Arctic Crustal Thickness, Oceanic Lithosphere Distribution and Ocean-Continent Transition Location from Gravity Inversion

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The ocean basins of the Arctic formed during the Late Jurassic, Cretaceous and Tertiary as a series of small distinct ocean basins leading to a complex distribution of oceanic crust, thinned continental crust and rifted continental margins. Using gravity anomaly inversion, we have produced the first comprehensive maps of crustal thickness and oceanic lithosphere distribution for the Arctic region. We determine crustal thickness, continental lithosphere thinning factors and ocean-continent transition location for the Amerasia and Eurasian Basins of the Arctic using a new gravity inversion method which incorporates a lithosphere thermal gravity anomaly correction (Greenhalgh & Kusznir, 2007; Chappell & Kusznir, 2008). We use crustal thickness and continental lithosphere thinning factor maps, determined by inversion of the NGA (U) Arctic Gravity Project and IBCAO bathymetry data to predict the distribution of oceanic lithosphere and ocean-continent transition (OCT) location for the Amerasia and Eurasia Basins. The resulting gravity inversion predictions of crustal thickness, OCT location and oceanic lithosphere distribution are used to test plate tectonic reconstructions of the Amerasia Basin (Alvy, Gaina, Kusznir & Torsvik, 2008). Our gravity inversion predicts thin crust and high continental lithosphere thinning factors in the Makarov, Podvodnikov, Nautilus and Canada Basins consistent with these basins being oceanic or highly thinned continental crust. Larger crustal thicknesses, in the range 20 - 30 km, are predicted for the Lomonosov, Alpha and Mendeleev Ridges. Moho depths predicted by gravity inversion compare well with estimates from the TransArctica-Arctica seismic profiles for the Podvodnikov and Makarov Basins, and the Lomonosov Ridge. Outside the main oceanic Amerasia and Eurasia Basins, locally thinner crust is predicted in the Laptev Sea and North Chuchki Basins. Thinner crust is also predicted in the region of the East Siberian Sea Basin and separated from the Podvodnikov Basin by thick crust under the De Long Massif. The presence of very thin continental or oceanic crust under the North Chuchki Basin, Laptev Sea and East Siberian Sea Basin has major implications for understanding the Mesozoic and Cenozoic plate tectonic history of the Siberian and Chuchki Amerasia Basin margins.