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THE FIRST OCCURRENCE OF HÖGBOMITE IN ANTARCTICA: SINNAN ROCKS AND CAPE RYÛGÛ (ABSTRACT)

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Högbomite has been found in 19 samples of upper amphibolite-facies quartz-andesine (An 42–49)-biotite gneisses from a partially migmatized metamorphic complex at Sinnan Rocks and Cape Ryûgû, Prince Olav Coast, East Antarctica. Associated non-opaque minerals include garnet, sillimanite, cordierite, hercynite, rutile and less commonly, relict staurolite and kyanite; corundum, K-feldspar, anthophyllite, and hornblende are rare. Minor secondary chlorite and muscovite are ubiquitous. In the 15 samples studied under reflected light, magnetite and ilmeno-hematite are present, while ilmenite is less abundant and in many cases, appears to be secondary. Högbomite forms small grains ($\leq$0.4 mm) along the margins of magnetite or less commonly enclosed in it and appears either to replace magnetite or to overgrow it. Högbomite is in direct contact with all the major minerals, including quartz. Electron microprobe analyses of högbomite in 9 samples yield 3.9–8.2 wt% TiO_2, 57–63% Al_2O_3, 0–0.2% Cr_2O_3, 18–25% Fe(as FeO), 0.04–1.4% MnO, 3.5–6.4% MgO, and 2.7–11% ZnO. In the 8 analyzed Sinnan Rocks samples, högbomite compositions in a given sample are more or less constant. Zn varies inversely with (Mg+Fe) from sample to sample. In the Cape Ryûgû sample, compositions are variable, notably Fe inversely with Al and Ti. Regularities in Zn-Mg-Mn-Fe distribution among the ferromagnesian minerals suggest an approach to equilibrium. We propose that högbomite formed by a process analogous to A. F. BUDDINGTON's and D. H. LINDSLEY's "oxidation-exsolution" of titaniferous magnetite to form ilmenite. In our scenario, magnetite contained Al, Zn, and Mg, as well as Ti, and under the oxidizing conditions of the magnetite-hematite assemblage, it broke down during retrogression releasing these impurities to form högbomite (rarely hercynite) in external granules. Water activities in metamorphic fluids, possibly released by crystallizing anatectic melts, were sufficiently high for högbomite but too low to allow extensive chloritization of cordierite. Temperatures appear to have been $\leq$500°C, low enough for rutile to form with magnetite. Högbomite formation under these conditions could represent metastable equilibrium, resulting in an unexpected association with quartz.

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