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NW Indian Ocean crustal thickness, micro-continent distribution and ocean-continent transition location from satellite gravity inversion

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Satellite gravity anomaly inversion incorporating a lithosphere thermal gravity anomaly correction has been used to determine Moho depth, crustal thickness and lithosphere thinning factor for the NW Indian Ocean and to map ocean-continent transition location (OCT) and micro-continent distribution. Input data is satellite gravity (Sandwell & Smith 1997) and digital bathymetry (Gebco 2003). Crustal thicknesses predicted by gravity inversion under the Seychelles and Mascarenes are in excess of 30 km and form a single micro-continent extending southwards towards Mauritius. Thick crust (> 25 km) offshore SW India is predicted to extend oceanwards under the Lacadive and Maldive Islands and southwards under the Chagos Archipelago. Superposition of illuminated satellite gravity data onto crustal thickness maps from gravity inversion clearly shows pre-separation conjugacy of the thick crust underlying the Chagos and Mascarene Islands. Maps of crustal thickness from gravity inversion show a pronounced discontinuity in crustal thickness between Mauritius-Reunion and the Mascarene Basin which is of Late Cretaceous age and pre-dates recent plume volcanism. Gravity inversion to determine Moho depth and crustal thickness variation is carried out in the 3D spectral domain and incorporates a lithosphere thermal gravity anomaly correction for both oceanic and continental margin lithosphere (Chappell & Kusznir 2008). Failure to incorporate a lithosphere thermal gravity anomaly correction gives a substantial over-estimate of crustal thickness predicted by gravity inversion. The lithosphere thermal model used to predict the lithosphere thermal gravity anomaly correction may be conditioned using magnetic isochron data to provide the age of oceanic lithosphere (Mueller et al. 1997). The resulting crustal thickness determination and the location of the OCT are sensitive to errors in the magnetic isochron data. An alternative method of inverting satellite gravity to give crustal thickness, incorporating a lithosphere thermal gravity correction, which does not use magnetic isochron data provides an isochron independent prediction of crustal thickness and OCT location. For continental margin lithosphere, the lithosphere thermal perturbation is calculated from the lithosphere thinning factor (1-1/beta) obtained from crustal thinning determined by gravity inversion and breakup age for thermal re-equilibration time. A correction is made for crustal volcanic addition due to decompression melting during breakup and sea-floor spreading.