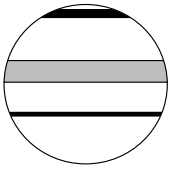

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Holocene relative sea-level records from coral microatolls in Western Borneo, South China Sea

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Abstract

The spatial variability of Holocene relative sea level (RSL) in the South China Sea is unknown, with data restricted to Thailand, the Malay Peninsula, and a few other isolated sites. In this study, we present new continuous RSL records for Borneo using surveyed and U–Th dated coral microatolls from four sites in western Sarawak. The record spans 450 years of RSL from 7450 to 7000 yr BP. Our data suggest that RSL was higher than present and rapid RSL rise had ceased by 7450 yr BP. We compare these RSL reconstructions with a regional model of glacial-isostatic adjustment (GIA). The RSL reconstructions from three sites off the coast of Sarawak show a spatial gradient opposite to that predicted by the GIA model. This disagreement can best be explained by tectonic deformation since 7000 yr BP, which was previously unrecognized. We propose vertical land motion of 0.7–1.45 m due to slip on the Serabang fault, which runs between our four sites. This slip may have occurred in response to the loading of the Sunda Shelf by rising sea level.

Keywords

Borneo, Borneo tectonics, coral microatolls, GIA models, Holocene highstand, relative sea level, Sarawak, Serabang fault

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Introduction

Reconstructions of Holocene relative sea level (RSL) provide context for projections of the magnitude and rate of future sea-level rise (Dutton et al., 2015). Changes in RSL, which is defined as the height of the ocean surface relative to the land surface or ocean floor (Khan et al., 2015), are not globally uniform (Milne et al., 2009). RSL is influenced by a combination of factors that act over a variety of spatial and temporal scales (Shennan and Horton, 2002). At regional scales, glacio- and hydro-isostasy, ocean dynamics, and tectonics are the main processes driving the RSL signal over Holocene timescales. At local scales, tidal regime changes and sediment consolidation can influence RSL records. Reconstructions of RSL far from major glaciated locations are referred to as far field (Pluet and Pirazzoli, 1991). In these locations, eustatic contributions to RSL change generally exceeded glacio-isostatic contributions during the early and mid-Holocene (e.g. Lambeck et al., 2014). The RSL reconstructions of many tectonically stable far-field locations are characterized by a mid-Holocene RSL highstand, at the time meltwater production decreased (e.g. Angulo and Lessa, 1997; Baker and Haworth, 2000; Grossman et al., 1998; Hanebuth et al., 2011; Lambeck et al., 2014). The timing and magnitude of the highstand can be used to provide information about the nature of the end of melting of the global ice sheets. Following this highstand, the fall in RSL to present is due to a combination of hydro-isostatic loading (continental levering) and a global fall in the ocean surface due to equatorial ocean siphoning, that is, a flow of water away from far-field regions and into collapsing forebulges near formerly glaciated regions (Milne and Mitrovica, 2008; Mitrovica and Peltier, 1991).

Sundaland is located in Southeast Asia, comprising the Malay Peninsula and parts of Thailand, Borneo, Sumatra, and Java. It is considered to be tectonically stable, based in part on GPS studies (Simons et al., 2007). Over this region (Figure 1), there is considerable variability in the timing and amplitude of the Holocene highstand (Figure 2), with estimates of the timing between 7000 and 4000 yr BP and amplitudes of 1–5 m above present (Horton et al., 2005 (and references therein); Bird et al., 2007, 2010;

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