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Oceanic Crust in the Canada Basin of the Arctic Ocean

Deborah Hutchinson (1), Deping Chian (2), Ruth Jackson (3), Nina Lebedeva-Ivanova (4), John Shimeld (3), Qingmou Li (3), David Mosher (3), Richard Saltus (5), and Gordon Oakey (3)

(1) U.S. Geological Survey, Woods Hole, United States (dhutchinson@usgs.gov), (2) Chian Consulting, Dartmouth, NS, Canada B2Y 4A2, (3) Geological Survey of Canada, Dartmouth, NS, Canada B2Y 4A2, (4) University of Oslo, Oslo, Norway 0316, (5) U.S. Geological Survey, Denver, CO, United States

Crustal velocities from 85 expendable sonobuoys in the Canada Basin of the Arctic Ocean acquired between 2007 and 2011 distinguish oceanic, transitional, and extended continental crust. Crustal type was based on objective assignments of diagnostic velocities – oceanic from the presence of layer 3 velocities (6.7-7.2 km/s); transitional from the presence of a lower-most, high velocity layer (7.2-7.7 km/s), and continental for velocities typical of continental crust ($\leq$6.6 km/s). Combined interpretations of sonobuoys, coincident multichannel seismic reflection profiles and existing maps of potential field (gravity and magnetic) are used to refine the distribution of oceanic crust. Oceanic crust forms a polygon approximately 320-350 km wide (east-west) by $\sim$500 km (north-south). The northern segment of the Canada Basin Gravity Low (CBGL) bisects this zone of oceanic crust, as would be expected from the axis of the spreading center. The multichannel profiles also image a prominent bathymetric valley along this segment of the CBGL, similar to axial valleys found on slow and ultra-slow spreading ridges. Paired magnetic anomalies are associated only with crust that has typical oceanic velocities and are interpreted to represent possibly Mesozoic marine magnetic anomalies M0r – M4 (?), for a duration of opening of 8 million years, and a half spreading rate of $\sim$10 mm/a. The southern segment of the CBGL, where it trends toward the Mackenzie Delta/fan, is associated with transitional velocities that are interpreted to represent serpentinized peridotite (mantle). As a result of being close to the inferred pole of rotation, this southern area may have had a spreading rate too low to support magmatism, producing amagmatic transitional crust. Further north, near Alpha Ridge and along Northwind Ridge, transitional crust is interpreted to be underplated or intruded material related to the emplacement of the High Arctic Large Igneous Province. Seismic reflection profiles across the Canada Basin show the topography of the basement surface varies with the crustal types determined by the velocity data. The top of oceanic crust is generally a weak reflection with a high-relief blocky character, and rare deeper reflections. The top of transitional crust is a low-relief, bright reflection with numerous subparallel bright reflections that extend as much as .5 km deeper. The areas of continental crust show grabens possibly associated with rifting. Previously published longer offset wide-angle reflection/refraction experiments in the southern Canada Basin are consistent with the lack of oceanic layer 3 velocities and the depth to Moho based on our interpretation of the sonobuoy profiles. Our new sonobuoy results show a restricted area of oceanic crust centered within the middle of Canada Basin. This result has implications for plate reconstruction models, which now must close a smaller area and must also account for the poorly known but finite extension in the transitional crust.