potentially Cumbria, to date. Additionally, even in the unlikely event that each hazelnut fragment represented a single nut, the entire assemblage could have easily been brought to the site from elsewhere. It should be remembered, however, that the density of material within the deposits (especially contexts **8**, **33** and **35**) was high and that these were likely just the surviving remnants of a much larger accumulation of waste (see Rowley-Conwy 2000, 49-51) from a wider area of activity (see Taphonomy and interpretation below).

7.22 Organic residue analysis of 17 pottery sherds produced evidence for the routine processing of dairy fats from nine samples (Appendix G). This represents the first evidence of Early Neolithic dairying in Cumbria and complements studies at a timber hall at Warren Field, Aberdeenshire (Šoberl and Evershed 2009), a 'scoop house' at Garthdee Road, Aberdeen (Fig. 8, no. 16; Cramp 2014, 50-3), as well as a larger study of northern sites (Cramp *et al.* 2014). Conversely, these results differed from analysis undertaken on pottery sherds recovered from Oversley Farm, Cheshire (Fig. 8, 30; Dudd and Evershed 2007).

7.23 The Stainton Quarry evidence suggested that the residents who produced the Early Neolithic deposits were engaged in cereal production and animal husbandry (including the use of secondary products), as well as the consumption of hazelnuts. In short, the inhabitants were engaged in a mixed farming strategy with an element of utilisation of wild resources. The combined subsistence data, with taphonomical considerations in mind (Bishop *et al.* 2009, 79-82), was in line with the evidence for mainland Scotland and seems to fit well within wider studies that propose there were some settled farming communities in some regions of the UK during the Early Neolithic (Bishop *et al.* 2009, 90; Sheridan 2010, 98). However, these models do include elements of variability in both the subsistence strategies pursued and how these changed with time.

7.24 Previous studies of Early Neolithic settlement and subsistence within Furness (Evans 2008, 118-39; Appley 2012, 211) were undertaken before the Stainton Quarry investigations and hence were based largely on surface finds, pollen evidence and small amounts of excavated material recovered from Holbeck Park Avenue (OAN 2002; Evans 2018) and Roose Quarry (Jones 2001; OAN 2014). Evans combined the available antiquarian, environmental, monumental, topographical and fieldwalking data to suggest a pattern of transitory occupation between coastal and upland areas (Evans 2008, 126). This model comprised shifting settlement patterns across the coastal scarps and ridges, with valley-focused clearances for pasture inland. Upland sites located close to water sources may have been associated with woodland management, grazing, or hunting, while arable agriculture may have been carried out on the coastal glacial sands (*ibid*.). A burial/ceremonial focus was suggested on the limestone uplands around the Urswick Valley (*ibid*., 127), along with the deposition and possibly exchange of axes, as well as hunting and grazing associated occupation (*ibid*., 128).

7.25 The evidence recorded at Stainton Quarry, whilst not entirely contrary to this model, suggested that the area around Stone Closes (Dobson 1912) may have been a long-lived focus of activity. The palaeobotanical remains and residue analysis indicated that the Early Neolithic inhabitants followed a mixed subsistence strategy, but this does not necessarily indicate permanent occupation at this location (but see Rowley-Conwy 2004). However, the dating results, in combination with previously discovered evidence in the vicinity, do at least suggest a repeated presence, and therefore a permanence of 'place' (Bailey 1999, 97; Gibson 2003, 142; Milner 2005, 36).

7.26 The Stone Closes enclosure, while undated, incorporated areas of outcropping limestone similar to those recorded during the Stainton Quarry investigations (Dobson 1912). This utilisation of natural outcrops was mirrored at Skelmore Heads, near Urswick Tarn (Fig. 8, no. 21; Powell 1963) and Howe Robin, near Orton (no. 38; Oswald *et al*. 2001, 159) and is a common characteristic of the Neolithic 'tor enclosures' of South West England (*ibid*., 86). None of the Cumbrian enclosures have been proven to be Neolithic in date (*ibid*., 159), but the circumstantial association of finds of a Neolithic and Bronze Age date (Dobson 1912) at Stone Closes suggest it was in an area that was a focus for early prehistoric activity. Similarly, lithic (including axe fragments) and ceramic finds around and within the Howe Robin enclosure (Cherry *et* *al*. 1985; Evans 2008, 180) hint at a similar situation on the eastern fells of the Lake District (Evans 2008, 38).

7.27 It would therefore be tempting to suggest that Stone Closes was in fact an Early Neolithic enclosure (similar to a tor enclosure), defining either an area of occupation (Dobson 1912; Oswald *et al*. 2001, 124-6) where stone axes may have been polished (Manby 1965, 4; Evans 2008, 30; Bradley and Edmonds 1993, 92, 144; Edmonds 2004) or a ceremonial area linked to the deposition and exchange of stone axes (Evans 2008, 128; Bradley and Edmonds 1993, 50-2).

Taphonomy and interpretation

7.28 The association of artefacts and cremated bone with natural features, such as caves or limestone fissures, has often been attributed to burial or ceremonial traditions (Barnett and Edmonds 2002; Edmonds and Evans 2007, 135; Evans 2008, 128). Indeed, direct early prehistoric (and Bronze Age) evidence has been recorded at Bart's Shelter (Fig. 7, no. 6; Hodgkinson *et al*. 2000; Evans 2008, 128) and Bonfire Scar Cave (Fig. 7, no. 7; Atkinson 1927; Evans 2008, 128). Equally, at Allithwaite, near Grange-over-Sands (Fig. 8, no. 5; Wild 2003), Collared Urns and cremations were deposited within several grykes. Furthermore, the deliberate breaking of polished stone axes and/or their deposition either within pits or grykes (Bradley and Edmonds 1993, 166; Edmonds and Evans 2007, 135-7; Evans 2008, 127) has been suggested to be part of a wider tradition of deposition (Thomas 1999; 2012, 5-9; Pollard 2001; Garrow 2006, 59; 2007, 11-2, 14).

7.29 At Sizergh Fell, a ground stone axe, three flakes and an upturned polissoir were recovered from within a gryke in the vicinity of a cairn (Fig. 8, no. 6; Edmonds and Evans 2007, 122-3). This cairn contained Early Bronze Age remains but also produced human bone that was radiocarbon dated to 3790-3650 cal BC (Edmonds and Evans 2007, 130) suggesting reuse of an earlier ceremonial site (Evans 2008, 103). This longevity of the use of certain locations for burial and ceremonial activities has been highlighted as a common occurrence in Cumbria (Evans 2008, 115-6). Another Bronze Age burial site, Birkrigg Disc Barrow (Fig. 7, no. 11; Dobson 1927), with potential Neolithic phases of activity (Evans 2008, 103) was recorded on the limestone upland of Birkrigg Common.

7.30 Similar 'caches' of axes and associated material have been recorded close to several Cumbrian burial monuments (Evans 2008, 117), including the Skelmore Heads long cairn, near Urswick (Fig. 7, no. 7). Interestingly, similar caches were potentially recorded within the Stone Closes enclosure (Dobson 1912) and at High Haume, to the north of Dalton-in-Furness (Fig. 7, no. 12; Evans 2008, 127).

7.31 This evidence seems to suggest that the remains recorded at Stainton Quarry resulted from a similar tradition. The prominent location upon the southern limit of a limestone ridge, its proximity to a potential spring (see Wild 2003, 43; Evans 2008, 83, 112-3), the potentially contemporary nearby enclosure at Stone Closes, the deliberately broken stone axes and the mix of material recovered from the grykes, could all be interpreted as evidence for 'meaningful' deposition as part of some form of ceremonial activity (Becket and MacGregor 2012, 61).

7.32 As stated above, however, the interpretation of the Stainton Quarry evidence is problematic without careful assessment of the associated processes of formation and taphonomy. Failure to do so would result in a misreading of the data, which was, by the nature of the project and the evidence itself, skewed by several factors.

7.33 Indeed, the whole process of interpreting past activities from the results of an archaeological excavation is fraught with difficulties that arise from a variety of skewing factors (see Orton 2000, 40 and figs 3.1 and 3.7). This is largely due to the fact that, as archaeologists, we are attempting to understand people who (for the most part) existed above ground from their below-ground remnants (Wilson 2000).

7.34 In the case of Stainton Quarry, as is common on many prehistoric sites in Cumbria and further afield (Hall and Huntley 2007, 27), the soils were not favourable for the preservation of animal bone or other organic remains. This was especially evident in the poor condition of the few fragments that were recovered (Appendix F). Consequently, the bone (animal and possibly human) recovered during the investigations probably under-represents the totality produced by activities undertaken in the vicinity of the excavation.

7.35 It was apparent from the distribution of potentially contemporary features, especially the post- and stakeholes (**18**, **408** and **412**), that the focus of activity may have been to the east, just beyond the excavated area. This raises the possibility that further features relating to occupation structures and/or burial/ceremonial practices may exist outside of the excavated area. Also, even though there was no direct evidence of ploughing across the site, the deep topsoil (up to 0.3m) and former soils (up to an additional

0.3m) that sealed many of the features (especially along the eastern edge) indicated that the area must have been under the plough at some stage. These factors suggested that the recorded features may have been part of a wider area of activity and that they were likely truncated. Additionally, past ploughing may have removed or dispersed any associated above ground remains and/or shallow cut features.

7.36 Interestingly, the majority of the deliberately cut features did not produce finds and the concentrations of pottery, worked stone, burnt bone and charcoal were mostly within secondary (or even tertiary) contexts in the upper portion of tree-throw **32** and sinkholes within the grykes. These deposits, especially contexts **31**, **38** and **39**, were mixed, containing lenses of differently coloured silt, sand and clay. The artefacts and stones within these deposits were not 'placed' but followed a complex series of tip lines. The measured radiocarbon dates and Bayesian modelling also indicated (some) levels of residuality among the ecofacts contained within.

7.37 This could indicate that the deposits were shovelled or, in the case of the gryke deposits, had possibly slumped into the features, either from different sources (spoil heaps) or from a source that was already mixed (or layered), such as an above ground midden. The presence of such 'pre-pit contexts' has been suggested by Garrow (2006, 40) during his extensive investigation into the Neolithic pits of East Anglia. Garrow (2006, 36) also stated that the artefacts within the Early Neolithic pits were a mix of occupational waste that had been dumped as a mass of material rather than being placed. This lack of 'structure' within the deposition was similar to that recorded at Stainton Quarry, but was not necessarily the result of ceremonial behaviour (Rowley-Conwy 2003, 124; Harding 2006, 109; Bishop *et al.* 2009, 84; Rowley-Conwy and Owen 2011, 352; *contra* Pollard 2001, 323; Garrow 2006, 36; Thomas 2012, 5).

7.38 The idea of above ground piles of waste around areas of human occupation of any period, prior to the organised waste removal services of the modern world, should not be problematic (e.g. see Gibson 2003, 140; Tipper 2004, 157-9; Garrow 2006, 38; Millett 2006, 25, 79 and 89). Indeed, a mixed soil matrix containing abraded pottery sherds, pitchstone, flint, quartz and charred hazelnut shells recorded at The Carrick, on the banks of Loch Lomond, was potentially a remnant of an Early Neolithic midden (Fig. 8, no. 14; Becket and MacGregor 2012, 57). Anyone who has camped for any length of time away from the convenience of toilet blocks and rubbish bins will be well aware that human activity, whether short term or not, creates waste. Repeated or longer-term activity, therefore, would create piles of waste (middens) and, without a formal organised system of removal and disposal, these middens would linger until the destructive farming practices of later periods (see Manby *et al.* 2003, 70).

7.39 This probability that the deposits recorded at Stainton Quarry were either intentionally backfilled from another source or were part of the natural slumping of a midden is crucial in interpreting the artefacts, the activities that produced them, and the meaning of their deposition. Indeed, this consideration would seem to help explain the distribution of finds across bedrock outcrop **20**, as well as the dearth of similar material in similar solution features in the other areas of the site.

7.40 Another important factor to consider when interpreting the remains is the duration of deposition, and especially potential differences between contexts. Estimated spans of activity produced by Bayesian modelling of the radiocarbon dates from the grykes, tree-throw **32** and pit **7** has suggested that each was infilled over differing periods of time. The duration over which the gryke deposits formed was potentially more than 2000 years. This time span may, in part, be due to the mixing of material prior to deposition. However, considering the associated formation processes, including solution features and sinkholes, a long duration of deposition seems likely.

7.41 Conversely, the modelling associated with the three dates from tree-throw **32** indicated an estimated duration of infilling of between less than a year and up to 695 years, indicating a very different duration. These demonstrate marked differences that are fundamental to interpretation of the site. For instance, the material within tree-throw **32** is possibly more of a chronological 'snapshot' of activity in the vicinity, whereas the artefacts and ecofacts recovered from the grykes are representative of a much longer time span.

Inter-site comparison

7.42 With these factors in mind, what can the artefacts and ecofacts recovered and the landscape setting (geological, topographical and ecological; see Gibson 2003) of the site tell us about the activity undertaken? In particular, if the deposits are redeposited waste from something carried out beyond the excavated area, can the nature of the deposits and the composition and density of the finds be used to interpret the nature of this activity?

7.43 In other words, as the Stainton Quarry features and deposits are probably on the periphery of either a settlement, a ceremonial/burial area, or indeed, both, can comparison with other previously recorded sites inform us what is likely to have existed beyond the excavated area?

7.44 Additionally, can the landscape setting (see Cooney 2003, 52; Gibson 2003, 136) of the Stainton Quarry site, when compared to regional patterns, be used to infer the types of activities undertaken?

7.45 To investigate these possibilities, a holistic comparison (*ibid*.) with selected Early Neolithic sites recorded at a variety of locations within North Wales, north-western England, south-western and central Scotland, the Isle of Man and north-eastern Ireland was made. It should be noted that this comparison was not a comprehensive overview of all the current evidence in this region; such a study was beyond the scope of this project.

Site selection

7.46 The majority of the comparison sites were selected because they lay within an exchange zone evident from the presence of 'imported' items, such as pitchstone from Arran, Group VI stone axes from the Langdale quarries, Yorkshire flint, and occasionally porcellanite axes (Group XI) and Antrim flint from Northern Island (Bradley *et al*. 2016, fig. 16), as well as rarer jadeite axes from Europe. Bradley *et al*. (2016) theorised that concentrations of early prehistoric finds at several coastal locations associated with possible 'maritime havens' (Bradley *et al*. 2016, 143, fig. 11) indicated the presence of prehistoric sites that were key to this exchange network (*ibid*., 125, 152). These included remains recorded at: Walney North End, in Furness (Fig. 7, no. 2); Luce Sands, Dumfries and Galloway (Fig. 8, no. 28); and the Irvine complex, North Ayrshire (Fig. 8, no. 29).

7.47 Further evidence for such a network was recorded during recent excavations at Stainton West, near Carlisle (Fig. 8, no. 36; OAN 2011). Worked lithics from a variety of sources were recovered from deposits within and adjacent to a palaeochannel that spanned the Late Mesolithic to the Late Bronze Age; however, the majority were of a Late Mesolithic date. This material included local beach-pebble flint, Carboniferous chert (potentially from the north of England), chert from the Southern Uplands of Scotland, flint (probably from north-east England), pitchstone from Arran, tuff from the English Lake District and limestone (probably from sources close to the site) (OAN 2011, 35).

7.48 All of the sites identified by Bradley *et al.* (2016), similar to the Stainton West remains, included evidence for longevity of use, hearths or structures, Early Neolithic pottery, imported artefacts and evidence for artefact production.

7.49 The Stainton Quarry material was also compared with remains recorded at a timber hall at Warren Field, Aberdeenshire (Fig. 8, no. 15; Murray *et al.* 2009), a nearby scoop house at Garthdee Road, Aberdeen (Fig. 8, no. 16; Murray and Murray 2014) and an Early Neolithic structure at Oversley Farm, Cheshire (Fig. 8, no. 30; Garner 2007) due to the analyses of absorbed residues within pottery recovered from these three sites. Few Cumbrian Early Neolithic burial monuments have been excavated using modern techniques. Therefore, comparisons were made with the long cairns at Skelmore Heads (Fig. 7, no. 10; Powell 1963) and Raiset Pike (Fig. 8, no. 22; Greenwell 1877), and the more extensively investigated site at Willerby Wold, East Riding of Yorkshire (Fig. 8, no. 23; Manby 1963).

7.50 It has been stated that the distinction between a Neolithic 'settlement' and a burial, ritual, or ceremonial site may not have been as important to the creators as it seems to modern observers (Thomas 1996, 7-8; 2004; 2007, 265; Brück 1999; Gibson 2003, 136). However, like their Mesolithic predecessors (see Bailey and Spikins 2008), Early Neolithic people of the UK and Ireland (regardless of their subsistence strategy) did create settlements (Gibson 2003). To suggest otherwise would be a rejection of the available data. Whether these were temporary camps, semi-permanent and/or permanent farmsteads (Pollard 2000, 36; Armit *et al.* 2003b, 1-2; Cooney 2003, 47; Rowley-Conwy 2004, 93; Sheridan 2010, 97-8) or even villages (Rathbone 2013) can be elucidated only on a site-by-site basis through a vigorous interrogation of the evidence.

7.51 The dead (or at least a portion) were burnt or buried at timber mortuary structures, which were often covered by long cairns and long barrows (Sheridan 2010, 98). In addition, evidence for structured deposition and formal burial within natural features, such as caves and fissures exists (Evans 2008, 128).

7.52 The oversimplification of archaeological remains into these broad categories can sometimes obscure the nuances of the data, but to reject all classification is equally unwise. Therefore, for this analysis, burial sites were defined as recognised monuments (long cairns/barrows) or concentrations of human remains, burial urns and/or pyre deposits. Questions regarding potential 'structured deposition' were addressed on a site-by-site basis using all the available evidence.

7.53 Settlement sites were defined as areas with occupational evidence, including hearths, structures and domestic waste. The temporality or permanence of these settlements was, however, very difficult to define without complementary evidence (Milner 2005). Whilst these functionalist classifications were useful for comparing and contrasting the available data with the Stainton Quarry evidence, they are not meant to suggest that occupation did not occur at burial sites (see Manby 1963) or that ritual behaviour was not undertaken at settlements (see Murray *et al*. 2009, 39-40).

Was Stainton Quarry a burial site?

7.54 As mentioned above, deposition within grykes at Sizergh Fell and Allithwaite was undoubtedly ceremonial in nature, given the associated burial remains. However, although some of the small fragments of calcinated bone recovered at Stainton Quarry could have been human, they were not within formal pyre debris nor did they comprise discrete burials (McKinley 2003, 29).

7.55 The fragments of burnt bone were only recovered from the gryke deposits and were 'dispersed' throughout contexts **31**, **48** and **39** along with other material. Therefore, they could have been inconsequential inclusions. The presence of the bones does raise the possibility that people were cremated somewhere in the vicinity; however, their fragmentary state prevented definitive species identification. It is just as likely that all of the calcinated bone derived from animal bones burnt on domestic fires (see Snoeck and Schulting 2013).

7.56 The presence of small amounts of calcinated bone (whether human or animal), however, does not indicate a particular type of Early Neolithic site. Deposits of Early Neolithic cremated human bone have been recorded at burial sites, including the Raiset Pike 'crematoria' long cairn (Greenwell 1877, 511). The primary burial deposits at this site were markedly different than the deposits at Stainton Quarry; however, a second trench excavated by Greenwell '8ft from the south-east end of the mound…' (*ibid*.) produced deposits of burnt earth, burnt stones, charcoal and two small fragments of indeterminate calcinated bone. More recent excavations of similar monuments, such as those undertaken at Willerby Wold, East Riding of Yorkshire (Manby 1963), have demonstrated the presence of a variety of deposits, including potential 'offerings', as well as occupational debris (*ibid*., 183-4).

7.57 Similarly, surface collections of lithics, including axe fragments in the vicinity of the Raiset Pike long barrow (Cherry and Cherry 2002, 9) and the surrounding eastern fells (e.g., Bank Moor) are suggestive of Late Mesolithic and Neolithic upland occupation (Evans 2008, 38). Therefore, it is highly likely that upland domestic sites existed in close association with the monuments in this area (Helen Evans pers. comm.).

7.58 Assemblages of fragmentary calcinated bone were also recovered from a cluster of Early Neolithic pits recorded at Maybole, South Ayrshire (Fig. 8, no. 9; Becket and MacGregor 2009). These features produced deposits containing comparable assemblages of occupational waste to those recorded at Stainton Quarry. This, combined with the presence of a possible hearth, led to the interpretation that this was an occupation site where a wide range of activities, including utilisation of the surrounding landscape and cremation of humans, may have been undertaken (*ibid*., 118-20).

7.59 Assemblages of small fragments of dispersed calcinated bone were also recovered from a cluster of early prehistoric pits recorded at New Cowper Quarry on the Abbeytown ridge near Silloth, Cumbria (Fig. 8, no. 7; North Pennines Archaeology 2007, 24-6). Further afield, a fragment of burnt bone was retrieved from a posthole (102) recorded at the Holywood North cursus, Dumfries and Galloway (Fig. 8, no. 12; Thomas 2007, 181).

7.60 Concentrations of burnt bone have also been recovered from settlement sites including features at Biggar Common (indeterminate), Clydesdale, South Lanarkshire (Fig. 8, no. 13; Johnston 1997, 199), an Early Neolithic structure recorded at Oversley Farm (indeterminate), Cheshire (Fig. 8, no. 30; Smith 2007) and timber halls recorded at Lockerbie Academy (probable animal and human), Dumfries and Galloway (Fig. 8, no. 26; Kirby 2011), Claish (indeterminate mammal, pig and red deer), near Callander (Fig. 8, no. 11; Barclay *et al*. 2002), Warren Field (indeterminate mammal) (Murray *et al*. 2009, 46) and Balbridie (minute fragments), Aberdeenshire (Canmore no date).

7.61 In Ireland, pits recorded at Balgatheran 1, County Louth (Fig. 8, no. 27; Chapple 2005, 36; forthcoming) and a series of large, shallow pits/depressions recorded at the long-lived settlement site at Ballyharry, County Antrim (Fig. 8, no. 25; Moore 2003, 158), produced cremated human bone and assemblages of burnt bone respectively. At Llandygai, near Bangor, North Wales, tiny fragments of burnt bone (mostly unidentifiable) were recovered from postholes and pits associated with a rectangular timber building radiocarbon dated to between 3760-3700 cal BC and 3670-3620 cal BC (Fig. 8, no. 18; Kenney 2008, 16). A similar site discovered at Llanfaethlu, Anglesey contained evidence for three Early Neolithic structures, as well as a cremated ovine or possibly cervid leg joint (Fig. 8, no. 17; Rees and Jones 2015, 2).

7.62 The remains recorded at these sites demonstrate the difficulties in interpreting what activities were undertaken using solely recovered artefacts and ecofacts. Therefore, the discovery of small amounts of calcinated bone does not necessarily indicate the presence of a burial/ceremonial site, such as a crematoria long barrow. Conversely, the artefacts recovered at Willerby Wold suggested that the presence of occupational debris alone cannot be used to rule out ceremonial activity.

Was the deposition of axes at Stainton Quarry ceremonial or 'structured'?

7.63 The seemingly ceremonial deposition of a polished axe and related items at Sizergh Fell (Edmonds and Evans 2007, 123) was markedly different from that at Stainton Quarry. At Sizergh, the collection of related items was placed near the top of a gryke on the surface of a 'sterile' natural deposit (Helen Evans pers comm.). Conversely, at Stainton the axe fragments were within a mixed matrix of soil, sand, clay, charcoal and other artefacts.

7.64 Both of the Stainton Quarry axes were finished items that had been deliberately broken across their width, potentially to form a platform from which flakes were struck. One of the axes (RF 4) had been reworked prior to this, possibly to repair damage sustained during use. Such deposition of deliberately broken axes is sometimes attributed to ceremonial traditions (Bradley and Edmonds 1993, 52, 166; Williams and Kenney 2009; Becket and MacGregor 2012, 58). However, the 'mundane' reuse of broken axes as rubbers or hammerstones (Manby 1965, 16-7) and the retouching of detached flakes into tools, such as scrapers (*ibid*.; Bradley and Edmonds 1993, 48; Evans 2008, 30), are well documented. Working of tuff beach pebbles and material derived from glacial till has also been recorded (Evans 2008, 28).

7.65 In the Stainton area, a tuff end scraper was discovered to the south of the quarry (Evans 2008, 127) and, further afield, a pit excavated at Carzield, near Kirkton, Dumfriesshire (Fig. 8, no. 8; Maynard 1993, 27), contained an axe flake reworked into a scraper. Additionally, during investigations at Luce Sands (Coles *et al.* 2011; Bradley *et al*. 2016, 136-7), an axe fragment reworked into a scraper was recovered along with Carinated Bowl fragments and worked flint.

7.66 This suggests that the axe heads recovered at Stainton may have been broken to reuse the stone to produce flakes for tool manufacture. Consequently, their disposal could have been as mundane as the discarding of any fragment of debitage. Their inclusion with other 'domestic waste' may have therefore been completely coincidental.

Was Stainton Quarry a settlement?

7.67 The range (or diversity) of artefacts (see Orton 2000, 171-6) and ecofacts recovered at Stainton Quarry was representative of the debris recovered from Early Neolithic occupation sites previously recorded in Cumbria and the wider Irish Sea fringe. The small number of worked lithics, however, casts some doubt on this comparison. Long-lived early prehistoric settlements would have produced large volumes of debitage and discarded tools; indeed, such concentrations recovered during fieldwalking are used to infer occupation. It should be remembered, however, that distribution of lithics across a site need not be even. At Oversley Farm, for instance, few of the Early Neolithic features contained any worked flints, whereas a lithics scatter, c.7.5m by 6m in size, to the north of a structure produced 216 flints and was considered to be an Early Neolithic knapping floor (Garner 2007, 12-5, 22-5).

7.68 In recent years, numerous Early Neolithic occupation sites have been recorded in Scotland and north-eastern Ireland (Armit *et al*. 2003c, 1; Barclay 2003, fig. 8.1; Sheridan 2010, 91), as well as a growing number in Wales (Kenny 2008, 26) and on the Isle of Man (Darvill 2003, 115-6). Although dispersed over some considerable distance, similarities in the structures recorded, as well as the artefacts and ecofacts recovered at these sites, have led to the suggestion that these settlements are part of a similar tradition of Early Neolithic occupation (Sheridan 2010, 97), as well as an extended network of exchange (Bradley and Edmonds 1993, 40; Bradley *et al*. 2016, fig. 16, 152).

7.69 These settlements fit into three broad categories: those with timber halls; sites with smaller structures (Sheridan 2010, 97); and 'pit sites' (Rowley-Conwy 2004, 93). The latter range from individual pits containing domestic waste to clusters of pits with associated stake- and postholes and/or hearths, and a few with structural slots (see feature C605 recorded at Gransha site 12 – Chapple 2005, fig. 12). These categories are not rigid, however, and the possibility that some 'pit sites' may have originally had structures with shallow foundations that were destroyed by later ploughing cannot be discounted (see Gibson 2003, 137; Rowley-Conwy 2004, 93).

Timber halls

7.70 The timber hall sites of Scotland, Wales and Ireland are undoubtedly settlements (Armit *et al.* 2003b, 1-2; Cooney 2003, 50; Rowley-Conwy 2004, 93-6; Sheridan 2010, 97) and are likely indicators of occupation of some permanency (Rowley-Conwy 2004, 96; Murray *et al.* 2009; Sheridan 2010, 97). These sites are typified by the presence of postholes and/or construction slots of rectangular or sub-rectangular structures and include examples recorded at Ballygalley (Simpson *et al.* 1990) and Ballyharry, Co. Antrim (Moore 2003), Lockerbie Academy, Dumfries and Galloway (Kirby 2011), Claish, Stirling (Barclay *et al.* 2002), Balbridie and Warren Field, Aberdeenshire (Murray *et al.* 2009), Llandygai, near Bangor, North Wales (Kenney 2008, 16) and Llanfaethlu, Anglesey (Rees and Jones 2015, 2).

7.71 In contrast to the Stainton Quarry remains, however, all of these timber halls were in lowland settings. The Scottish sites were all located on sand and gravel river terraces, while the Irish and Welsh examples were on glacial tills located either on river valleys or close to the coast. Pits with deposits and assemblages of artefacts/ecofacts comparable to those recorded at Stainton Quarry were recorded at some of these sites. However, all of the timber halls produced larger pottery assemblages, with at least 45 to 60 vessels being identified.

7.72 It therefore seems unlikely that the Stainton Quarry remains derived from a similar type of settlement. To date, no timber halls have been recorded in Cumbria. This could be a ‘true’ distribution, as the current evidence for Neolithic settlement displays regional diversity (Cooney 2003, 46). Equally, this lack of halls could merely be a function of the dearth of large-scale excavations undertaken in Cumbria. The closest excavated evidence for substantive Early Neolithic settlement to Stainton Quarry comprises the Walney North End shell middens (Cross 1938; 1939; 1942; 1946; 1947; 1949; 1950; Barnes 1955; Evans 2008, 120; Greenlane Archaeology 2015) and discoveries made at Ehenside Tarn (Manby 2007). Both of these sites suffer from differing levels of excavation and recording, as well as differing levels of preservation. Neither was subject to excavation under modern standards of sampling and recording and, although important assemblages of artefacts were recovered, both are poorly understood.

Smaller structures

7.73 A growing number of smaller Neolithic (and Mesolithic) structures, comparable to European examples (see Sørensen 2009), have been recorded throughout Britain and Ireland (Darvill 1996, fig. 6.5; Grogan 1996, fig. 4.3 and 4.4; Barclay 2003; Sheridan 2010, 97; Murray and Murray 2014, 57). These sites include those constructed around an oval or amorphous 'scoop', or structures represented by clusters of post- and stakeholes. Four examples were included within the comparative analysis, one at Garthdee Road, Aberdeen (Murray and Murray 2014, 57), a settlement recorded at Biggar Common (Johnston 1997), a structure at Oversley Farm, Cheshire (Garner 2007), and a group of scoops, pits and shafts recorded at Billown, Isle of Man (Fig. 8, no. 24; Darvill 2003).

7.74 The Garthdee Road structure (Murray and Murray 2014) was recorded on a river terrace formed of gravel and sand to the east of Balbridie and Warren Field timber halls. In total, 709 sherds of pottery (4.8kg; a minimum of 34 vessels), 409 worked flints, two fragments of polished stone axes, 118 charred cereal grains, 82 fragments of charred hazelnut shell and a small amount of calcinated bone were recovered. Analysis of absorbed residues within several pottery sherds identified dairy fats in five samples (Cramp 2014).

7.75 At Biggar Common, an occupation area located by fieldwalking was investigated through excavation (Johnston 1997). The site comprised a scatter of pits, post- and stakeholes and at least one hearth; it was located on high ground overlooking a river valley, in the vicinity of a cluster of cairns. Excavation produced a large pottery assemblage, comprising up to 180 vessels (1300 sherds; 8.1kg), as well as 16 axe fragments, 519 lithics (including 408 chert, 46 pitchstone and 39 flint), 27 charred cereal grains and some hazelnut shells.

7.76 The Oversley Farm structure (Garner 2007) was rectangular but was smaller than the Scottish timber halls. It comprised hearths associated with two short sections of structural gully and was located on a low hill on the edge of higher ground, overlooking a largely flat plain to the north. It was situated on glacial tills close to the River Bollin, hence seemed to be sited to utilise a variety of habitats. The site produced 361 sherds of pottery (1.67kg), 51 lithics, a few fragments of burnt bone and charred cereal grains. Residue analysis of 20 pottery sherds produced evidence for the cooking of animal fats (mostly ovine) and possibly the processing of plant/fish oils (Dudd and Evershed 2007). Interestingly, a later Neolithic structure was constructed over the same footprint as the earlier building, suggesting longevity of occupation (Garner 2007, 26). Additionally, the same area was a focus for three phases of Early Bronze Age occupation, as well as later prehistoric activity.

7.77 Evidence of Early Neolithic occupation was recorded at Billown Quarry to the west of Ballasalla, Isle of Man (Darvill 2003). Remains that included pits, postholes and gullies containing Early Neolithic pottery were discovered during developer-funded work associated with a quarry extension (LUAU 1992). This prompted a joint venture between Bournemouth University's School of Conservation Science and Manx National Heritage, comprising open-area excavation and geophysical and geochemical surveys (Darvill 2003, 113).

7.78 These investigations identified a series of Early Neolithic enclosures (including a section of interrupted ditch) and an associated occupation area (Darvill 2003, 115-6). The remains were located on glacial till, on a slight rise in the undulating landscape of the Silverburn Valley. The occupation area comprised a series of pits and scoops located outside the main enclosure, including potential structures with hearths, one of which contained burnt planks over a circular shaft. These features produced Early Neolithic pottery, charred cereal grains and hazelnut shells and radiocarbon date ranges of 4899-4719 cal BC, 3500-3460 cal BC and 2886-2586 cal BC. Geophysical surveys in the vicinity suggested the presence of up to 70 of these features. These remains were interpreted as indicative of short-term occupation (Darvill 2003, 115), but the site was clearly a focus of activity over a long period of time (*ibid.*, 118-9).

7.79 The landscape setting (but not the geology) of Biggar Common was similar to that of Stainton Quarry; however, the volume of pottery and lithics recovered was much larger. Both the Oversley Farm and Garthdee Road settlements were located in lowland settings that differed from Stainton Quarry. Artefactual assemblages recovered at Garthdee Road included more pottery vessels and lithics than Stainton Quarry, but the Oversley Farm material was similar.

7.80 The Billown site was located in a similar landscape setting to the Stainton Quarry site. It was positioned on a low rise overlooking a broad river valley close to the coast. The occupation evidence was in close association to an enclosure and, although no worked pitchstone or stone axes were recovered, similar domestic waste was present. Additionally, the range of radiocarbon dates measured indicated that, similar to Stainton Quarry, the Billown site was a focus for activity over a long time period.

Pit sites

7.81 'Pit sites' are by far the most commonly excavated form of Early Neolithic occupation (Rowley-Conwy 2004, 93) and, apart from surface lithic scatters and findspots, represent the majority of the Cumbrian settlement evidence (Hodgson and Brennand 2006, 31-3). These remains sometimes include material within tree-throws and other natural features; however, the presence of similar features alongside other forms of evidence indicate that they should be considered as part of a wider landscape of activity (Cooney 2003, 52). The features recorded at Billown Quarry clearly illustrate this important point (Darvill 2003, fig. 12.3).

7.82 Pits have been recorded within and alongside contemporary structures (Darvill 1996, 81, 90; Grogan 1996, 50; Barclay 2003), cursus (for instance at Holywood – Leivers and Thomas 2007, 173-7), long barrows (Manby *et al.* 2003, 42-6), enclosures (Oswald *et al.* 2001, 124), and beneath later monuments, such as at Pict's Knowe (Thomas 2007, 54-6). Numerous Early Neolithic pit sites have been excavated in Cumbria and the wider Irish Sea fringe. Many of these produced deposits and assemblages of artefacts, including worked Arran pitchstone and stone axe fragments, indicating many were part of the same exchange network. These sites are often interpreted as temporary or short-lived occupation sites (Pollard 2000, 363); however, such conclusions are usually assumed rather than based on evidence (see Rowley-Conwy 2004, 93).

7.83 In Cumbria, previously recorded pit sites include a tree-throw at Holbeck Park Avenue (OAN 2002; Evans 2018) and pits at Roose Quarry, both close to Barrow-in-Furness (Jones 2001; OAN 2014), as well as features at New Cowper Quarry in northern Cumbria (North Pennines Archaeology 2007). The western Scottish examples considered comprised: a single pit at Carzield, Dumfries and Galloway (Maynard 1993); a cluster of pits and a hearth at Maybole (Becket and MacGregor 2009) and pits at Girvan (Fig. 8, no. 10; Becket and MacGregor 2012), both in South Ayrshire; and pairs of pits at The Carrick on the banks of Loch Lomond, Argyle and Butte (Fig. 8, no. 14; Becket and MacGregor 2012).

7.84 The closest parallel for the deposits recorded within tree-throw 32 at Stainton Quarry was the comparable feature discovered at Holbeck Park Avenue (OAN 2002; Evans 2018). The upper fills of this produced 138 sherds of Early Neolithic pottery (from an estimated 12 vessels; 825g), 40 worked flints (including a microlith, two utilised flakes and burnt debitage) and two pieces of volcanic tuff (a Group XI blade and a Group VI flake). These fills also contained abundant charcoal (both oak and diffuse porous taxa, such as alder and hazel), some hazelnut shells and a carbonised wheat grain. Four radiocarbon dates, measured from charcoal, hazelnut shell and the cereal grain, produced date ranges between c.3950-3770 cal BC (Evans 2018, table 1), suggesting the activity that produced these remains was broadly contemporary with the main phase of deposition at Stainton Quarry, if potentially a little earlier.

7.85 The remains recorded at Stainton Quarry could have derived from similar activity, although the two sites were located within very different topographical and geological landscapes. Additionally, as the deposits at both sites were potentially the remnants of waste from nearby activity, evidence for temporality was lacking. The Holbeck site was situated on the lower slopes of a sandstone hill (c.53m aOD) on the coastal lowlands between Sarah Beck and Mill Beck, and hence had more in common with the previously considered sites with structures. Similarly, Early Neolithic pits recorded to the south and east at Roose Quarry (Jones 2001; OAN 2014) were located on low-lying coastal sand and gravel ridges. In addition, concentrations of Late Mesolithic/Early Neolithic flint were identified at Leece, Stank, Dungeon Lane and Moorhead Cottages (Evans 2008, fig. 9.8, 123-4), suggesting that the area around Sarah Beck Valley may have been a focus of activity.

7.86 This association of aspects of Neolithic settlement with ‘prime cultivation’ areas on free-draining sand and gravel deposits in river valleys has been previously identified (Brophy and Sheridan 2012, 22, 44; Murray and Murray 2014, 58). This pattern was mirrored in the lithic assemblages recovered in the Furness Peninsula (Evans 2008, 37, 125) and was a strong pattern within the siting of all the other pit sites in this comparative study. So, in terms of their geological and topographical setting, none of the pit sites were similar to Stainton Quarry.

7.87 All of these pit sites, however, produced similar diversities (Orton 2000, 171-6) of material to those recovered at Stainton Quarry, including charcoal, charred grain and hazelnut shells, pottery and lithics. Worked pitchstone was recovered from all of the sites except The Carrick, Holbeck Park Avenue and Roose Quarry, and flakes from stone axes were recovered from all except New Cowper Quarry and The Carrick. The assemblages varied in size, with New Cowper Quarry producing mainly pottery (131 sherds, from three vessels; c.1.5kg), while the single pit at Carzield contained charcoal, pottery, pitchstone, flint, an axe flake, and charred grain and hazelnut shells.

7.88 The features recorded at Maybole (Becket and MacGregor 2009) were the most productive, although the nature and sizes of these assemblages varied across the site. The remains were interpreted (Becket and MacGregor 2009, 118-9) as a relatively short phase of activity comprising a broad range of activities, which included the production of pottery, knapping of lithics, and potentially the tending of goats and crops. However, the site was truncated by ploughing (Becket and MacGregor 2009, 105), and hence evidence for associated structures, whether temporary tents or more permanent, had been destroyed (see Gibson 2003, 137; Rowley-Conwy 2004, 93). Additionally, the dating evidence (including two radiocarbon dates) provided no conclusive evidence for the length of occupation on the site (see Bayliss *et al.* 2011, 18).

Site location, landscapes and mobility

7.89 Interestingly, although the Maybole site was located in a river valley, it was close to a ridge between the heads of two valleys. One of these, Kilhenzie Burn (and its tributaries), ran to the south-east towards the Water of Girvan, while to the north, over the ridge on which the modern town of Maybole lies, was the head of a valley than ran westwards into Culzean Bay. This landscape would have provided a range of habitats and hence a range of resources, some of which were obviously instrumental in the positioning of the occupation site.

7.90 This choice in the placement of settlements has also been identified in Ireland (Grogan 1996, 57; Cooney 2003, 51) and has led to a call for investigation into similar patterns elsewhere (Barclay 2003, 81). In light of this, the location of the Stainton Quarry site could be seen as equally 'well chosen.' It was on a prominent hill, sheltered from the prevailing westerly winds, and at the head of a small valley (possibly next to a spring) that led into a broad valley, which in turn led to the coast. It was also located close to the boundary between the limestone uplands and sandstone lowlands, and therefore was close to several ecotones, the resource-rich transitional zones between different habitats.

7.91 Alternatively, concentrations of lithics discovered during fieldwalking near Gleaston Castle (Fig. 7, no. 14; Evans 2008, 125) may indicate an alternative focus of occupation that was situated for similar reasons. The two locations were approximately 2km apart so, at a comfortable walking speed of 5km per hour (Browning *et al.* 2006), it would take only about 24 minutes to travel between them.

7.92 Considering the Stainton Quarry site within the range of known Early Neolithic evidence across the varied landscape of the Furness Peninsula, a pattern (though obviously still incomplete) begins to emerge. This suggests that a hierarchy of potential contemporary sites existed; some comprised very small lithic scatters, whilst others, such as Walney North End, Stainton Quarry and Gleaston, represent places of more permanence (see Evans 2008, 126; Milner 2010). If the mobile, shifting cultivation model of Early Neolithic subsistence is accurate, then the latter sites would be places of repeated occupation.

7.93 Alternatively, if this was not the case (see Rowley-Conwy 2004, 93), then these could have been longer-lived settlements, similar to the Oversley Farm site. Furthermore, if, as Bradley *et al.* (2016) suggest, Walney North End was the site of a 'beach market' during the Early Neolithic then this may have been the focus for permanent or repeated occupation. This may have been related to the gathering of marine resources, the finishing of stone axes and the exchange of items such as Arran pitchstone. Whether this site was occupied at certain times of the year or throughout could be tested through targeted fieldwork.

7.94 The evidence recorded at Stainton Quarry, when considered within its immediate landscape and in the context of the finds from Stone Closes, seems to have been the site of similar repeated or permanent activity from at least the Late Mesolithic to later prehistory (with perhaps a hiatus in the later Neolithic). Stainton Quarry and Walney North End were approximately 7km apart, a journey that would have taken at least two hours (taking topography into account) and a trip from one to the other could have easily been undertaken within the span of a day. It is therefore suggested that, if the relationship between the Stainton Quarry and Walney North End sites could be understood through further investigation, this would be instrumental for a better understanding of how Furness' early communities subsisted and utilised the surrounding landscape.

8.0 CONCLUSIONS: FURNESS' FIRST FARMERS

8.1 The archaeological mitigation works undertaken at Stainton Quarry have revealed regionally significant prehistoric remains relating to the early farming communities of the Furness Peninsula. Evidence that the occupants of the site raised crops, tended cattle and gathered hazelnuts was recovered, suggesting they followed a mixed subsistence strategy. Absorbed residue analysis undertaken as part of this project provided the first Cumbrian evidence for the use of dairy products during the Early Neolithic. In addition, the presence of a pitchstone core from Arran and two broken axe heads from the Langdale quarries indicated that the denizens were connected to a wider exchange network that linked Ireland, Cumbria, Scotland and potentially Wales (Bradley *et al.* 2016).

8.2 The assemblages of artefacts and ecofacts retrieved were suggestive of Early Neolithic occupation, the focus of which probably lay to the east beyond the stripped area. Radiocarbon dating indicated activity sometime during the 40th to 35th centuries BC as well as an earlier presence during the 46th to 45th centuries. Later activity during the Chalcolithic and the Early Bronze Age was also demonstrated. Conversely, no evidence for a later Neolithic presence was recorded.

8.3 The deposits that produced these assemblages were likely remnants from above ground middens, parts of which were preserved within sinkholes in the outcropping limestone through natural processes or deliberate backfilling. It was unclear whether the deposits recorded within the upper portions of a tree-throw represented deliberate backfilling or were deposited through natural processes.

8.4 Considering the position of the Stainton site within its contemporary landscape, it would seem an ideal location for repeated, if not permanent occupation. Unfortunately, as the potential focus of activity lay beyond the excavated area to the east, the recorded remains alone cannot fully answer the contentious question of sedentism. Evidence previously recorded in the vicinity raised the possibility that the area, including the now destroyed Stone Closes enclosure, was likely a long-lived focus of activity. This activity may have been related to settlement, farming and the polishing of stone axes (Manby 1965, 4). Alternatively, considering the possibility that the enclosure may have been a 'causewayed camp' (but see Oswald *et al.* 2001), the area may have been a focus of ceremonial activity and/or the deposition and/or exchange of axes (Evans 2008, 128; Bradley and Edmonds 1993, 50-2).

8.5 The deposits and assemblages of artefacts and ecofacts recorded at Stainton Quarry have parallels in the Furness Peninsula at Holbeck Park Avenue and Roose Quarry, as well as at other sites previously recorded around the fringes of the Irish Sea. Comparisons with these have demonstrated that similar remains were present at a variety of occupation sites including timber halls, settlement sites with smaller structures and so called 'pit sites.'

8.6 But considering the full range of evidence, the closest parallel was at Billown on the Isle of Man where occupation associated with an Early Neolithic enclosure was recorded. This occupation was interpreted as short-lived (Darvill 2003, 119), however, it could be argued (see Rowley-Conwy 2004, 93) that this was an assumption rather than apparent from the evidence. Such 'camps', whether defined by scatters of pits, post- and stakeholes, construction trenches or structures around oval or amorphous hollows, could easily be the truncated remains of long-lived settlements. Substantial long-lived structures can be constructed with relatively shallow foundations (see EH 2014; Tipper 2004, fig. 18).

8.7 Structures recorded at the long-lived site at Oversley Farm, Cheshire (Garner 2007), clearly demonstrated this probability. At this site, which produced comparable assemblages of material to those recovered at Stainton Quarry, a later Neolithic house was constructed over the footprint of an Early Neolithic structure. The buildings were defined by partial foundation trenches that if truncated by later activity, would have left what would have been interpreted as a temporary camp.

8.8 The presence of cultivated crops, pottery and other heavy items such as stone axes, when considered alongside the practicalities of the labour-intensive activities undertaken including raising crops (Rowley-Conwy 2004, 92), managing hazel stands (McComb 2009, 229), tending livestock (Rowley-Conwy 2004, 96; Grigson 1984, 299), coppicing (Tomii 1996; Rowley-Conwy 2004, 96), polishing axes (Bradley and Edmonds 1993, 49) and potentially constructing enclosures would seem to suggest a more sedentary lifestyle than is often stated.

8.9 The excavations at Stainton Quarry and the associated analyses have demonstrated that the Furness region contains a largely untapped potential with regard to understanding the Early Neolithic farmers of Cumbria. The data recovered during this project has shown that evidence relating to the most elusive of transitions can be found in the most unexpected locations. Equally, the project has highlighted the importance of diligent palaeoenvironmental sampling, radiocarbon dating, Bayesian analysis and residue analysis.

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APPENDIX A

CONTEXT CATALOGUE

Context	Interpretative description	Relationships	Area/ Trench	Finds	CPR/charcoal
1	Topsoil	Same as 9 and 10. Above 2	EX		
2	Upper subsoil	Below 1, above 3	EX	1 charcoal frag (1g)	
3	Lower pale subsoil	Below 2, seals feature 18	EX	3 pieces of (?)cinder (14g)	Plants: *Triticum* sp. (1), charcoal: *Corylus avellana* (1), *Rosaceae* (1), *Quercus* (1)
4	Natural clays, sands and gravel		EX		
5	Fill of tree-throw 6		EX	1 Early Neolithic Carinated Bowl fragment (1g)	
6	Cut of tree-throw		EX		
7	Cut of pit		EX		
8	Fill of pit 7		EX		Plants: *Horedeum* sp. (9), *Triticum* sp. (2), *Triticum turgidum* ssp. *Dicoccon* (7), charcoal: *Quercus* (10)
9	Turf	Over layer 10	EX	9+ Early Neolithic Carinated Bowl sherds (72g)	
10	Topsoil	Over bedrock 20 and layer 11	EX		
11	Subsoil	Below layer 10, above layer 23. Same as 22 and 49	EX	2+ Early Neolithic Carinated Bowl sherds (7g)	
12	Cut of root bole/pit		EX		
13	Fill of root bole/pit 12		EX		
14	Cut of root bole/pit		EX		
15	Fill of root bole/pit 14		EX		nothing
16	Cut of root bole/pit		EX		
17	Fill of root bole/pit 16		EX		nothing
18	Cut of posthole		EX		
19	Fill of posthole 18	Sealed by layer 3	EX		nothing
20	Bedrock outcrop		EX		
21	Solution feature	In top of bedrock outcrop 20. Filled by 23 and 22	EX		
22	Upper fill of solution feature 21	Below layer 10, above layer 23. In feature 21 (and other solution features). Same as 11 and 49	EX	1 quartz, 1 pitchstone core, 6+ Early Neolithic Carinated Bowl sherds and crumbs (21g)	Charcoal: *Quercus* (1), *Corylus avellana* (5), *Salix/Populus* (2), indet. (2)
23	Lower silty layer in solution feature 21	Below 11, 22 and 49	EX	Early prehistoric pottery crumbs (1g)	Plants: Hazelnut shell fragments (2), charcoal: *Quercus* (5), *Rosaceae* (5)
24	Cut of root bole/pit		EX		
25	Fill of root bole/pit 24		EX		nothing
26	Cut of root		EX		

Context	Interpretative description	Relationships	Area/ Trench	Finds	CPR/charcoal
	bole/pit				
27	Fill of root bole/pit 26		EX		Plants: *Horedeum* sp. (2), charcoal: *Corylus avellana* (8), , *Salix/Populus* (1), *Fraxinus excelsior* (1)
28	Cut of root bole/pit		EX		
29	Fill of root bole/pit 28		EX		nothing
30	Cleaning around layers 39 and 31		EX	2 flints, 2 hematite rocks (RFs 2 and 3), 6+ Early Neolithic Carinated Bowl sherds (24g) and a worked stone axe head (RF 1)	
31	Upper fill of sinkhole 46	In sinkhole 46, above 40	EX	1 worked stone axe head (RF 4), 9+ Early Neolithic Carinated Bowl sherds (47g), 5 fragments burnt bone (0.8g)	Plants: *Horedeum* sp. (1), charcoal: *Quercus* (6), *Corylus avellana* (5)
32	Cut of tree-throw		EX		
33	Upper fill of tree-throw 32	Above fill 35	EX	16+ Early Neolithic Carinated Bowl sherds (65g), 1 quartz fragment, 1 stone fragment, 1 flint fragment	Plants: *Triticum* sp. (1), *Triticum* cf. *Aestivium* ssp. *Spelta* (1), Hazelnut shell fragments (6), charcoal: *Quercus* (14), *Corylus avellana* (5), *Rosaceae* (14), *Salix/Populus* (2), *Calluna vulgaris* (1), cf. *Betula* sp. (1), indet. (3)
34	Fill of solution features in grykes	Below 66. Same as 23	Ex		
35	Mid-fill of tree-throw 32	Below fill 33, above fill 41	EX	5 flints, 3 fragments of rock crystal, 88+ Early Neolithic Carinated Bowl sherds (811g)	Plants: Hazelnut shell fragments (2), charcoal: *Quercus* (8), *Corylus avellana* (1), *Salix/Populus* (1)
36	Cut of root bole/pit		EX		
37	Fill of root bole/pit 36		EX		
38	Fill of sinkhole 63	Possibly contemporary with deposit 39. Above clay 51	EX	1 flint, 10+ Early Neolithic Carinated Bowl sherds (21g), 7 fragments of burnt bone (0.87g)	Charcoal: *Quercus* (2), *Salix/Populus* (1), indet. (1)
39	Upper fill of sinkhole 47	In sinkhole 47, above fill 48	EX	13+ Early Neolithic Carinated Bowl sherds (131g), 7 Beaker sherds (7g), 26 burnt bone fragments (3.6g) (including cattle teeth)	Charcoal: *Quercus* (4), *Corylus avellana* (7), *Rosaceae* (1)
40	Lower fill of sinkhole 46	In sinkhole 46, below fill 31. Above layer 49	EX	55+ Early Neolithic Carinated Bowl sherds (375g)	Charcoal: *Quercus* (5)
41	Lower fill of	Above fill 52, below	EX	3+ Early Neolithic	Charcoal: *Quercus* (22),

Context	Interpretative description	Relationships	Area/ Trench	Finds	CPR/charcoal
	tree-throw 32	fill 35		Carinated Bowl sherds (13g)	*Corylus avellana* (5)
42	Cut of root bole/pit		EX		
43	Fill of root bole/pit 42		EX		
44	Cut of root bole/pit		EX		
45	Fill of root bole/pit 44		EX		nothing
46	Sinkhole in layer 49	Filled by 65, 66, 40 and 31	EX		
47	Sinkhole in layer 49	Filled by 48 and 39	EX		
48	Lower fill of sinkhole 47	In sinkhole 47, below fill 39. Above layer 49	EX	8+ Early Neolithic Carinated Bowl sherds (28g), 3 fragments of burnt bone (0.8g)	nothing
49	Subsoil fill of solution features in outcrop 20	Same as 11 and 22. Cut by sinkholes 46 and 47. Overlies clay 51	EX		
50	Natural layer of stone beneath limestone outcrop 20	Below 20	EX		
51	Natural clay in gryke in outcrop 20	Formed after gryke in limestone. Worn by solution features and sealed by 23	EX		
52	Primary fill of tree-throw 32	Below fill 52	EX		
53	Cut of root bole/pit		EX		
54	Fill of root bole/pit 53		EX		
55	Cut of root bole/pit		EX		
56	Fill of root bole/pit 55		EX		nothing
57	Cut of root bole/pit		EX		
58	Fill of root bole/pit 57		EX		nothing
59	Cut of root bole/pit		EX		
60	Fill of root bole/pit 59		EX		
61	Cut of pit		EX		
62	Fill of pit 61		EX		nothing
63	Sinkhole in layer 49	Contemporary with sinkholes 46 and 47. Filled by 38	EX		
64	Sinkhole in layer 49	Filled with deposits 34 and 66. Potentially same as sinkhole 46	EX		
65	void	void			
66	Deposit in sinkholes 46 and 64	redeposited layer 49	EX		

Context	Interpretative description	Relationships	Area/ Trench	Finds	CPR/charcoal
100	Topsoil		1		
101	Subsoil		1	6 Early Neolithic Carinated Bowl sherds (11g)	
102	Natural clay		1		
103	Bedrock		1		
200	Topsoil		2		
201	Subsoil		2		
202	Natural clay		2		
300	Topsoil		3		
301	Subsoil		3		
302	Natural clay		3		
400	Topsoil		4		
401	Subsoil		4		
402	Fill of pit 403		4		
403	Pit cut		4		
404	Fill of pit 405		4		
405	Pit cut		4		
406	Natural clay		4		
407	Fill of posthole 408		4		
408	Posthole cut		4		
409	Fill of posthole 410		4	7+ Early Neolithic Carinated Bowl sherds (35g)	Plants: *Horedeum* sp. (2), *Triticum* sp. (3), indet, *Cerealia* (2), Hazelnut shell fragments (52), charcoal: *Corylus avellana*, cf. *Salix/Populus*, *Quercus*
410	Posthole cut		4		
411	Fill of posthole 412		4		nothing
412	Posthole cut		4		
413	Fill of cut 414		4		
414	Cut for possible terracing of ground		4		
415	Fill of pit 403		4		
416	Redeposited natural fill of cut 417		4		
417	Cut for modern disturbed area		4		
500	Topsoil		5		
501	Subsoil		5		
502	Natural clay		5		

APPENDIX B

FLINT

Hannah Russ

INTRODUCTION

A total of 15 lithics, including flint, quartz and pitchstone (see Appendix C), were recovered by hand and through bulk environmental sampling during archaeological excavations at Stainton Quarry, Furness, Cumbria, in 2015 (SQF15).

METHODOLOGY

Each item was observed at 10x magnification in order to establish raw material, technology class and tool form. Where no evidence for human manipulation was identified an item was deemed 'natural'. The following analysis is presented by raw material type, within which the assemblage is discussed by context in numerical order where appropriate.

RESULTS AND DISCUSSION

In total, 10 lithics (Fig. 9) including flint, quartz and pitchstone were recovered by hand during the excavations. An additional five fragments, two of flint and three of crystal quartz, were recovered from the bulk environmental samples (see Table B1). All of the lithic evidence was recovered from the fills of natural features, including a solution feature, a tree-throw and a gryke (NAA 2015).

Table B1: Summary of lithics recovered during excavations at Stainton Quarry, Cumbria

Context	Flint		Quartz		Pitchstone		Total
	Hand collected	From sample	Hand collected	From Sample	Hand collected	From sample	
22			1		1		**2**
30	2						**2**
33		1	1				**2**
35	4	1		3			**8**
38	1						**1**
Total	**7**	**2**	**2**	**3**	**1**	**0**	**15**

Flint

Generally, the flint pieces were in very good, fresh condition with the exception of two fragments from context **30**. A single partial tool fragment from context **38** was in good condition despite being completely patinated.

Context 30

Two hand-collected flint fragments (not illustrated) from context 30 represent waste from flint working, but do not bear any further modification or evidence for usewear. Both pieces are patinated and bear c.20% cortex; one displays evidence for thermal alteration. Neither piece can be placed typologically within a specific time period, but they are very likely to be early prehistoric in date.

Context 33

A single flint piece was recovered from the bulk environmental sample from context **33** (not illustrated). The small fragment of dark grey flint represents the proximal part of a small flake or bladelet. The colour and quality of the raw material are very similar to that seen in the worked flint in context **35** (see below), and therefore may result from working of the same flint nodule from which the tools were derived. No further modification in the form of retouch, or any evidence for usewear is present, therefore this piece can be identified as flint working debitage. The piece could not be placed typologically within a specific time period.

Context 35

Context **35** contained the largest assemblage of lithics from the site. Five flint items were recovered; four were collected by hand during excavation, and an additional piece retrieved from the environmental sample. Three small fragments of crystal quartz were also recovered from this context, see below. The hand-collected flint included three pieces that had been modified by retouch; two blades with semi-abrupt retouch to one (Fig. 9, no. 1) or both lateral edges (no. 2) and a flake (no. 3) with semi-abrupt retouch to at least one lateral edge (the other edge being missing due to subsequent damage to the piece). In addition to the retouched pieces, a flake (no. 4) which bears evidence of usewear was also present. All four pieces were produced on dark grey flint, and had all potentially been produced from the same flint nodule. The three worked pieces and the utilised flake were typical of the Neolithic period. It is likely that they were produced during the earlier part of the Neolithic, as during this period, it was common for blades and flakes to be retouched (sometimes in part) along one lateral edge and then used for a variety of tasks (Butler 2005, 134). However, the suggested date for this material should be considered with some caution due to the small size of the assemblage and lack of more chronologically diagnostic stone tool forms.

The fragment of light grey flint recovered from an environmental sample (not illustrated) is a small but complete flake with no evidence for further modification or usewear, so this piece can be identified as flint working debitage. This piece could not be placed typologically within a specific time period.

Context 38

Context **38** yielded a single piece of flint (no. 5), which was recovered by hand during the excavations. This heavily patinated piece represents the proximal portion of an invasively retouched knife. Both lateral edges bear retouch, which is steep on one side and shallow on the other. The knife is of typical Neolithic form; is it likely to have been produced during the earlier part of the Neolithic.

Quartz (contexts 22, 33 and 35)

Quartz is a naturally occurring part of the drift geology at Stainton Quarry and, as such, its presence at the site is not unexpected and may not reflect human use of the material. However, despite the difficulties that are known in the identification of stone tools made from quartz due to its material properties and fracture patterns, prehistoric quartz stone tools have been identified elsewhere (e.g. Driscoll 2010). In total, five pieces of quartz were recovered; two through hand collection during excavation, and three from an environmental sample. The two hand-collected pieces (one each from contexts **22** and **33**) were of very poor quality and did not display any fractures that might suggest human manipulation. As such, these were considered to be natural.

The three fragments from the environmental sample from context 35 represented crystal quartz of high quality. However, their small size and lack of fractured surfaces that might be considered to result from human working of the material, suggest that they too were natural. It is possible, being attractive pieces of stone that, whilst unmodified, they could have been collected and curated by people in the past and disposed of or deposited within the natural features at the site. Interestingly, one of the crystal quartz fragments bears a flat surface that is stained a dark reddish colour. Given the reddish colour of the sediments at Stainton Quarry, this may be natural, however, it may be possible in the future for this to be studied further, and therefore these fragments have been retained within the archive (see below).

Pitchstone (context 22)

One piece (no. 6) of worked stone from context **22** was identified as a small worked-out core of unusual form. Flakes appear to have been removed using several 'platforms'. The raw material is similar to black chert, but with an atypical dull glassy appearance. As such, it was sent for further specialist analysis (see Appendix C) and subsequently was confirmed as Arran pitchstone.

CONCLUSION

The flint and pitchstone artefacts provided evidence for prehistoric activity at Stainton Quarry. The tool forms suggested that this activity was likely to date to the Neolithic, and possibly during the earlier part of this period. Dating of elements of this assemblage was confirmed and refined by radiocarbon dating (see below).

Stone tool production results in substantial quantities of debitage; this pattern was not observed in the Stainton Quarry lithic assemblage. Though debitage can take the form of very small flakes and fragments, which could potentially be missed by hand collection during excavation, these would have been recovered from the environmental samples if they were present at the site. Though the lithic assemblage is small it appears, based on the evidence recovered, that the lithics, for the most part, were brought to the site as pre-made tools, for possible use followed by deposition or discard.

The assemblage was small when compared to potential contemporary collections from the Gleaston area c.2.4km to the south-east (Hodgkinson *et al*. 2000, 35; Evans 2008, 124-5), which is likely indicative of short-term and/or small-scale activity. The excavated contexts were, however, probably on the periphery of a focus of activity (see above) and hence may represent only part of a larger assemblage. Interestingly, the material comprised both tools and waste flakes, two of which were from the primary stages of flint working (one was burnt).

The five quartz items were considered to be natural in form; however, the three fragments of crystal quartz may represent items that were collected and curated by people in the past, and therefore could be evidence for human activity that at present cannot be confirmed.

Whilst only a small stone tool assemblage, their association with a range of other prehistoric artefacts raises their significance. All the lithics, except the two low-quality quartz fragments from contexts **22** and **33**, were retained within the site archive to ensure their availability for any future research and analyses.

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APPENDIX C

PITCHSTONE

Torben Bjarke Ballin

In connection with mitigation work at Stainton Quarry a small lithic object (Fig. 9, no. 6) was recovered, initially identified as black chert (NAA 2015, 10). Due to the likeness of the material to some forms of Arran pitchstone, the piece was sent to this analyst for analysis.

Following inspection it was possible to determine without doubt that the raw material of the object is indeed Arran pitchstone. Pitchstones may be described in terms of a number of components (Ballin and Faithfull 2009, 5), such as:

- Glassy matrix;
- Phenocrysts: larger isolated or clustered crystals formed at depth during slow cooling;
- Spherulites: finely crystalline, usually radiating intergrowths of quartz and feldspar, indicating devitrification of the glass phase;
- Crystallites (formerly occasionally termed microlites): very small skeletal or dendritic crystals, often Fe-Mg silicates, in glass; banding in pitchstones is often marked by variation in crystallite density; and
- Other alteration products.

The present piece contains neither phenocrysts nor spherulites, and the raw material is clearly aphyric pitchstone. It does, however, contain numerous small specks, most probably crystallites, which gives it a slightly spotted appearance. It has no original outer surface, and is in terms of reduction sequence a tertiary piece.

Aphyric pitchstone is usually associated with the eastern parts of Arran, such as the Corriegills district, the Fairy Glen immediately to the west, and the Monamore Glen further south along the island's east coast (Ballin and Faithfull 2009, Ch. 5). However, aphyric bands may also be found in some outcrops of porphyritic pitchstone, such as some of the dykes at Tormore on Arran's west coast. However, on balance, the raw material for this piece was probably procured from eastern Arran.

In terms of artefact type, the piece is a small core (19.5 x 18.3 x 9.1mm), and it belongs to a core type which is particularly common amongst Scottish pitchstone assemblages and rare or absent in assemblages based on most other forms of lithic material. It has had small flakes or bladelets detached from opposed directions, first from one face, and then from the other face. However, when the piece was turned over to be reduced from its second face, it was rotated 90 degrees, so that the reduction axes of the two flaking-fronts are at perpendicular angles to each other (Fig. C1). Cores like the present one were particularly common in the large combined assemblage collected from sites in the Glen Luce area, Dumfries and Galloway, and the analyst therefore suggested to refer to these pieces as discoidal cores of 'Glen Luce Type' (Ballin 2009, fig. 9).

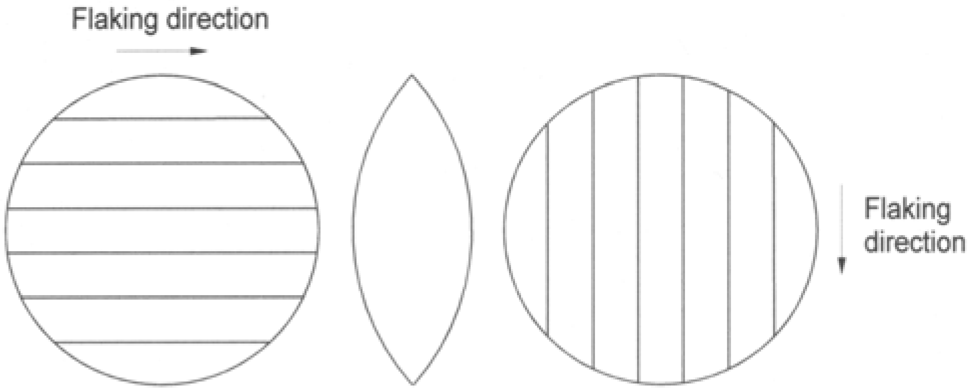

Figure C1: A typical small pitchstone core of 'Glen Luce Type'.

The core was recovered from a solution feature at Stainton Quarry, but Early Neolithic pottery was found nearby (see Results above). As pitchstone was used on Arran throughout prehistory, it is quite possible that the odd individual piece may have found its way to the mainland during the Mesolithic period, but the composition of the pitchstone assemblages recovered from sites off Arran generally suggests that the extensive pitchstone exchange network responsible for the distribution of Arran pitchstone across northern Britain – from Orkney in the north to the Isle of Man and Dublin in the south – is a post-Mesolithic phenomenon.

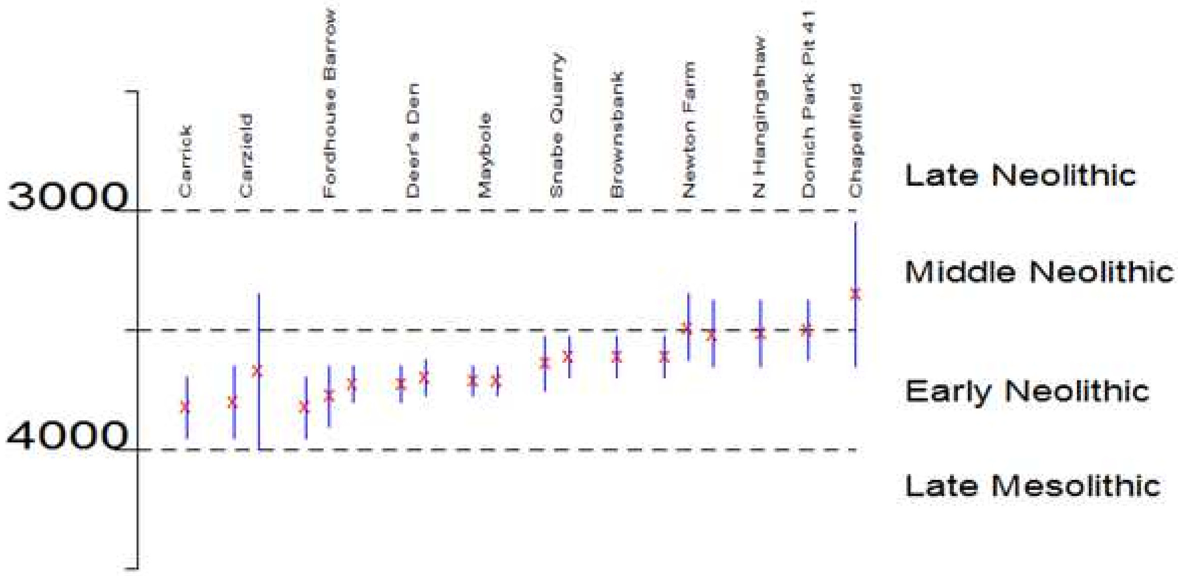

Figure C2: Radiocarbon dates relating to pitchstone-bearing pits (site names along the top of the diagram). Note that the dates from Fordhouse Barrow are TAQ dates provided by charcoal recovered immediately above the pitchstone-bearing pit; a leaf-shaped point from this pit defines the deposition as Early Neolithic, and the pitchstone from the Fordhouse Barrow pit therefore clearly dates to the first half of the Early Neolithic.

As demonstrated in Ballin (2009), assemblages from the mainland generally do not include Mesolithic diagnostic material, whereas Mesolithic sites on Arran itself include large numbers of well-known Mesolithic types like microliths, microburins and burins. It has also been shown that, so far, all pitchstone recovered from pits on the mainland are of Early Neolithic dates (Fig. C2), and frequently associated with pottery of the Carinated Bowl tradition and flakes from Cumbrian tuff axe heads (Ballin 2015; Sheridan 2007; Bradley and Edmonds 1993). The association (although not from a closed context) of the present pitchstone core with likely Early Neolithic pottery supports the suggested date of the pitchstone exchange network to the Early Neolithic period (although with some exceptions, such as Late Neolithic Orkney; Ballin 2013).

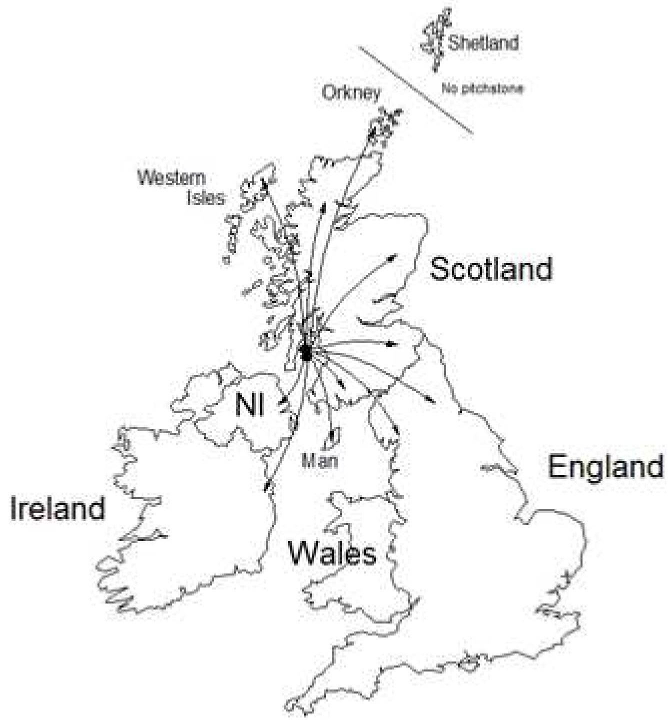

Figure C3: The distribution of archaeological pitchstone across northern Britain from the Isle of Arran in the Firth of Clyde, west of Glasgow. The only part of northern Britain where pitchstone artefacts have not been recovered is Shetland, where a marked insularity in the use of raw materials is evident (Ballin 2011). The distance from Arran to Orkney is c.400km. Pitchstone is expected – in due course of time – to be identified in assemblages further towards the south where it may have been misidentified as black chert, black flint, jet/cannel coal or glassy slag (Ballin 2008).

Figure C3 shows the general distribution of archaeological pitchstone across northern Britain, and although archaeological pitchstone has been found at various locations in Cumbria (Antony Dickson and Fraser Brown (Oxford North) pers. comm.; Peter Cherry pers. comm.; Annie Hamilton-Gibney pers. comm.), Stainton Quarry may presently be the most southerly location on the British mainland from which archaeological pitchstone has been retrieved. Given the distances across which pitchstone was traded towards the north (Orkney), it is highly likely that this raw material was also traded into Lancashire and Yorkshire – if not further towards the south (Ballin 2008).

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APPENDIX D

STONE AXES AND HAEMATITE

Ann Clarke

INTRODUCTION

Two axe fragments (Fig. 9) were found, both of which were blade ends. One is fine-grained grey/green Langdale tuff (RF 1) whilst the other is a blue/grey fine- to medium-grained rock with occasional large angular inclusions (RF 4); this is some type of volcaniclastic rock likely to be related to tuff though of a coarser texture. Both of these axes were flaked, ground, and polished all over to produce a sharp, undamaged curved blade end. Little survives of the rest of these axes to determine the original morphology; the sides are thin and rounded except for one narrow flat facet which is worn down one side of RF 1. There has possibly been some reshaping of the blade of RF 4 after its original use because there is some pecking, a regrinding facet and an asymmetrical curve to the blade outline all suggestive of careful reworking.

After this careful shaping and, in the case of RF 4 reshaping, both of the axes were deliberately broken by a blow to the centre of one face. On RF 1 this broken edge was subsequently used as a platform from which several large flakes were detached to remove much of one polished face. RF 4 was recovered from the upper fill of sinkhole **46**; RF 1 and the haematite nodules (see below) were recovered during post-machining cleaning in the vicinity.

A flake of Langdale tuff (Fig. 9, no. 7) of very similar material to the axe RF 1 was found in the upper fill of tree-throw **32**. This inner broad flake has a narrow flat platform and multi-directional flake scars on the dorsal face. There was no sign of a remnant polished surface to indicate that it had been detached from a ground stone axe. However, given the deliberate intention to break the stone axes and then detach further flakes from the blade fragments it is likely that this inner flake was part of a larger ground stone axe that had been subjected to further and considerable fragmentation by flaking.

Two lumps of grey/silver haematite (RFs 2 and 3) were recovered during post-machining cleaning (**30**). Neither of the haematite lumps appears to have been modified in any way; for instance by rubbing or deliberate fragmentation. The purpose, if any, of this material in these contexts is not known. Haematite is formed naturally in limestone deposits and was mined in the immediate area, so these items may have been incidental discoveries.

DISCUSSION

Although hundreds of Langdale axes have been found across the British Isles from Orkney to Cornwall, the great majority are not associated with their original context of use, having been collected as stray finds. Consequently, the means by which the axes were moved around the landscape, and the life-cycles of these stone objects are not fully understood beyond their initial production at the stone quarries themselves. Finds of axes both in rough-out form (neither ground or polished) as well as finished examples are a feature of the Furness Peninsula where their current distribution is concentrated at its southern end. This may indicate that this was one of the areas to which axe blanks were brought from the quarries of Great Langdale to be finished by grinding and polishing (Manby 1965; Bradley and Edmonds 1993, figs. 7.4 and 7.5). Currently, there is no conclusive dating for this activity except for the observation that in the later phases of quarrying axes were more carefully shaped by flaking leaving just the grinding and polishing to be carried out in the lowlands (Bradley and Edmonds 1993, 142-4).

Polissoirs and axes were found during excavation at Ehenside Tarn on the south-western Cumbrian coast (Hodgson and Brennand 2006, 33-4) and more recently at Stainton West, Carlisle. At the latter site a polissoir was found in a pit dated to 3630-3360 cal BC (OAN 2015). The axes from Stainton Quarry were from a later stage of use as not only had they been ground and polished, they had then been deliberately broken prior to deposition.

The 2015 excavation at Stainton Quarry lies in an area adjacent to the location of earlier finds of stone axes; Dobson (1912) mentions approximately 12 stone axes found in the area of the quarry at the turn of the century. He observed that several were found either in limestone crevices or in weathered hollows and that most were polished and some were broken (*ibid.*, 281). This suggests that the occupation of this area was more extensive than that indicated by the present excavation and that the natural hollows and crevices were either deliberately selected for deposition or that occupation debris found its way into these by natural agency or from human clearance of the area.

There is increasing evidence for the presence of stone axe fragments in pits dating to the Early Neolithic. In south-west Scotland at Maybole, Ayrshire, a flake of Langdale tuff had been detached from a larger polished implement and deposited in a pit. The pit also contained cremated bone (some of which was identified as human) and other stone tools including some of Arran pitchstone (Becket and MacGregor 2009). Three flakes of Langdale tuff were found in a pit at Carzield, Dumfriesshire, with similar contents to that at Maybole (Maynard 1993). The Carzield pit was dated to the early 4th millennium which was broadly contemporary to an axe fragment from a pit at Eweford, East Lothian (Sheridan 2007), and also from Biggar, Lanarkshire (Ballin and Ward 2008, 19). It is possible that the axe fragments from Stainton Quarry discovered in, albeit natural, hollows were placed there with the same intention as those axe fragments in the dug pits recorded elsewhere. A comparison of the assemblages of material recovered from the deposits at Stainton with the pit fills recorded in the wider region and beyond should help to identify whether these deposits share any other similarities such as the presence of Carinated Bowls and blades of flint or Arran pitchstone.

CATALOGUE

Stone axe, context 30, RF 1

Blade end survives from this polished axe of fine-grained, grey/green Langdale Tuff. The sides converge slightly to a finely curved, crisp blade end. There is a narrow facet ground down one side forming a slightly flattened profile; the opposite side is rounded in profile. It was flaked then ground and polished all over. Prior to deposition the axe was deliberately broken across its width by a blow in the centre of one face causing a hinge fracture on the distal end. This broken edge has subsequently been used as a platform from which several large flakes have been detached to remove much of one of the polished faces. Flake scars on opposite face have been made from either side.

Broken length 68mm; width at break 60mm; width at blade 55mm; maximum thickness 28mm

Stone axe, context 31, RF 4

Blade end survives from this polished axe of blue/grey fine- to medium-grained rock with occasional large angular inclusions (some type of volcaniclastic rock). The blade end is crisp and slightly asymmetrically curved. The axe was flaked then ground and polished all over leaving some indented flake scars. There is an area of pecking and a regrinding facet on one face and these features together with the asymmetry of the blade outline indicate the reworking of the original axe. The sides have a rounded cross-section. Prior to deposition the axe was deliberately broken across the width by a blow in the centre of one face which has left an irregular fractured face. Small flake scars have been made from the side of one face.

Broken length 74mm; width at break 75mm; width at blade 70mm; maximum thickness 35mm

Stone axe flake, context 33

Inner flake of fine-grained grey/green Langdale tuff. Broad flake with narrow flat platform. Multi-directional flake scars exist on the dorsal face.

Maximum length 28mm; maximum width 29mm; maximum thickness 6mm

Natural lump of haematite, context 30, RF 3

No sign of deliberate shaping or use.

Maximum length 82mm; maximum width 70mm; maximum thickness 61mm; weight 428g

Large natural lump of haematite, context 30, RF 2

No sign of deliberate shaping or use.

Maximum length 165mm; maximum width 140mm; maximum thickness 108mm; weight 4600g

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APPENDIX E

PREHISTORIC POTTERY

Alex Gibson

INTRODUCTION

In September 2015 some 1.65kg of pottery was delivered to the writer for identification, description and advice on future storage to maintain a potential for lipid analysis. The pottery was packed in aluminium foil within self-seal bags which were clearly marked with material and context. The sherds themselves were not marked. Discrepancies were noted in the weights recorded on the bags perhaps due to scale inaccuracies or perhaps the pottery was still wet when originally weighed. Slight discrepancies in the number of sherds originally recorded are almost certainly due to sherd fragmentation during storage and the definition of 'crumbs' (as opposed to sherds) used by the present writer (sherds measuring less than 10mm across are classed here as crumbs unless displaying characteristic diagnostic traits). The pottery was unpacked and laid out by context in good natural light. The sherds were counted and weighed and fabric variation noted. The examination of the pottery was undertaken using a x10 hand lens. No microscopic examination has been undertaken so fabric descriptions here are liable to modification should this analysis be carried out at a later date. No carbonised residues were noted on any of the sherds. The assemblage was then examined for conjoining sherds. Some were noted and have been recorded in the catalogue. It is possible that more joins will be found, particularly amongst some of the wall sherds, should more time be spent on the assemblage.

FABRIC

Four fabrics were identified. Fabrics 1 and 3 are similar given their quartz opening materials however fabric 3 is softer with some evidence for organic inclusions. Fabric 2 is unusual in having grog inclusions and may possibly represent a later element such as Collared Urn but it is unwise to speculate given the absence of diagnostic formal or decorative traits. The fabrics can be described as follows:

- Fabric 1: Grey to black fabric with abundant angular quartzite inclusions measuring up to 5mm across. Some inclusions break both surfaces but especially the outer which often appears more abraded. The fabric is hard and well-fired and some smooth surfaces are visible especially on sherds from the upper part of the vessels;

- Fabric 2: Soft brown fabric with abundant quartz and grog inclusions measuring up to 5mm across. The grog gives the sherds a slightly smooth and 'soapy' texture. Despite this, the fabric is still well-fired;

- Fabric 3: Fabric similar to 1 but containing far fewer quartzite inclusions and with some voids resulting from the burning out of organic inclusions. The fabric has a soft, slightly soapy texture but is nevertheless well-fired; and

- Fabric 4: Thin, fine, soft brown fabric with finely crushed grog inclusions and a darker core.

SHERD GROUPS

The present writer prefers to use the term 'sherd group' (SG) as opposed to 'individual vessel' especially in cases when there are few conjoining sherds. The lack of refitting adds a degree of subjectivity to the attribution of sherds to specific pots using criteria such as fabric, colouration, abrasion, surface finish and so on. These criteria are incredibly variable in hand-built and open fired early prehistoric (Neolithic and Bronze Age) pottery; sherds can have a mottled colour due to firing or post-depositional conditions, thickness and the degree of abrasion can vary within individual vessels as can rim forms. 'Sherd group' therefore is a more objective term and acknowledges that similar sherds may or may not be from the same vessel. It does, however, suggest a minimum number of individual pots while acknowledging that the actual number may be much greater.

TECHNOLOGY

The SGs all represent hand-built, open-fired vessels (Fig. 10). The blotchy surface colouration of many sherds varying from black through grey to brown or brown/pink is typical of open-fired pottery where the firing conditions (smokey, variable oxygen) cannot be properly controlled. The dark cores exhibited by many sherds and caused by the incomplete combustion of naturally occurring organic material is also representative of a short (and therefore economical) firing time. Join voids can be detected in the assemblage (SG1 and SG4) indicating the hand building technique of coil, ring or strap construction (it is impossible to differentiate between the three techniques in small sherd material). Join voids represent improperly bonded coils, rings or straps caused in most cases by the clay being too dry.

Evidence for secondary forming techniques is not really visible due to the fragmentary and abraded nature of much of the assemblage but smoothing and finishing facets can be seen on some sherds (SG8, SG10 and SG11), particularly those from or near the rim appearing to indicate smoothing or wiping with a soft material such as a cloth or soft leather. The flattening facets on some rims (SG11) may have been formed using a more robust item made from, for example, wood.

FORMAL CHARACTERISTICS

Rim sherds were noted in SG8, 9, 10, 11, 12, 13, 15 and 19. The rims are generally well formed and rounded in profile. Smoothing marks are visible on SG8, 11 and 15. The rims have either an upright (SG 11, 12 and 15) or everted (SG 10, 13 and 19) profile. The rim of SG10 is slightly thickened externally whilst that of SG13 is slightly thinned giving the rim a rounded but slightly pointed profile. Rim diameters are difficult to estimate given the small sherd size as well as the variability of curvature often noted on prehistoric pottery, but SG10 may possibly have had a diameter of 16-18cm, SG11, c.22cm and SG19 c.20cm. This suggests moderately sized bowls though the thickness of some wall sherds hints at a larger element in the assemblage.

Shoulder sherds are identifiable in SG1, 4 and 19. These suggest strongly angled shoulders in the case of SG 1 and 4 whilst in the case of SG 19 the profile is much more rounded suggesting a 'baggy' profile not dissimilar to SG12. Simple rounded bowls are difficult to identify with certainty but SG11 and 15 may represent such vessels.

Hollow or concave neck sherds are also recognisable in the assemblage (SG2 and 10) and further confirm the presence of everted rim bowls.

SG17 differs markedly from the rest of the assemblage in terms of the fabric, colour and texture of the sherds. They are all small body sherds with no rim or base sherds present but the thinness of the sherds and the toothed comb decoration clearly identifies them as Beaker. Too little survives for the decorative scheme to be identifiable but the presence of oblique lines may possibly suggest filled chevron motifs.

There are no examples of base sherds in the assemblage

ATTRIBUTION

Some 20 sherd groups can be identified from 13 different contexts. The majority of these sherd groups (18) are in Fabric 1 and represent Early Neolithic Carinated Bowls. The fabric and finish of these vessels are entirely in keeping with vessels from this tradition which tend to be well-made and well-formed. Some shoulder sherds (SG1 and SG4) suggest sharply carinated vessels whilst others (SG3 and SG10) suggest more slack shoulders or indeed rounded bowls both of which variants are found in Carinated Bowl assemblages in Northern Britain (Sheridan 2007). As such, these can be dated from the 39th to 38th centuries BC and lasting into the 36th (Sheridan 2007; Whittle *et al*. 2011) and represent the first ceramic type in Britain at the start of the Neolithic.

The Early Neolithic Pottery from north-west England has been reviewed by Manby (2007) and the rim profiles of the present assemblage as well as the fabric bear comparison with those from Ehenside Tarn (Manby 2007, fig 4.2) as does vessel size. The corpus of such material in Cumbria is small, however, and the present assemblage may well be the largest recovered to date. Manby lists other findspots in Cumbria such as Walney Island, Carlisle, Crosby by-pass, Barrow-in-Furness, Silloth and fieldwalking finds from the Westmorland Fells but none are illustrated. Carinated Bowl is also rare in the Pennines to the east separating Cumbria from the larger Carinated Bowl assemblages of eastern Yorkshire (Manby *et al*. 2003). The chance find of two Neolithic pits at the hillfort at Portfield, however, is an obvious exception (Beswick and Coombs 1986). Here two oval pits produced fragments of six vessels represented mainly by rims of forms comparable to the present assemblage. One strongly everted and slack profiled bowl (P1) may bear comparison to some of the material from Stainton Quarry, particularly SG19. A rounded, strongly everted rim-sherd from Low Plains, Cumbria, has been burnished with the horizontal burnishing facets still visible and is almost certainly from a well-made Carinated Bowl. The sherd comes from a fairly large vessel and though it is difficult to estimate the size accurately, the rim is unlikely to have had a diameter of less than 24cm (Gibson 2015).

The Beaker represented by SG17 is clearly a much later element of the assemblage attesting activity in the Chalcolithic or Earlier Bronze Age. Beaker pottery appears in Britain at c.2450 cal BC and is a comparatively long-lived tradition finally ending around 1650 cal BC (Needham 2005). Whilst finds of early Beaker are almost totally sepulchral in context, its appearance on domestic sites increases considerably after 2000 BC. It may be to this later phase that the Stainton sherds belong. Clarke (1970) records some 15 Beakers from Cumberland and Westmorland all belonging to his North British series with the exception of an All Over Corded Beaker from Sizergh Fell near Kendal and a similarly cord decorated vessel from Santon Bridge. Of the Cumberland vessels, those from Hunsonby (Clarke 1970, No 113), Carlisle (109) and Newton Penrith (114) are comb decorated incorporating motifs involving diagonal lines. Incised Beaker sherds have been found as part of multi-period scatters at Walney Island (Gibson 1982, 254) but lack contextual data. The Stainton Quarry sherds are, however, too small to warrant further comparison.

One sherd in the grog-filled Fabric 2 differs from the other material and may possibly be from a later vessel, perhaps Collared Urn of the Bronze Age, dating to c.2000-1500 cal BC, however, it is unwise to date earlier prehistoric pottery by fabric alone. In the absence of diagnostic decorative or formal traits, this vessel may still be part of the Carinated Bowl assemblage as so little is known about the fabric variation of this period in this region.

STAINTON QUARRY CATALOGUE

Sherd Group	Fabric	Context	No	Weight (g)	Description
*1	1	101	6	11	Hard well-fired sherds. Abraded sherds but traces of well-finished surfaces. One shoulder sherd indicating a coil join on the inside.
2	1	409	6+	20	Abraded sherds with grey to brown surfaces. One sherd with both surfaces surviving measures 7mm across. Very slight curvature may represent a concave neck.
*3	2	409	1	15	Sherd from a rounded shoulder 12mm thick.
*4	1	9	11+	72	Grey coarsely filled but with smooth inner surfaces. Two sherds join along a coil break and these plus another smaller sherd are from a strong shoulder above which is the start of a concave neck. Coil breaks are visible on other sherds. The fabric is 15mm thick at the shoulder but the neck thins to 6mm.
5	1	11	2+	7	Two abraded sherds.
6	1	22	8	29	Abraded sherds.
7	1	30	6+	24	Black to brown surfaces averaging 6mm thick.
*8	1	31	9+^	32	Black to brown surfaces averaging 6mm thick. Wall sherds average 6mm thick. One well-formed rim sherd with smooth surfaces. Smoothing marks visible externally.
*9	1	33	16+^	37	Black to brown surfaces averaging 6mm thick. One large body sherd in a hard well-fired fabric, other sherds slightly softer and more abraded but probably from the same vessel. Two small rim sherds from a simple rounded rim. Two conjoining body sherds.
*10	1	35	17+	174	Six rim sherds, some conjoining. Hard, smooth almost burnished black surfaces. Sherds averaging 6mm thick. The rim is everted and externally thickened though the profile does vary amongst the conjoining sherds. The rim diameter is an estimated 16-18cm. The neck is concave but there are no surviving shoulder sherds suggesting a slack profile. Material recovered from a sample may also belong to this SG. Included amongst the material is a small rim fragment and two fragments from a well-finished concave neck.
*11	1	35	2	24	Two conjoining rim sherds. Smooth surfaces with wipe marks and smoothing facets visible. The rim is rounded, slightly thickened and some 7mm thick with an estimated diameter of 22cm. The profile suggests that the rim is almost vertical, only slightly everted and may be from a round bodied, rather than strictly Carinated Bowl.
*12	1	35	67	510	Three rounded and abraded rim sherds and 64 large body sherds in a grey-brown fabric. Where surfaces survive, the body sherds are smooth and well finished and average 10mm thick. The majority of sherds have lost their surfaces, however and appear coarse and gritty. There are no shoulder sherds identifiable, but the curvature of some sherds suggest a very loose, baggy s-shaped profile.
*13	3	35	2	23	Everted, rim sherd and a body sherd averaging 10mm thick. The rim is simple, rounded and slightly thinned. The fragment is too small to estimate diameter.
14	1	38	10	10	Small abraded sherds. Largest measures 7mm thick.
*15	1	39	13+^	50	Small, hard, well-fired sherds with abundant well-crushed inclusions. Sherds are black throughout. One simple rounded rim, with smooth surfaces is too small to allow an estimation of the diameter but, given the thickness of the other sherds may be from a small open bowl. The rim sherd averages 5mm thick.
16	1	39/ 48	12	62	Coarse gritty sherds with black inner surface and core and a brown to grey outer surface. The fabric averages 10mm thick. Eight sherds (28g) from context 48 probably also belong to this sherd group.

Sherd Group	Fabric	Context	No	Weight (g)	Description
*17	4	39	7	7	Thin sherds averaging 6mm thick. Three sherds have traces of square toothed-comb impressions. No motifs are discernible however some diagonal lines my hint at chevron motifs.
18	1	40	24	146	Body sherds with a light brown to grey outer surface, black inner surface and core. The sherds average 10mm thick. Similar to sherd group 16.
*19	1	40	31+	178	Five rounded rim sherds. The rim is simple and slightly everted and averages 6mm thick. The outer surface is grey-brown, the core and inner surface black. One sherd is from a concave neck and another is from a slack rounded shoulder. The estimated rim diameter is 20cm.
20	1	41	3	12	Abraded body sherds with grey surfaces, averaging 10mm thick.
		5	+	<1	Small fragment with brown surface and black core. Prehistoric
	1	22	+	<1	Undiagnostic crumbs from sample. Likely from SG6
	?	23	+	<1	Crumbs
	1	31	+	15	Undiagnostic crumbs from sample. Likely from SG8
	1	33	+	5	Undiagnostic crumbs from sample. Likely from SG9
	1	33	+	5	Undiagnostic crumbs from sample. Likely from SG9
	1	33	+	18	Undiagnostic crumbs from sample. Likely from SG9
	1	35	+	80	Small crumbs belonging to any of the Sherd Groups from this context.
	1	38	+	11	Undiagnostic crumbs from sample. Likely from SG14
		39	+	14	Undiagnostic crumbs
	1	39	+	5	Undiagnostic crumbs from sample. Likely from SG15/16
		40	+	36	Undiagnostic crumbs from sample. Likely from SG18/19
	1	40	+	15	Undiagnostic crumbs from sample. Likely from SG18/19
	1	41	+	<1	Undiagnostic crumb from sample. Likely from SG20

* = illustrated (see Fig. 10); + = crumbs; ^ = stone fragments discarded

CONCLUSION

The Stainton Quarry assemblage comprises two distinct and widely separated chronological elements: Early Neolithic and Early Bronze Age. The former is represented by a comparatively large and rare assemblage in this area and is thus of considerable importance in the western distribution of Carinated Bowl.

The Early Bronze Age is represented by small sherds of undoubted Beaker affinity with characteristic fabric and decoration. Unfortunately, too little survives to allow further discussion of this material.

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APPENDIX F

PALAEOBOTANICAL AND CHARCOAL ANALYSIS

Lynne F. Gardiner

INTRODUCTION

This report presents the results of analysis of the palaeobotanical and charcoal remains from the Stainton Quarry site in accordance with Campbell *et al.* (2011) and English Heritage (2008). This analysis was undertaken on samples selected by the excavator in conjunction with the results of a previous phase of palaeoenvironmental assessment (Gardiner 2015, 53-59).

METHODOLOGY

The methodology was detailed in earlier reporting as was all sediment descriptions, weights and volumes (Gardiner 2015, 53). For the purpose of this analysis, the remaining fine fractions highlighted as a priority for further work were refloated (which will be referred to as 'reflots') to maximise the recovery of any plant remains and charcoal. This was undertaken using bucket-flotation method and a 500µm flot mesh.

When dried, any charcoal from the reflots was sieved using a 2mm mesh. Any charcoal from the <2mm fraction were discarded as fragments this size are very difficult to identify to species.

The plant remains and charcoal were identified to species, as far as possible, using Cappers *et al.* (2006), Cappers and Bekker (2013), Cappers and Neef (2012), Hather (2000), Jacomet (2006), Schoch *et al.* (2004) and Schweingruber (1982) along with the NAA reference collection. Nomenclature for plant taxa followed Stace (2010) and cereals followed Cappers and Neef (2012).

The selection of suitable material for radiocarbon dating was a two-fold process which involved examining the formation processes of the contexts to be dated but also the reliability of the material to be suitable for dating. Evidence of bioturbation (including earthworm capsules and rootlets) provided a measure of sample reliability; for instance, low numbers of small items (such as charred seeds) within a heavily bioturbated context are likely to be intrusive.

Where it was present, short-lived material such as hazelnut shell fragments and charred grain were favoured over charcoal, however, the formation processes and the recorded bioturbation were instrumental in interpreting the meaning of the measured date ranges.

The suitability of charcoal for radiocarbon dating is dependent on species and where on the original plant the sample came from. All of the material selected at Stainton Quarry was from relatively short-lived species and potential twig charcoal was favoured over timbered or heartwood fragments. In this way artificially young dates created by the 'old wood effect' (Waterbolk 1971; Gillespie 1984; Aitken 1990) was minimised.

RESULTS

Mesolithic/Neolithic transition to Chalcolithic

Sinkhole 46: 31 AA and AB, 40 AA and AB

Material from these two contexts was submitted for radiocarbon dating at SUERC. A fragment of hazel (*Corylus avellana*) charcoal from the upper fill (**31** AA) returned an Early Neolithic date (see Appendix H), whilst a fragment of hazelnut shell from the lower fill (**40** AA) was dated to the very late Mesolithic.

These samples were not particularly productive with respect to charred plant remains; a single barley (*Hordeum* sp.) grain was observed in upper fill **31** AA, whilst a hazelnut shell fragment was recovered from sample **40** AA.

The weight of charcoal from this feature was not large with only 4.29g being retrieved from the >2mm fraction (see Table F2). Only 23 fragments were suitable for identification to species. Oak (*Quercus* sp.) was the dominant species in the assemblage recovered from context **31** (55%; n=10), with hazel (*Corylus avellana*) also being identified (33%; n=6), along with a single fragment of willow/poplar (*Salix*/*Populus*). The lower fill, **40** AA, yielded only oak fragments (n=5) and the majority of these were vitrified; see Table F3 for species breakdown.

Sinkhole 47: 39 AA, AB and 48 AA

A single fragment of hazel charcoal from **39** AB provided a date suggesting it was deposited during the transition into the Early Bronze Age. A single wheat (*Triticum* sp.) grain was observed within sample **48** AA. This was submitted for radiocarbon assay, returning an Early to Middle Neolithic date of 3640-3370 cal BC (2σ; SUERC-68522, 4735±29 BP).

The charcoal fragments weighed a collective 2.82g and were very small for the most part, inhibiting identification (Table F2). Oak (**39** AA n=2, **48** AA n=5) and rose (*Rosa* sp.) (**39** AA n=3, **48** AA n=2) were present in all the samples; hazel (n=4) was also identified in sample **39** AA and alder/hazel (*Alnus*/*Corylus*) (n=2) in **48** AA (Table F3).

Sinkhole 63: 38 AA

No charred plant remains were observed within this context and the charcoal recovered was minimal; a total of 0.73g was retrieved during both the initial processing and the refloating (see Table F2). The most dominant species was oak (n=6) with a minimal presence of rose (n=1), willow/poplar (n=1) and guelder rose (*Viburnum opulus*) (n=1). Table F3 provides a species list.

Upper fill of solution feature 21: 22 AA

Similarly, no charred plant remains were observed within sample **22** AA, though it did produce 2.08g of charcoal. This assemblage, dated only by its association with Early Neolithic pottery, comprised material recovered during sample processing as well as hand-collected fragments. Slightly more oak (n=5) and hazel fragments (n=6) were present, however, the amounts of ash (*Fraxinus excelsior*) (n=3), privet (*Ligustrum vulgare*) (n=1) and cherry (*Prunus* sp.) (n=2) were similar to each other. Tables F2 and F3 provide a detailed overview and identification of taxa.

Tree-throw 32: upper fill (33 AA-AD), mid-fill (35 AA) and lower fill (41 AA-AC)

Material from these three fills was radiocarbon dated to the Early Neolithic (See Appendix H). Hazelnut fragments were used to date both contexts **33** and **35** and a fragment of hazel charcoal from lower fill **41** was submitted.

Charred cereal remains recovered during the initial processing comprised a single possible spelt grain (*Triticum aestivum* cf. ssp. *spelta*) from sample **33** AA and a single wheat grain from **33** AD. The most ubiquitous charred plant material from this tree-throw was hazelnut shell fragments. Table F4 shows the proportions between the different samples with Figure F1 giving an overview. The two contemporaneous contexts (**33** and **35**) were relatively similar in their ecofactual yield.

The charcoal yield from this feature was 464.57g. Weights and the number of fragments are in Table F5.

The context that contained the most variety of tree species was upper fill **33** (Table F3), comprising oak, hazel (including alder/hazel), rose, willow/poplar and guelder rose. The most prevalent was oak (27.5%; n=33), closely followed by guelder rose (24%; n=29), with rose (19%; n=23) not far behind. If alder-type and hazel were considered together then they collectively represent 17% (n=20) of the samples assemblage. Figure F2 presents this as a histogram.

Mid-fill **35** contained fewer species but oak remained the most numerous (58%; n=35), with fewer hazel (16.7%; n=10), willow/poplar (16.7%; n=10) and guelder rose (5%; n=3) fragments.

The lower fill, 41, was less diverse with oak representing 79% (n=53) of the total; hazel comprised 18% (n=12) and guelder rose 1.5% (n=1).

Fill of pit 7: 8 AA

This pit contained the most significant charred cereal assemblage for this site with 60 grains being present, two of which were radiocarbon dated (see Appendix H). An emmer (*Triticum turgidum* ssp. *dicoccon*) grain was dated to the Early to Middle Neolithic (SUERC-68510) whilst a barley grain returned a later Early Neolithic date (SUERC-68511).

Barley grains were slightly more numerous (n=15) within this assemblage, however, emmer was a close second (n=13). With the difficulties in identifying poorly preserved wheat grain to sub-species it cannot be stated with certainty that barley was the most widely used grain, especially as the assemblage is moderately small; Table F6 gives a breakdown of taxa. Collectively there were 21 specimens of indeterminate grain and a further 11 that could only be identified as wheat due to the very poor preservation of the grains from this assemblage.

This sample also contained 55.96g of charcoal >2mm. Of the 30 fragments identified only one was a fragment of guelder rose and the remainder were oak. This assemblage contained the largest ring counts with 10% of the assemblage having ring counts of greater than 15. See Tables F2 and F3.

2013 Evaluation: 409 AA (fill of posthole 410) and 411 AA (fill of posthole 412)

No further work was undertaken on the two samples that were recovered during the archaeological evaluation in 2013. Only sample **409** AA yielded any ecofactual material. The analysis of this material is presented in earlier reporting (Lowrie 2013, 13). In summary, the most abundant charcoal species was hazel with smaller quantities of willow/poplar and oak. A small amount of wheat (n=3) and naked barley (n=2) grains were also identified.

Early Bronze Age

Fill of root bole/pit 26: 27 AA

Two barley grains were recovered from a sample from this feature during the first stage of processing; 20 fragments of hazelnut shell were retrieved during refloating. Thirty fragments of charcoal from the 8.46g assemblage were examined; the wood species observed comprised hazel (63%; n=19), with ash (27%; n=8) and willow/poplar (n=2) (see Table F3).

Indeterminate age

Upper subsoil 2: hand-collected charcoal

Three fragments of guelder rose comprised this small hand-collected sample.

Fill of posthole 18 (19 AA) and fill of pit 61 (62 AA)

Sample **19** AA yielded only 0.1g of charcoal, all of which were too small for identification; sample **62** AA did not yield any ecofacts.

Lower fill in solution feature 21: 23 AA

Charred plant remains were observed in sample **23** AA, including hazelnut shell fragments (n=3), indeterminate cereal (n=1) and indeterminate weeds (n=3). Charcoal in the recovered assemblage weighed a total of 4.51g (Table F2). Oak was not as significant in this assemblage when compared to the other Stainton Quarry samples. The most dominant species was rose family in **23** AA (n=12), however, oak was present in almost equal quantity (n=10). A species overview can be seen in Table F3.

DISCUSSION

The radiocarbon measurements on material from sinkholes **46** and **47** returned dates spanning the Mesolithic/Neolithic transition to the Chalcolithic, indicating that the contexts spanned a considerable length of time. Typological dating was also possible due to the presence of Early Neolithic pottery. These deposits, however, were likely subject to pre-deposition mixing (see the site results above) or may have accumulated over a long period of time elsewhere before being deposited intermittently within this feature. Interpretation of the assemblages of palaeobotanical remains and charcoal from these contexts should therefore be cautious.

Some of the oak charcoal fragments from sinkhole **46**, especially **40** AA, were vitrified. In the past this was thought to have been evidence of a fire reaching high temperatures (McParland *et al.* 2010, 2679; Gale and Cutler 2000, 12). However, experiments have demonstrated that the glossy appearance of such fragments is not the product of high-temperature burning

(McParland *et al.* 2010, 2686). The presence of the vitrified charcoal within sample **40** AA was more likely to have been the result of leeching within its burial environment.

The largest grain assemblage from the Stainton site originated from the later Early to Middle Neolithic pit (**7**) and comprised barley and emmer. The presence of these cereals and their relative proportions (i.e. more barley than emmer) was comparable to evidence detailed in Bishop *et al.*'s (2009, 77) review of Neolithic sites in Scotland. A lack of other cereal plant parts (i.e. chaff and rachis), like that recorded at Stainton, can be indicative of crops being processed away from their point of final deposition, however, many factors affect their survivability in the archaeological record. Bishop *et al.* (2009, 82) state that, due to their fragility, these plant parts are the components least likely to survive long-term burial. Furthermore, reuse of the discarded parts of a crop, for instance as animal fodder, would also bias against their survival.

Overall, the most abundant wood taxa observed in the charcoal was oak. However, this could be a product of the ease with which oak charcoal fractures into small pieces creating an artificially high count.

Keeping the dating and mixing issues in mind, the taxa present in the combined Stainton assemblage are known to often co-habit the same environmental niches and, collectively, they suggest open woodland (see Table F7). This supports Evans (2008, 19) when she dismisses previous palynological-based antiquarian views of a closed canopy forest throughout Cumbria during the period c.5500 to 3200 BC.

The Stainton data also questions previous suggestions for earlier Neolithic subsistence patterns in the vicinity (Appley 2012, 180; Evans 2008, 123, 126; Oldfield and Statham 1963) where small-scale clearances for pasture were proposed within the Furness river valleys and small-scale cereal production on the coastal plain. This pattern, however, was largely constructed from palynological studies at Urswick Tarn and Sarah Beck Valley and small amounts of charred grain recovered from the Holbeck Park Avenue (Evans 2008, 123; OAN 2002) and Roose Quarry (Jones 2001; OAN 2014) sites. This potential lack of cereal production away from the coast was apparent within pollen data recovered from both Urswick Tarn and Sarah Beck Valley (Evans 2008, 126), however, cereal pollen dispersal is much localised and is mostly shed within the flowers (Huntley 2000, 67). Hence, whilst the data suggests that no cereal pollen was being deposited close to the areas sampled by coring, this may not be representative of wider Early Neolithic patterns of subsistence.

There is a paucity of early prehistoric palaeoenvironmental assemblages from the Furness Peninsula. This is mainly due to the small number of early prehistoric sites excavated using 'modern' techniques. Financial constraints and a prevailing assumption that most contexts will not yield important ecofactual material unless they have obvious visible concentrations or contain artefacts (for instance OAN 2014, 7), however, have contributed to this paucity.

At Stainton Quarry, all contexts were sampled because of the potential importance of the entire site. All of these samples were processed and assessed, following this, all of the remaining residues from the significant contexts were refloated to maximise recovery. Pit **7**, whilst containing no artefacts, was part of this further processing which increased the recovered charred grain from 18 to 60 items (Table F6). Radiocarbon dating of two of these grains proved the importance of the feature.

During excavations at Holbeck Park Avenue, Barrow-in-Furness a single charred wheat grain, hazelnut shell fragments and abundant charcoal including oak and possible alder or hazel were present (OAN 2002; Evans 2018). The assemblage from Stainton Quarry, along with the

Holbeck Park Avenue material, should highlight the potential for the recovery of significant palaeoenvironmental material in Furness and Cumbria as a whole. This further demonstrates that future archaeological works in the region should incorporate a strategy for the recovery of sediments for palaeoenvironmental study as a priority (see Hodgson and Brennand 2007, 36). As previously highlighted by the author (Gardiner 2015, 57), Hodgson and Brennand (2007, 36) stated that with respect to prehistoric sites '…every avenue of analysis must be investigated'. This is a statement worthy of repeating here.

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Table F2: charcoal weights and quantities

	Sample	Weight (g)	Quantity identified
Sinkhole 46	31 AA	1	7
	31 AA.R	1.31	7
	31 AB	0.6	4
	40 AA	0.08	n/a
	40 AB	1.3	5
	Total	**4.29**	**23**
Sinkhole 47	39 AA	0.6	6
	39 AA.R	1.9	5
	48 AA	0.32	10
	Total	**2.82**	**21**
Deposit 38	38 AA	0.01	4
	38 AA.R	0.72	7
	Total	**0.73**	**11**
Upper fill of solution features in outcrop 20	22 AA	1	10
	22 AA.R	0.88	10
	22 HC	0.2	3
	Total	**2.08**	**23**
Pit 7	8 AA	25.49	20
	8 AA.R	30.47	10
	Total	**55.96**	**30**
Deposit 23	23 AA	4.1	20
	23 AA.R	0.41	10
	Total	**5.51**	**30**

Key: '.R' after the sample code indicates it is from the reflot.

Table F3: charcoal identifications and quantities

Description	**Sample**	***Quercus* sp. oak**	***Fraxinus excelsior* ash**	**cf. *Betula* sp. cf. birch**	***Salix/populus* willow/poplar**	***Alnus*-type Alder/hazel**	***Corylus avellana* hazel**	***Prunus* sp. cherry family**	***Rosa* sp. rose**	***Ligustrum vulgare* privet**	***Viburnum opulus* guelder rose**	***Calluna vulgaris* heather**	**Indet**	**Totals**
Sinkhole 46	31 AA	2					5							7
	31 AA.R	4			1		1						1	7
	31 AB	4												4
	40 AB	5												5
	Total	**15**			**1**		**6**						**1**	**23**
Sinkhole 47	39 AA	1					4		1					6
	AA.R	1							2				2	5
	48 AA	5				2			2				1	10
	Total	**7**				**2**	**4**		**5**				**3**	**21**
Deposit 38	38 AA	2			1								1	4
	38 AA.R	4							1		1		1	7
	Total	**6**			**1**				**1**		**1**		**2**	**11**
Solution features in outcrop 20	22 AA	1			2		5						2	10
	22 AA.R	4					1	3		1			1	10
	22 HC		3											3
	Total	**5**	**3**		**2**		**6**	**3**		**1**			**3**	**23**
Tree-throw 32	33 AA	5				1	1		5		4		4	20
	33 AA.R	1				2			1		6			10
	33 AB	7			3		1		1		8			20
	33 AB.R	3				2			1		3		1	10
	33 AC	4				4	3		4		2	1	2	20
	33 AC.R	6					1		1		2			10
	33 AD	4		1		4	1		7		2		1	20

Description	Sample	*Quercus* sp. oak	*Fraxinus excelsior* ash	cf. *Betula* sp. cf. birch	*Salix/populus* willow/poplar	*Alnus*-type Alder/hazel	*Corylus avellana* hazel	*Prunus* sp. cherry family	*Rosa* sp. rose	*Ligustrum vulgare* privet	*Viburnum opulus* guelder rose	*Calluna vulgaris* heather	Indet	Totals
	33 AD.R	3			1				3		2		1	10
	35 AA	30			8		9				3			50
	35 AA.R	5			2		1						2	10
	41 AA	29					1							30
	41 AB	2					5							7
	41 AB.R	2					6				1		1	10
	41 AC	20												20
	Total	**121**		**1**	**14**	**13**	**29**		**23**		**33**	**1**	**12**	**247**
Pit 7	8 AA	19									1			
	8 AA.R	10												
	Total	**29**									**1**			
Root bole/pit 26	27 AA		7		2	1	16							26
	27 AA.R		1				3							4
	Total		**8**		**2**	**1**	**19**							**30**
Deposit 23	23 AA	8					2		9				1	20
	23 AA.R	2			1	3			3				1	10
	Total	**10**			**1**	**3**	**2**		**12**				**2**	**30**

Key: the '.R' after the sample code indicates it is from the reflot.

Table F4: hazelnut shell fragment counts from tree-throw 32

Sample	From reflot?	Quantity	Sample total	Context total
33 AB	Yes	3	3	35
33 AC	No	4	19	
33 AC	Yes	15		
33 AD	No	2	13	
33 AD	Yes	11		
35 AA	Yes	27	27	29
35 AB	No	2	2	
41 AB	No	5	5	5

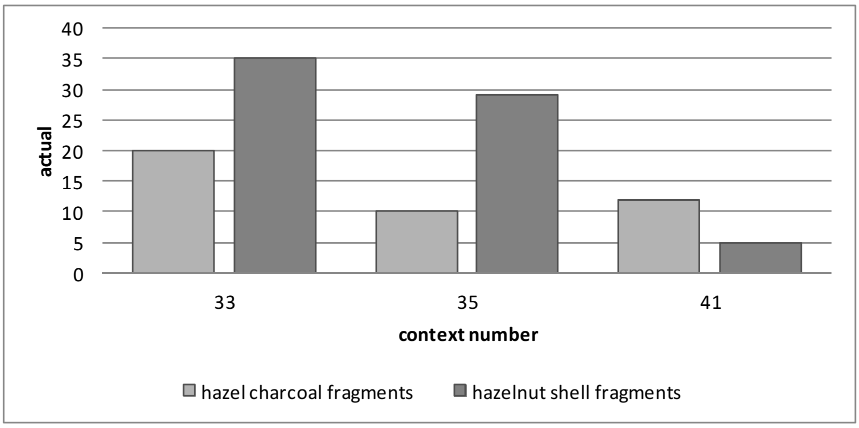

Figure F1: hazel (including Alnus-type) and hazelnut shell fragment from tree-throw 32

Table F5: charcoal data for tree-throw 32

Sample	First process weight (g)	Fragment count	Reflot weight (g)	Fragment count	Combined weight (g)	Fragment count	Weight (g) per context	Fragments
33 AA	8.27	20	7.08	10	45.35	30	156.5	120
33 AB	2.24	20	5.84	10	38.08	30		
33 AC	3.6	20	7.27	10	40.87	30		
33 AD	6.66	20	5.54	10	32.2	30		
35 AA	96.7	50	25.09	10	181.79	60	181.79	60
41 AA	40.2	30			40.2	30	126.28	67
41 AB	2	7	4.88	10	23.88	17		
41 AC	62.2	20			62.2	20		
							464.57	247

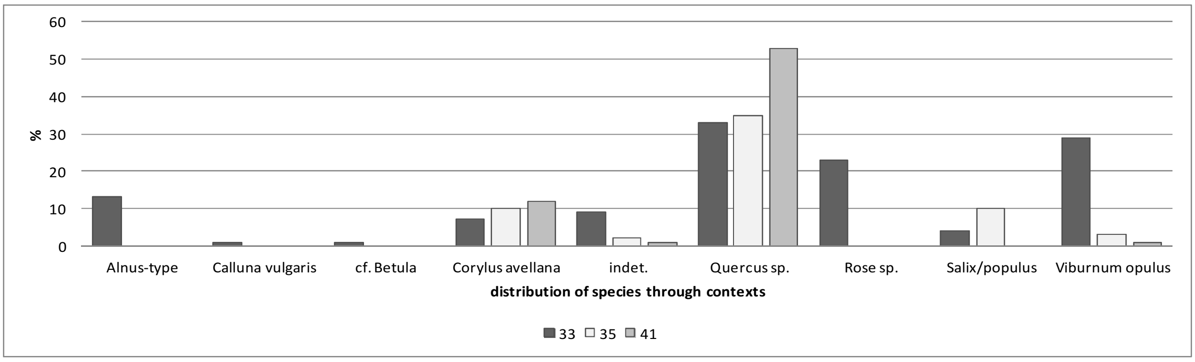

Figure F2: breakdown of species identified in tree-throw 32 (by number of fragments)

Table F6: cereal species from fill of pit 7 (by count)

Sample	*Triticum* sp. wheat	*Triticum turgidum* ssp. *dicoccon* emmer	*Hordeum* sp. barley	Indet. *Cerealia* Indet. cereal	Total
8 AA	2	7	9		18
8 AA.R	9	6	6	21	42
Total	11	13	15	21	60
%	18	22	25	35	

Table F7: species overview for samples selected for analysis and brief comment on species

Species	Qty	Comments
Calluna vulgaris: heather	1	Small to medium-sized shrub, grows on well-drained acid soils and heaths, forms an understory in open woodland (Gale and Cutler, 2000, 61)
Viburnum opulus: guelder rose	38	Large shrubs
Ligustrum vulgare: privet	1	Small shrub base-rich woodland, can grow up to 5m in shrub or marginal woodland (*op. cit*., 149)
Alnus-type: alder/hazel	19	Medium to large shrub, hazel occurs in understory where it can grow to 10m, when growing in the open it becomes shrubby, and in order for it to be nut-bearing it needs sunlight (*op. cit*., 88)
Corylus avellana: hazel	66	As above
Rosa sp.: rose	41	Shrubs, small trees, scrambler
cf. *Prunus* sp.: cf.	1	Trees and shrubs, cherry species native to Britain include wild cherry (*P. avium*),

Species	Qty	Comments
cherry		bird cherry (*P. padus*) and blackthorn (*P. spinosa*). Blackthorn prefers marginal woodland (*op. cit.*, 196)
Prunus sp.: cherry	2	As above
cf. *Salix/Populus*: cf. willow/poplar	2	Large poplar tree, willow shrubs to large trees, common on damp ground or beside flowing water (*op. cit.*, 236)
Salix/Populus: willow/poplar	19	As above
cf. *Betula* sp.: cf. birch	1	Medium to large tree
Fraxinus excelsior: ash	11	Large tree, most frequently observed in mixed woodland with oak on damp, slightly acidic soils (*op. cit.*, 120)
Quercus sp.: oak	188	Large tree: often grown in association with hazel and ash (*op. cit.,* 204)
Indet.	23	Indeterminate
Total	413	

Qty refers to the actual quantity from the site as a whole.

APPENDIX G

ORGANIC RESIDUE ANALYSIS

Julie Dunne and Richard P. Evershed

INTRODUCTION

Lipids, the organic solvent soluble components of living organisms, i.e. the fats, waxes and resins of the natural world, are the most frequently recovered compounds from archaeological contexts. They are resistant to decay and are likely to endure at their site of deposition, often for thousands of years, because of their inherent hydrophobicity, making them excellent candidates for use as biomarkers in archaeological research (Evershed 1993).

Pottery has become one of the most extensively studied materials for organic residue analysis (Mukherjee *et al.* 2005) as ceramics, once made, are virtually indestructible and thus are one of the most, if not the most, common artefacts recovered from archaeological sites from the Neolithic period onwards (Tite 2008). Survival of these residues occurs in three ways; rarely, actual contents are preserved *in situ* (e.g. Charrié-Duhaut *et al.* 2007) or, more commonly, as surface residues (Evershed 2008b). The last, most frequent occurrence, is that of absorbed residues preserved within the vessel wall, which have been found to survive in >80% of domestic cooking pottery assemblages worldwide (Evershed 2008b).

The application of modern analytical techniques enables the identification and characterisation of these sometimes highly degraded remnants of natural commodities used in antiquity (Evershed 2008b). Often, data obtained from the organic residue analysis of pottery or other organic material provides the only evidence for the processing of animal commodities, aquatic products or plant oils and waxes, particularly at sites exhibiting a paucity of environmental evidence. To date, the use of chemical analyses in the reconstruction of vessel use at sites worldwide has enabled the identification of terrestrial animal fats (Evershed *et al.* 1997a; Mottram *et al.* 1999), marine animal fats (Copley *et al.* 2004; Craig *et al.* 2007), plant waxes (Evershed *et al.* 1991), beeswax (Evershed *et al.* 1997b) and birch bark tar (Charters *et al.* 1993; Urem-Kotsou *et al.* 2002). This has increased our understanding of ancient diet and foodways and has provided insights into herding strategies and early agricultural practices. Organic residue analysis has also considerably enhanced our understanding of the technologies involved in the production, repair and use of ancient ceramics.

Preserved animal fats are by far the most commonly observed constituents of lipid residues recovered from archaeological ceramics. This demonstrates their considerable significance to past cultures, not just for their nutritional value but also for diverse uses such as binding media, illuminants, sealers, lubricants, varnish, adhesives and ritual, medical and cosmetic purposes (Mills and White 1977; Evershed *et al.* 1997a).

Today, the high sensitivities of instrumental methods such as gas chromatography and mass spectrometry allow very small amounts of compounds to be detected and identified. Furthermore, higher sensitivity can be achieved using selected ion monitoring (SIM) methods for the detection of specific marine biomarkers (Evershed *et al.* 2008; Cramp and Evershed 2013). The advent of gas chromatography-combustion-isotope ratio mass spectrometry in the 1990s introduced the possibility of accessing stable isotope information from individual biomarker structures, opening a range of new avenues for the application of organic residue analysis in archaeology (Evershed *et al.* 1994; 1997a).

This stable carbon isotope approach, using GC-C-IRMS, is employed to determine the $\sigma^{13}C$ values of the principal fatty acids (C_{16} and C_{18}), ubiquitous in archaeological ceramics. Differences occur in the $\sigma^{13}C$ values of these major fatty acids due to the differential routing of dietary carbon and fatty acids during the synthesis of adipose and dairy fats in ruminant animals, thus allowing ruminant milk fatty acids to be distinguished from carcass fats by calculating $\Sigma^{13}C$ values ($\sigma^{13}C_{18:0}$ - $\sigma^{13}C_{16:0}$) and plotting that against the $\sigma^{13}C$ value of the $C_{16:0}$ fatty acid. Previous research has shown that by plotting $\Delta^{13}C$ values, variations in C_3 versus C_4 plant consumption are removed, thereby emphasising biosynthetic and metabolic characteristics of the fat source (Dudd and Evershed 1998; Copley *et al.* 2003).

STAINTON QUARRY, FURNESS, CUMBRIA

Archaeological mitigation works undertaken at Stainton Quarry revealed regionally significant early prehistoric remains comprising six pits or postholes, one of which contained Early Neolithic pottery. Deposits containing further similar pottery, charcoal, flint, pitchstone and tuff flakes were discovered in the upper portion of a tree-throw and within grykes in an outcrop of limestone bedrock. The archaeological features were suggestive of early prehistoric occupation, the focus of which lay to the east of the stripped area. These excavated remains represent a rare and significant addition to the existing corpus of Early Neolithic information for the region. Furthermore, the Stainton Quarry pottery assemblage, comprising Early Neolithic Carinated Bowls, represents a comparatively large and rare assemblage for Cumbria (Appendix E). These vessels can be dated from the 39th-38th centuries BC through to the 36th century BC (Sheridan 2007; Whittle *et al.* 2011). Thus, this assemblage is of considerable importance in the western distribution of the Carinated Bowl (Appendix E). It was therefore recommended that organic residue analysis be carried out on a representative selection of the pottery.

AIMS AND OBJECTIVES

The objective of this investigation was to determine whether organic residues were preserved in Early Neolithic potsherds from the archaeological remains excavated from Stainton Quarry, Furness, Cumbria.

ANALYTICAL METHODS

Lipid analysis and interpretations were performed using established protocols described in detail in earlier publications (Correa-Ascencio and Evershed 2014). Briefly, ~2g of potsherds were sampled and surfaces cleaned with a modelling drill to remove exogenous lipids. The cleaned sherd powder was crushed in a solvent-washed mortar and pestle and weighed into a furnaced culture tube (I). Sediment samples were weighed directly into furnace culture tubes. An internal standard was added (20µg n-tetratriacontane; Sigma Aldrich Company Ltd) together with 5ml of H_2SO_4/MeOH 2-4% ($\sigma^{13}C$ measured) and the culture tubes were placed on a heating block for one hour at 70ºC, mixing every 10 minutes. Once cooled, the methanolic acid was transferred to test tubes and centrifuged at 2500 rpm for 10 minutes. The supernatant was then decanted into another furnaced culture tube (II) and 2ml of DCM extracted double distilled water was added. In order to recover any lipids not fully solubilised by the methanol solution, 2 x 3ml of hexane was added to the extracted potsherds contained in the original culture tubes, mixed well and transferred to culture tube II. The extraction was transferred to a clean, furnaced 3.5mm vial and blown down to dryness. Following this, 2 x 2ml hexane was added directly to the H_2SO_4/MeOH solution in culture tube II and whirlimixed to extract the remaining residues, then transferred to the 3.5mm vials and blown down until a full vial of hexane remained. Aliquots of the TLE's were derivatised using 20µl BSTFA, excess BSTFA was removed under nitrogen and the derivatised TLE was dissolved in hexane prior to GC, GC-MS and GC-C-IRMS. Firstly, the samples underwent high-temperature gas chromatography using a gas chromatograph (GC) fitted with a high temperature non-polar column (DB1-HT; 100% dimethylpolysiloxane, 15m x 0.32mm i.d., 0.1µm film thickness). The carrier gas was helium and the temperature programme comprised a 50°C isothermal followed by an increase to 350°C at a rate of 10° min^{-1} followed by a 10-minute isothermal. A procedural blank (no sample) was prepared and analysed alongside every batch of samples. Further compound identification was accomplished using gas chromatography-mass spectrometry (GC-MS). FAMEs were then introduced by autosampler onto a GC-MS fitted with a non-polar column (100% dimethyl polysiloxane stationary phase; 60m x 0.25mm i.d., 0.1µm film thickness). The instrument was a ThermoFinnigan single quadrupole TraceMS run in EI mode (electron energy 70eV, scan time of 0.6s). Samples were run in full scan mode (*m/z* 50-650) and the temperature programme comprised an isothermal hold at 50°C for two minutes, ramping to 300°C at 10° min^{-1}, followed by an isothermal hold at 300°C (15 minutes).

Carbon isotope analyses by GC-C-IRMS were also carried out using a GC Agilent Technologies 7890A coupled to an Isoprime 100 (EI, 70eV, three faraday cup collectors *m/z* 44, 45 and 46) via an IsoprimeGC5 combustion interface with a CuO and silver wool reactor maintained at 850°C.

RESULTS

Lipid analysis and interpretations were performed using established protocols described in detail in earlier publications (e.g. Dudd and Evershed 1998; Correa-Ascencio and Evershed 2014). The lipid recovery rate was 59% which compares favourably to those extracted from British Neolithic sites (43%, Copley *et al.* 2005a). The mean lipid concentration from the sherds (Table G1) was 2521.7µg g^{-1} (2.52mg g^{-1}), with a maximum lipid concentration of 17456.4µg g^{-1} (17.46mg g^{-1}). Several of the potsherds contained extremely high levels of lipids (e.g. STQ004, 17.4mg g^{-1} and STQ012, 15.9mg g^{-1}), demonstrating excellent preservation. For example, to date, the maximum concentration of absorbed lipid observed in an archaeological potsherd to date is 17.8mg g^{-1}(Copley *et al.* 2005c). This likely indicates that these were vessels which underwent sustained use, over considerable periods of time.

To date, analysis of the total lipid extracts (TLEs, n=18), using GC and GC-MS, from the Stainton Quarry site all contained sufficient concentrations (>5µg g^{-1}) of lipids that can be reliably interpreted (Evershed 2008a). However, some of these lipid profiles contained either contaminants or low abundances of unidentified lipids and these were not taken forward for analysis. The remainder comprised lipid profiles which demonstrated that the free fatty acids, palmitic (C_{16}) and stearic (C_{18}), typical of a degraded animal fat (Fig. G1), are the most abundant components (e.g. Evershed *et al.* 1997a; Berstan *et al.* 2008).

Samples STQ003, STQ004, STQ006, STQ007, STQ008, STQ012, STQ013 and STQ017A also include a series of long-chain fatty acids (in low abundance), containing C20 to C28 acyl carbon atoms. It is thought these LCFAs likely originate directly from animal fats, incorporated via routing from the ruminant animal's plant diet (Halmemies-Beauchet-Filleau *et al.* 2013; 2014). However, sample STQ017B, which also comprised a series of long chain fatty acids, also included a series of long-chain n-alkanes, although no long-chain n-alkanols were identified. This may have a plant origin or possibly originate from beeswax, although no wax esters were identified.

Table G1: Sample number, sherd group, fabric and context, lipid concentrations (µg g^{-1}), total lipid concentration in extract (µg), $\sigma^{13}C$ and $\Sigma^{13}C$ values and attributions of Stainton Quarry residues.

Laboratory Number	Sherd group	Fabric	Context	Lipid concentration (ug g-1)	Total lipid in extract (ug)	$\delta^{13}C_{16:0}$	$\delta^{13}C_{18:0}$	$\Delta^{13}C$	Attribution
STQ001	16	1	39	256.0	491.5	-26.1	-32.6	-6.5	Dairy fat
STQ002	17	4	39	35.0	26.6	-	-	-	-
STQ003	13	3	35	52.1	107.4	-27.1	-31.9	-4.8	Dairy fat
STQ004	11	1	35	17456.4	20598.6	-26.8	-32.6	-5.8	Dairy fat
STQ005	12	1	35	238.8	236.4	-	-	-	-
STQ006	19	1	40	1333.4	1866.8	-27.0	-32.5	-5.5	Dairy fat
STQ007	15	1	39	3934.4	4327.8	-27.2	-32.7	-5.5	Dairy fat
STQ008	20	1	41	840.5	1849.2	-28.2	-33.0	-4.8	Dairy fat
STQ009	3	2	409	81.0	150.6	-	-	-	-
STQ010	9	1	33	46.3	101.4	-	-	-	-
STQ011	18	1	40	29.1	45.0	-	-	-	-
STQ012	10	1	35	15910.8	24980.0	-26.6	-32.3	-5.7	Dairy fat
STQ013	14	1	38	771.3	809.9	-27.1	-32.6	-5.5	Dairy fat
STQ014	4	1	9	-	-	-	-	-	Not sampled - too friable
STQ015	2	1	409	95.3	150.5	-	-	-	-
STQ016	7	1	30	16.1	19.2	-	-	-	-
STQ017A	8	1	31	1703.5	2419.0	-28.1	-34.6	-6.5	Dairy fat
STQ017B	8	1	31	68.1	101.4	-	-	-	Poss Beeswax

GC-C-IRMS analyses were carried out on samples STQ001, STQ003, STQ004, STQ006, STQ007, STQ008, STQ012, STQ013 and STQ017A to determine the $\sigma^{13}C$ values of the major fatty acids, $C_{16:0}$ and $C_{18:0}$, and ascertain the source of the lipids extracted, through the use of the $\Sigma^{13}C$ proxy (Table G1). These all originate from fabric type 1 but there does not seem to be any further relationship between the lipid residues and sherd groups.

The $\sigma^{13}C$ values of the $C_{16:0}$ and $C_{18:0}$ fatty acids for the samples are plotted onto a scatter plot along with the reference animal fat ellipses (Fig. G2a). It has been established that when the extract from a vessel plots directly within an ellipse, for example, ruminant dairy, ruminant adipose or non-ruminant adipose, then it can attributed to that particular classification. If it plots just outside then it can be described as predominantly of that particular origin. However, it should be noted that extracts commonly plot between reference animal fat ellipses and along the theoretical mixing curves, suggesting either the mixing of animal fats contemporaneously or during the lifetime of use of the vessel (Mukherjee 2004; Mukherjee *et al.* 2005).

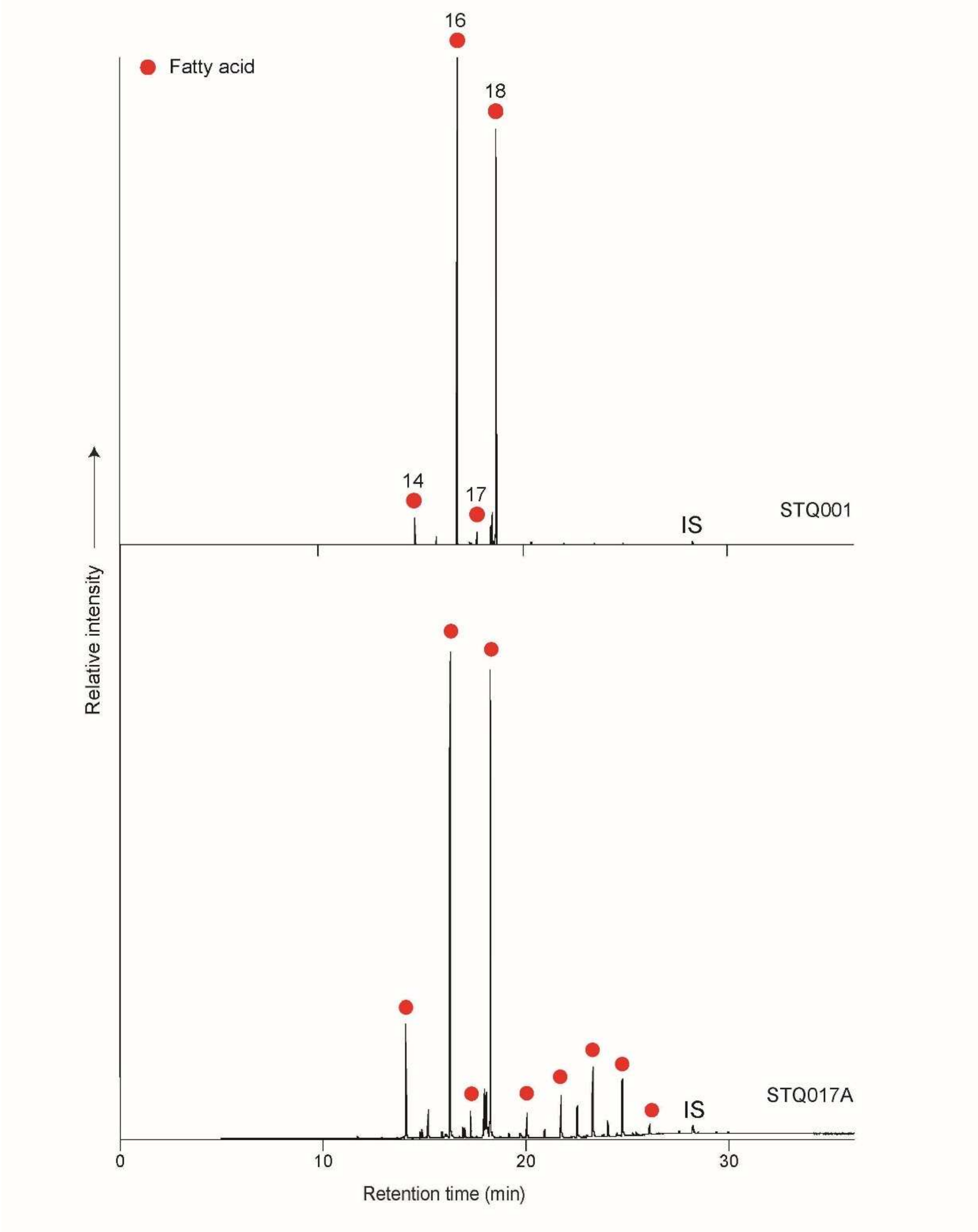

Figure G1: Gas chromatogram of trimethylsilylated FAME from pottery extract STQ001, circles, n-alkanoic acids (fatty acids, FA); IS, internal standard, C_{34}n-tetratriacontane.

In this instance, sample STQ008 plots within the reference ellipse, suggesting this vessel was solely used to process dairy fats. The remaining samples all plot just outside the dairy fats ellipse, indicative of some mixing of animal fats in prehistory, although it is likely that they were predominantly used to process milk products.

Ruminant dairy fats are differentiated from ruminant adipose fats when they display $\Sigma^{13}C$ values of less than -3.1 ‰, known as the universal proxy (Dunne *et al.* 2012; Salque 2012). Significantly, all of these lipid residues plot in the ruminant dairy region (Fig. G2b), confirming a strong reliance on secondary products, such as milk, butter and cheese.

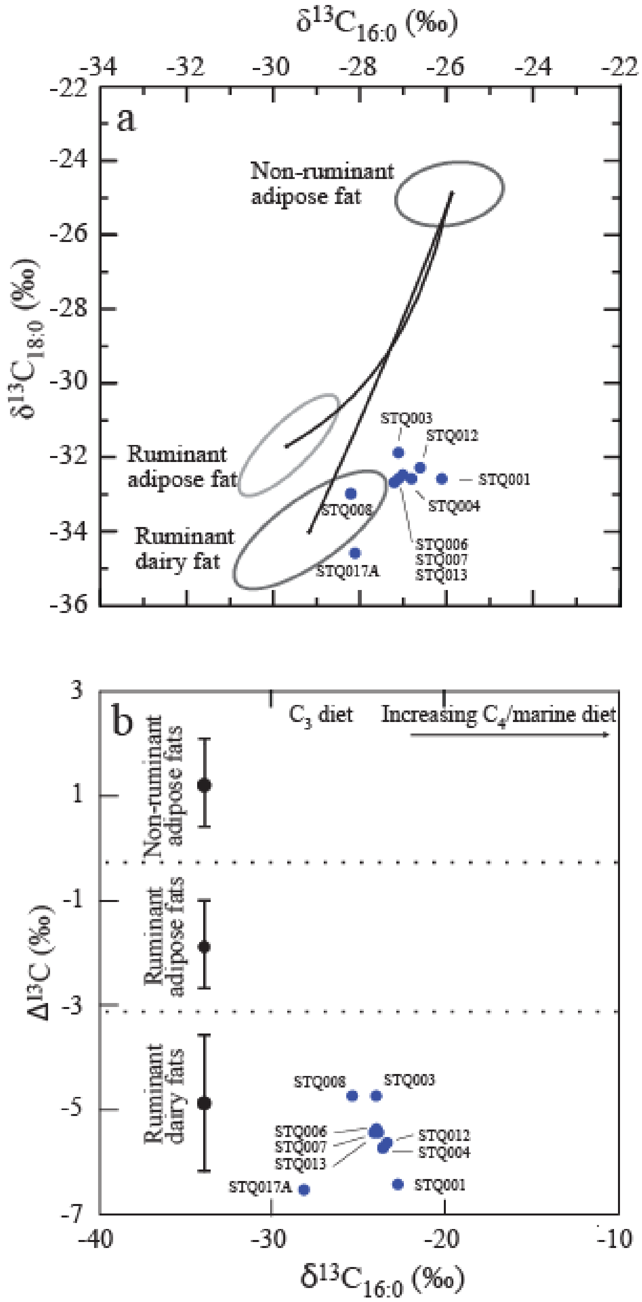

Figure G2: Graphs showing: a) $\sigma^{13}C$ values for the $C_{16:0}$ and $C_{18:0}$ fatty acids for archaeological fats extracted from Stainton Quarry ceramics. The three fields correspond to the P = 0.684 confidence ellipses for animals raised on a strict C_3 diet in Britain (Copley et al. 2003). Each data point represents an individual vessel. b) shows the $\Sigma^{13}C$ ($\sigma^{13}C_{18:0}$ - $\sigma^{13}C_{16:0}$) values from the same potsherds. The ranges shown here represent the mean ±1 s.d. of the $\Sigma^{13}C$ values for a global database comprising modern reference animal fats from Africa (Dunne et al. 2012), UK (animals raised on a pure C_3 diet) (Dudd and Evershed 1998), Kazakhstan (Outram et al. 2009), Switzerland (Spangenberg et al. 2006) and the Near East (Gregg et al. 2009), published elsewhere.

CONCLUSION

The objective of this investigation was to determine whether organic residues were preserved in potsherds from Early Neolithic Carinated Bowls excavated from the Early Neolithic site of Stainton Quarry, Furness, Cumbria.

The results, determined from GC, GC-MS and GC-C-IRMS analyses, demonstrate that nine pottery samples from Stainton Quarry vessels (59%) were routinely used to process dairy fats. This is in contrast to a study of 438 potsherds from six Southern British Neolithic sites, where dairy fats were observed in approximately 25% (equivalent to 57% of the lipid-containing extracts) of all the sherds (Copley *et al.* 2005b). However, an overwhelming predominance of dairy products (80%) was associated with Neolithic pottery throughout the north-east archipelago of the British Isles (Cramp *et al.* 2014). This provides strong evidence that, in Northern Britain, during the earliest Neolithic, the exploitation of secondary animal products was well established. It is noteworthy that, although this population would be lactose intolerant, fermented dairy products (i.e. yoghurt or cheese) contain less lactose, allowing consumption by non-persistent individuals without any deleterious effects (Gerbault *et al.* 2011).

In this instance, organic residue analysis has also acted as a proxy in providing information regarding Early Neolithic animal husbandry practices, given the general poor preservation of animal bone recovered from the contexts investigated during the project.

In conclusion, these results confirm that dairying was clearly an established component of agricultural practices in Northern Britain in the 4th millennium BC.

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APPENDIX H

RADIOCARBON DATING AND BAYESIAN MODELLING

Gav Robinson

INTRODUCTION

The importance of radiocarbon dating is clearly stated multiple times in all current regional, national and thematic research framework documents (for example, Manby, King and Vyner 2003, 42; Haselgrove *et al.* 2001, 3-7; Petts and Gerrard 2006, 130-1, 136-7; Brennand 2007, e.g. 34, 38-9; EH 2010, 12; Blinkhorn and Milner 2014, 33-4). Most of these guideline documents also highlight that multiple dating of the same material or context and the use of statistical analysis to refine the date ranges achieved are routine requirements for most projects (Manby, King and Vyner 2003, 42; Haselgrove *et al.* 2001, 3-7; Petts and Gerrard 2006, 130-1, 136-7). This need for modelling is further stated by Bayliss *et al.* (2011, 18-9) in Whittle *et al.*'s (2011) extensive analysis of Neolithic enclosures of southern Britain.

With regard to the Stainton Quarry project and the potential Early Neolithic date of the deposits, there was a clear need for independent dating (NAA 2015). Furthermore, there was a need to independently date the assemblages of prehistoric artefacts and the potentially regionally significant concentrations of charcoal and charred plant remains. Therefore, 10 samples were submitted to the Scottish Universities Environmental Research Centre AMS Facility (SUERC) for radiocarbon dating.

During the analysis associated with this project a programme of Bayesian modelling (Naylor and Smith 1988; Bayliss 2009; Bayliss *et al.* 2011, 19-59; Bayliss 2015) of the radiocarbon dates was undertaken using the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal) v4.3.2 r5 (Bronk Ramsey 1995; 2009). The aims and objectives of this and the models utilised are detailed below. The brackets and keywords used in the associated diagrams (H1 and H2) define the OxCal models used. Within the text (and tables) the models and queries used are indicated by keywords in bold. Calculated posterior ranges were rounded outwards to 10 years (Bayliss *et al.* 2011, 21).

The ^{14}C ages measured by SUERC and presented in Table H1 below are quoted in conventional years BP (before 1950 AD). The associated 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 initial calibrated age ranges (Table H1) were determined from the OxCal4 using the IntCal 13 atmospheric curve (Reimer *et al.* 2013). The Bayesian modelling, however, was undertaken using a later version (OxCal4.3.2 r5; Bronk Ramsey 1995; 2009).

All calibrated radiocarbon dates reproduced in the text, unless stated otherwise, represent calibrated calendar years (AD or BC) at a probability of 95.4%. Modelled 'posterior density estimates' (Bayliss *et al.* 2011, 21) are presented in italics.

Table H1: radiocarbon results (unmodelled)

Context	Interpretative description	Lab Code	Material	d13C relative to VPDB (‰)	Radiocarbon result BP	95.40%
8 (1)	Fill of pit 7	SUERC-68510	Emmer grain	-24.3	4759±29	3639(89.4%)3515 3422(0.6%)3418 3413(1.6%)3404 3399(3.9%)3384
8 (2)	Fill of pit 7	SUERC-68511	Barley grain	-25.1	4934±29	3773(95.4%)3652
27	Fill of root bole/pit 26	SUERC-68515	Hazelnut shell	-25.2	3532±29	1945(95.4%)1766
31	Upper fill of sinkhole 46	SUERC-68516	Hazel charcoal	-25.8	4917±30	3765(95.4%)3645
33	Upper fill of tree-throw 32	SUERC-68517	Hazelnut shell	-24.8	4959±26	3790(95.4%)3661
35	Mid-fill of tree-throw 32	SUERC-68518	Hazelnut shell	-27.3	4922±29	3766(95.4%)3648
39	Upper fill of sinkhole 47	SUERC-68519	Hazel charcoal	-25.4	3888±29	2467(95.4%)2292
40	Lower fill of sinkhole 46	SUERC-68520	Hazelnut shell	-22.3	5679±27	4580(1.2%)4571 4561(94.2%)4454
41	Lower fill of tree-throw 32	SUERC-68521	Hazel charcoal	-23.3	5012±26	3939(35.0%)3861 3813(60.4%)3708
48	Lower fill of sinkhole 47	SUERC-68522	Wheat grain	-24.4	4735±29	3635(50.4%)3551 3542(20.7%)3499 3433(24.2%)3378

AIMS AND OBJECTIVES

The aim of the Bayesian modelling was linked to that of the initial radiocarbon analysis, which was to provide a chronology for the recorded remains and artefacts recovered to aid their interpretation. The objectives of both of these programmes of analysis were:

- to help understand the length of activity on the site;
- to provide dating evidence for the Neolithic pottery, polished stone axes and charred plant remains;
- to test for residuality within the deposits and longevity of deposition; and
- to enable a comparison of the recorded remains within the local and wider region.

METHODOLOGY

The selection of material for submission and an understanding of the depositional processes that led to their inclusion within the contexts were both crucial to achieving a meaningful interpretation of the returned measurements (see Bayliss 1998; Ashmore 1999; Gibson and Bayliss 2009, 41, 67-72; Haselgrove *et al.* 2001, 5; Bayliss 2009, 129; Bayliss 2015, 683-90). All of the material dated was from relatively short-lived items (including nuts and seeds), and hazel charcoal was favoured over longer-lived species; timbered or heartwood fragments were avoided. In this way, potentially artificially young dates created by the 'old wood effect' (Waterbolk 1971; Gillespie 1984; Aitken 1990) were minimised.

However, the pool of material available did not include any large accumulations of charred material (such as discrete dumped lenses), articulated bone or residues on artefacts. This issue increased the chance that any material chosen for dating was intrusive from later activity or residual from earlier. For instance, charred hazelnut shell fragments may have been 'stored', either in a former soil or an above-ground pile (or midden) for some considerable time before entering a context selected for dating.

Because of this issue 'test' Bayesian models were run for each sequence recorded on the site before an overall model was constructed.

Bayesian modelling

The measured radiocarbon dates were tested using Bayesian chronological modelling (Naylor and Smith 1988; Bayliss 2009; Bayliss *et al.* 2011, 19-59; Bayliss 2015). This allowed the combination of the dates with archaeological data ('prior information') such as stratigraphical relationships using a formal statistical methodology. This modelling also allowed the calculation of statistical probabilities of the '**Span**' of certain events to investigate the speed and, hence, the nature of deposition.

It should be noted, however, that the low number of radiocarbon determinations available for each context (usually one) potentially restricted the accuracy of many of the models tested. Furthermore, it became apparent that there were varying levels of residuality and/or mixing of material within the contexts. Both of these factors must be taken into account during interpretation of the results.

With respect to the Stainton Quarry samples; this modelling was carried out to:

- refine the date ranges achieved through radiocarbon dating alone;
- test the measured ages within the recorded stratigraphic sequences;
- statistically check for residuality with the deposits; and
- provide statistically tested spans for the durations of deposition.

All of these models were produced within the OxCal online facility (OxCal v4.3.2) using the '**Phase**' model where the order of samples was unknown and the '**Sequence**' model where stratigraphical information was available. The '**Span**' query was also used to calculate the probabilistic ranges of certain activities and processes.

RESULTS

Pit 7

Although no artefacts were recovered from this feature, it produced 60 charred cereal grains. This pit was located away from the features containing Early Neolithic pottery but still may have been contemporary. Given the rarity of Early Neolithic charred plant remains in Cumbria, it was decided to submit two grains (one of emmer wheat and one of barley) for radiocarbon dating. It was anticipated that these two dates could provide an indication of levels of residuality within the pit and/or the time depth of activity (or deposition) that produced the remains.

The first model implemented (not illustrated) was to test if the two dates from pit 7 could be contemporary using the '**R_combine**' function. These dates came from the same context but were shown to be statistically inconsistent via a chi-square test (df=1 T=18.204 (5% 3.8)). It was assumed that these grains (and the others recovered from the feature) were from nearby activity prior to the infilling of the pit and hence were then modelled as a '**Phase**' to investigate the potential start and finish dates (not illustrated). This model was statistically consistent (A_{model}=105.4 and $A_{overall}$=105.3) and produced a statistical '**Span**' of between *25* and *1465* years (*95.4% probability*). This indicated that either the pit was infilled over a considerable period of time, or (more likely) one of the grains was residual from earlier activity or intrusive from later. Equally, however, both items may have derived from a secondary source of material such as an above-ground midden that was used to infill the pit.

These two dates represented a small sample of the 60 charred grains recovered and, equally, were potentially an even smaller sample of the theoretical nearby activity. It was therefore decided that these two dates were an unreliable measure of the span of the infilling of pit **7**; furthermore, they only provide a broad likely date for the other charred grains within context **8**. The measured dates were, however, probably a reliable *terminus post quem* (TPQ) for the infilling of the pit as well as an indicator of the date of some of the charring of grain in the vicinity. The posterior density estimates produced by this model are presented in Table H2.

Table H2: Bayesian test modelling data for pit 7

Am=105.1, Ao=105.1	**Unmodelled (BC)**						**Modelled (BC)**							
	from	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**A**	**C**
Sequence														
Boundary Start 1							3910	3650	68.2	4590	3650	95.5		96.4
Phase 1														
SUERC-68511	3759	3657	68.2	3773	3652	95.4	3710	3650	68.2	3770	3640	95.4	103.8	99.6
SUERC-68510	3633	3522	68.2	3639	3384	95.5	3640	3560	68.2	3650	3510	95.4	103.4	99.3
Span Pit 7							40	560	68.2	20	1470	95.4		95.2
Boundary End 1							3640	3360	68.2	3640	2730	95.4		96

A=individual agreement indices; C=convergence test; Am=A (model); Ao=A (overall)

Root bole 26

Material for radiocarbon dating was sought from the numerous burnt root boles that were recorded across the investigated area in order to gain some understanding of the chronology of this episode (or episodes) of clearance. Due to limited availability of material as well as cost implications, a single sample of hazel charcoal from root bole **26** was chosen for submission. The single radiocarbon measurement potentially represented the latest phase of activity on the site and was included within the overall model for the dated contexts (see below).

Grykes

As detailed in the main text, the sequence of deposition in the grykes within bedrock outcrop **20** was complex and difficult to interpret. Radiocarbon dating of samples of suitable material from each of the four main contexts recorded (**31**, **39**, **40** and 48**)** was sought to aid understanding. The material chosen comprised: a hazelnut shell from deposit **40**; hazel charcoal from **31**; a wheat grain from context **48**; and hazel charcoal from **30**. All of these samples were from short-lived items and the charcoal submitted was identified as hazel twig-charcoal. The small number of items recovered from each context, however, meant that the chance that any (or all) of these samples were residual from earlier activity or intrusive from later was moderately high.

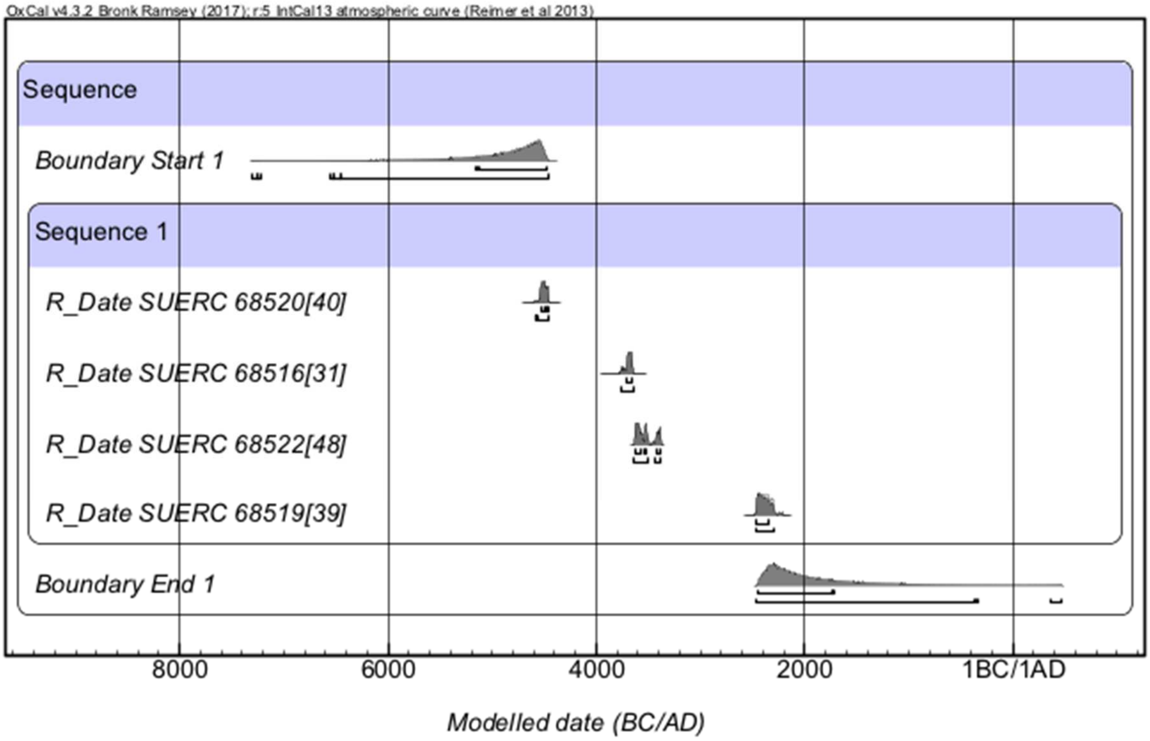

Figure H1: probability distributions of dates measured from the gryke deposits as a sequence

The radiocarbon measurements achieved for the gryke deposits were modelled (Fig. H1) using the '**Sequence**' function, assuming contexts **40**, **31**, **48** and **39** were deposited in that order sequentially (that is one starts after the previous one has ended with a possible gap – OxCal online), as suggested by the excavator.

This model had a good overall index of agreement (A_{model}=100.1%, $A_{overall}$=100.1%) and the individual indices were all above the required 60%. Posterior density estimates for the individual radiocarbon measurements are presented within Table H3. This model was constructed from few dates and hence should be treated with caution. However, the modelling demonstrated that the dates matched the stratigraphical sequence.

Using just this simple model, the posterior estimate for the start of deposition within the grykes was during *7320-4450 cal BC* (*94.6% probability*), or during *5160-4470* (*68.2% probability*). The estimate for its end was during *2450 cal BC-cal AD470* (*95.5% probability*), or during *2450-1720cal BC* (*68.2% probability*). An estimated '**Span**' of deposition within the grykes was calculated using this model. This indicated that the feature was likely infilled over between *2140* and *3540* years (*probability of 68.2%*), and potentially between *2050* and *5750* years (*probability of 95.4%*).

These four dates represented a small sample of the charred material recovered and, equally, were potentially an even smaller sample of the theoretical nearby activity that produced it. The dates matched the stratigraphical sequence and, in general, agreed with the other available dating evidence. However, due to the presence of Early Neolithic pottery within context 40 and the robust nature of hazelnut shells, the fragment from this context was considered to be a remnant from earlier activity. Even so, the modelled '**Span**' of deposition within the grykes is considered to relatively accurate. Additionally, the measured dates represent reliable TPQs for the individual contexts and the material they contain.

Table H3: Bayesian modelling data for the Gryke deposits as a simple sequence

Am=100.1, Ao=100.1	**Unmodelled (BC)**						**Modelled (BC)**							
	from	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**A**	**C**
Sequence														
Boundary Start 1							5160	4470	68.2	7320	4450	95.5		97.1
Sequence 1														
SUERC-68520	4540	4466	68.2	4580	4454	95.4	4540	4460	68.2	4580	4450	95.4	100.1	99.8
SUERC-68516	3706	3656	68.2	3765	3645	95.4	3710	3650	68.2	3770	3640	95.4	99.6	99.7
SUERC-68522	3631	3384	68.1	3635	3378	95.3	3640	3380	68.3	3640	3370	95.4	99.2	99.9
SUERC-68519	2457	2344	68.2	2467	2292	95.4	2470	2340	68.2	2470	2290	95.4	101.6	99.8
Span gryke							2140	3540	68.3	2050	5750	95.4		97.3
Boundary End 1							2450	1720	68.2	2470	AD 470	95.4		97.6

A=individual agreement indices; C=convergence test; Am=A (model); Ao=A (overall)

Tree-throw 32

This feature produced almost half of the pottery recovered from the site and hence three samples for radiocarbon dating were chosen in order to facilitate Bayesian modelling. The primary fill of the tree-throw failed to produce suitable material; hazel charcoal from the overlying fill (**41**) and hazelnut shell fragments from the penultimate (**35**) and upper (**33**) deposits were submitted.

The three measurements from this feature were first modelled as a simple '**Sequence**' as each date was taken from a clear stratigraphical sequence. This produced a low index of agreement (A=56.4%) for the measurement from context **35**, and, the model had a low overall index of agreement (A_{model}=60.5%, $A_{overall}$=70.4%). This indicated that the hazelnut shell from context **35** was either intrusive or the material from the overlying context was residual from earlier activity (or both). In summary, the modelling suggested some level of residuality or mixing between contexts.

In light of this result, this stratigraphical sequence was not included within the overall site model. The measured dates were, however, included in the general '**Phase**' of activity.

Another model treating the three dates as a simple '**Phase**' of activity was ran to test the potential duration of infilling of this tree-throw. From this, a '**Span**' was calculated (not illustrated). This indicated that the feature was likely infilled over between *0* and *190* years (*probability of 68.2%*), and potentially between *0* and *680* years (*probability of 95.4%*).

The three dates for this feature represented a small sample of the charred material recovered, and equally, were potentially an even smaller sample of the theoretical nearby activity that produced the material deposited. Bayesian modelling showed that one of the measured dates was not a good match to the stratigraphical sequence. As this was probably due to mixing prior to deposition, the second model of the dates as a '**Phase**' is considered to have produced reliable TPQs for the contexts and the material recovered from them. The modelled '**Span**' of deposition within the tree-throw is therefore considered to relatively accurate.

Table H4: Bayesian modelling data for tree-throw 32 as a single phase

Am=84.4, Ao=85.8	**Unmodelled (BC)**						**Modelled (BC)**							
	from	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**A**	**C**
Sequence														
Boundary Start 1							3840	3710	68.2	4130	3700	95.4		97.4
Phase 1														
SUERC-68521	3910	3715	68.2	3939	3708	95.4	3790	3710	68.2	3910	3700	95.4	92.2	99.6
SUERC-68517	3768	3704	68.2	3790	3661	95.4	3770	3700	68.2	3790	3660	95.4	107.1	99.6
SUERC-68518	3708	3657	68.2	3766	3648	95.4	3770	3670	68.2	3780	3650	95.4	77.7	99.5
Span tree							0	190	68.2	0	680	95.4		96.9
Boundary End 1							3760	3630	68.2	3780	3370	95.4		97.5

A=individual agreement indices; C=convergence test; Am=A (model); Ao=A (overall)

Overall phase model

In light of the results of the test models, and the likelihood that some (or all) of the dated material was residual from earlier activity (or intrusive from later), a simple overall Bayesian model for the site was constructed as four simple '**Phases**'. A '**Sequence**' (sequential) of the gryke deposits was included within the second phase due to the reliability of this sequence.

This model (Fig. H2) had a good overall index of agreement (A_{model}=98.4%, $A_{overall}$=98.5%) and the individual indices were all above the required 60%. Posterior density estimates for the individual radiocarbon measurements are presented within Table H5. The posterior estimate for the start of deposition produced by this model was during *5370-4450 cal BC* (*95.4% probability*) and was likely during *4790-4480 cal BC* (*68.2% probability*). The estimate for the end of deposition was during *1960-1000 cal BC* (*95.4% probability*), and was likely during *1910-1560 cal BC* (*68.2% probability*).

From this an estimated '**Span**' of deposition within the dated contexts of between *2550* and *4050* years (*probability of 95.4%*) was calculated. This span was also likely to have been between *2650* and *3250* years long (*probability of 68.2%*).

This model was constructed from all of the radiocarbon dates measured during the project. Even so, in statistical terms, the dates represented a small sample of the charred material recovered and were an even smaller sample of the theoretical nearby activity that produced them. This is an unavoidable product of developer-funded rescue archaeology and it is hoped, with future research-based investigation and analysis that the chronological model can be improved.

Even so, the modelled dates are considered to have produced reliable TPQs for the contexts and the material recovered from them. The modelled '**Span**' of deposition is also considered to be relatively accurate. The dates from this model have been quoted within the site narrative (see above).

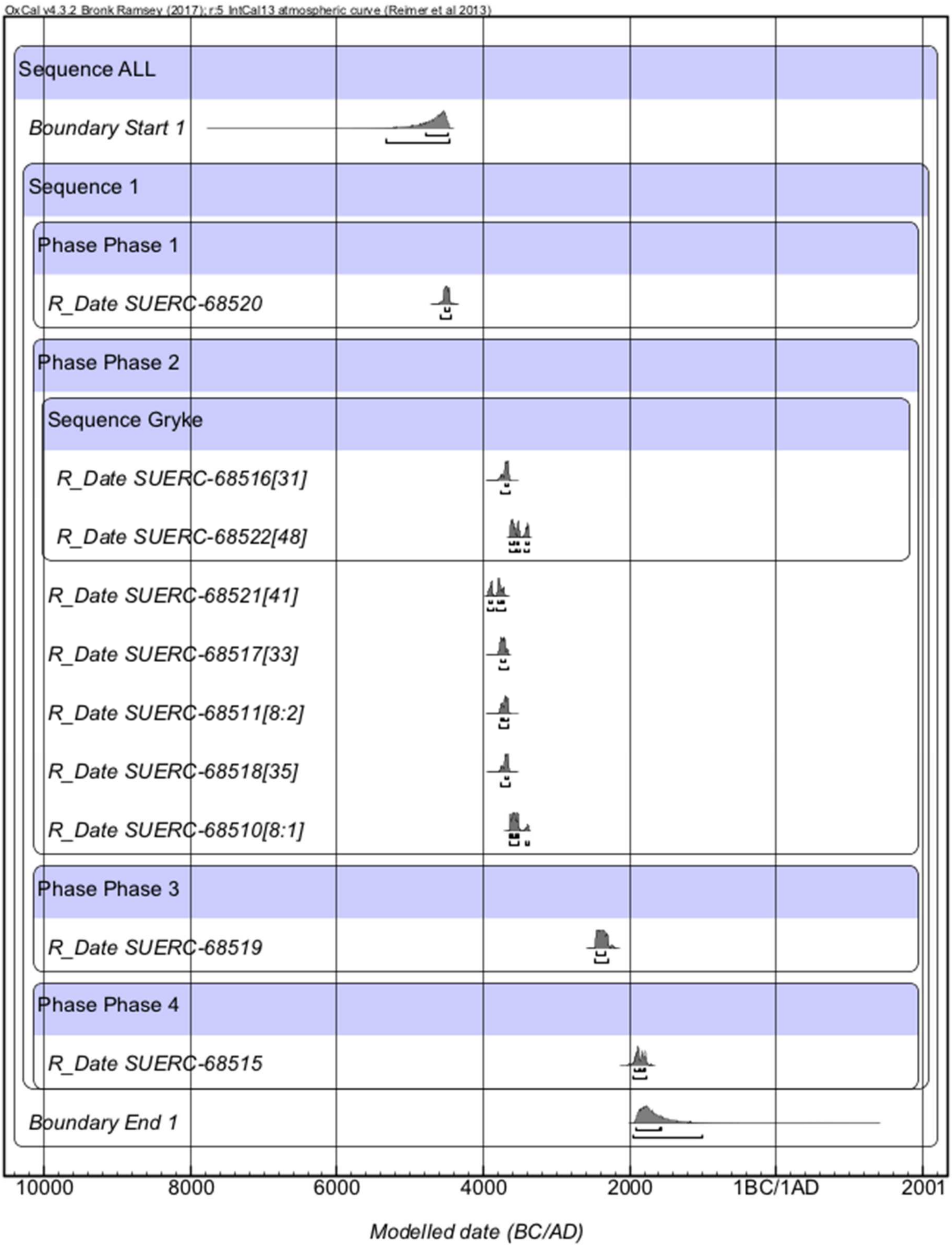

Figure H2: probability distributions of dates as four phases with the gryke deposits as a sequence

Table H5: Bayesian modelling data for all of the radiocarbon dates as four phases

Am=98.4, Ao=98.5	**Unmodelled (BC)**						**Modelled (BC)**							
Sequence ALL	from	to	%	from	to	%	from	to	%	from	to	%	A	C
Boundary Start 1							4790	4480	68.2	5370	4450	95.4		97
Sequence 1														
Phase 1														
SUERC-68520	4540	4466	68.2	4583	4453	95.4	4530	4460	68.2	4590	4450	95.4	100.4	99.7
Phase 2														
Sequence Gryke														
SUERC-68516	3706	3656	68.2	3765	3645	95.4	3710	3650	68.2	3770	3640	95.4	99.6	99.7
SUERC-68522	3631	3384	68.1	3635	3378	95.3	3640	3380	68.2	3640	3370	95.4	99.2	99.7
SUERC-68521	3910	3715	68.2	3939	3708	95.4	3920	3710	68.3	3940	3700	95.4	99.3	99.8
SUERC-68517	3768	3704	68.2	3790	3661	95.4	3770	3700	68.2	3790	3660	95.4	99.8	99.8
SUERC-68511	3759	3657	68.2	3773	3652	95.4	3760	3650	68.2	3780	3650	95.4	99.5	99.7
SUERC-68518]	3708	3657	68.2	3766	3648	95.4	3710	3650	68.2	3770	3640	95.4	99.6	99.8
SUERC-68510	3633	3522	68.2	3639	3384	95.5	3640	3520	68.3	3640	3380	95.4	99.5	99.8
Phase 3														
SUERC-68519	2457	2344	68.2	2467	2292	95.4	2460	2340	68.2	2470	2290	95.4	100	99.7
Phase 4														
SUERC-68515	1919	1778	68.3	1945	1766	95.4	1940	1780	68.2	1960	1760	95.4	98.5	99.7
Span All							2650	3250	68.2	2550	4050	95.4		97.2
Boundary End 1							1910	1560	68.2	1960	1000	95.4		96

A=individual agreement indices; C=convergence test; Am=A (model); Ao=A (overall)

Neolithic Phase

The excavator suggested that the recorded contexts, and the material recovered from within, represented dumped waste from another source such as an above-ground midden (or middens). The test models have added some weight to this theory with the presence of potential residual material and the presence of two charred grains within pit **7** that could not have died in the same year. This mixing of material prior to deposition has been demonstrated in Early Neolithic contexts in Lincolnshire by Duncan Garrow (2006, 36), and has been a common occurrence in archaeological contexts from a variety of time periods (see Orton 2000, 40 and fig. 42; Gibson 2003, 140; Tipper 2004, 157-9).

Therefore, as is the case in many archaeological contexts that are not intentionally 'placed', not all the material within a context died or was discarded in the same year. At Stainton Quarry, this probability hinders closer dating of, for instance, the recovered pottery.

However, it is possible, and in this case considered appropriate, to model the chronology of the pre-pit contexts of the Early Neolithic material to investigate the date and '**Span**' of the activity that created it. This would refine the dating of the charred material and by inference, the initial discard of the pottery and other artefacts. Logically, with the seven available dates, this modelling should provide a fairly reliable chronology and time depth for this activity. The reliability of this modelling could be improved upon, in future, through increasing the number of radiocarbon dates from the contexts that produced pottery.

A simple Bayesian model for the Early Neolithic dates was constructed as a single '**Phase**' irrespective of stratigraphy. The Late Mesolithic date (SUERC-68520) from fill **40** was not included. As stated above, though the hazelnut shell came from a context that produced pottery, it was considered to be residual. This is because, due to its robust nature, the shell fragment was most likely a remnant from earlier activity, rather than being representative of the date range of activity that produced the pottery.

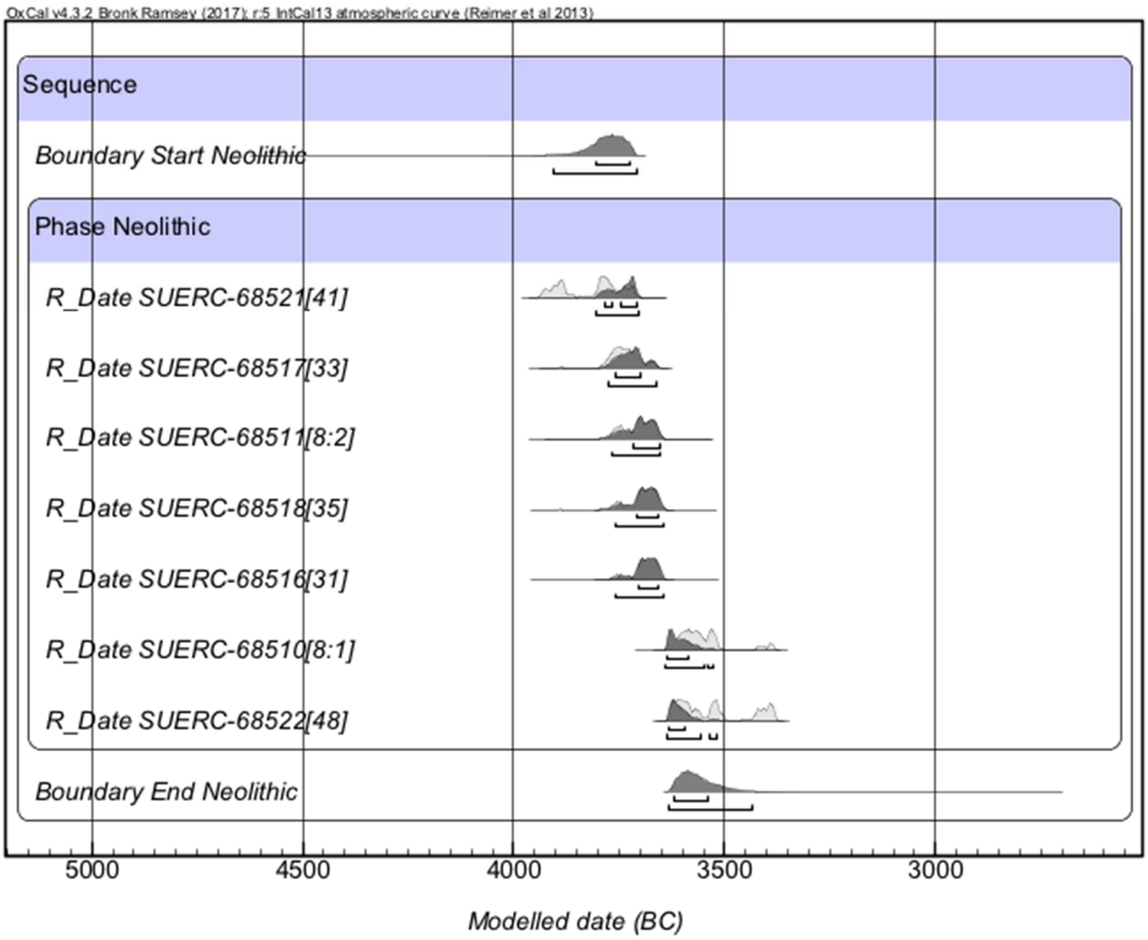

Figure H3: probability distributions of dates measured from the Phase II dates as a 'Phase'

This model (Fig. H3) had a good overall index of agreement (A_{model}=107.2%, $A_{overall}$=108%) and the individual indices were all above the required 60%. The highest posterior density estimates for the individual radiocarbon measurements are presented within Table H6. The posterior estimate for the start of Phase II produced by this model was during *3910-3700* cal BC *(95.4% probability)* and was likely during *3810-3720* cal BC *(68.2% probability)*. The estimate for the end of the phase was during *3640-3430* cal BC *(95.4% probability)* and was likely during *3630-3540* cal BC *(68.2% probability)*.

From this an estimated '**Span**' of activity within the Early Neolithic (and possibly into the middle Neolithic) of between *90-430* years *(probability of 95.4%)* was calculated. This span was also likely to have been between *120-270* years long *(probability of 68.2%)*.

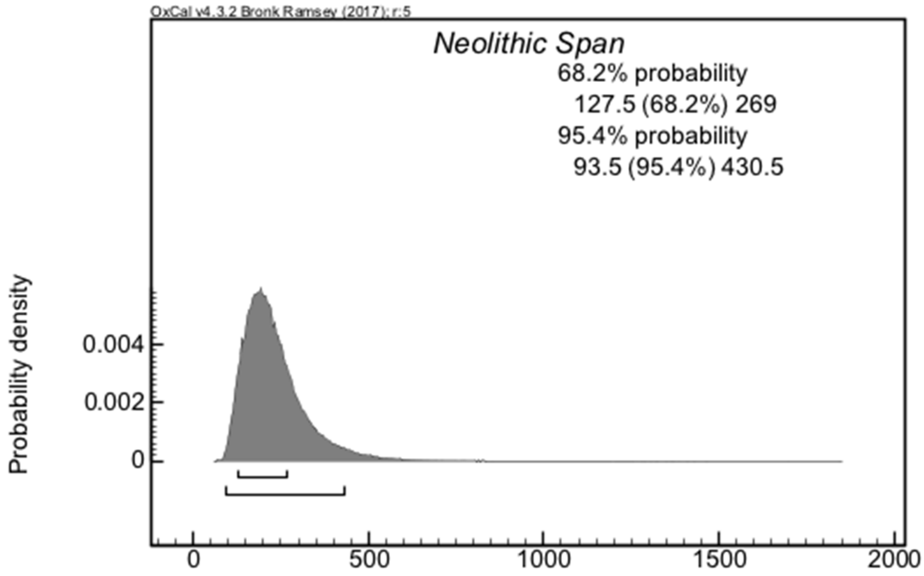

Figure H4: probability distribution of the total number of years of Early Neolithic activity

Table H6: Bayesian modelling data for Phase II dates as a 'Phase'

Am=107.2, Ao=108	**Unmodelled (BC)**						**Modelled (BC)**							
	from	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**from**	**to**	**%**	**A**	**C**
Sequence														
Boundary Start Neolithic							3810	3720	68.2	3910	3700	95.4		98.5
Phase Neolithic														
SUERC-68521	3910	3715	68.2	3939	3708	95.4	3790	3700	68.2	3810	3700	95.4	88.2	99.7
SUERC-68517	3768	3704	68.2	3790	3661	95.4	3760	3690	68.2	3780	3660	95.4	100.2	99.8
SUERC-68511	3759	3657	68.2	3773	3652	95.4	3720	3650	68.2	3770	3650	95.4	104	99.9
SUERC-68518	3708	3657	68.2	3766	3648	95.4	3710	3650	68.2	3760	3640	95.4	103.4	99.9
SUERC-68516	3706	3656	68.2	3765	3645	95.4	3710	3650	68.2	3760	3640	95.4	103	99.8
SUERC-68510	3633	3522	68.2	3639	3384	95.5	3640	3580	68.2	3650	3520	95.4	105	99.8
SUERC-68522	3631	3384	68.1	3635	3378	95.3	3640	3590	68.2	3640	3510	95.4	119.2	99.8
Boundary End Neolithic							3630	3540	68.2	3640	3430	95.4		98.3
Span Neolithic							120	270	68.2	90	430	95.4		98.5

A=individual agreement indices; C=convergence test; Am=A (model); Ao=A (overall)

DISCUSSION

In general, the Bayesian modelling was successful in refining the chronology of the recorded contexts. It also identified the residuality of some of the samples and has suggested that some (if not all of) the charred material was from activity that pre-dated the infilling of the features.

Considering this alongside the processes of formation recorded by the excavator, the material dated is therefore likely to represent secondary or tertiary deposition and potentially includes elements from above ground middens. The Bayesian modelling of the Phase II dates therefore probably represents a chronology for the nearby Early Neolithic activity that created the charred waste, and not necessarily the infilling of the features directly.

Even so, the modelling has provided a statistical understanding of the time-depth of deposition within the grykes, the tree-throw **32** and pit **7** and broad *TPQ's* for their infilling.

Additionally, the modelling of the Phase II contexts, some of which contained Early Neolithic Carinated Bowls, has provided a date range for their use/deposition of between *3910-3700 cal BC (95.4% probability)* and *3640-3430* cal BC *(95.4% probability)*, or between the 40th and 35th centuries BC. The deposition of the Early Neolithic pottery, whilst not directly dated, was almost certainly within this period.

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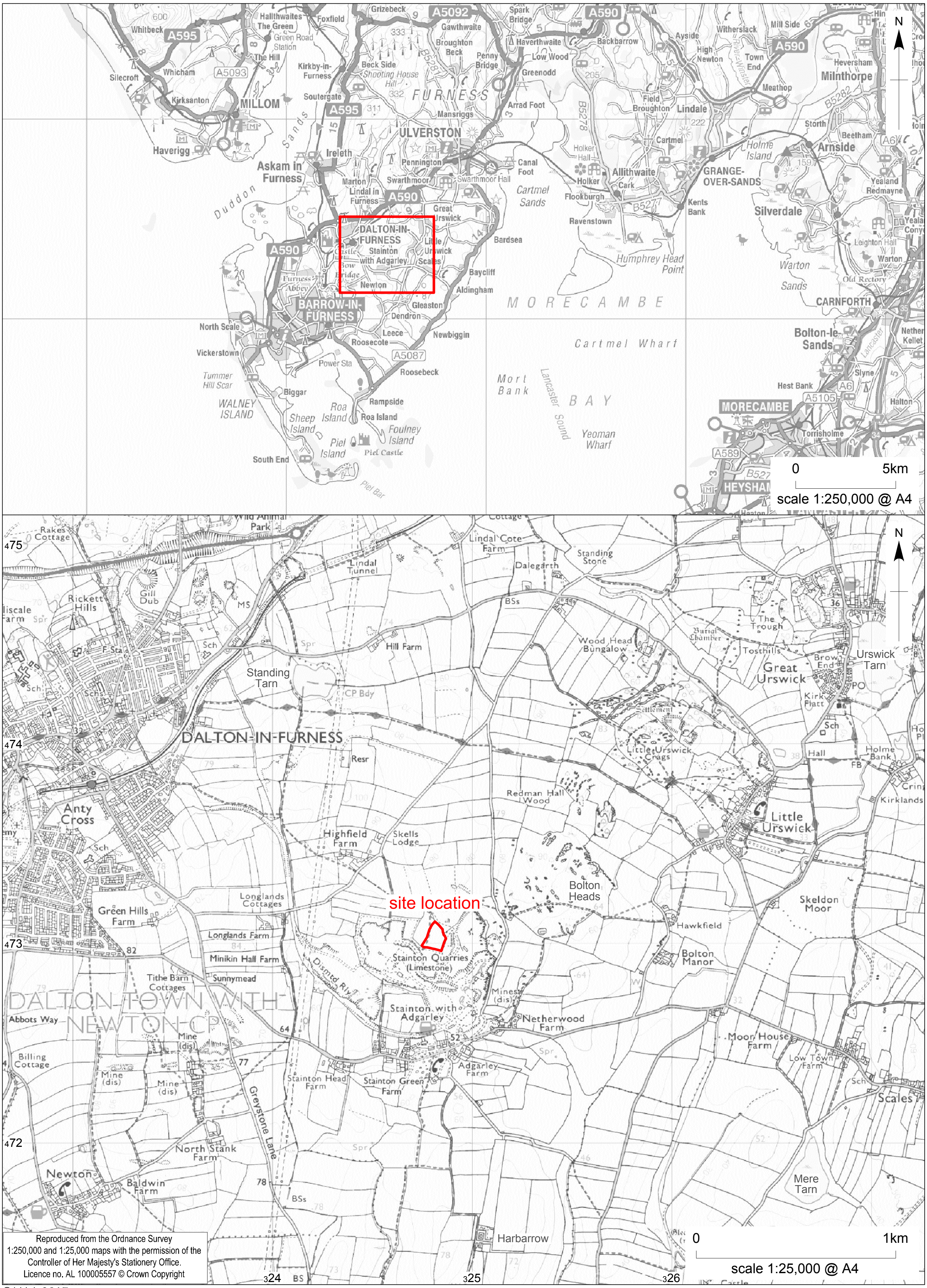
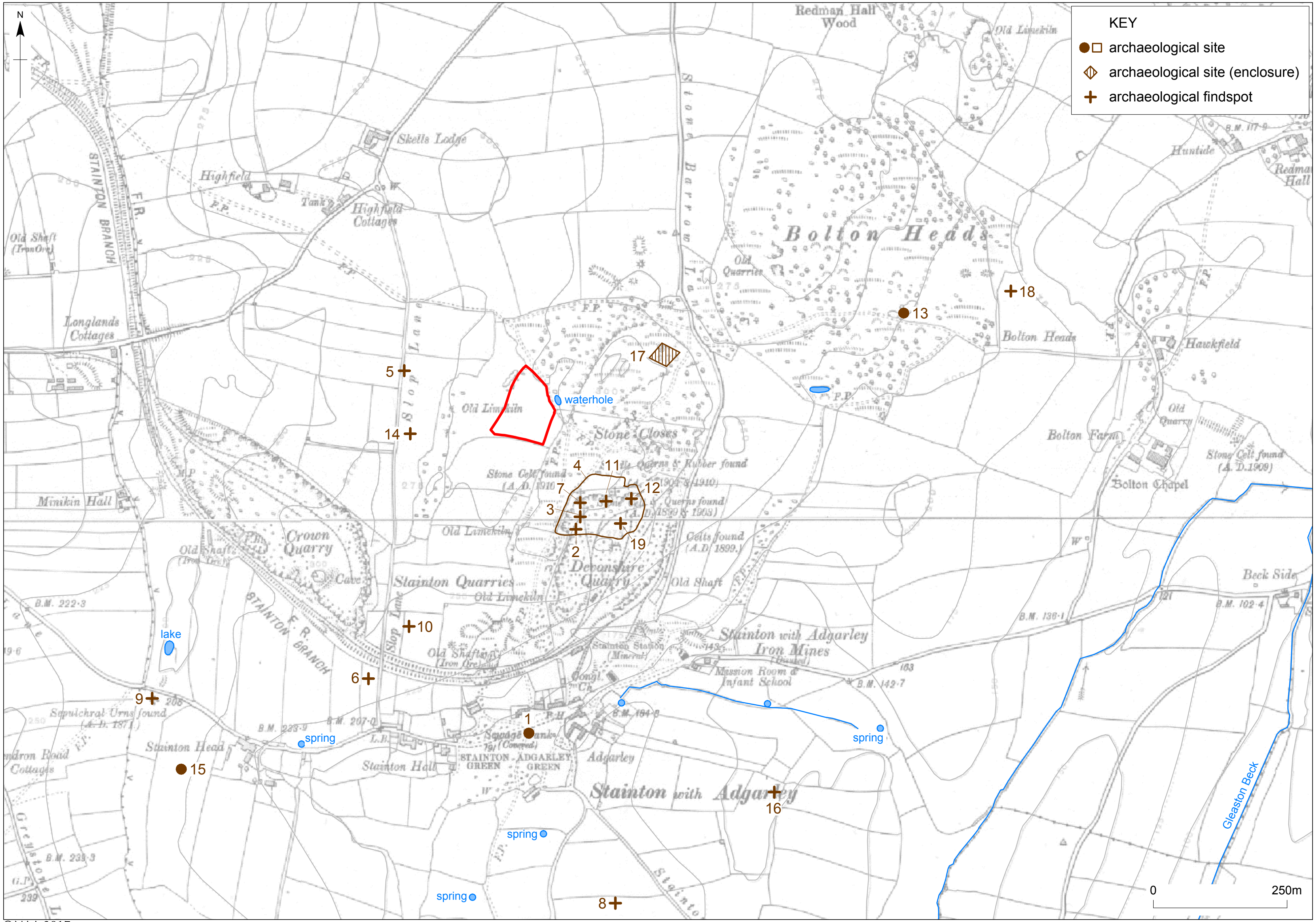
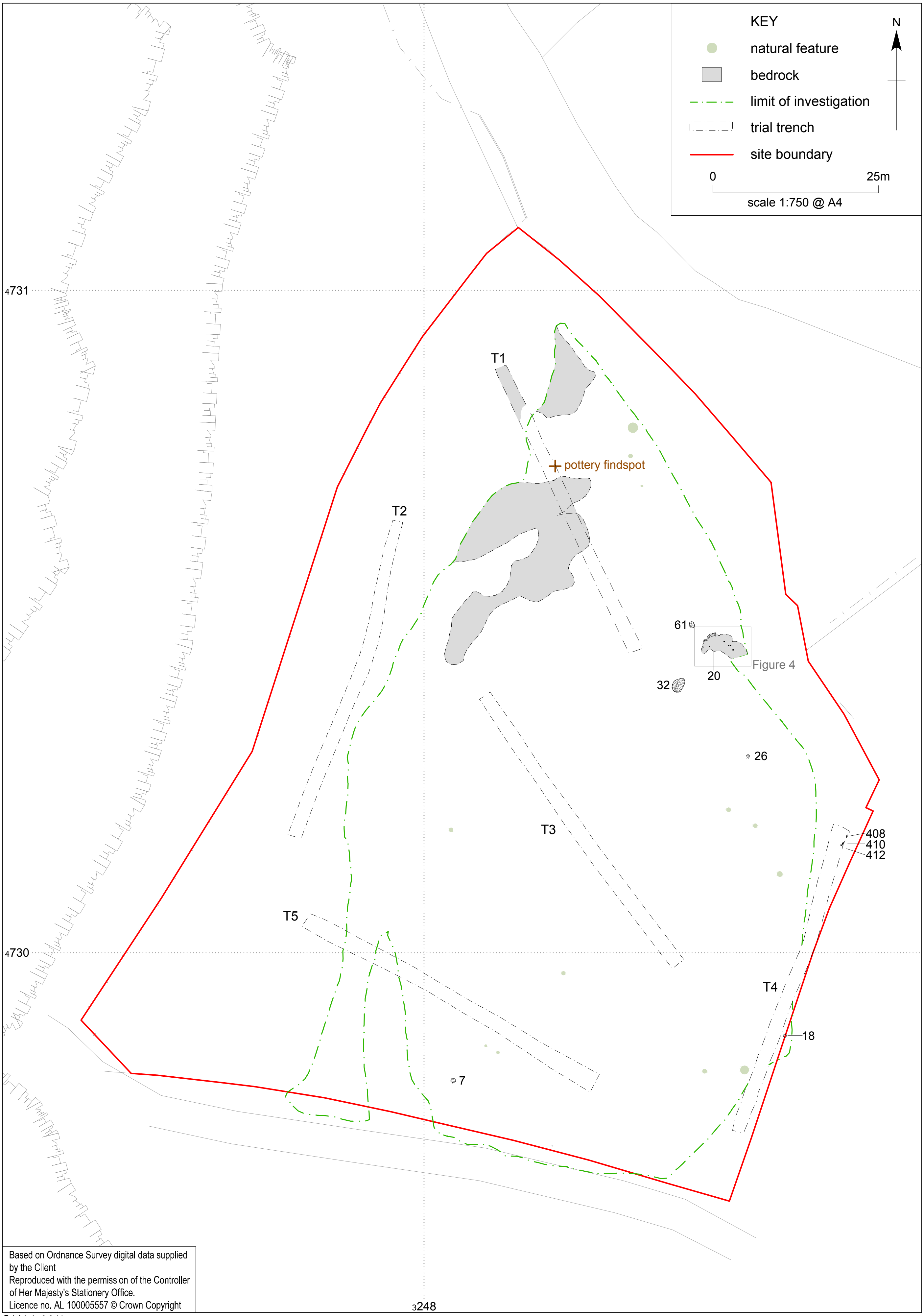


Stainton Quarry, Furness, Cumbria: site location

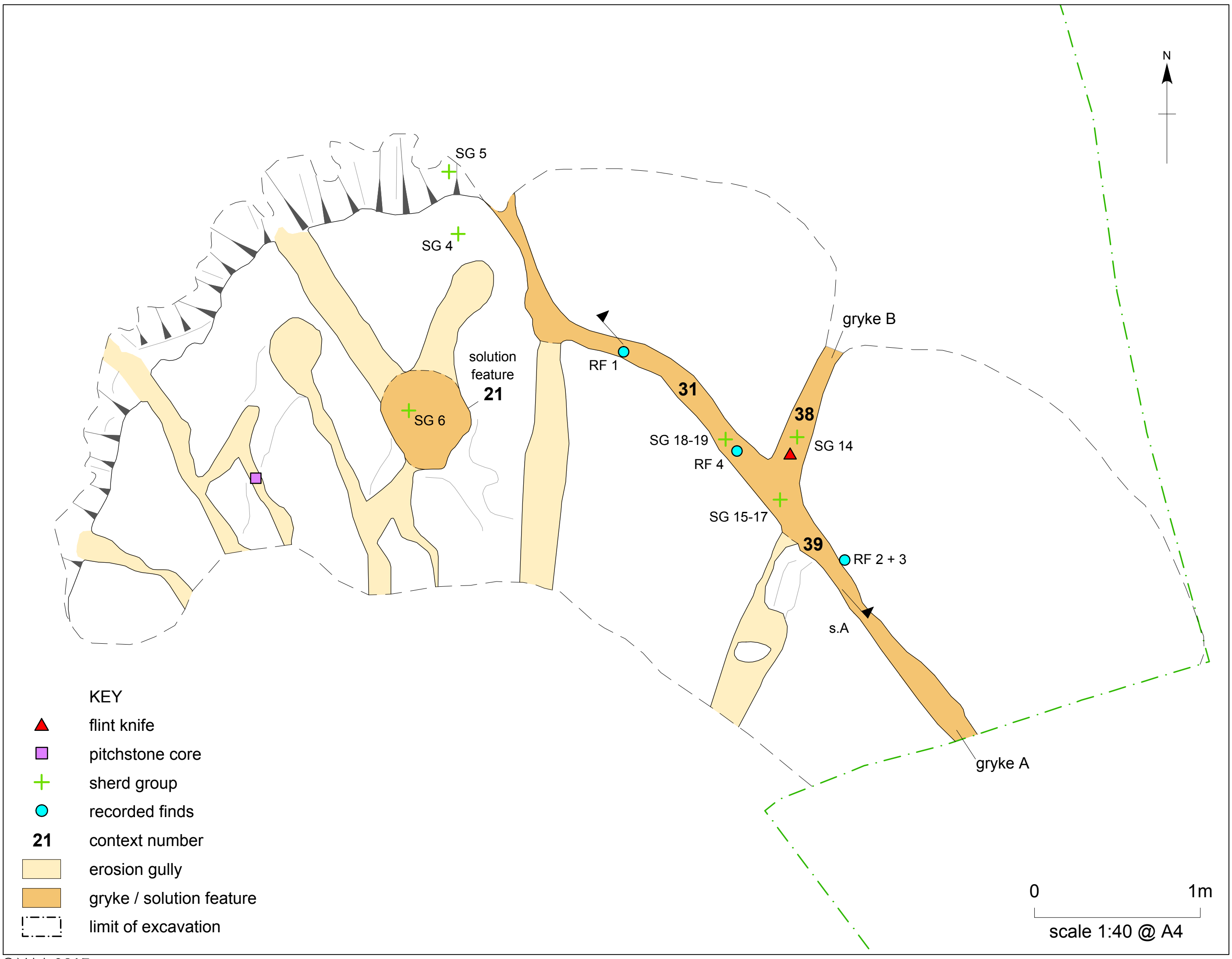
Figure 1



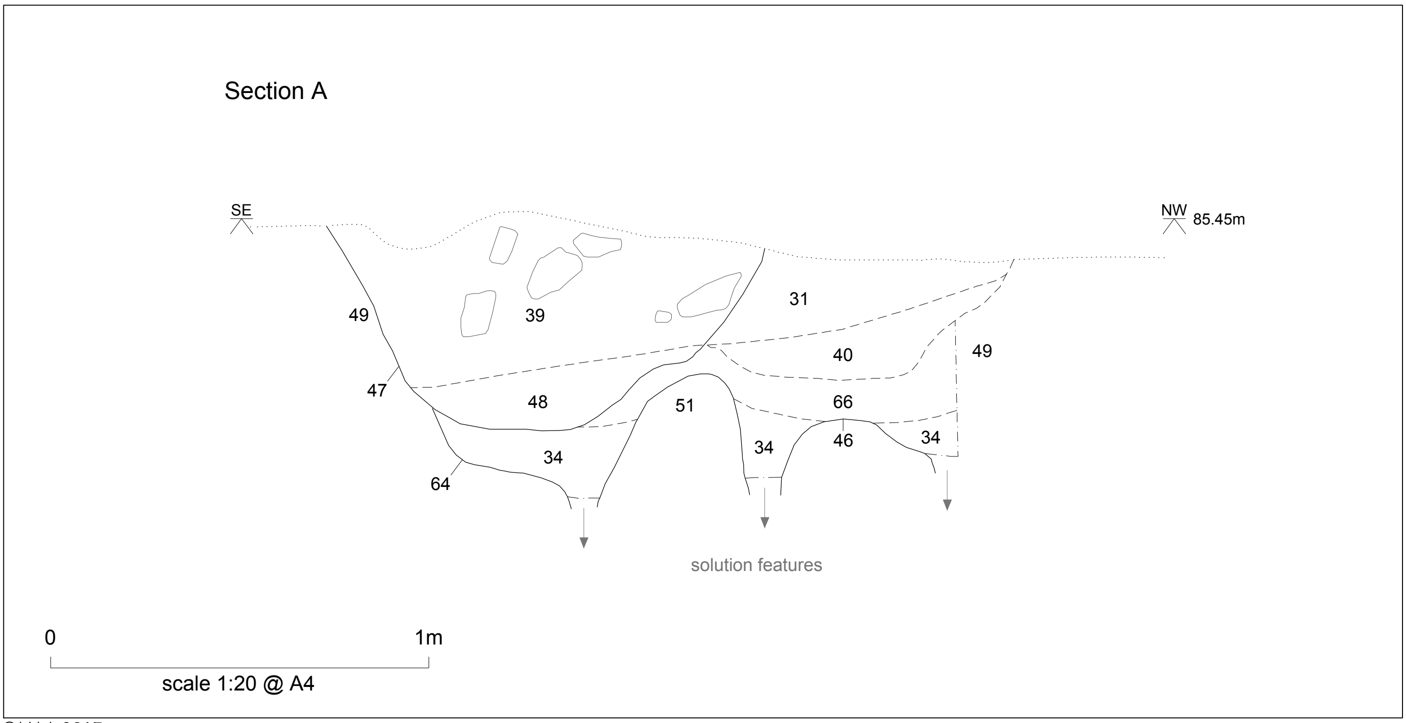
Stainton Quarry, Furness, Cumbria: Ordnance Survey map of 1919 showing sites in the vicinity *Figure 2*



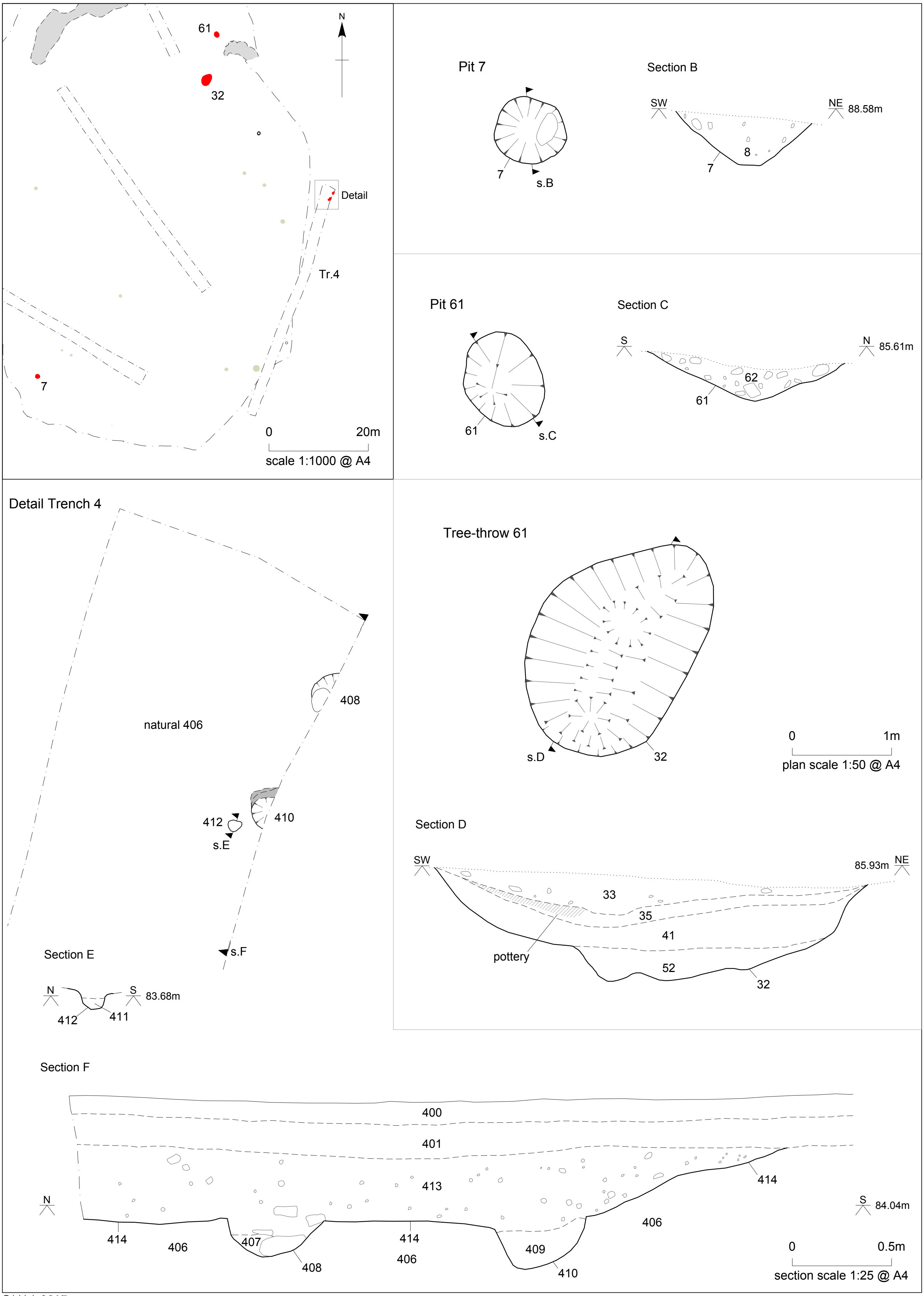
Stainton Quarry, Furness, Cumbria: investigation results *Figure 3*



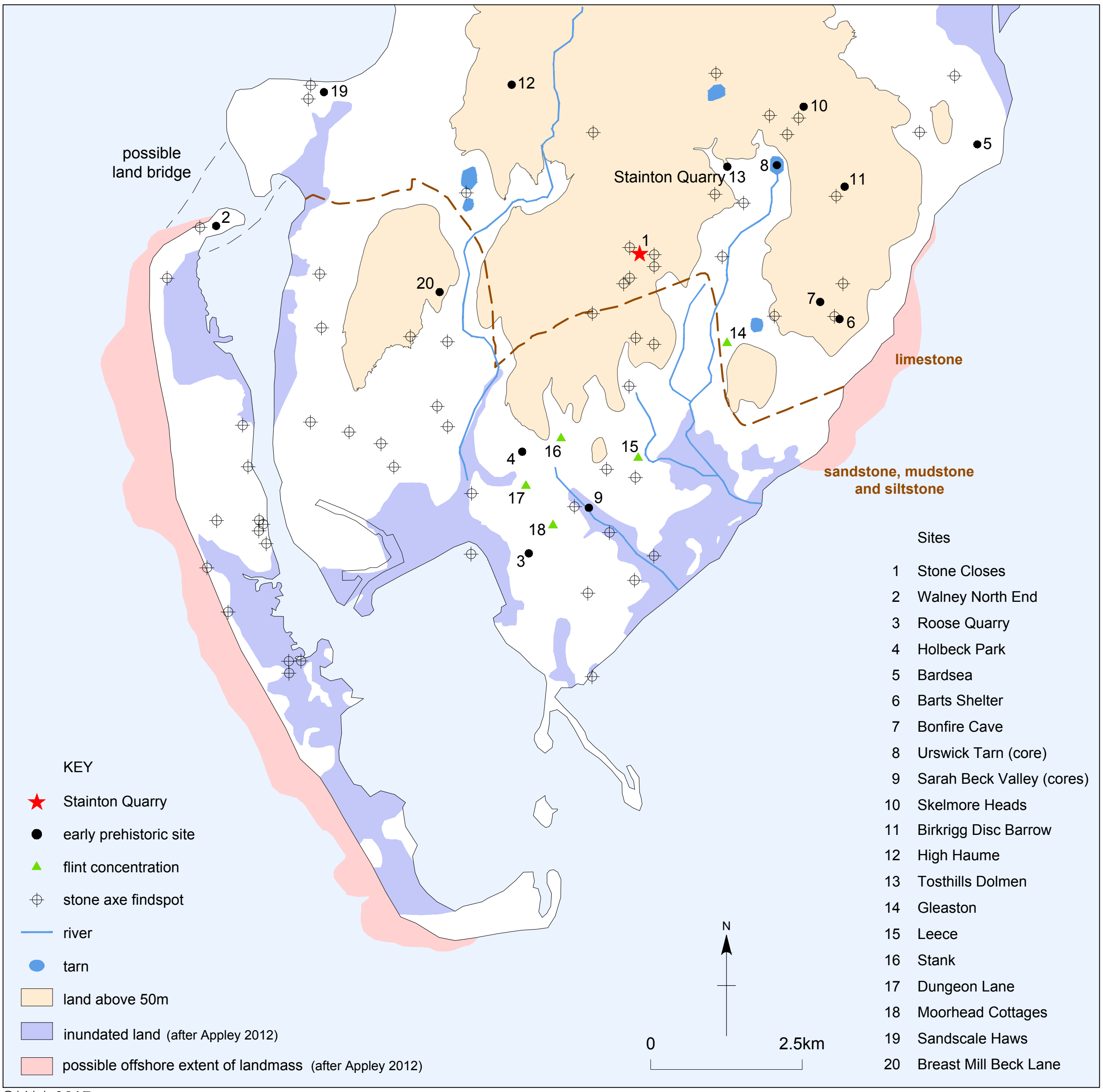
Stainton Quarry, Furness, Cumbria: grykes and solution features in bedrock outcrop 20 — *Figure 4*



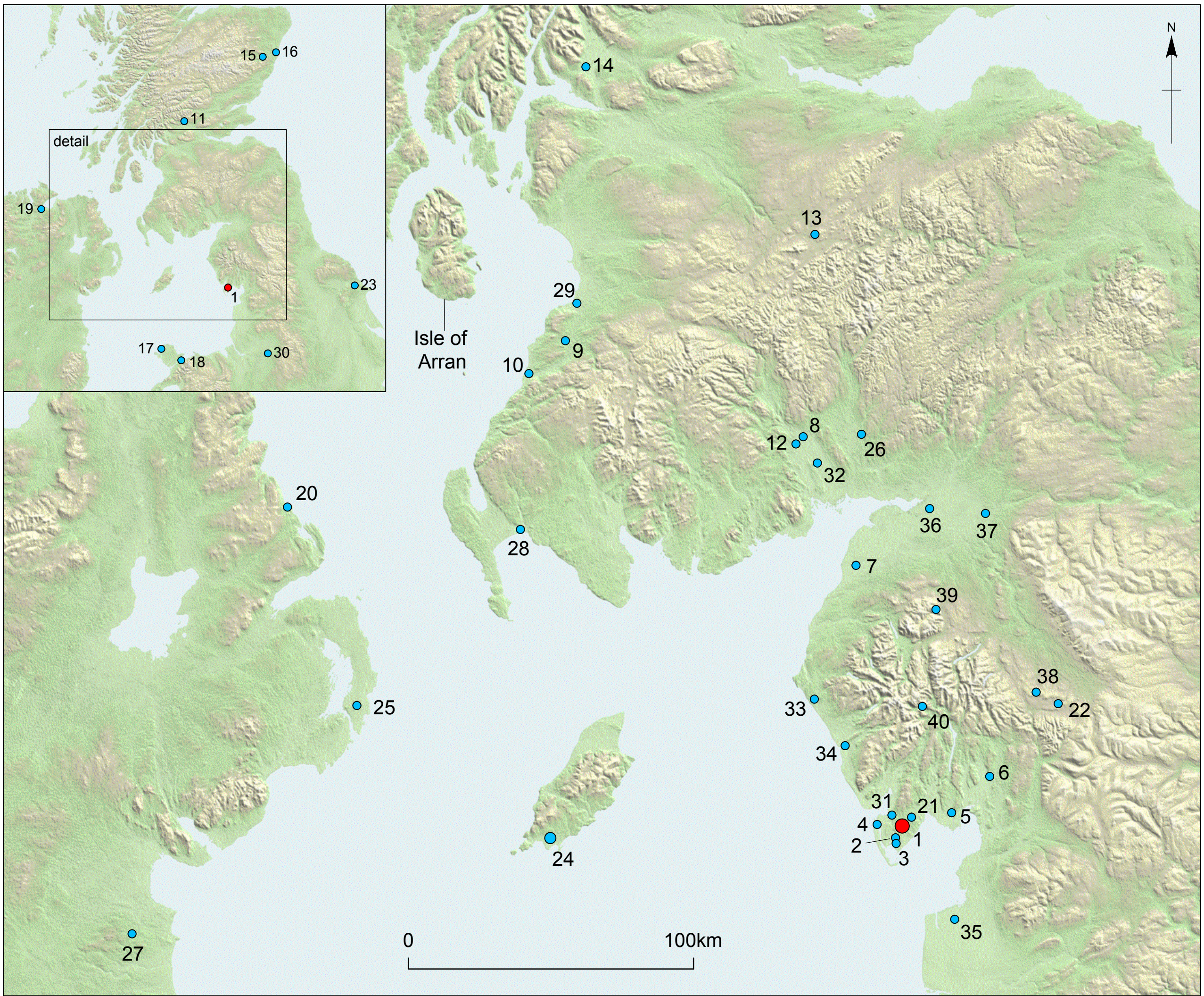
Stainton Quarry, Furness, Cumbria: section through gryke deposits — *Figure 5*



Stainton Quarry, Furness, Cumbria: feature plans and sections *Figure 6*



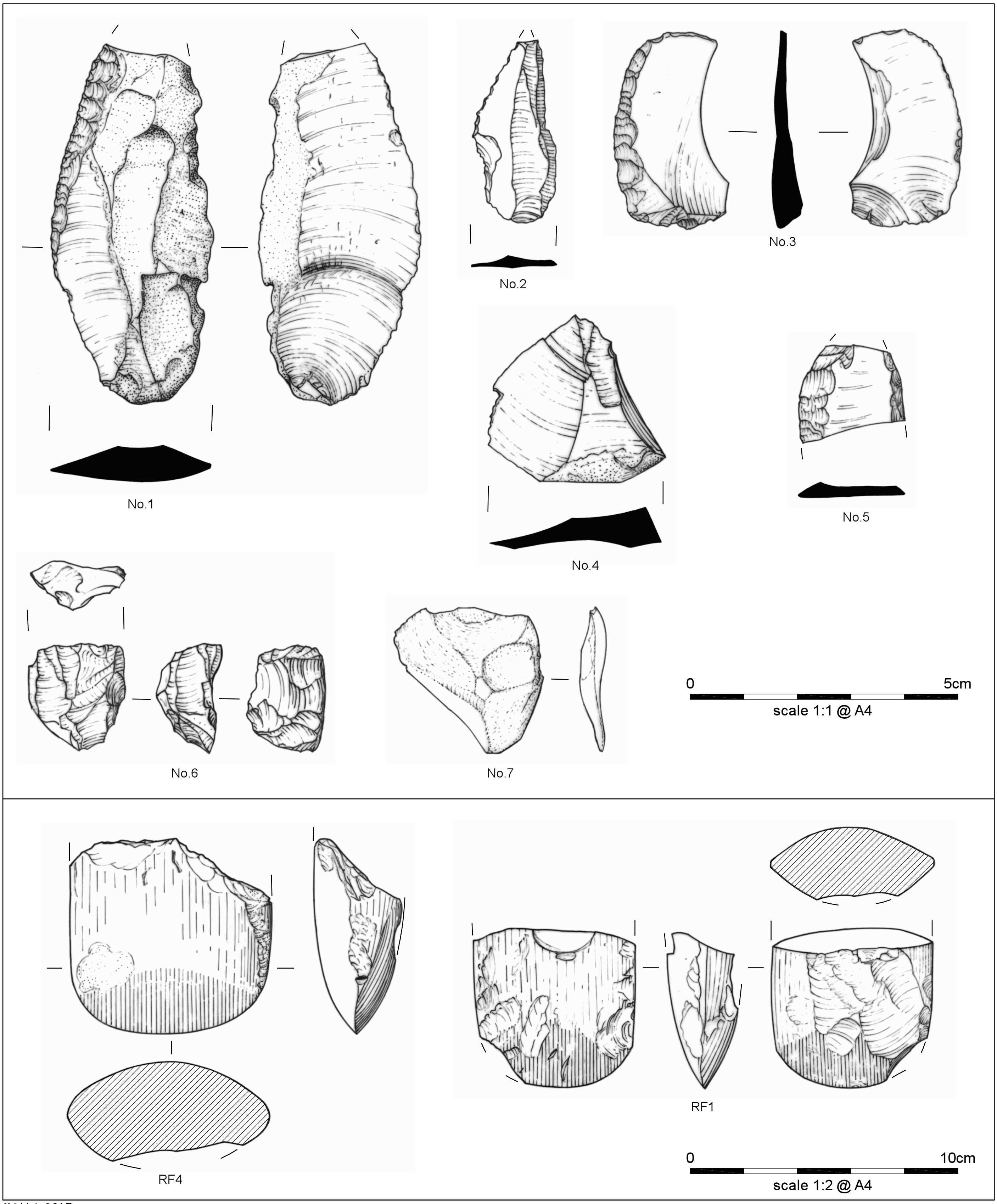
 Stainton Quarry, Furness, Cumbria: early prehistoric evidence in Furness *Figure 7*



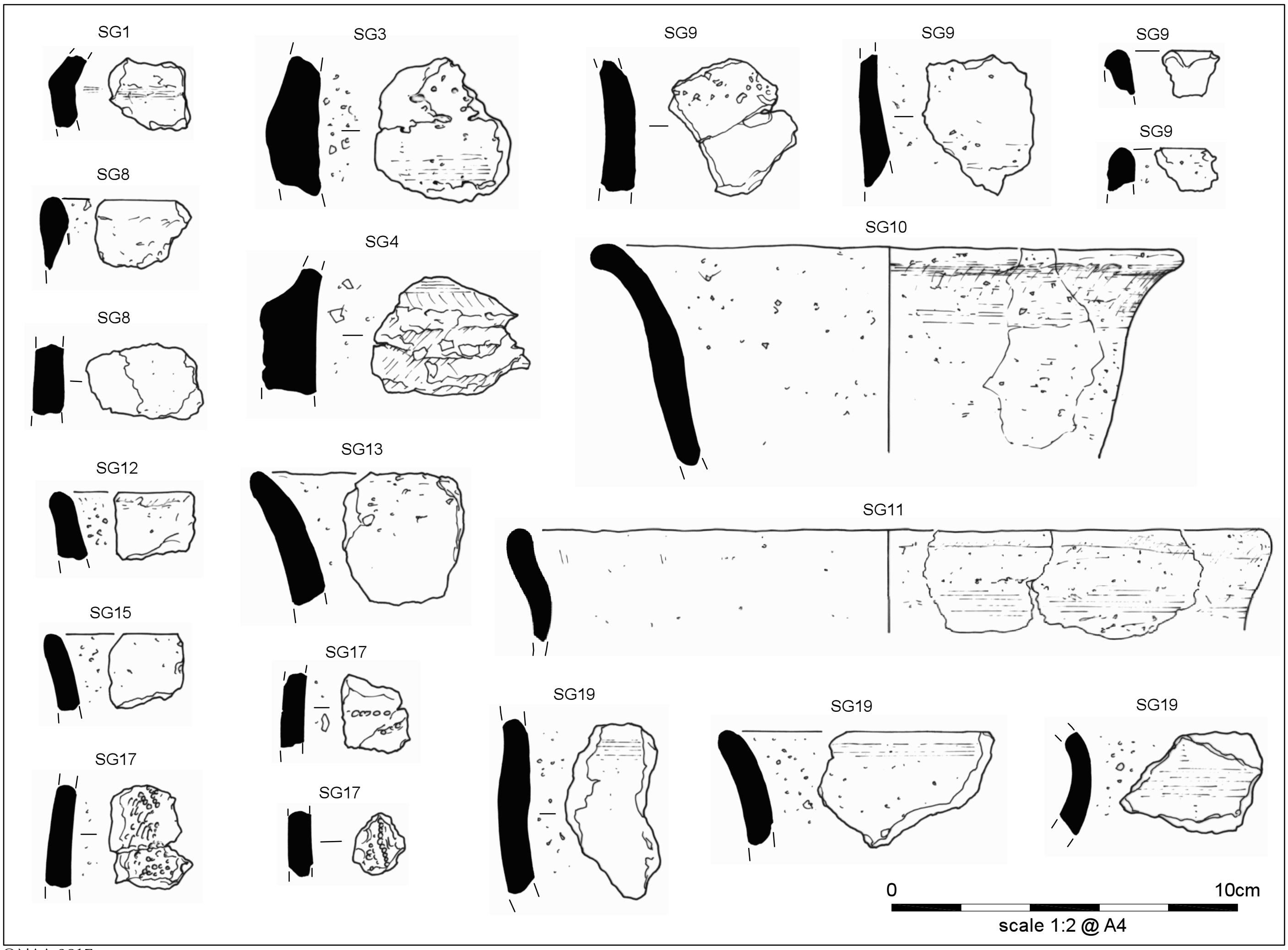
KEY

1 Stainton Quarry and Stone Closes
2 Holbeck Park Avenue
3 Roose Quarry
4 Walney North End
5 Allithwaite
6 Sizergh
7 New Cowper Quarry
8 Carzield
9 Maybole
10 Girvan
11 Claish
12 Holywood Cursus
13 Biggar Common
14 The Carrick
15 Warren Field / Balbridie
16 Garthdee Road
17 LLanfaethlu
18 LLandygai
19 Gransha
20 Ballygalley
21 Skelmore Heads
22 Raiset Pike
23 Willerby Wold
24 Billown
25 Ballyharry
26 Lockerbie Academy
27 Balgatheran
28 Luce Sands
29 Irvine complex
30 Oversley Farm
31 Sandscale Haws
32 Picts Knowe
33 Ehenside Tarn
34 Williamson's Moss
35 Pilling Moss
36 Stainton West
37 Carlisle Airport
38 Howe Robin
39 Carrock Fell
40 Langdale Quarries

Stainton Quarry, Furness, Cumbria: sites mentioned in text *Figure 8*



Stainton Quarry: lithics and stone axes *Figure 9*



Stainton Quarry: Neolithic pottery

Figure 10