International Association of Sedimentologists Postgraduate Grant Award Scheme

Candidate: Suzanne Palmer

Supervisors: Drs Chris Perry and Kevin Taylor (Manchester Metropolitan University, UK)
Dr Scott Smithers (James Cook University, Townsville, Australia)

Research title: 'Sediment facies and Holocene evolution of a nearshore, turbid-zone coral reefs; Paluma Shoals, central Great Barrier Reef'.

Terrigenous sedimentation and chronic turbidity are traditionally considered adverse conditions for coral reef growth and widely cited as causes for coral reef disturbance (Fabricius & Wolansky, 2000; Rogers, 1990). However, it is becoming increasingly recognised that coral reefs grow under a wide range of environmental conditions including those of high turbidity and terrigenous sedimentation (Woolfe & Larcombe, 1999). Nearshore coral reefs on the Great Barrier Reef (GBR) coastline are widespread and of particular significance as they are located within a nearshore zone of persistent chronic turbidity (>40NTU estimated to occur for >40 days per year) and intermittent 'high' sedimentation (over 120 mg $cm^{-2}day^{-1}$) (Larcombe et al., 2001). Despite such apparently adverse conditions for coral growth, coral reefs have developed as sites of high diversity and live coral cover. They represent the most recent phases of reef growth on the GBR shelf (Smithers et al., 2006) and have the potential for representing analogues of past phases of reef development across the shelf during the Holocene transgression (Larcombe & Woolfe, 1999). Despite their significance there remain a limited number of detailed studies on the sedimentology and Holocene growth histories of such coral reefs. This research therefore aims to examine the sedimentology and Holocene reef growth of a modern turbid-zone reef, Paluma Shoals located on the inner shelf of the GBR, Australia. This will increase our understanding of the development and dynamics of these important inshore reef systems.

Preliminary findings from the nearshore turbid-zone coral reef of Paluma Shoals reveal a distinctive feature with an internal structure comprising coral rubble floatstone facies with little or no biological binding or cementation of clasts. Given that coral reefs are often associated with rigid coral dominated framework Paluma Shoals provides evidence of a distinctive type of reef development. Cores have recovered Pleistocene clays at their base, confirming that the entire sequence of Holocene reef accumulation has been penetrated and establishing that reef initiation occurred over a basal clay substrate. Distinct 'reef' units have been identified throughout the reef sequence representing various stages of reef growth. As the reef has accreted vertically mud content has decreased and $CaCO_3$ has increased reflecting the increasing

influence of the developing reef flat on the immediate surrounding sedimentary environment. The present day coral reef community display a series of well developed reef flats which have accreted close to present sea level. Despite adverse conditions for coral reef growth Paluma Shoals flourish with up to 90% LCC in parts and would appear to have done so throughout the history of reef accretion.

In order to further constrain the depositional history and Holocene reef growth of Paluma Shoals, and with the aid of IAS funding, further vertical cores have been recovered from across the Paluma Shoals reef complex. This is to allow further constraining the spatial variation in reef growth and to provide new samples for geochemistry work to investigate the diagenesis of the systems. Further grab samples were recovered to determine the surrounding sedimentary environments in which Paluma Shoals is growing and RTK surveys of the nearshore profile were carried out to determine the reef topography and elevation with respect to sea level. Following the two field seasons (2005 and 2006) 14 percussion cores have been recovered across the reef profile, 6 of which recovered the complete Holocene reef sequence, and as a result there now exists the largest dataset for coral reefs of this type. The results of which will enable to constrain the sedimentary facies development in order to characterise the range of 'turbid-zone' coral reef depositional facies. This will enable an improved understanding of these important alternative states of coral reef development.

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

References

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Larcombe, P. et al., (2001) The hydrodynamic and sedimentary settings of nearshore coral reefs, central Great Barrier Reef, Australia: Paluma Shoals, a case study. *Sedimentology*. 48: 881-835.

Rogers, C.S. (1990) Responses of coral reefs and reef organisms to sedimentation. *Marine Ecology Progress Series*. 62: 185-202.

Smithers, S. et al. (2006) Fringing and nearshore coral reefs of the Great Barrier Reef: Episodic Holocene development and future prospects. *Journal of Coastal Research*. 22 (1) 175-187.

Woolfe, K.J. & Larcombe, P. (1999) Terrigenous sedimentation and coral reef growth: a conceptual framework. *Marine Geology*. 155: 331-345.

Curriculum Vitae

Academic experience:

BSc (Hons) Geography (1st Class), 2005, Manchester Metropolitan University, UK

PhD 'Sediment facies and Holocene evolution of a nearshore, turbid-zone coral reefs; Paluma Shoals, central Great Barrier Reef'. 2005 – Date, Manchester Metropolitan University, UK.

Other Research Awards:

2005 NERC Radiocarbon AMS Laboratory, £5400

2006 British Society for Geomorphology (BSG) Postgraduate Research Funds, £200

Research Presentations:

Palmer, S., Perry, C.T., Smithers, S., Taylor, K.T. (2005) Structure and evolution of nearshore turbid-zone coral reef communities, central Great Barrier Reef (GBR). Reef Conservation UK (RCUK), London Zoological Society, London Zoo

Palmer, S., Perry, C.T., Smithers, S., Taylor, K.T. (2006) Structure and evolution of nearshore turbid-zone coral reef communities, central Great Barrier Reef (GBR). EGI 2006 Annual Meeting, Vienna. (Geophysical Research Abstracts Vol. 8, 04052, 2006)

Palmer, S., Perry, C.T., Smithers, S. (2006) Sedimentary facies development and Holocene reef growth of a nearshore turbid-zone reef: a case study from Paluma Shoals, central GBR, Australia. ISRS European Meeting 2006, Bremen.