Fossil Shorelines Record Multiple Sea Level Highstands and Surface Deformation on Million Year Timescales at Cape Range National Park, Northwestern Australia

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Introduction

The Cape Range in Northwestern Australia is a slowly uplifting anticlinal structure, likely caused by reverse reactivation of ancient fault zones normal to the principal horizontal compressive stress, resulting in the warping of overlying marine units. Four distinct marine terraces and coral reefs ranging from the last interglacial sea level maximum into the Neogene document these neotectonics, and provide constraints for the timing of deformation. The Mioryere and Muiron are the older, upper terraces cutting into the Miocene aged Jurabi and Pilgramama formations,1 with elevations ranging between 18.4m and 57.8m, respectively. The Jurabi terrace lies just below, reaching 9.2m-to-21m in height, with sub-tidal marine and semi-isolated coral heads up to 5.5 m, and an abrasion scarp as high as 12.6 m at the apex of the anticline. This shoreline is a traditionally assigned age as Marine Isotope Stage (MIS) 5e, with U-Th dates placing the reef platform at 122 ± 5.4 ka.2

Marine deposits indicate a minimum age because any alteration to the original Sr isotopes will cause relative elevation changes in the Jurabi and Milyering shorelines.2

GPS Data:

Over 3600 elevation points along 30 transects (figure 1) on the western coast of Cape Range were collected using high precision differential GPS with four Star Sherpa II capabilities (30cm vertical error = 11cm for 2015-data, and 2-3cm vertical error for 2017-data). LiDAR was also acquired for certain locations to assist with interpolation and elevation (figure 2). Highest forms and morphological features for each terrace (figure 3) were determined through averaging the top recorded features (average range in points = 0.4 m).

Fossil Collection and Sr Isotope Analysis:

Coral heads in growth position were sampled from the various reef platforms and brought back to Lamont-Doherty Earth Observatory for screening and processing techniques. Samples were photographed under an optical microscope, followed by STEM imaging using an APEX II STEM. The specimens were then crushed into sand-sized gruels and picked under a microscope before processed in an acid cleaned agate mortar and pestle. String of powdered sample was housed in a weak Acetic Acid solution for 20 minutes. Producing a total of 4-6 grains. Sr analysis was performed on the leaches using ICP-MS at SUNY Stony Brook or VG Sector 54 TIMS at U. North Carolina. Results were normalized to an SrNIST987-standard reference material (0.709248 for the NIST 987-standard reference material). Results were normalized to an SrNIST987-standard reference material (0.709248 for the NIST 987-standard reference material).

Sex in 2017, the samples were assigned a minimum age because any diagenetic alteration with lower Sr isotopic values (volcanic dust and older carbonates) is deemed unlikely based on sample locations.

Conclusions

Jurabi Terrace is older than Jurabi and Milyering terraces, followed by the Jurabi and Tantabiddi notch. The MIS 5e reef platform shows slightly lower elevations at the center.

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