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Evidence for Depth-Dependent Stretching at the Propagating Tip of Sea-floor Spreading in the Woodlark Basin, from Satellite Gravity Inversion, Flexural Backstripping and Fault Analysis

S. Gozzard (1), N. Kusznir (1), A. Goodliffe (2) and G. Manatschal (3)

(1) Department of Earth and Ocean Sciences, University of Liverpool, Liverpool, UK

(2) Department of Geological Sciences, University of Alabama, Tuscaloosa, AL, USA

(3) University of Strasbourg, France

Understanding the processes by which continental crust and lithosphere thin at the propagating tip of sea-floor spreading is key to understanding continental breakup. The Woodlark Basin, a young ocean basin located in the Western Pacific to the east of Papua New Guinea, commenced formation at approximately 8.4Ma and is propagating westwards at a rate of approximately 140km/Myr. Immediately to the west of the most recent segment of sea-floor spreading propagation, in the vicinity of the Moresby Seamount, evidence from bathymetry, subsidence and seismic Moho depth suggests that continental lithosphere is being thinned. In this study we have determined lithosphere thinning in the vicinity of the Moresby Seamount at the level of the whole lithosphere, the whole crust and the upper crust. Whole lithosphere thinning factors have been determined from subsidence analysis; whole continental crustal thinning factors have been determined from gravity inversions and upper crustal thinning factors have been determined from fault analysis. Three 2D seismic profiles surrounding the Moresby Seamount have been flexurally backstripped to the base of the syn-rift sediments to determine the water loaded subsidence. Using the McKenzie lithosphere extension model, modified to include volcanic addition at high thinning factors, whole thinning factors for the lithosphere have been determined from the water loaded sub-

sidence. Results show that thermal subsidence alone cannot account for the observed subsidence, and that an additional initial subsidence is needed. Whole lithosphere thinning factors increase from an average of 0.5 to 0.8 across the Moresby Seamount eastwards towards the propagating tip. A satellite gravity inversion incorporating a lithosphere thermal gravity anomaly correction has been used to determine Moho depth, crustal thickness and thinning factors for the propagating tip in the Woodlark Basin. Moho depths are consistent with depths obtained from receiver function analysis (Ferris *et al.* 2006). Crustal thickness estimates determined from gravity inversion do not include a correction for sediment thickness and are upper bounds. Crustal thinning factors in the vicinity of the Moresby Seamount are similar to those observed for the whole lithosphere. Fault analyses of the three 2D profiles have been used to determine upper crustal stretching and thinning factors. Upper crustal thinning factors in the range of 0.1 to 0.4 are observed for the vicinity of the Moresby Seamount, substantially lower than thinning factors predicted for the whole lithosphere and continental crust, suggesting depth-dependent lithosphere thinning. Across the Moresby seamount, peak thinning factors for the upper crust, whole crust and whole lithosphere are 0.4, 0.6 and 0.7 respectively. Crustal thicknesses predicted from gravity inversion immediately to the east of the Moresby Seamount are substantially greater ($>$3km thicker) than would be expected for oceanic crust. It is inconclusive whether this region is thick oceanic crust, attenuated continental crust or very thin continental crust with volcanics.