Geophysical Research Abstracts
Vol. 13, EGU2011-13444, 2011
EGU General Assembly 2011

A Lithospheric Attractor of Mantle Plume Volcanism in the NW Indian Ocean

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Mapping of crustal thickness using satellite gravity inversion in the NW Indian Ocean shows regionally thicker crust underlying the Mascarene Islands and Mauritius into which younger Reunion mantle plume track volcanism has been focussed. The formation age of this thicker crust predates the passage of the Reunion mantle plume track by at least 40 Myr suggesting that the lithosphere underlying the anomalously thick crust has acted as an "attractor" for mantle plume volcanism. Gravity anomaly inversion incorporating a lithosphere thermal gravity anomaly correction has been used to determine Moho depth, crustal thickness and micro-continent distribution for the NW Indian Ocean. The gravity inversion uses satellite gravity anomaly (Sandwell & Smith 2008), bathymetry (Smith & Sandwell 2008) and ocean age isochron data (Mueller et al. 1997). 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, consistent with plate reconstructions predictions to $\sim$ 40 Ma and older which restore the thicker crust under Reunion, Mauritius, Mascarenes, Chagos and Maldives to form a single entity bounded to the SE by a single transform fault. Maps of crustal thickness from gravity inversion show that the thicker crust under the Mascarene Islands, Mauritius and Reunion is separated from the Mascarene Basin to the north by a transform fault of Late Cretaceous age, and to the south by another transform fault of at least 40 Ma age and probably older. Recent (0 – 8 Ma) Reunion mantle plume volcanism has been emplaced within this older thicker crust. We postulate that mantle plume volcanism has been focussed into an older pre-existing strip of lithosphere within which melting preferentially occurred during the passage of the Reunion mantle plume track. This older pre-existing strip of lithosphere (or its underlying asthenosphere) may have greater chemical fertility or anomalously warm temperature structure favouring preferential melting during transient mantle plume heating. 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 (Greenhalgh & Kusznir 2007, Chappell & Kusznir 2008).