The Alpha-Mendeelev Magmatic Province, Arctic Ocean: A new synthesis

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Since the 1970s, the Alpha-Mendeleev Ridge (AMR) has been considered oceanic by most researchers, with a thickened (ca. 35km from seismic data) crustal or/and abnormally low-density mantle root, and linked to a "hotspot"-type, Cretaceous-aged aseismic ridge, perhaps generated by the controversial Iceland mantle plume. The high amplitudes of AMR magnetic anomalies (locally over 1000nT at 600m flight elevation) were shown by more recent NRL aeromagnetics to be sublinear, largely correlated with ±20mgal free-air gravity anomalies and bathymetric/basement topography. Such correlation is consistent with most or all eruptions/intrusions dating from the long Cretaceous normal polarity interval (120–83Ma). (However, some present basement topography may have formed tectonically, slightly postdating the magmatism).

Building on post-1999 papers by authors such as M. Jakobsson, A. Grantz, Y. Kristoffersen and W. Jokat, multibeam bathymetry from the 2003 Healy expedition, and other sources, we present a new synthesis of the mid-Cretaceous-age Alpha-Mendeleev Ridge (AMR) complex, a ca.300–700km × 1500km Arctic Basin rise (>700 000 km sq; mininum basement depths <1.5km and depth residuals of + 2–3.5 km relative to normal Cretaceous crust). Bathymetric, aerogeophysical, and terrestrial geology (Canadian Arctic Islands bordering the polar continental margin) suggests magmatism extended over a much larger area than the AMR proper. We compare and contrast the AMR with the Pacific Ontong Java, Shatsky and Hess rises, and the Atlantic Iceland-Faeroe Ridge. Assuming Airy compensation, we calculate > 10^7 km^2 (preliminary estimate) excess mafic materials under the AMR, a volume exceeded only by the Ontong Java Plateau.

Multibeam bathymetry collected on *USCGC Healy* in 2003 discovered probable volcanic seamounts in the Northwind Basin and also mapped "Healy Seamount", rising from the deep Nautilus Basin off the tip of the Chukchi Rise, previously inferred from archival soundings and aerogeophysical crossings. We suggest these edifices, and linear aeromagnetic anomalies—suggesting major dikes or dike swarms crossing the continental Chukchi Rise—are part of the same large, probably extended igneous episode that created the AMR.

Other evidence for a more extensive "AMR Magmatic Province" (AMRMP) includes: 1) Basement peaks/seamounts in the Sever and Peary spurs and Nautilus and Stefansson basins, which together would bring the total AMRMP area to ca. 10^6 km^2; 2) Aeromagnetics, showing AMR-type magnetic and gravity anomaly patterns well beyond the AMR; and 3) Mafic rocks (125–89Ma) of the Sverdrup Basin Magmatic Province (SBMP), as shown by M-C. Williamson and her colleagues. The northeastern SBMP adjoins the polar margin, not far from the poorly dated AMR. The two final SBMP igneous episodes are coeval with AMR magmatism, and comprise ferrogabbroic sills and thin successions of ferrobasaltic lavas, a clue that high AMR magnetic anomalies may have a similar origin, as first suggested by Williamson and Van Wagoner in 1985. However, simple amplitude comparison would be incorrect — the higher geomagnetic field intensity near the poles, shallow AMR basement, high AMR basement relief, and possibly stronger middle Cretaceous dipole would all contribute to increasing anomaly amplitudes relative to typical Cenozoic oceanic crust created at lower latitudes. We hypothesize that the AMRMP constitutes a vast mass of anomalously fractionated, highly magnetized FeTi basalts and ferrograbbros. We cannot exclude the possibility of admixed continental crust, especially at the Siberian end of the AMR, and only deep drilling into AMR basement will provide firm answers.