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Occurrence of apatite associated with magnetite in an ophiolite complex (Othrys), Greece

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ABSTRACT

Small irregular to lens-like occurrences (maximum 0.5 × 1 m) of apatite associated with magnetite and silicates are present in the Agoriani area of the Othrys ophiolite complex, central Greece. The Ano Agoriani area is dominated by peridotite (plagioclase lherzolite) of the mantle sequence, intruded by irregular bodies, dikes, and veins of gabbro, as well as by dikes of pyroxenite and pegmatitic gabbro.

Apatite occurs as large (up to 3 cm long) well-formed crystals associated with magnetite. The aggregates consist predominantly of apatite, or massive magnetite with subordinate amounts of apatite. Apatite may also be accompanied by silicate minerals, mainly chlorite and lesser amounts of serpentine, tremolite, and Ni-silicates (nepouite, pimelite), and by Ni-sulfides (pentlandite, violarite, heazlewoodite).

The apatite-magnetite association from the Agoriani area differs from nelsonite hosted by anorthosite suites with respect to: (1) the host rock type (ophiolites); (2) the highly variable proportion between apatite-magnetite; (3) the large size (up to 3 cm) of the apatite crystals; (4) the lack of fluorine (<20 ppm F) in the apatite; (5) the presence of abundant liquid-rich, fluid inclusions in apatite, and (6) the lack of ilmenite.

The high V content (700–1000 ppm) of the magnetite from Agoriani differs from that of disseminated Fe-Ti mineralization (Ti-magnetite, ilmenite) in the magmatic sequence of ophiolite complexes (mainly hosted in gabbronorites), as well as the pure, massive magnetite associated with Fe-Ni-Cu-Co sulfides found in shear zones in ophiolite complexes. The composition of the apatite (chlor-hydroxylapatite), the presence of abundant primary two-phase aqueous fluid inclusions in the apatite, and the composition of the associated magnetite and sulfides, suggest that a hydrothermal system played an essential role in the formation of these deposits.