Geophysical Research Abstracts
Vol. 16, EGU2014-11987-1, 2014
EGU General Assembly 2014

Antarctic Crustal Thickness from Gravity Inversion and Comparison with Seismic Estimates

Nick Kusznir (1), Fausto Ferraccioli (2), Alan Vaughan (3), and Tom Jordan (2)

(1) Earth and Ocean Sciences, University of Liverpool, Liverpool, L69 3BX, UK (n.kusznir@liverpool.ac.uk), (2) British Antarctic Survey, Cambridge, CB3 0ET, UK, (3) Department of Geology, Trinity College Dublin, Dublin 2, Ireland

Using gravity anomaly inversion, we have produced the first comprehensive regional maps of crustal thickness and oceanic lithosphere distribution for Antarctica and the adjacent Southern Ocean. Crustal thicknesses from gravity inversion are compared with independent seismic estimates (Baranov 2011). We determine Moho depth, crustal basement thickness, continental lithosphere thinning (1-1/?) and ocean-continent transition location using a 3D spectral domain gravity inversion method, which incorporates a lithosphere thermal gravity anomaly correction (Chappell & Kusznir 2008). The gravity anomaly contribution from ice thickness is included in the gravity inversion, as is the contribution from sediments which assumes a compaction controlled sediment density increase with depth. Data used in the gravity inversion are elevation and bathymetry, free-air gravity anomaly, the most recent Bedmap ice thickness and bedrock topography compilation south of 60 degrees south and relatively sparse constraints on sediment thickness. Ocean isochrons are used to define the cooling age of oceanic lithosphere. Crustal thicknesses derived from gravity inversion are generally consistent with seismic estimates which are still relatively sparse over Antarctica. Our gravity inversion study predicts thick crust (> 45 km) under interior East Antarctica penetrated by narrow continental rifts that feature relatively thinner crust. The large crustal thicknesses under part of East Antarctica predicted from gravity inversion are consistent with seismic estimates. The East Antarctic Rift System (EARS) is a major Permian to Cretaceous age rift system that appears to extend from the continental margin at the Lambert Rift to the South Pole region, a distance of 2500 km (Ferraccioli et al. 2011) which is comparable in scale to the well-studied East African rift system. Intermediate crustal thickness with an inferred linear rift fabric is predicted under Coats Land. An extensive region of either thick oceanic crust or highly thinned continental crust is predicted offshore Oates Land and north Victoria Land, and also off West Antarctica around the Amundsen Ridges. Thin crust is predicted under the Ross Sea and beneath the West Antarctic Ice Sheet and delineates the regional extent of the broad West Antarctic Rift System (WARS). Substantial regional uplift is required under Marie Byrd Land to reconcile gravity and seismic estimates. A mantle dynamic uplift origin of the uplift is preferred to a thermal anomaly from a very young rift.. The new maps produced by this study support the hypothesis that one branch of the WARS links through to the De Gerlache sea-mounts and Peter I Island in the Bellingshausen Sea region, while another branch may link to the George V Sound Rift in the Antarctic Peninsula region.