International Association of Sedimentologists Post-graduate Grant Scheme Report

Grant Awarded – 1st Round 2006

Candidate: Mr Andrew Berkeley

PhD Thesis: The development of microfossil assemblages in tropical intertidal sedimentary systems: implications for palaeoenvironmental studies

Supervisors: Drs. Chris Perry & Kevin Taylor, Manchester Metropolitan University, UK
Dr. Scott Smithers, James Cook University, Australia
Dr. Ben Horton, University of Pennsylvania

Mangrove forests, which are widespread along tropical / sub-tropical coastlines, occupy an important terrestrial / marine transitional zone and exert an important influence on the sedimentology of intertidal systems by promoting sediment deposition and facilitating sediment stabilisation. The biotic constituents of mangrove sediments, for example microfossil and pollen assemblages, also provide a potentially important repository of palaeoenvironmental information. In particular, foraminifera, which have been shown to exhibit a well-defined faunal zonation across intertidal profiles, are potentially useful tools for the reconstruction of former sea-levels. Such studies, however, are usually based on a modern faunal gradient characterised from the uppermost 1 cm of sediment, effectively ignoring the modifications to assemblages which may occur subsequent to burial. Such processes, which include sub-surface production of foraminifera (*infauna*) as well as taphonomic loss, have received some attention in temperate settings but are not well understood from tropical, mangrove-fringed coastlines. This project aims to test the applicability of tropical intertidal foraminifera to the reconstruction of Holocene sea-level change by assessing the impact of infauna and taphonomy on the development of microfossil assemblages across a mangrove-mudflat system in Cleveland Bay, Queensland, Australia.

Preliminary findings from a mud dominated setting at the south of Cleveland Bay suggest a marked dichotomy in the preservational tendencies of foraminifera within mangrove and mudflat sediment facies. Live populations are characterised by a dominance of agglutinated species within the upper mangrove with a gradual increase in calcareous forms through the lower mangrove and eventual calcareous dominance on the mudflat. Calcareous foraminifera appear to dissolve very soon after death within the organic-rich mangrove muds whereas their abundance increases markedly beneath the surface in the silty-clay mudflat sediments. Perhaps more surprisingly, agglutinated foraminifera - which tend to dominate within the mangrove, also appear to be poorly preserved, declining significantly with depth below the sediment surface. This distinction is likely to cause an under-representation of high-intertidal mangrove biofacies in the fossil record, in contrast to temperate settings where these assemblages appear to be the most readily preserved.

In order to broaden this study, and with the aid of IAS funding, samples have been collected from a contrasting site at the more energetic, northern end of Cleveland Bay. This location is characterised by more coarsely grained sediment facies, less acidic porewaters and a markedly different surface microfossil assemblage (dominated by calcareous species throughout; see Woodroffe et al., 2005). Cores were collected for the analysis of foraminiferal content (both live and dead), sedimentological parameters, as well as pH and redox conditions. This will provide an opportunity to test the controls under which intertidal foraminifera are preserved in relation to specific environmental and sedimentological characteristics. The results

will permit a wider understanding of the development of tropical intertidal microfossil assemblages and will have direct implications for the use of surface foraminiferal distributions as palaeoenvironmental tools.

My supervisors and I are grateful the support provided by the IAS in helping to make this work possible.

(Reference: Woodroffe et al. (2005) Intertidal mangrove foraminifera from the Great Barrier Reef shelf, Australia: implications for sea-level reconstructions, *Journal of Foraminiferal Research*, 35, 259-270.)

Curriculum Vitae

Academic Experience:

BSc (Hons) Geography (1st Class), 2004, Manchester Metropolitan University, UK.

PhD '*Preservation of microfossils in tropical intertidal environments: implications for studies of Holocene sea-level change*', 2004 – Date, Manchester Metropolitan University, UK.

Publications and Conference Presentations:

Berkeley, A., Thomas, A.D. and Dougill, A.J. (2005) Cyanobacterial soil crusts and woody shrub canopies in Kalahari rangelands, *African Journal of Ecology*, **43**, 137-145. (Undergraduate Dissertation material).

Berkeley, A., Perry, C.T., Smithers, S. and Horton, B. (In prep.) Microfossil based palaeoenvironmental records in intertidal environments: a review of the ecological and diagenetic controls on foraminiferal assemblage development, *Quaternary Science Reviews*.

Berkeley, A., Perry, C.T., Smithers, S. and Horton, B. (2005) *Preservation of foraminifera in tropical intertidal environments: implications for palaeoenvironmental studies*, British Geomorphological Research Group Annual Meeting, University of Southampton.

Berkeley, A., Perry, C.T., Smithers, S. and Horton, B. (2006) *Preservation of foraminifera in tropical intertidal environments: implications for palaeoenvironmental studies*, European Geosciences Union General Assembly, Vienna.

Other Awards

Manchester Geographical Society, Best Undergraduate Dissertation, 2004, £50.

British Geomorphological Research Group Conference Fund, *for* European Geosciences Union General Assembly, Vienna, 2006, £250.