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SPECIAL COLLECTION: APATITE: A COMMON MINERAL, UNCOMMONLY VERSATILE

Fluorapatite-monazite-allanite relations in the Grängesberg apatite-iron oxide ore district, Bergslagen, Sweden

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Abstract

Fluorapatite-monazite-xenotime-allanite mineralogy, petrology, and textures are described for a suite of Kiruna-type apatite-iron oxide ore bodies from the Grängesberg Mining District in the Bergslagen ore province, south central Sweden. Fluorapatite occurs in three main lithological assemblages. These include: (1) the apatite-iron oxide ore bodies, (2) breccias associated with the ore bodies, which contain fragmented fluorapatite crystals, and (3) the variably altered host rocks, which contain sporadic, isolated fluorapatite grains or aggregates that are occasionally associated with magnetite in the silicate mineral matrix. Fluorapatite associated with the ore bodies is often zoned, with the outer rim enriched in Y+REE compared to the inner core. It contains sparse monazite inclusions. In the breccia, fluorapatite is rich in monazite-(Ce) ± xenotime-(Y) inclusions, especially in its cores, along with reworked, larger monazite grains along fluorapatite and other mineral grain rims. In the host rocks, a small subset of the fluorapatite grains contain monazite ± xenotime inclusions, while the large majority are devoid of inclusions. Overall, these monazites are relatively poor in Th and U. Allanite-(Ce) is found as inclusions and crack fillings in the fluorapatite from all three assemblage types as well as in the form of independent grains in the surrounding silicate mineral matrix in the host rocks. The apatite-iron oxide ore bodies are proposed to have an igneous, sub-volcanic origin, potentially accompanied by explosive eruptions, which were responsible for the accompanying fluorapatite-rich breccias. Metasomatic alteration of the ore bodies probably began during the later stages of crystallization from residual, magmatically derived HCl- and H_2SO_4-bearing fluids present along grain boundaries. This was most likely followed by fluid exchange between the ore and its host rocks, both immediately after emplacement of the apatite-iron oxide body, and during subsequent phases of regional metamorphism and deformation.

Keywords: Fluorapatite, monazite, xenotime, allanite, magnetite, REE, Kiruna-type