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Replacement of Pyrrhotite by Chalcopyrite in Amphibolite

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The replacement of pyrrhotite by chalcopyrite reaction due to the interaction of fluid to mineral can occur in hydrothermal mineralization and retrograde metamorphism during exhumation types of settings. However, the effect of sulfur activity (αS) and oxygen (fO_2) on replacement reactions remains unclear. Here, we studied three types of sulfide minerals from the textural and chemical point of view, classified as (1) homogenous pyrrhotite, (2) homogeneous chalcopyrite, and (3) pyrrhotite containing patches of chalcopyrite on the edges. These sulfides minerals are present along the main foliation plane of this amphibolite rock, homogenous pyrrhotite is surrounded by the quartz and felspar matrix and the homogeneous chalcopyrite enclosed by amphiboles. The third one is present inside the garnet mineral as well as in the quartz-feldspar and amphibole matrix. Homogeneous pyrrhotite is relatively coarser, compositionally enriching in Ni and Co. All the other trace elements such as Ag, As and Pb homogeneously distributed in all the sulfides apart from Fe, S and Cu, but Au enrichment is observed in the surrounding silicates rather than sulfides. We postulate that during retrograde metamorphism under low sulfur and oxygen activity pyrrhotite forms. Replacement of chalcopyrite took place by the late-stage influx of Cu and S rich hydrothermal fluids and as the temperature decreased, homogeneous pyrrhotite and chalcopyrite became stable. From a regional point of view, sulfide minerals microtextures and chemistry evolved during retrogression of amphibolite facies related to the exhumation of the rock complex.