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The High Arctic Magnetic High – The Geophysical Manifestation of a Large (1.36 x 10e6 km2) and Voluminous (5-10 x 10e6 km3) Igneous Province

Richard Saltus (1), Gordon Oakey (2), Elizabeth Miller (3), and Ruth Jackson (2)

(1) United States Geological Survey, Denver, CO, USA (saltus@usgs.gov), (2) Geological Survey of Canada, Halifax, Canada, (3) Stanford University, Stanford, CA, USA

The High Arctic Magnetic High (HAMH) dominates the magnetic anomaly field of the Earth north of about 75°N; this magnetic domain consists of very high amplitude magnetic highs and lows with variable orientations. The HAMH is visible on satellite magnetic compilations (e.g., MF6) with anomaly amplitudes greater than 200 nT indicating it is a globally significant feature. The magnetic potential of this magnetic feature is a single large intensity high indicative of a large volume of magnetic material in the crust. The map area of this magnetic domain is roughly 1.36 x 10e6 km2. Geographically the HAMH lies within the Amerasian Basin adjacent to the Lomonosov Ridge, encompasses the region of the Alpha and Mendeleev Ridges, and extends beneath the northern portions of the Canada Basin.

Ocean floor geomorphology, limited seismic and sonobouy data, sparse dredge samples, and dated samples from the perimeter of the Arctic Ocean are consistent with the interpretation of the HAMH as the geophysical manifestation of a Large Igneous Province. The designation "High Arctic Large Igneous Province (HALIP)" has been applied to portions of the Arctic perimeter based on geologic mapping and sampling. The designation "Alpha/Mendeleev Large Igneous Province (AMLIP)" has been applied to the offshore Alpha/Mendeleev region (e.g., Grantz et al., 2009) with boundaries defined, in large part, by magnetic anomaly patterns.

We have constructed 2D and 3D models of the HAMH to investigate the structure and geometry of this significant crustal feature. We estimate the overall volume of magnetic material as between 5-10 x 10e6 km3. The area and volume of this feature are comparable with estimates for the Deccan Traps and the North Atlantic Igneous Province, but are significantly smaller than the Kerguellen or Ontong Java Plateaus (based on tables in Coffin and Eldholm, 1994). In detail we find significant correlation between shorter wavelength portions of this magnetic feature and the comparable wavelength patterns in the complex, basin and range – style bathymetry of the Alpha and Mendeleev Ridges. Although there are many open questions regarding the development of this crustal domain, the broad geophysical expression of this feature show that it represents a substantial portion of the high Arctic crust and, as a large igneous province, a significant influx of mass and heat during its formation. Any successful model for the tectonic development of the Amerasian Basin must account for the effects of these fluxes on the strength and composition of the crust.