Humberside Geologist No. 16

Ongoing work by the Bisat Research Group, Hull Geological Society, on the glacial stratigraphy of the Holderness cliff sections.

Rodger Connell, Graham Kings, Dennis Haughey, Arthur Speed.

Introduction

In his 1939 Presidential Address to the Yorkshire Geological Society, W.S.Bisat wrote “The sections exposed on the Holderness coast are deservedly famous, for they are probably the finest exposures of boulder-clay in Britain” (Bisat, 1939b). Indeed the coastal exposures from Sewerby to Kilnsea (some 62.5 km of which only ca. 10.25 km are concealed behind sea defences or slumped/grassed cliffs) are the best and longest exposures of last cold-stage glacial sediments in the British Isles. Furthermore at Dimlington, south Holderness, the site provides the type section for the period of most extensive glaciation in Britain during that cold-stage: the Dimlington Stadial (Rose, 1985). The coastal sections are clearly important as significant inland exposures are very rare. Indeed, reconstruction of the inland glacial stratigraphy from various vintage borehole records can be problematic (e.g. Evans and Thomson 2010 and Burke *et al*., 2015). However, recent cored British Geological Survey boreholes (e.g. TA 23 NE 10 (BGS 2015)) provide good evidence of the till stratigraphy and even allow identification of Bisat’s “Upper and Middle Drab” tills (see Figure 1 below).

At the time of writing (February 2021) the Bisat Research Group is unable to undertake joint fieldwork due to COVID-19 restrictions. However, we would like to thank Mike Horne for leading two visits to

coastal sections, at Barmston and Skipsea Withow, to practise section logging when small group meetings were still allowed during September and October 2020. So now is an opportunity to review the work undertaken by the project team. Graham and Dennis (Kings 2020 and Haughey 2020) have already written about the huge task of providing a complete photographic archive of the Holderness cliffs over the period 2014 to 2019 and have reviewed the work in the area by W.S. Bisat. The photographic archive confirms the stratigraphy of both the glacial and post-glacial deposits along the Holderness coast. This present report will look at some preliminary findings of walking and photographing the cliffs and look again at important earlier work under taken on the Holderness sediments.

Chronology of the glacial sequence

The section at Dimlington cliff is the type section for the Dimlington Stadial (Rose, 1985), the last major ice sheet expansion in the British Isles. The Dimlington Silts at the site occur between the Basement Till (exposed low in the cliffs, on the foreshore and in two deep nearby boreholes (Lamplugh, 1919 and Catt and Digby, 1988) and the younger Skipsea and Withernsea Tills (the Drab and Purple Boulder Clays of Bisat). Remains of arctic moss from the silts provided two radiocarbon dates from separate laboratories in 1969 (Penny, Coope and Catt 1969) equating to 20,757 – 22,953 calendar years B.P. (Catt, 2007). This chronology is significant in understanding the timing of the last ice sheet advance in the area and more widely in the British Isles. What Penny, Coope and Catt (1969) did not reference was Bisat and Dell's 1941 paper which first reported the discovery of the arctic moss remains (*Hypnum* possibly *H. exannulatum*) and ostracods in the silts. The latter paper even included photographs of the moss *in situ* and magnified. So Bisat's work not only established the detailed stratigraphy of the glacial sediments in the coastal cliffs but also his and Dell's discovery in the Dimlington Silts provided a basis for establishing an important chronology for the sequences.

Significant early findings of the Bisat Project work

Bisat (1939a) recorded multiple till beds in each of his Drab and Purple Boulder Clays. He identified five distinctive till beds in each, although he

was less certain about the correlation of Drab till units south and north of Withernsea. More recent work has acknowledged lithological complexity in the tills but tended to assign sections to a lower Skipsea and an upper Withernsea Till (see Catt, 2007 and older references therein).

However, good exposures between Hornsea and south of Aldbrough revealed Bisat's Middle and Upper Drab separated by Reid's (1885) "red band" (Figure 1). This sequence was followed for over 14 km until the "red band" passes below modern beach sands to the south towards Withernsea. A possible site with Middle and Upper Drab tills may also be present near the Spurn Observatory (Figure 2).

Figure 1. Section between Hornsea and Mappleton (TA 21998 45186) showing Bisat's Middle and Upper Drab boulder clays separated by Reid's "red band"; all now Skipsea Till. Spade is 1.08 m.

Figure 2. Close to Spurn Observatory. Bisat's thin Upper Drab overlying lighter-coloured Middle Drab? A site not recorded by Bisat. There may be a very thin version of the "red band" separating the two.

There are conflicting interpretations of the age of the Basement Till of Holderness (see Catt, 2007). Some believe it is older than the last interglacial based on exposures seen at Sewerby in 1963. Geological test pits dug by East Riding of Yorkshire Council on the beach at Sewerby in 2016 (details as yet unpublished) failed to re-expose the original stratigraphy as identified (see Catt, 2007) despite pits being dug close to the original 1963 locations. At Dimlington the Basement Till is certainly older than the Dimlington Silts (see above) but Eyles *et al.* (1994) reported amino acid ratios in shells and shell fragments within the exposed till that suggested a Late Devensian age. More recently (2018) Graham Kings and Rodger Connell collected a 30cm square block of Basement Till from the foreshore at Easington(Figure 3).Professor Mark Bateman (Sheffield University) has extracted sand from the till matrix for optically stimulated luminescence (OSL) dating as a means of testing the work of Eyles *et al.*(1994). The results are eagerly awaited! Recent (2018 – 2019) exposures of the Basement Till on Bridlington North Sands may also allow dating of the deposit. The till contained relatively common Pleistocene shells and shell fragments which may be amenable to amino acid chronology or radiocarbon dating in the future.

Figure 3. The block of Basement Till excavated from Easington foreshore in October (scale 30cm).

Conclusions

Whilst the project has achieved much so far we look forward to being able to return to the field as a group before long to continue the work.

References

Bisat, W.S. 1939a. The relationship of the Basement Clays of Dimlington, Bridlington and Filey Bays. *The Naturalist (Hull),* 133-135 and 161-168.

Bisat, W. S. 1939b. Older and Newer Drift in East Yorkshire. *Proceedings of the Yorkshire Geological Society,* **24**, 137 – 151.

Bisat, W.S. and Dell, J.A. 1941. The occurrence of a bed containing moss in the boulder clays of Dimlington. *Proceedings of the Yorkshire Geological Society* **24**, 219 – 222.

British Geological Survey 2015. [borehole log] *BGS ID: 19654022: BGS Reference: TA23NE10* (accessed March 2021) <http://scans.bgs.ac.uk/sobi_scans/boreholes/19654022/images/19654018.html > and < http://scans.bgs.ac.uk/sobi_scans/boreholes/19654022/images/19654019.html >

Burke, H.F., Morgan, D.J., Kessler, H. and Cooper, A.H. 2015. A 3D geological model of the superficial deposits of the Holderness area. *British Geological Survey Commissioned Report,* CR/09/132N, 58pp.

Catt, J. A. 2007. The Pleistocene glaciations of eastern Yorkshire: a review. *Proceedings of the Yorkshire Geological Society,* **56,** 177 – 207.

Catt, J.A. and Digby, P.G. 1988. Boreholes in the Wolstonian Basement Till at Easington, Holderness, July 1985. *Proceedings of the Yorkshire Geological Society,* **47**, 21 – 27.

Evans, D.J.A. and Thomson, S.A. 2010. Glacial sediments and landforms of Holderness, eastern England: A glacial depositional model

for the North Sea Lobe of the British-Irish Ice Sheet. *Earth-Science Reviews* **101**, 147 – 189.

Eyles, N., McCabe, A.M. and Bowen, D.Q. 1994. The stratigraphic and sedimentological significance of Late Devensian ice sheet surging in Holderness, Yorkshire, U.K. *Quaternary Science Reviews,* **13**, 727 – 759.

Haughey, D. 2020. Report of the Bisat Project 2014 – 2019. *Humberside Geologist Online* (Accessed February 2021) <http://www.hullgeolsoc.co.uk/hg1605.htm>

Kings, G. 2020. The Bisat Project Phase 1. Sequential Photographs of the Cliffs of the Holderness Coast. *Humberside Geologist Online.* (Accessed February 2021) <http://www.hullgeolsoc.co.uk/hg1609.pdf>

Lamplugh, G.W. 1919. On a boring at Kilnsea, Holderness. *Summary of Progress of the Geological Survey of Great Britain,* 1918, 63 – 64.

Penny, L.F., Coope, G.R. and Catt, J.A. 1969. Age and insect fauna of the Dimlington Silts, East Yorkshire. *Nature*, **224**, 65 – 67.

Reid, C. 1885. *The Geology of Holderness and the adjoining parts of Yorkshire and Lincolnshire.* Memoirs of the Geological Survey of Great Britain , England and Wales, HMSO, London.

Rose, J. 1985. The Dimlington Stadial/Dimlington Chronozone: a proposal for naming the main glacial episode of the Late Devensian in Britain. *Boreas*, **14**, 225 - 230.