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Mapping Arctic Crustal Thickness and Ocean-Continent Transition using Gravity Inversion with a Lithosphere Thermal Correction

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Crustal thickness and continental lithosphere thinning factors have been determined for the Amerasia and Eurasian Basins of the Arctic using a gravity inversion method which incorporates a lithosphere thermal gravity anomaly correction. Crustal thickness and continental lithosphere thinning factor maps, determined by inversion of the NGA(U) Arctic Gravity Project and IBCAO bathymetry data have been used to predict the distribution of oceanic lithosphere and ocean-continent transition (OCT) location for the Amerasia and Eurasia Basins. Gravity inversion to determine Moho depth and crustal thickness variation is carried out in the 3D spectral domain. A correction for the large negative residual thermal gravity anomaly within oceanic and stretched continental margin lithosphere is made and requires a lithosphere thermal model to predict the present day lithosphere thermal anomaly. 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. For the Amerasia Basin, where ocean isochrons are uncertain, all lithosphere is assumed to be initially continental, and a lithosphere thinning and thermal perturbation age corresponding to the time of continental breakup is used. For the Eurasia Basin and the N

Atlantic, oceanic magnetic isochron ages are used to condition the lithosphere thermal model. The new gravity inversion method, incorporating the lithosphere thermal gravity anomaly correction, provides an isochron independent prediction of OCT location for the Amerasia Basin. Thin crust and high lithosphere thinning factors are predicted in the Makarov, Podvodnikov and Canada Basins consistent with these basins being oceanic. Larger crustal thicknesses, in the range 20 - 30 km, are predicted for the Lomonosov, Alpha and Mendeleev Ridges. Moho depths predicted by gravity inversion have been compared with seismic estimates for the TransArctica and Arctica profiles with seismically observed sediment thickness included in the gravity inversion. Agreement between gravity and seismic Moho depths is generally good. The largest differences between gravity and seismic Moho depths occur where lower crustal seismic velocities, Vp, are in excess of ~ 7.3km/s. Predicted continental lithosphere thinning factors and crustal thickness for the Amerasia Basin are sensitive to continental breakup age and volcanic addition. Comparison of gravity and seismic Moho depths for the Makarov/Podvodnikov Basins supports a Cretaceous age for their formation.
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