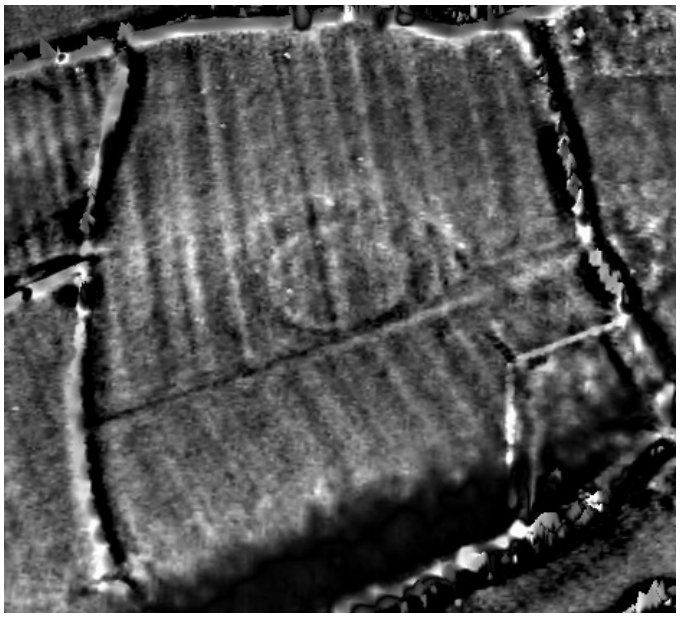
Altogether Archaeology
Digging our heritage in the North Pennines

The Weardale lidar circle: an archaeological assessment

Report on lidar and geophysics investigations, 2019



ALTOGETHER ARCHAEOLOGY

A UNESCO Global Geopark
Exploring the... NORTH PENNINES
Area of Outstanding Natural Beauty

Document compiled by Martin Green and Stephen Eastmead

Version 1.1 (5 Dec 2019)

Site location: lower Weardale (between Stanhope and Wolsingham) south of River Wear; exact location not given at request of owner.

The Lidar Landscapes survey was a project of the North Pennines AONB Partnership http://www.northpennines.org.uk

Drone images and processing of lidar and magnetometry data by Stephen Eastmead, https://eastmead.com/

Magnetometry used the manpower, skills and equipment of the Swaledale and Arkengarthdale Archaeology Group http://SWAAG.org

Please note: The features described in this report lie on private farm-land with no public access.

Cover image: Lidar image of the Weardale circular feature.

Contents

1 SUMMARY

This is a report on the investigation of a circular feature in Weardale by the community group Altogether Archaeology (AA). The feature was one of many new discoveries by the Lidar Landscapes Project, run by the North Pennines Area of Outstanding Natural Beauty (AONB) Partnership with support from the Heritage Lottery Fund. The Project used volunteers to scrutinise lidar images of Weardale, Teesdale and the upper Derwent Valley.

One of the features found was an almost circular feature, about 60m in outside diameter, suggestive of a circular ditch. As this feature was unlike any other lidar feature noted in Weardale and was a candidate for a prehistoric monument, it was selected for further investigations. The results are given in this report.

At the request of the owner, the location of the site is not being made public, but lies in fields used for grazing on the lower slopes of the south side of Weardale, between Wolsingham and Stanhope.

2 HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

2.1 The prehistoric archaeology of Weardale

Compared to Teesdale, Weardale has seen comparatively little investigation of prehistoric archaeology. The main exception to this is the work of Rob Young, starting with his thesis (Young 1984) on the prehistory of Weardale, and excavation of a Bronze Age Cairnfield at Crawleyside (Young and Welfare 1992), near Stanhope. More recently, he and Jane Webster (Newcastle University) have investigated the multi-period settlement and metal-working sites in upper Bollihope, south of Stanhope.

The other major survey of prehistoric sites was carried out by Tom Gledhill and Ros Nichol for Friends of Killhope in 2004-5, looking at the dale between Eastgate and Westgate. This area was the Bishop of Durham's deer-park, which inhibited damage from medieval farming. Unfortunately, this survey is unpublished and sites from it are not on the public Historic Environment Record, http://www.keystothepast.info. Gledhill also discovered some Bronze Age burnt mounds in Weardale, particularly in the Rookhope side valley. Scattered finds of all eras have been detailed, but their distribution is hard to interpret as so little of the dale is ploughland (where collection of scattered finds is more likely to happen).

Thus, prior to the Lidar Survey, some prehistoric sites were known. Several scatters of Mesolithic flints had been found, particularly where pollution from lead smelting had killed vegetation. The Crawleyside cairnfield had been excavated and several other probable Bronze Age cairns were known, as well as a few burnt mounds assumed to be of that era. A major find of this era was the Heathery Burn hoard, from a cave near Stanhope. No field systems dated to that era had been identified. From the late prehistoric (i.e. Iron Age into Romano-British eras), a few enclosed settlements had been noted, particularly between Eastgate and Westgate, with an associated field system on the northern side of the dale. The Romans themselves left little trace, apart from a couple of altars and the possible Roman road over the moors from Stanhope to Teesdale.

2.2 Results of the Lidar Landscapes Project

The Lidar Landscapes Project used volunteers to examine lidar images of parts of the North Pennines, with the intention of discovering new archaeological features. The results are summarised in a report by Frodsham (2017b). The Project followed on from the Allen Valleys and Hexhamshire Lidar Landscape Survey (Ainsworth 2016) which itself was inspired by the Miner-Farmer landscape

project, run by English Heritage. This project examined the landscape around Alston (Oakey, Radford and Knight 2012). Between these three projects, most of the lidar data currently available for the North Pennines has been examined, although some areas are yet to be covered.

The lidar data used to produce the imagery for the Lidar Landscapes Project was the 1 metre resolution data published, free for public use, by the Environment Agency at https://data.gov.uk. A processed version of this data can be accessed using the side-by-side viewer on the National Library of Scotland's website https://maps.nls.uk.

Lidar Landscapes was unable to examine Weardale above Westgate as the only lidar data available for the uppermost part of the dale was 2 metre resolution: too coarse to enable recognition of most archaeological features. Even with the 1m resolution data for the rest of the dale, recognition of small features, clearance cairns in particular, is difficult. Cairns may in any case be indistinguishable on lidar from farm livestock or deer.

Lidar Landscapes found that late prehistoric (including Romano-British) field systems and settlements cover large areas of the lower slopes upstream of Stanhope in Weardale, both north and south of the river. These are areas unaffected by the intensive medieval ploughing lower down the dale, which is likely to have destroyed evidence of earlier settlement. Evidence of earlier (pre 800BC) prehistoric features in Weardale was scanty, although a probable previously unrecognised cairnfield was discovered at Westernhope, with a nearby double-banked enclosure at Billingshield which may also be Bronze Age (around 1,500BC), as it is overlain by a late-prehistoric field-system.

The Weardale circle site is one of three possible Neolithic (4,000BC to 2,500BC) sites found by the lidar surveys of the North Pennines. The other two are near to Cotherstone (Teesdale) and to Allendale Town (West Allendale). These are shown in Figure 1, to the same scale and with lidar data processed in the same way.

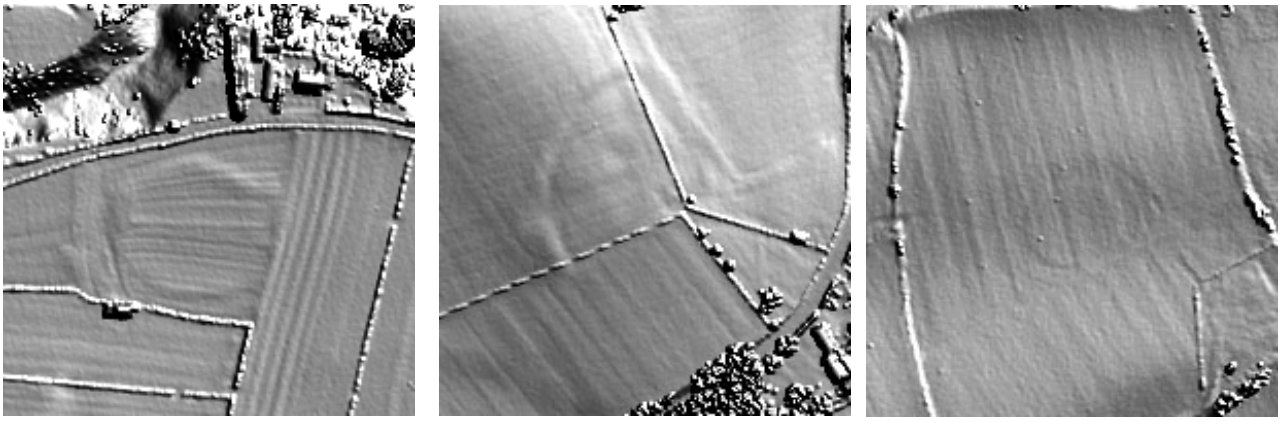


Figure 1: Possible Neolithic features: Cotherstone (left), Allendale (centre), Weardale (right)
All images are 200m x 200m Lidar DSM with illumination from north-east

The lidar of the three features suggests similarities but also differences. Only one quadrant of the Allendale monument is apparent (presumably due to plough damage to the rest), but an external bank is clear, making it likely that it is a henge (i.e. an enclosure with its bank external to the ditch so probably ceremonial, not for defence). The other two are less likely to be henges. All three have fairly similar locations: in prominent positions but close to rivers in the lower part of their dales. All three have been ploughed over, explaining why they had not been previously recognised.

2.3 Medieval and later settlement

Information in this section is largely taken from Bowes (1990), who details the progressive enclosure of Weardale, and establishment of farms in medieval and post-medieval times. The three main settlements of the lower dale: Stanhope, Frosterley and Wolsingham probably existed by late Saxon times, so were already villages in 1066. They are all on the north side of the Wear. Open field systems of extensive ridge and furrow arable land surrounded them, but in only one case (Stanhope) did the villages' common fields definitely extend south of the river (at Newlandside). The 11th century Domesday survey did not cover County Durham, but the Boldon Book (1183), a similar catalogue of village assets, does include entries for all three villages.

In the case of Frosterley, excavations by AA of the St Botolph's site have shown that this was the location of an Anglo-Saxon chapel (Archaeological Services 2016). The dating is secure, being from several radiocarbon dates and the finding of typical fragments of a stone cross. However, no other evidence of early medieval settlement (i.e. after the Romans, but before 1066) has been found in Weardale.

The open field systems around the three villages can still be traced as ridge and furrow on lidar images, and by the curving "reverse-S" hedges obvious on aerial views (e.g. on the north side of the main road both to east and west of Wolsingham). Such field systems were probably established from about 900 AD when the heavy plough was introduced (which was effective but difficult to turn, so favouring long fields). Beyond these open fields were areas of useful farmland, too far from the villages to be part of the common agricultural system. There is evidence from the Hatfield Survey (1381) that, by that time, farms were in operation along nearly all the lower slopes of Weardale between Stanhope and Wolsingham (and beyond). The date at which these farms came into existence is unknown: some may have been in continuous use from prehistory, but it is possible that much of the land was out of use for farming and had to be cleared and farms established in early medieval or medieval times.

Bowes (1980) used the title "Clearing the Forest" for his work; as a historical geographer he quite reasonably tended to assume (given the lack of any other evidence) that the first appearance of farms in the written record indicated the most likely time at which the land had been cleared. With expanding archaeological knowledge of extensive earlier agriculture in Weardale, this assumption is less secure. There was clearly more early agriculture in Weardale than previously thought.

The site which is the subject of this report lies in this area of medieval farms: outside the common fields of the villages, but below the rough pasture and moorland of the higher ground. Bowes (1980) describes how another set of farms were established higher on the valley side from 1400 to about 1765. In that year an Enclosure Act enabled the establishment of new farms even higher on the south side of the valley. Much of the newly enclosed land was poor quality and was never improved. The comparatively close spacing of farms on the sides of Weardale was encouraged in the post-medieval period by the miner-farmer economy, in which lead mining supplemented the meagre income from under-sized farms.

3 AERIAL VIEWS

Figure 2 shows aerial views of the site in early 2001, November 2007 and May 2018. The 2001 view shows worn circular areas in the grass that looks consistent with the recreational use of powered vehicles. The worn patches appear to be superficial and don't correspond to the features in either the lidar or the magnetometry data.

The November 2007 view shows recovery of the grass. The southern half of this view is shown in greater detail in Figure 3. An old field boundary passing through at least two of the southern group of three 30 m grids is visible, as are some ridge and furrow plough lines. In the May 2018 view the site looks lush with no wear visible. The old field boundary crossing the 90 m grid is no longer visible, neither is the ridge and furrow.

Figure 4 is an aerial view from a different source, taken on an unspecified date in the year range 2012 – 2019. The site has been ploughed prior to re-sowing with grass.

Figure 2: Aerial Images (Google Earth)

dated: 01/01/2001 (left) 09/11/2007 (centre) 27/05/2018 (right)

Figure 4: Enlarged southern part of 2007 aerial view from Figure 3

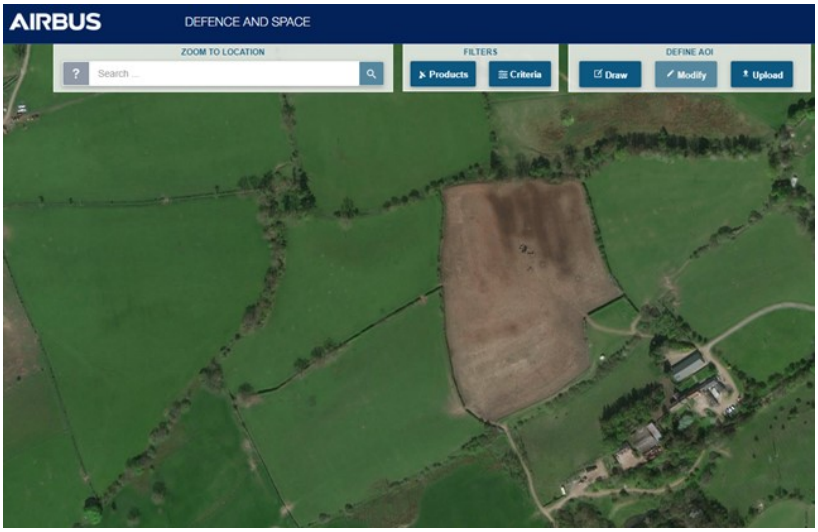


Figure 4: Aerial Image (Airbus) dated 2012 - 2019

4 LIDAR IMAGES

The initial lidar survey that discovered this site was repeated using planlauf/TERRAIN software and 1m DSM data from 2008. The lidar was visualised using the 'Elevation' (Figure 5) and 'Local Relief / Trend Removal' tools (Figure 6). The latter method producing the most detailed image. The 3-D lidar (Figure 7) shows the prominent position of the site above the River Wear valley.

The enlarged lidar image (Figure 8) shows a suspected circular prehistoric site that predates both the ridge and furrow ploughing and an old field boundary. The ridge and furrow ploughing respects the old field boundary as it changes orientation at the boundary. Construction of this boundary appears to have partially destroyed the south-southeast outer edge of the circular lidar feature. The yellow square identifies the 90 m x 90 m magnetometry grid which was sub-divided into nine 30 m x 30 m survey sub-grids. The lidar Interpretation (Figure 9) identifies these features.

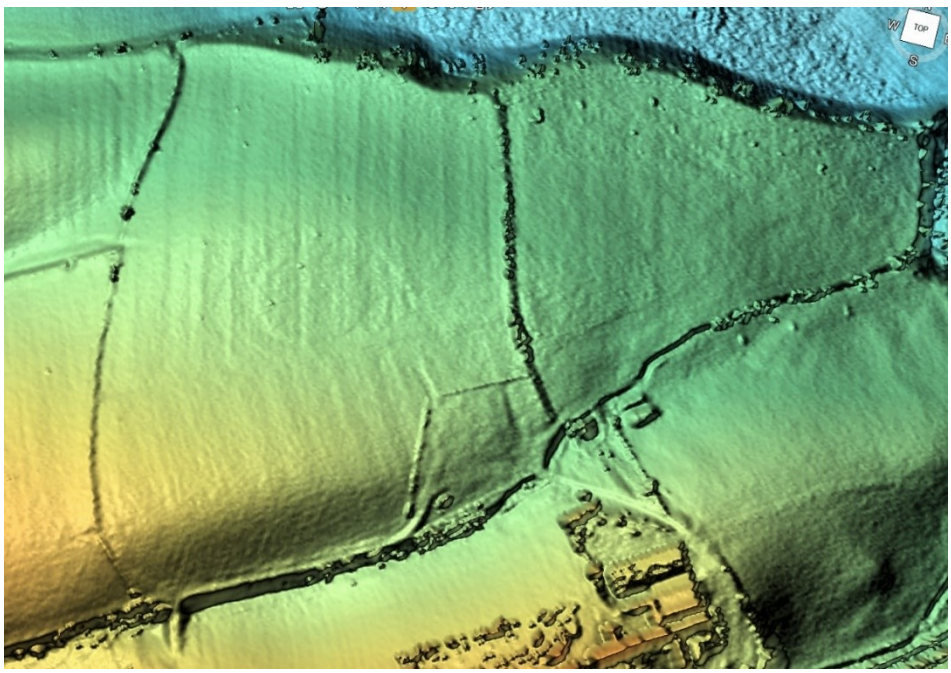


Figure 5: Lidar image (1m resolution) of the site with colour coded elevations.

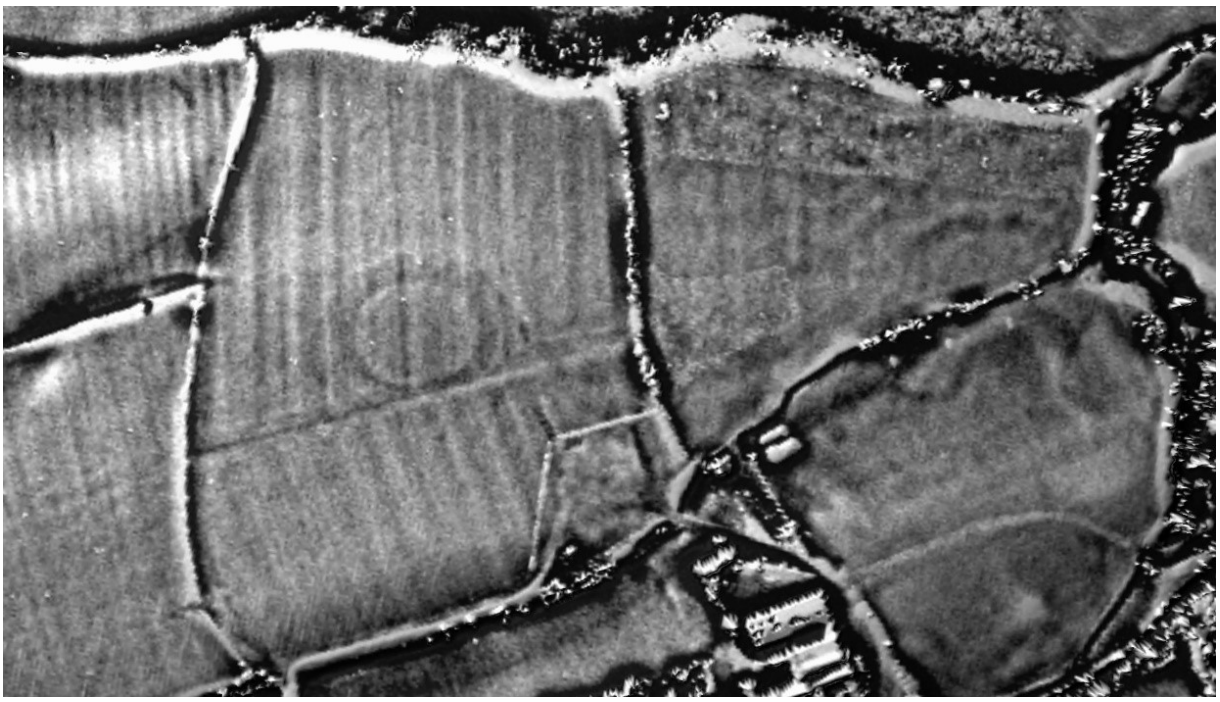


Figure 6: Lidar image (1m resolution) of the site – Local relief view.

Figure 7: Lidar image (1m resolution) of the site – 3D Local relief view, River Wear crosses top of image

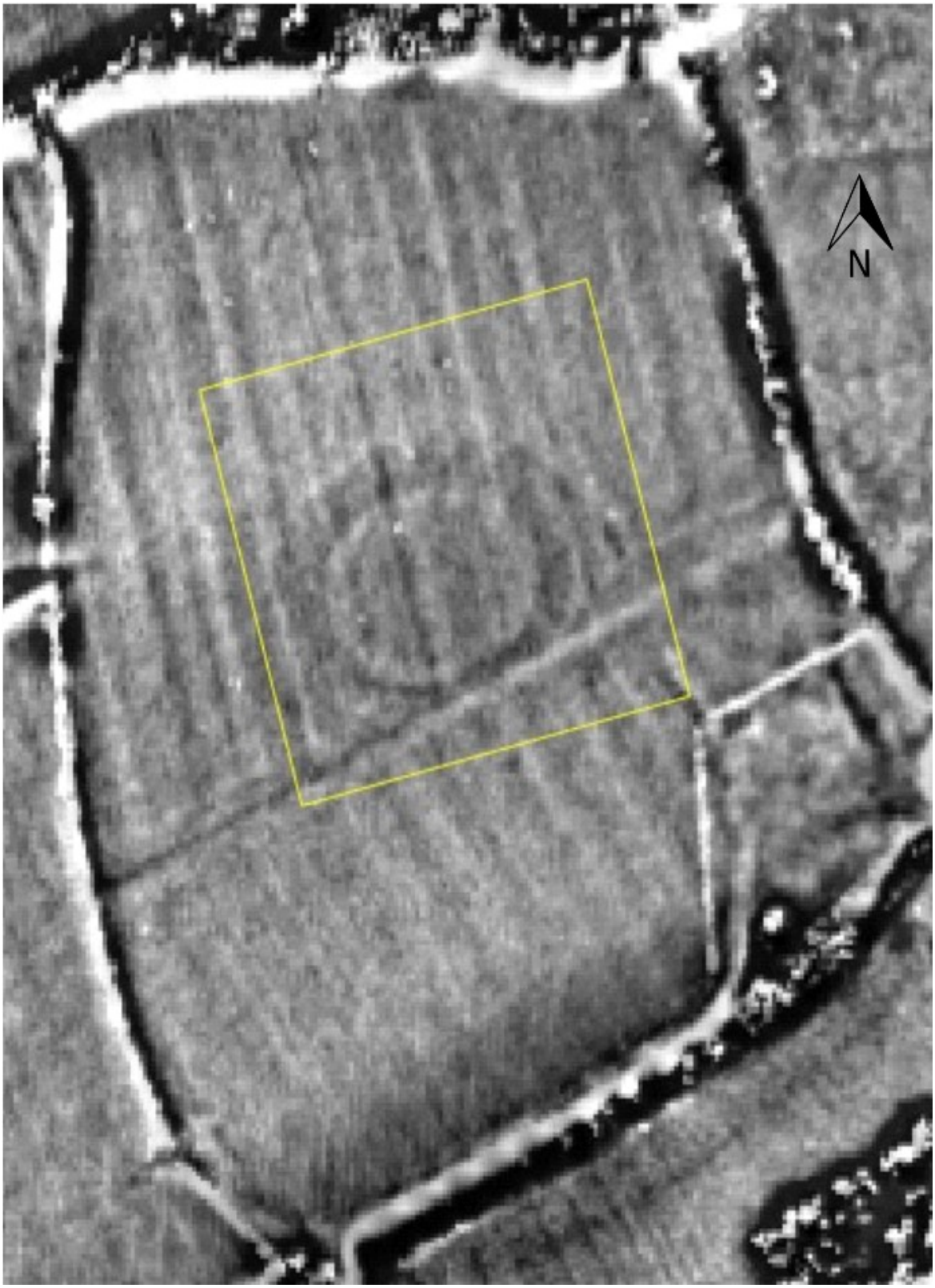


Figure 8: Lidar image (enlarged) including position of the magnetometry grid.

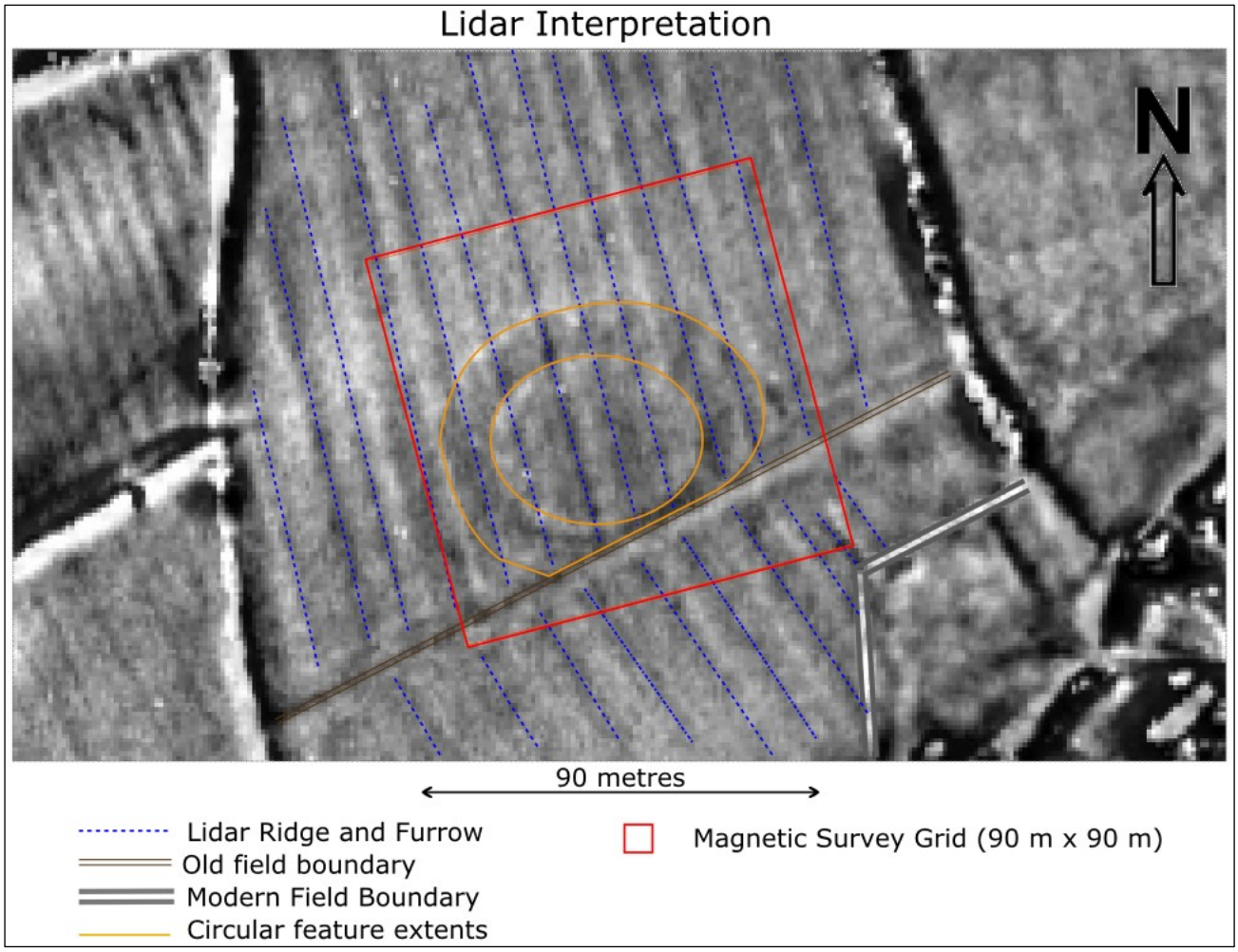


Figure 9: Interpretation of lidar image

5 MAGNETOMETRY

5.1 Magnetometry Methods

The magnetometry survey of this site was accomplished using a 90 m by 90 m grid, sub-divided into nine 30 m by 30 m sub-grids based on the QGIS Lidar map of the site. Swaledale and Arkengarthdale Archaeology Group SWAAG (http://swaag.org) kindly allowed use of their magnetometry equipment, expertise and software (Spectra Precision Survey Office and TerraSurveyor). Further information processing and display used QGIS, GPS Utility, DrawPlus.

The equipment and settings used were:

➢ ProMark 120 GPS - using 1-minute Rinex OS-Net correction data. Indicated accuracy usually better than 20cm.

➢ Bartington 601-2 Gradiometer - Sensors: 2, Traverses: 1m, Readings/m: 4, Range: 100nT, Resolution: 0.03nT, Grid size: 30m, Pattern: zigzag.

It must be noted that both the lidar images and the corresponding magnetometry display striped ridge and furrow. However, as these surveys measure different components (height in lidar, positive magnetic values in the magnetometry) the stripes are not expected to be identical

5.2 Magnetometry Results

In the unprocessed data (Figure 10) the statistical range of results spans from -100 nT (white) to +99.32 nT (black) on the greyscale image. Yet most results span a narrow range either side of 0.0 nT. Therefore, the image is mostly grey at this stage. If the data is 'clipped' to reassign the relatively small number of extreme results to either white or black, then the bulk of results are assigned to a much wider range of greyscale colours and the detail begins to appear (Figure 11).

Figure 11 has been processed to the minimum amount to obtain a good image. The data was clipped from outside the range -3.00 nT to +5.00nT, where negative values are shown as white and positive values are coloured black. Additional processing used included de-striping and selective de-staggering (40 cm).

Figure 12 shows the 3-D relief view of the processed magnetometry data, whilst Figure 13 shows the magnetometry data superimposed on top of the lidar image. Figure 14 shows the outline of the circular feature from the lidar image (Figure 8).

The magnetometry interpretation (Figure 15) also includes the outline of the circular feature from the lidar image to help interpretation. It is immediately apparent that the circular lidar feature is not magnetic. However, other magnetic features are present:

a) The old field boundary is a very faint anomaly crossing the southern end of the 90 m grid.
b) There is an irregular strongly positive magnetic anomaly at the northern end of the 90 m grid which diminishes towards the north eastern corner. This anomaly also appears to predate the ridge and furrow ploughing (Figures 11 and 12).
c) The ridge and furrow plough lines are more visible but somewhat irregular in shape where they cross anomaly b) and gradually becoming less obvious as they near the old field boundary a).
d) Immediately south of b) is a narrow linear strongly negative magnetic anomaly that appears to be aligned with the current field boundary dividing the adjacent field to the west. This may be a remnant of another field boundary.
e) Scattered across the 90 m grid are a scatter of dipolar ferrous type readings. Many appear to be close to the old field boundary at the southern end of the grid. Likely causes of these magnetic "hot-spots" are old fence-nails and horse-shoes.

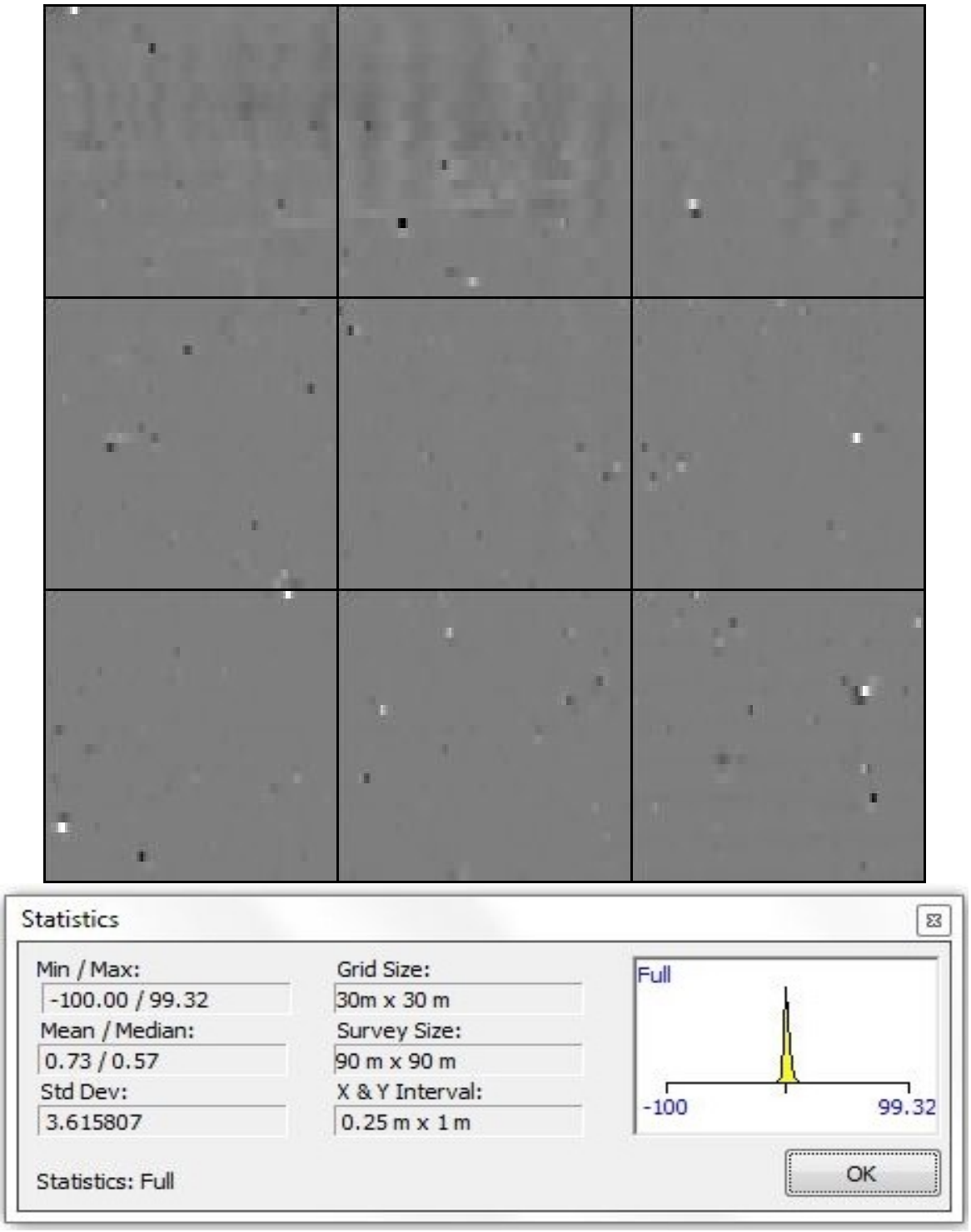


Figure 10: Unprocessed baseline magnetometry data and survey statistics

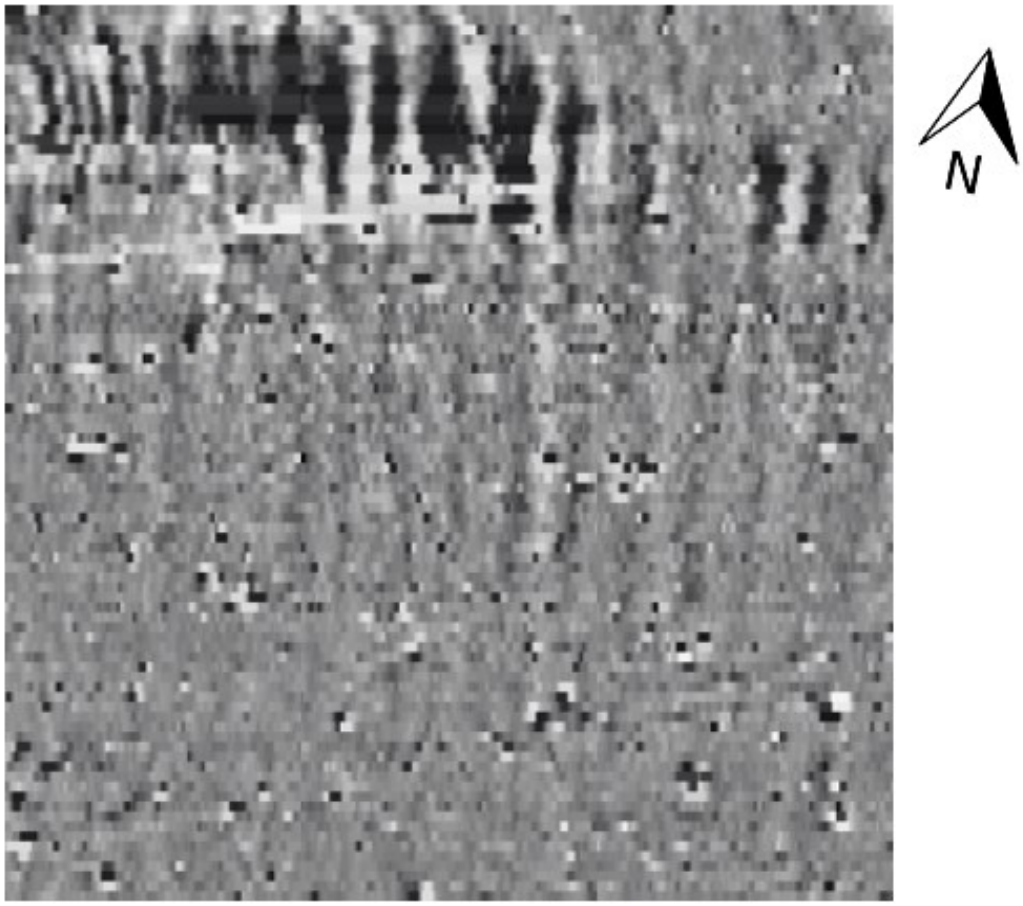


Figure 11: Processed magnetometry image

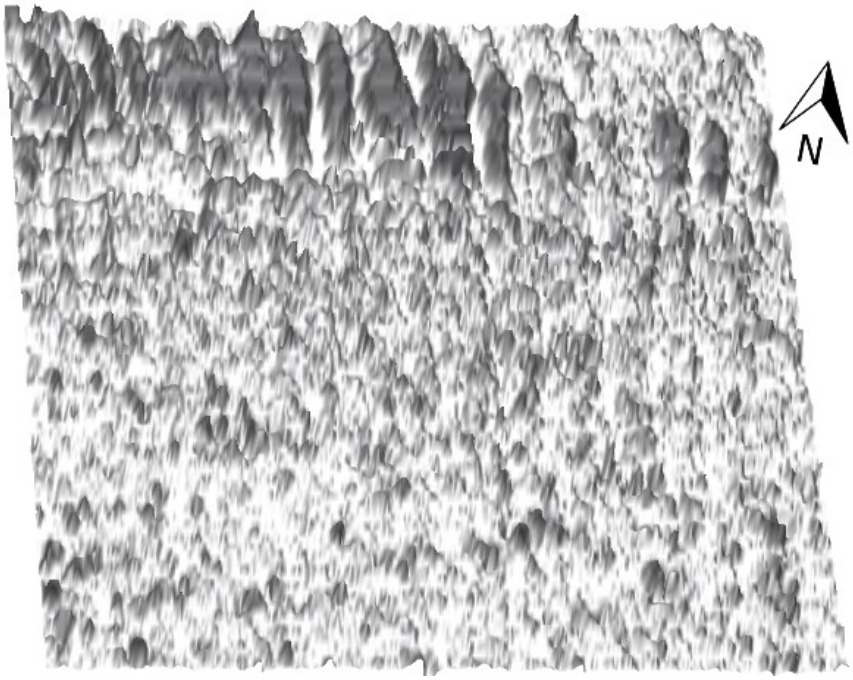


Figure 12 Processed magnetometry 3-D relief image

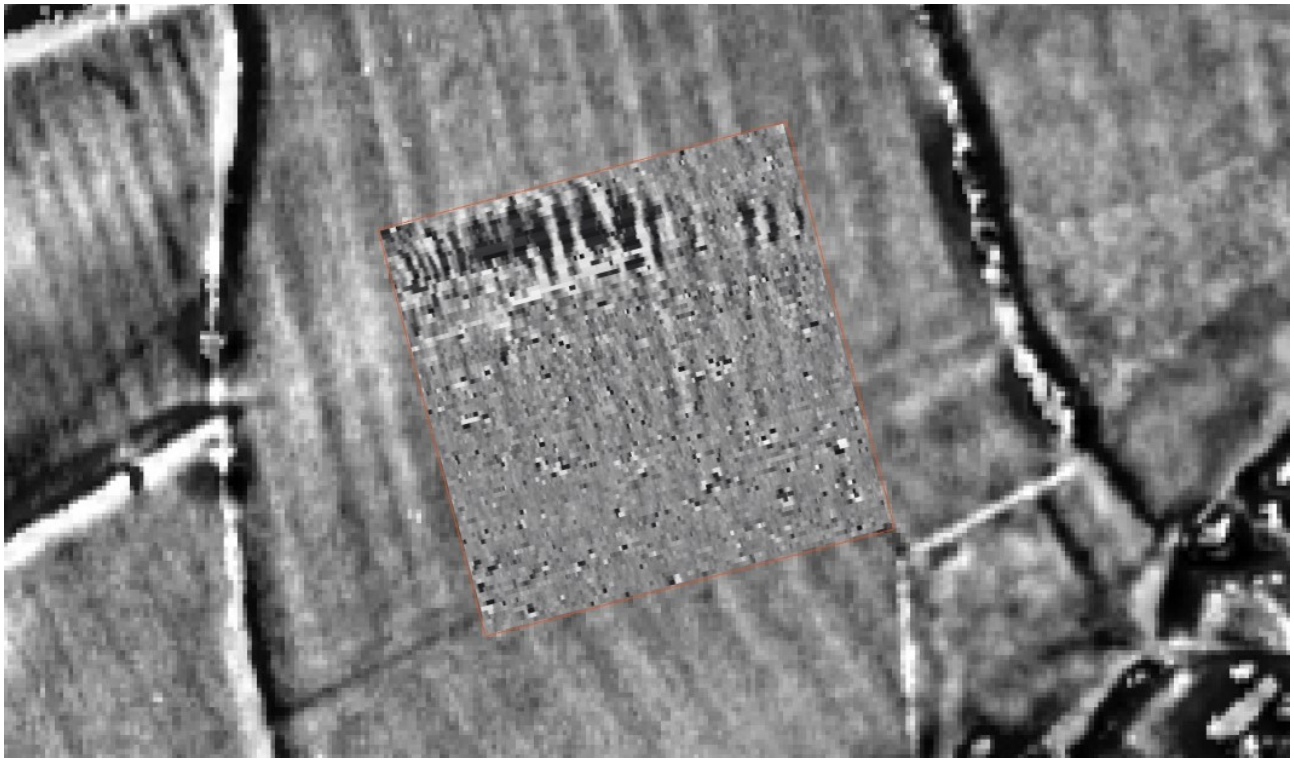


Figure 13: Processed magnetometry data superimposed on lidar image

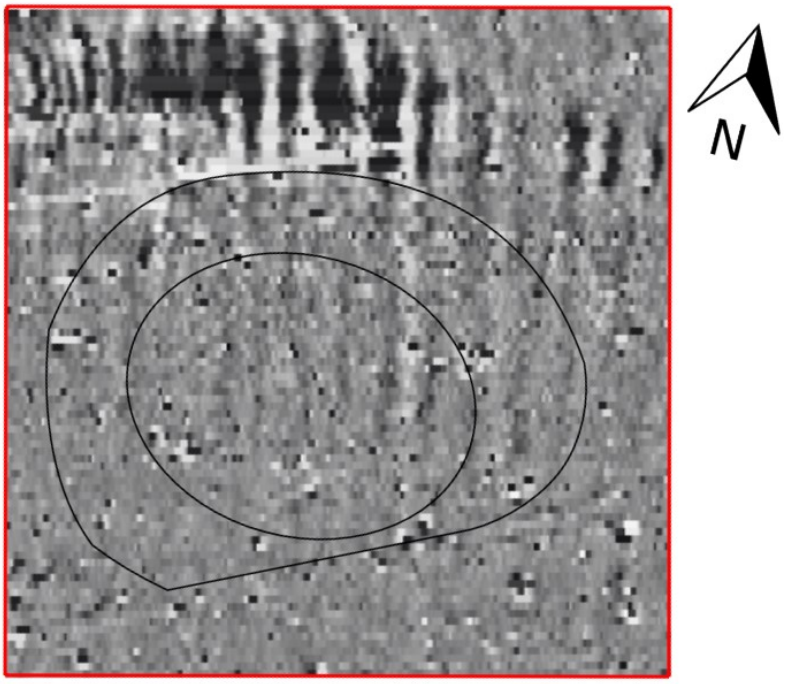


Figure 14: Processed magnetometry data, with position of circular feature seen on lidar image. There is no sign of this circular feature in the magnetometry data.

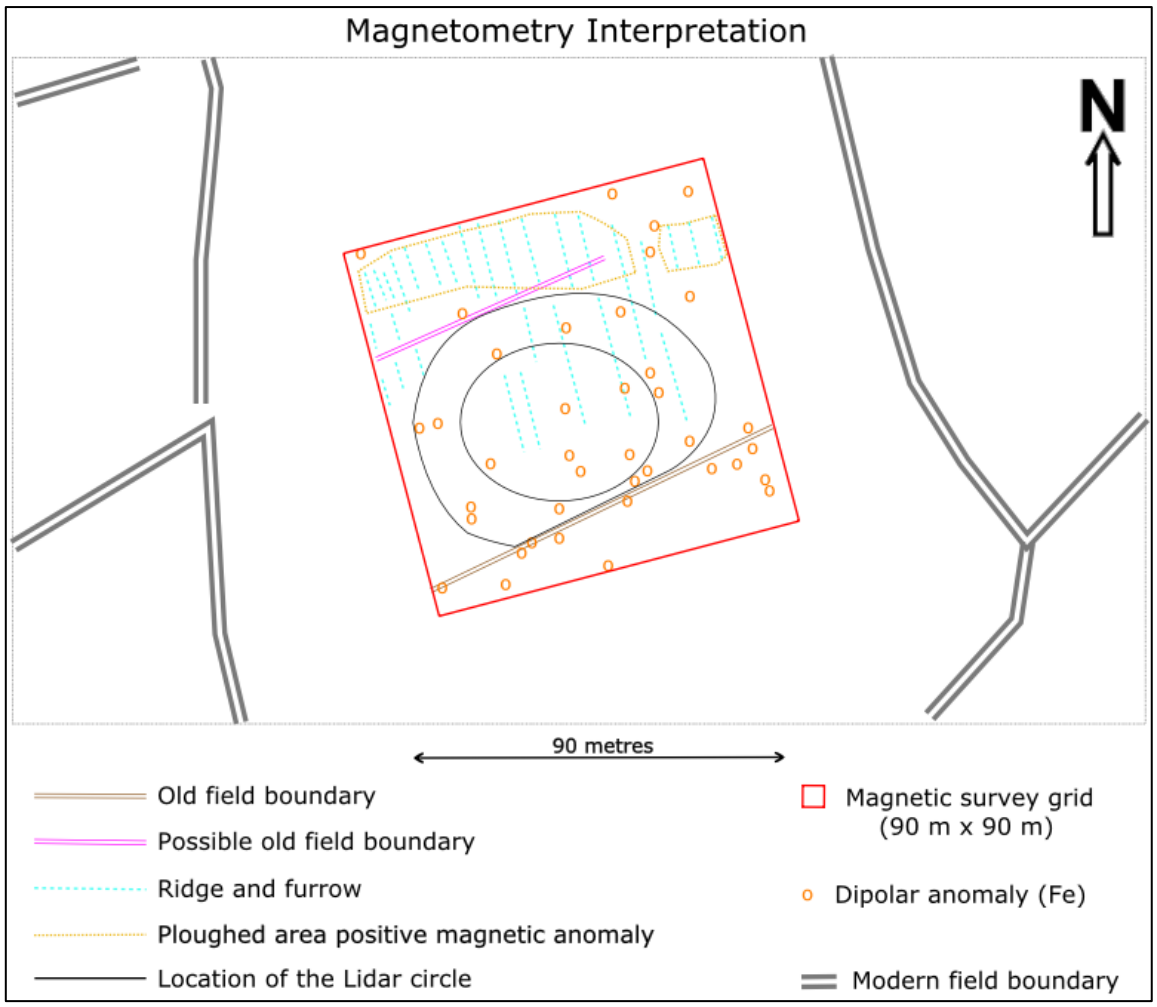


Figure 15: Magnetometry interpretation

6 DISCUSSION

The lidar images clearly show a circular feature, a possible prehistoric circular monument. However, magnetometry failed to detect it, despite successfully identifying an old field boundary and plough-ridging (both also shown on lidar). Recent aerial views, and observations of the field from ground level, suggest the field surface is featureless. Recent ploughing and re-sowing will have enhanced its even appearance.

Both the lidar images (2008) and the 2007 satellite image show that an old field boundary used to cross the southern 30 m grids. The boundary is not shown on any Ordnance Survey map (starting 1857) so is probably older. Associated with this was ridge and furrow from ploughing which changed angle at the old boundary. This plough ridging is typical of the medieval and early modern periods (900AD to 1700AD) when much more land in Weardale was under the plough than is now the case.

Any prehistoric archaeological feature would have to be deeper than this medieval ploughing to have avoided total destruction by it. As the medieval plough ridges survive (seen in the magnetometry image), then any prehistoric feature, if one had been present, would also have survived, untouched by modern shallow ploughing.

This leaves open the question as to the nature of the circular feature seen on lidar. It may be an old, possibly prehistoric, ditch underneath (so older than) the old field boundary and ridge and furrow. The lidar image seems to support this, with the plough ridges and field boundary seeming to run over the top of the feature. Such an old ditch would normally be seen clearly on the magnetometry data, but if it had been back-filled with the same or similar material to that dug out, then there would be no magnetic difference to show in the data.

Alternatively it may be a modern superficial feature, only in the plough-soil and not deeper, so eliminated by the recent ploughing and re-sowing, in the same way as the damage from recreational vehicles seen in the 2001 aerial view has been eliminated.

In summary, the negative magnetometry results make it less likely that this is a significant archaeological feature. Further evidence might be gained by carrying out a small-scale trial excavation, but even this would have difficulty in detecting a ditch that had been back-filled with the same material that had been extracted. The Environment Agency is currently improving lidar coverage in the UK; if the field is re-scanned it will be possible to see if there are any changes in the lidar appearance.

7 ACKNOWLEDGEMENTS

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- Swaledale and Arkengarthdale Archaeology Group for their generous use of their GPS and Bartington equipment, and to Mike Walton, Rob Nicholson and Andrea Dixon for their enthusiasm, time and assistance https://swaag.org/index.php#
- Members of Altogether Archaeology who gave assistance: Elaine Vallack, Rob Pearson, Alan Newham and Paul Frodsham.
- Ordnance Survey:
  https://www.ordnancesurvey.co.uk/opendatadownload/products.html
  https://www.ordnancesurvey.co.uk/gps/os-net-rinex-data/
- Environment Agency:
  https://environment.data.gov.uk/DefraDataDownload/?Mode=survey
- Google Earth current and historical images.
- Airbus Industries Defense and Space Images.

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