Geological evolution and reefal development in the Wakatobi National Park

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Aims: The overall aims of a large scale project begun in 2001 are to 1) understand the spatial and temporal development of reefs and their associated deposits in the Wakatobi region, and 2) to evaluate factors influencing marine environmental change in this complex tectonic region.

2005 fieldwork: The specific objectives of this year's fieldwork, undertaken during August and September, 2005, was to complete work on the onshore outcrops of reef associated deposits specifically on the islands of Tomea, Binongko, Runduma and Lintea Selatan. Geological data collection was possible on all these islands and some additional data collection together with undergraduate student training was undertaken on Wangi Wangi. This work now completes the collection of field data for all the islands in the Wakatobi region. However, considerable further data analysis is required in the UK and for this reason only very preliminary findings are presented herein. Within the remit of this large-scale project two undergraduate student dissertations are being undertaken:

1) *Environmental change of ancient coral reef systems* - Colin Guyton – University of Sussex

2) *Evaluating controlling influences on coral reef terrace development* – Emil Naylor-Morrell – University of Newcastle

Introduction:

The Wakatobi National Park lies at the centre of the region of highest marine diversity in the world and the reefal systems are remarkable for their diversity. The Wakatobi islands preserve a unique record of ancient uplifted coral reefs that formed within the last 5 million years. These ancient reefs are exposed as a series of stepped terrace levels that have been uplifted to maximum heights of 300 m. The deposits of each terrace formed in a variety of shallow marine environments associated with coral reefs that built towards sea level. As the shallow water deposits became emergent due to uplift forming a 'terrace', a new active fringing reef system developed around the emerging island. On subsequent uplift this 'new' reef became a lower, and younger terrace level. Thus on each of the islands the older

terrace levels are exposed at greater elevations with younger terrace development sequentially closer to current sea level. The shallow water reef deposits (limestone terraces) overlie deeper water deposits (muddy limestones or marls), and rare exposures of older basement thought to be of continental origin have been reported on Runduma. Despite an extensive search for these older rocks on Runduma no *in situ* exposures were located. However, blocks of silica-rich and ferromagnesium-rich igneous rocks were found. The latter, if originating on Runduma would throw into doubt the hypothesis of purely continental crust underlying the region.

Methodology:
All projects followed the same initial methodology of mapping and undertaking a number of spaced transects from sea level to the island's highest point. Along each of the transects the type of data collected varied for each project. Overall for all projects GPS locations and heights were recorded together with geomorphic markers, fossil types and their morphologies, deposit sediment texture, grain size and components.

Preliminary results:

Environmental change: Through analysis of fossil types, their morphologies and deposit characteristics the likely environment of formation of the studied deposits is being determined. Data on the deposits of the modern reefs collected in past years is being used as a modern analogue to aid this interpretation. Preliminary results show that beach, inner and outer reef flat, reef crest, reef slope and forereef deposits can all be distinguished. It is also possible to evaluate relative water depths and formational energies of the deposits. There appears to be distinct variations between deposit and terrace development on windward and leeward sides of islands, with windward terraces generally being narrower and formed under higher energies than their leeward counterparts. When complete this study will provide a unique insight into how marine environments vary with time as shallow submerged systems evolve into reefs surrounding uplifted oceanic islands.

Influences on environmental change and terrace development:
A complex series of oceanographic, climatic, tectonic and eustatic (global sea level change) factors influence deposit types and terrace development. The findings of this research have shown that a series of over 10 different stepped coral reef terraces have developed within the last 5 million years. Since the highest terrace level, at nearly 300

m is significantly greater than any known eustatic sea level fall there has to be a strong element of tectonic uplift in the region. Tracking the height of individual terrace levels has to date not revealed any significant systematic height variations which might have been suggestive of tectonic tilting or folding in the region. Further analysis of the data set is required to determine whether differential tectonic uplift has affected the different islands, and the relative roles of tectonics, eustasy and oceanography.

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As bird report