Identifying pyroxenite in the mantle source for Jan Mayen Island and Northern Kolbeinsey Ridge

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Sensitivity to rates of melting and the presence of garnet in the melting residue makes U-series isotope disequilibrium a key tool in assessing the presence and role of mantle pyroxenite rocks in generating magmatic crust at mid-ocean ridges and plume-fed hotspots alike. Here, ^{238}U-^{234}U-^{230}Th-^{226}Ra-^{210}Pb isotope disequilibria are presented for a suite of fresh lavas from the tectonically and geochemically complex Jan Mayen region, including the Jan Mayen Island hotspot and the Northern Kolbeinsey Ridge, which hosts the anomalous Eggvin Bank bathymetric high. Age-constrained, unaltered samples from the Northern Kolbeinsey Ridge and Eggvin Bank, including fresh popping rocks from the Eggvin seamount summit crater, are characterized by relatively high ($^{230}Th/^{238}U$) = 1.23 to 1.36 and low ($^{226}Ra/^{230}Th$) = 1.24 to 1.28, and are best explained by high contributions to magma mixtures from a pyroxenite-dominated, passively-upwelling mantle source with only modest transport or crustal aging or crystal fractionation effects. Similarly constrained lavas from Jan Mayen Island have lower ($^{230}Th/^{238}U$) = 1.15 and ($^{226}Ra/^{230}Th$) = 1.05 to 1.16, and forward modeling suggests a detectable but comparatively smaller pyroxenite source contribution to a peridotitic magma mixture in actively upwelling mantle, suggesting a local mantle plume may be present beneath the island. Time-dependent melting model results demonstrate the high likelihood that many global ocean island basalts record pyroxenite melt contributions that are similar to those detected for Jan Mayen Island, supporting a mantle dynamical paradigm for upwelling mantle plumes that entrain highly fusible, recycled mafic rocks. The Eggvin Bank, on the other hand, overlies a highly unusual mantle source that likely contains a concentrated remnant of delaminated, formerly underplated, ancient subcratonic mafic rocks, entrained by passive upwelling beneath the northernmost Kolbeinsey Ridge and clearly fingerprinted by U-series methods.