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Sequence stratigraphic and geomorphic manifestations of dynamic topography along passive margins

Nicky White
University of Cambridge, Bullard Laboratories, Earth Sciences, Cambridge, United Kingdom (njw10@cam.ac.uk)

Convective circulation of the Earth's mantle maintains plate motion but we know little about the spatial and temporal details of this circulation. Fortunately, the circulation pattern beneath lithospheric plates generates dynamic topography at the Earth's surface. Here, we describe how sequence stratigraphy of passive margins contains useful clues about the spatial and temporal pattern of dynamic topography. The age-depth relationship of oceanic crust at the distal end of passive margins forms a useful starting point. Residual depth anomalies are determined by comparing water-loaded depth to basement with a global age-depth curve. Positive and negative residual depth anomalies occur along most passive margins and have amplitudes of up to +/- 1 km and wavelengths of 100s of km. They mostly, but not always, correlate with long-wavelength gravity anomalies. At the proximal ends of passive margins, progress can be made on three fronts. First, long-wavelength gravity anomalies which straddle continental margins are an obvious and important guide. Secondly, stratal geometries across continental shelves contain key information about surface elevation changes if sea-level variation is known. Here, I describe examples from the west coast of Africa, from equatorial Brazil, from the north shelf of Australia, and from the North Atlantic Ocean. In all cases, sequence stratigraphic geometries yield estimates of dynamic topography that are consistent with distal estimates from adjacent oceanic crust. Our results suggest that most passive margins are affected by rapidly varying vertical motions that too large to be caused by glacio-eustatic sea-level variation. If used with care, modern sequence stratigraphy can be used to map spatial and temporal patterns of dynamic topography continent-wide.