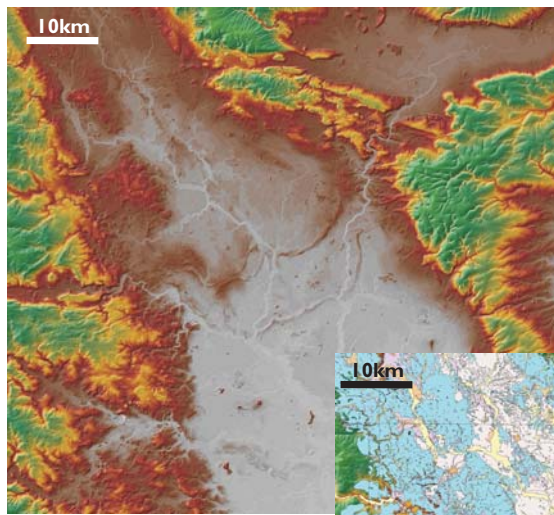


The digital approach to understanding the Quaternary evolution of the Vale of York, UK

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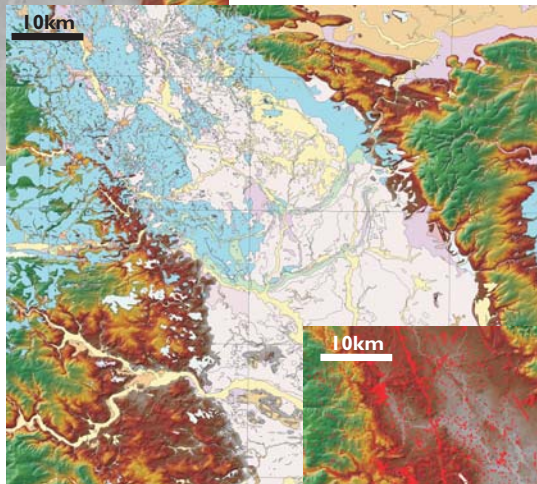
Datasets and interpretation



DEM for the Vale of York, shaded relief © NERC; NEXTMap Britain elevation data from Intermap Technologies.



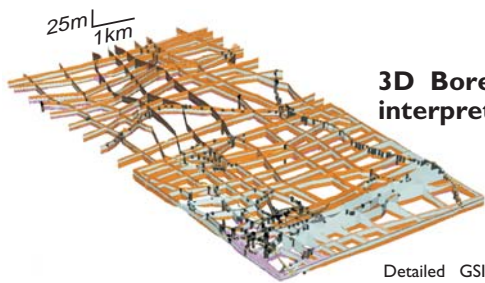
Location of study area with DEM outlined in red.



DigMapGB BGS digital superficial geology dataset, many parts recently resurveyed; Devensian glacial till shown in medium blue, moraines in green, sand and gravel in pink, glacial lake deposits in pale and medium brown, alluvium and blown sand in yellow.

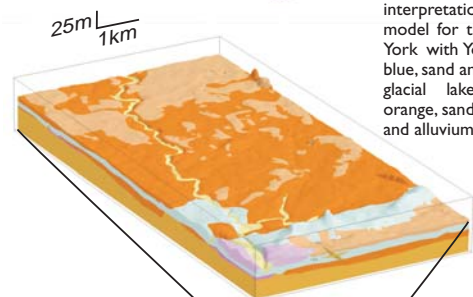


Field mapping and augering to map the superficial deposits in the Vale of York, UK.



3D Borehole interpretation

Detailed GSI3D borehole interpretation and 3D model for the area around York with York Moraine in blue, sand and gravel in pink, glacial lake deposits in orange, sands in pale brown and alluvium in yellow.



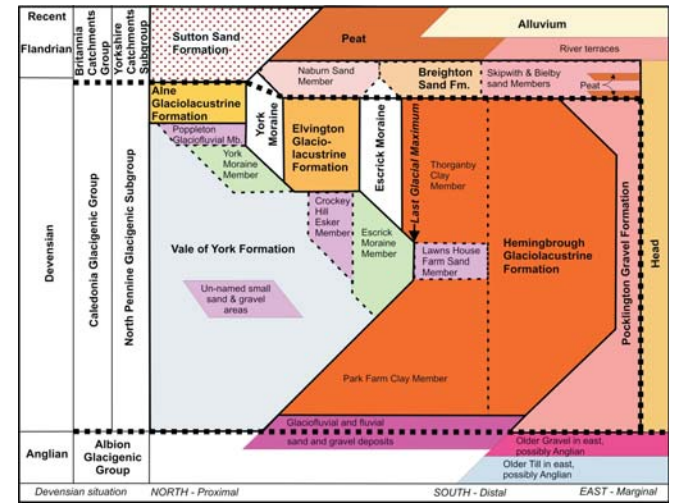
Localities of BGS boreholes shown as red dots, the lines of the GSI3D sections are shown in white. The BGS Single Onshore Borehole Index is available on the internet at <http://www.bgs.ac.uk/geoindex/home.html>

The boreholes were used to constrain the mapping and to construct cross-sections and 3D models of the superficial deposits.

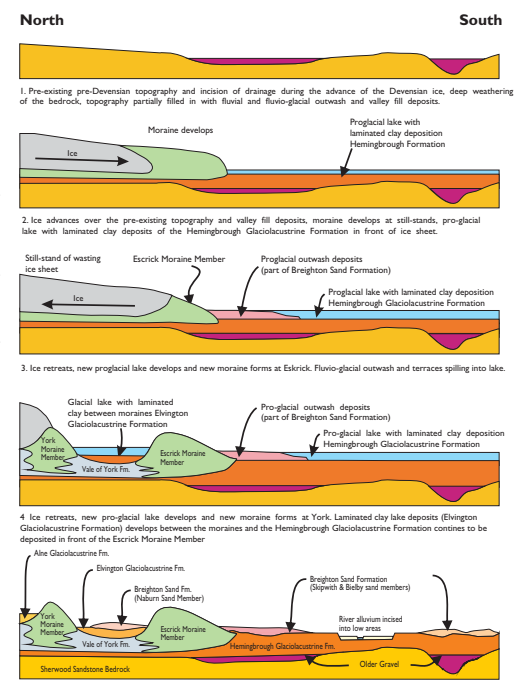
Introduction

During the Devensian glaciation, the Vale of York was glaciated with ice moving south-eastwards and ploughing into a large proglacial lake (Lake Humber) impounded by North Sea ice blocking the Humber Gap. Laminated clays forming the Hemingbrough Glaciolacustrine Formation were deposited here. The ice then overrode the lake deposits forming a terminal moraine at Esrick which is now confirmed as the last glacial maximum limit (LGM).

The ice then wasted back forming another moraine complex at York, then others further to the north-west. Long-lived drainage routes in the ice resulted in linear esker belts and the impounding of proglacial meltwater resulted in several glacial lakes in front, between and behind the moraines. The lithostratigraphy of these superficial deposits is shown to the right and the geometrical relationships below right.



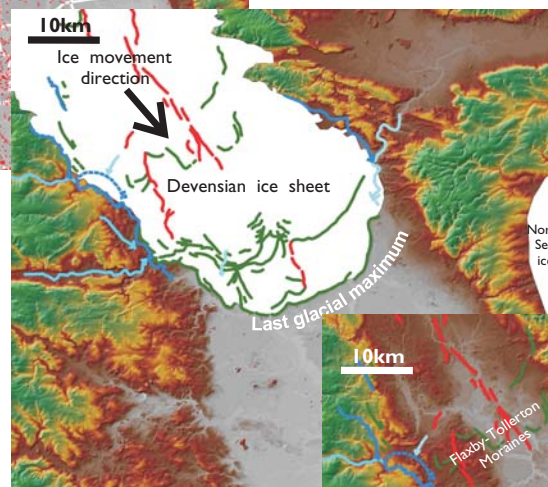
Lithostratigraphy of the Devensian glacial and pro-glacial deposits with their covering sequences in the Vale of York.



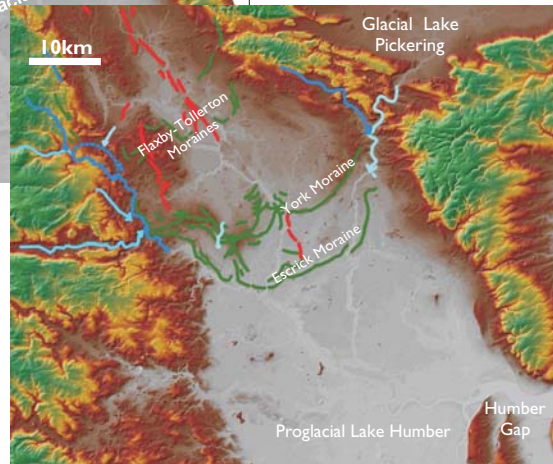
Depositional environment of the Vale of York sequence.

Methodology

The geological understanding of the Quaternary deposits has been built up from numerous datasets. It has been aided by interpretation of digital elevation model (DEM) information allied with air photograph interpretation and ground mapping. The mapping has utilised augering and many thousands of boreholes which have been used to generate 3D fence diagrams that around York have also permitted the production of a complete 3D block model.



Interpretation of features (1). The Devensian ice-sheet extended down the Vale of York to the Esrick Moraine which marks the last glacial maximum. The ice ploughed into and overrode the proglacial lake (Lake Humber) impounded by North Sea ice which blocked the Humber Gap. The lake drained southwards along what is now the River Trent. Drainage from the Pennines and the Vale of Pickering was diverted round the margin of the ice-sheet.



Interpretation of features (2). As the ice margin retreated northwards several belts of moraine were left (green on map above) with glacial drainage forming eskers (red on map above). Three sequences of glacial lakes are preserved, in front of the Esrick Moraine (Hemingbrough Fm.), between the Esrick and York moraines (Elvington Fm.). Outwash deposits formed in the lakes are associated with some of the eskers.

Conclusions

By combining 3D data from thousands of boreholes with detailed geological mapping and by utilising DEM interpretations we have a new understanding of the Quaternary geology of the Vale of York.

We conclude that the last glacial maximum (LGM) limit of the Devensian ice was at the Esrick Moraine. No evidence of glacial till deposits has been found in the proglacial lake deposits to the south. The survey has given new insight into the glacial and pro-glacial processes that affected this area during the Devensian glaciation.

Borehole cross-section interpretation of the area between York and Doncaster showing the Quaternary deposits of the Vale of York. More than 600 detailed boreholes were used to construct the sections using GSI3D. This software utilises the digital elevation model, geological surface linework and borehole data to enable the geologist to construct regularly spaced intersecting fence diagrams. Mathematical interpolation between the nodes of the sections and the unit boundaries produces a solid model composed of stacked triangulated objects representing the geological units.

This work was undertaken for the Environment Agency who are thanked for permission to use the information.