Abstract

This PhD research utilises, for the first time, sedimentary evidence for mid to late Quaternary environmental change in the Tequixquiac region of Central-eastern Mexico. This project has logged over 50 stratigraphic sections and geochemically analysed a 55 m lithostratigraphic sequence for multi-proxy palaeoenvironmental information. The main research objective was to develop a spatial and temporal Palaeogeographic and Palaeoenvironmental model for the study area the covered the late Pleistocene to early Holocene. The findings of the study, based on the analysis of sedimentology, micromorphology, stable isotopes $\delta^{18}O_{carbonate}$ and $\delta^{13}C_{DIC}$ as well as ICP-OES sediment and tephra geochemistry, LOI, AMS radiocarbon, $^{40}Ar/^{39}Ar$ and Uranium-series dating has allowed a chronologically constrained paleoenvironmental and palaeogeographic reconstruction of the study area. The results of the study suggest that the Tequixquiac Basin has undergone a significant hydrological change from perennial lacustrine to ephemeral fluvial conditions between MIS15 – MIS 1 controlled by a combination of; climatic fluctuations, expressed as depositional cyclicity driven by precessional fluctuations to insolation levels. On shorter time-scales, changes in the mean position of the ITCZ related to SST, latitudinal gradients, atmospheric surface pressure gradients, the extent of Northern Hemisphere land and sea ice cover, and oceanic circulation patterns. Fluctuations in the TOC content of sediments are thought to be related to El Niño-like (dry) and La Niña-like (wet) events. While climate is thought to have been critical to the development the Quaternary localised uplift, deformation and normal faulting have also influenced paleohydrology and water-table elevation during the recorded depositional period (Figs 8.15 d & 8.16 d).

Acknowledgements

Firstly, I would like to thank NERC for their funding and SUERC, without whom I would not have had the support to conduct the isotope, geochemical and Ar-Ar work. Appreciation and thanks are given to my project supervisors Prof. Silvia Gonzalez, Prof. David Huddart and my unofficial supervisor Prof. Christopher Hunt, whom I am indebted to. Special thanks are given to Dr Gilbert Price for help and assistance with U-Series dating and Prof Darren Mark for support and guidance with Ar-Ar dating; and to Dave Williams and Hazel Clark who have helped me numerous times throughout my studies, providing informal discussions about the best way to adapt methods to suit the sediment type. Also, to Dr Isabel Israde and Dr Gabriela Dominguez from the de la Universidad Michoacana de San Nicolas, Mexico for help and support with diatom and pollen analysis, and to Dr Elizabeth Whitfield, who helped me from a distance and pushed me past the finish line. Remembrance and thanks are given to Prof. Alan Turner (1947 – 2012) for his advice, support, belief, wit and endless humour that still motivates and makes me smile today. Acknowledgement and gratitude are heaped onto my family (actual and adopted), partner Anthony and friends Laura and Sarah for their endless support, patience and for keeping me grounded. Lastly, endless thanks are given to my three amazing children Ethan, Callum and Jack who have equally sacrificed to get me to this point.

Statement of originality

All fieldwork, sample collection, laboratory work, data analysis, data interpretation and discussion, tables, images and figures were conducted and/or produced by Emma Toole unless otherwise stated. Below is a statement of co-workers and their contributions towards the research.

Carbonate stable isotope analysis of the first batch of carbonate sediment samples was carried out at SUERC by the author under the guidance and supervision of Dr Alex Brasier. The second batch of carbonate sediment samples was prepared at Liverpool John Moores University and sent to Dr Alex Brasier at SUERC for analysis.

For ICP- OES data analysis one week was spent at SUERC preparing sediment samples for analysis, and analysis methods were set out by Professor Rob Ellam. Preparation of blanks and reference materials along with sample mass spectrometric analysis was carried out by Anne Kelly at SUERC. All data were then forwarded to the author for interpretation.

Five bulk tephra samples were sent to the litho-geochemistry lab, Activation Laboratories, Ancaster, Ontario, Canada. Package 4B, (Lithium Metaborate /Tetraborate Fusion – ICP/OES) was used to obtain the bulk major oxide content of the samples.

Samples were sent to BETA Analytic, Miami, USA to obtain ^{14}C AMS radiocarbon dates for five bulk organic sediment samples, two gastropods, and two bivalve shells.

The author prepared two tephra samples for Ar/Ar dating that were sent for irradiation and returned to the Scottish Universities Environmental Research Centre (SUERC) where all mass spectrometric analysis was carried out by Dr Darren Mark which was then forwarded to the author for interpretation.

The U – series dating three limestone samples were sent to Dr Gilbert Price, University of Queensland, Australia, for U-series dating. No preparation was carried out by the author (see Section 6.6).

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