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Surinamite: A high-temperature metamorphic beryllosilicate from Lewisian sapphirine-bearing kyanite-orthopyroxene-quartz-potassium feldspar gneiss at South Harris, N.W. Scotland

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Abstract

The sapphirine-like mineral surinamite, $(Mg,Fe^{2+})_3(Al,Fe^{3+})_3O[AlBeSi_3O_{15}]$, occurs at South Harris as tiny grains enclosed in kyanite or as tabular grains up to 1 mm long mostly surrounded by Si-rich cordierite. A few surinamite grains enclose orthopyroxene, sillimanite, and Si-rich sapphirine. Ion microprobe analyses gave 3.52 to 3.81 wt% BeO (0.766 to 0.824 Be atoms per formula unit) and 2 to 13 ppm B in surinamite. Excess Si suggests the presence of significant BeO in cordierite and sapphirine. Given the anti-clockwise *P-T*-time path inferred for the South Harris rock, we suggest that surinamite formed at first by the continuous reaction $BeSiAl_{-2}$ (in sapphirine) + sillimanite + orthopyroxene → surinamite + quartz and, subsequently, by the discontinuous reaction Be-depleted sapphirine + quartz → surinamite + orthopyroxene + kyanite with increase of P to >12 kbar at 850–900 °C. Surinamite reacted with orthopyroxene, kyanite, and quartz to form beryllian cordierite during subsequent decrease in P and T.

The high-silica content and peraluminous composition of the surinamite-bearing gneiss are consistent with a metasedimentary origin; this rock is markedly depleted in Th (0.13 ppm), U (0.11 ppm), Y (0.94 ppm), and rare-earth elements (e.g., Ce 7.7 ppm). Its bulk Be content (9 ppm) is not excessive. The appearance of a discrete Be phase in Be-poor rocks could be due to the absence of potential carriers of Be, namely muscovite and primary cordierite, at high T and low-water activity. Moreover, surinamite is indicative of a distinctive metamorphic history in which high-temperature rocks recrystallized at higher pressures or are isobarically cooled, and, consequently, scarcity of Be in metamorphic systems is not the only factor controlling surinamite formation.