

Manchester Geological Association

Saturday 11th December 2010 – The Quaternary of the North West

13.30 – 14.15 New Insights into the pre Last Glacial Maximum Succession of East Cheshire
Professor Peter Worsley, University of Reading

14.15 – 15.00 The last Ice Sheet and later Glaciers in Wales: Timings, Extents and associated Palaeoclimates - Dr. Phil Hughes, University of Manchester

15.00 – 15.30 Coffee Break

15.30 – 16.15 Moraines and Outwash Plains – A Re-assessment of the late Devensian in South Lancashire, Merseyside and Greater Manchester
Dr. Dick Crofts, British Geological Survey

16.15 – 17.00 Glacial Lake Deposits and Reconstructing Deglaciation in Northwest England
Dr. Cathy Delaney, Manchester Metropolitan University

Amazing as it may seem, barely 20,000 years ago Manchester was buried under a glacier the best part of a kilometre thick. Following the initial suggestion by Agassiz that parts of Britain had been covered by ice, geologists searched for evidence of glaciation. In the north-west, for instance, Morton in Liverpool and Binney in Manchester diligently recorded the occurrence of tills and other phenomena, such as exotic boulders deposited by the ice (known as *glacial erratics*), scratches on rocks produced by glaciers sliding over them (*glacial striae*) and marine shells found on hillsides far removed from the sea.

This allowed informed deductions to be made as to the source and direction of movement of the ice. It was concluded that ice sheets forming on Scottish and Lakeland peaks had moved westwards and southwards through the Irish Sea, diverting in part across the Lancashire and Cheshire plains, through the Midlands Gap into Staffordshire and the West Midlands. Ice growing on the Welsh peaks joined this southward moving ice in the region of Wrexham. On the other hand Derbyshire appeared not to have been covered by this last major ice advance.

More recently there were further revelations following the uncovering of evidence in sand quarries near Chelford, in Cheshire, which indicated that a retreat and re-advance of the ice had occurred during a period previously thought to be glaciated throughout. Research into the Quaternary Period continues, and in these talks we will be given a timely update from a number of researchers working in the northwest.

New Insights into the pre Last Glacial Maximum Succession of East Cheshire Professor Peter Worsley, University of Reading

A sand dominated succession ante-dating the Last Glacial Maximum has been recognised for many decades. The doyen Manchester based Geological Survey glacial geologist W.B. Wright suspected that it might be Pliocene in age. In the 1950's sand quarries at Farm Wood, Chelford, revealed the presence of an organic bed and this was brought to the attention of the University Geology department's stratigrapher Morven Simpson. At that time he was investigating the classic tripartite glacial sequence of Upper Boulder Clay – Middle sands - Lower Boulder Clay. Reasonably he assigned the organics to part of the 'Middle Sands'.

A series of attempts to establish the radiometric age of the organics brought disparate results and eventually the unavoidable conclusion was that the age was beyond the range of radiocarbon

dating. However, palynological based correlations by Richard West with Denmark led to the idea that the organics represented an early interstadial woodland within the Last Cold Stage (Devensian).

Subsequently new exposures showed that the sands at Chelford lay beneath a significant unconformity (Stockport - Chelford Sand Formations) and that the organics were confined to a palaeochannel trending SE – NW in the Chelford district. Later TL age determinations suggested that the interstadial sediments were ca. 100 ka BP and thereby supported an early Devensian interstadial age. The sedimentology of the sands suggests the presence of two major periglacial alluvial sand sequences separated by a phase of incision/infill. The possibility arises that the earlier sand succession might be pre Devensian in age. The presence of a till (Oakwood Till), between the basal sands of the earlier sand sequence and the Mercian Mudstone leads to speculations as to the age of the limiting glaciation pre the sands.

Apart from the Chelford area, the only other locality with organics within the Chelford-type sands is at Arclid, just east of Sandbach. Initially these were extracted from below the water table and not seen at outcrop. The cavity of a mammoth tooth associated with an organic bed has yielded a pollen spectra suggestive of a Last Interglacial (Ipswichian) age. A newer quarry with ground water pumping has shown that 3 separate organic beds are present and these generally are of similar (but not identical) aspect to those at Chelford. Significantly they do not appear to be within a palaeochannel comparable to that at Chelford. They do however show that salt solution probably created ponds favourable to peat formation. Work continues on these peats and a set of OSL assays on the associated sands give results anomalous to the stratigraphy. We ought not to forget the radiocarbon dating saga when assessing this conundrum – ‘radiometric data can be good servants but make bad masters’.

The last Ice Sheet and later Glaciers in Wales: Timings, Extents and associated Palaeoclimates - Dr. Phil Hughes, University of Manchester

The vertical extent (thickness) of the last Welsh ice sheet has been examined by investigating the evidence for glacier erosion on the summit of the Aran ridge in Wales, comprising Aran Fawddwy (905 m asl) and Aran Benllyn (885 m asl) – the highest land in the British Isles south of Snowdonia. Nine samples were analysed for paired $^{26}\text{Al}/^{10}\text{Be}$ concentrations in collaboration with **Neil Glasser** at Aberystwyth University and the NERC Cosmogenic Isotope Analysis Facility. Six samples above an inferred trimline at 750-800 m a.s.l. indicate complete ice coverage and glacial erosion of the Aran Ridge at the global Last Glacial Maximum (LGM, c. 21 ka). Three paired samples below the inferred trimline yielded $^{10}\text{Be} / ^{26}\text{Al}$ results indicating exposure several millennia after the LGM. The results indicate that the last Welsh Ice Cap was thick enough to completely submerge the Aran ridge and achieve glacial erosion at the LGM, although the ridge summits were later exposed as nunataks at c. 16-17 ka at a time when the lower slopes were still ice covered. This period of glacial activity at lower elevations between 16-17 ka could reflect renewed glacial erosion by ice sheet outlet glaciers in the valleys surrounding the mountains during Heinrich Event 1, a renewed period of cold conditions punctuating overall deglaciation in the North Atlantic region.

The last glaciers of Wales are commonly attributed to the Loch Lomond Stadial (Younger Dryas), at the end of the Pleistocene Late-glacial substage, between c. 12.9-11.7 cal. ka. The correlation of cirque glaciation in the Welsh uplands with the Loch Lomond Stadial has been tested and confirmed using pollen stratigraphy at a number of sites. Furthermore, recent cosmogenic exposure age dating from both North Wales and the Lake District has confirmed a Loch Lomond Stadial age for some of the last cwm glaciers in these areas. Glacier-climate

modelling indicates that climate at former glacier equilibrium line altitudes with annual accumulation of at least 2000 mm (water equivalent) and mean summer (JJA) temperatures of c. 9°C at sea-level (c. 6°C cooler than today). A significant proportion of accumulation was likely to have been supplied by windblown snow, in addition to direct meteorological precipitation, and constraining precise values of the latter is problematic. Nevertheless, general patterns of precipitation can be assessed based on the distribution of ELAs. The lowest glaciers formed in mountains closest to the modern coasts, such as in the Nantlle and the Rhondda Valley areas, in north and south Wales respectively. Glacier elevations rapidly rise with distance inland suggesting strong precipitation gradients. However, some low-lying glaciers do exist far inland, such as in parts of the Berwyns, although the low elevations of some of these glaciers was because of large inputs of windblown snow.

Moraines and Outwash Plains – A Re-assessment of the late Devensian in South Lancashire, Merseyside and Greater Manchester
Dr. Dick Crofts, British Geological Survey

Over the last 25 years BGS has remapped the majority of the county of Lancashire. The Drift Edition of maps, now referred to as Superficial Deposits Edition, were based on mapping from the 1920's and 30s. Lancashire, having one of the thickest and most extensive areas of Quaternary glacial and post-glacial sedimentation in the north-west of England therefore needed to be reconsidered within a modern context, both depositionally and stratigraphically.

Fieldwork has been carried out in Lancashire from Carnforth to Ingleton and Stalybridge to Birkenhead, and been aided by over 50,000 boreholes in the BGS archives as well as modern GIS and 3D techniques. The work has:

- Identified a series of moraines around the periphery of the Rossendale Plateau. These probably correlate with the mid-Shropshire moraine, and have subsequently influenced the development of post-glacial drainage in the Manchester embayment.
- Confirmed the existence of glacio-lacustrine sedimentation within a number of Rossendale's valleys.
- Confirmed, and extended, the extent of the Kirkham moraine and its correlation with the Bride and Killard Point moraines of the Isle of Man and Northern Ireland, respectively.
- Raised the possibility of local Pennine and Rossendale ice-centres and glaciers during the Devensian.
- Reassessed sand bodies formerly identified as Shirdley Hill Sand.

Glacial Lake Deposits and Reconstructing Deglaciation in Northwest England
Dr. Cathy Delaney, Manchester Metropolitan University

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