Late Quaternary environments on the Cheshire Plain, England

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Research on glacial-interglacial cycles has primarily focussed on the Last Glacial Maximum (LGM) and warming into the present interglacial. This represents only 25% of the cycle, and further research is needed in order to understand fully the whole cycle in the UK. The Cheshire-Shropshire plain is the type area in the British Isles for the Devensian interstadials within the early-mid Devensian, and these, in terms of their timing and environment, remain at best sketchy. Chelford interstadial deposits have been radiocarbon dated to 60ka BP and the Upton Warren to 40ka BP, but given the problems with radiocarbon ages at this range they are considered problematic (e.g. Bridglandet al. 2014). Previous luminescence research on Chelford extended the age range back to 100 ka BP (Rendell et al. 1991), and though these are poorly resolved the general consensus constrains these organic sediments within an extensive Aeolian-lacustrine complex to late Marine Isotope Stage 5 (~110-80ka). Previous palaeoecological research includes studies by Coope (1959; Worsley et al. 1983) on insects from organic sediments from quarries at Chelford and these indicate the potential of this technique for reconstructing climate and environmental change. These early results show a forested boreal environment, and refine the climate envelope provided by macrofloral studies (Simpson & West 1958). MCR estimates suggest a $T_{\text{max}}$ of 16 to 18°C and $T_{\text{min}}$ of -5 to -9°C, but these require further work to refine and corroborate. As detailed knowledge of the sequence of environmental changes during the early parts of the last glaciation remains limited, additional research on the stratigraphy and the insect faunas from sites on the Cheshire plain will provide more refined information on the timing, rates and nature of environmental change driven by climate, including changing patterns of insect distribution. At Arclid and other quarries, near the original Chelford site, sand extractions have created unique opportunities (see Fig. 1) to study the complex stratigraphy of the last glacial and its interstadials and to refine the dates of the aeolian-lacustrine Chelford Sands, using more exact optical luminescence (OSL) techniques, and to understand better the detail of climate and environmental change by studying the insect remains.

![Fig 1: Organic deposits within the Chelford sands at Arclid October 2013 (Photo: Matt Burke)](image)

**Research Questions:** The project will focus on climate and environmental change during the early to mid-Devensian, and will study: a. the site stratigraphy in order to relate the succession at Arclid with other relevant sites in the Cheshire, Staffordshire, Shropshire region
(Four Ashes and Chelford); b. the chronology of the fluvi-o-aeolian sands will be established using OSL dating; c. fossil insect assemblages in order to examine the detail of climatic and environmental change; d. Environmental reconstructions will be aided by elemental and isotopic analysis of organic material.

**Methodology:** A preliminary study from Arclid has confirmed preservation of insect remains and part of the section provided evidence of a cold insect fauna. Similar to Chelford, coniferous woodland is implied by pine and spruce cones from the site. Detailed fieldwork will take place with collaboration between the Universities of Edinburgh, Sheffield, Liverpool and the British Geological Survey. The stratigraphy of the area will be mapped in detail and samples will be taken for OSL, particle size, loss on ignition and insect remains, and selected peat samples will be measured for C/H/N and stable isotope ratios. OSL dating will take place in the Department of Geography, University of Sheffield, and insect studies at the School of GeoSciences University of Edinburgh.

**Research Training:** Formal training will be provided in: i) stratigraphic mapping and geomorphological analysis led by Professor Richard Chiverrell, Department of Geography, University of Liverpool and Dr Jonathan Lee, British Geological Survey. ii) sample recovery, processing and identification of fossil insect remains, and the interpretation of past environments from insect habitat data. The BugsCEP database, which includes modules for climate reconstructions (MCR) and faunal analysis, will facilitate habitat reconstruction and comparison. Insect research (including use of in the in-house insect collections) will be supervised by Dr Eva Panagiotakopulu, School of GeoSciences, University of Edinburgh. iii). OSL dating training will take place at the OSL laboratory, Dept of Geography, University of Sheffield, supervised by Professor Mark Bateman. The research will be supplemented by comprehensive transferable skills training.

**Requirements:** A background in physical geography, geology or biology would be preferred. Relevant field and laboratory experience and previous experience with geological mapping or expertise in palaeoecology or ecology would be an advantage.

**Further reading or any references referred to in the proposal:**

**A project summary:** Geomorphological and stratigraphic mapping, palaeoentomology and OSL dating, will be applied to study of climate and environmental change during the early to mid-Devensian of the Cheshire plain.