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Mössbauer characterization of upper mantle ferrikaersutite

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Abstract

Mössbauer spectroscopy, H_2O, and microprobe analysis techniques have been used to study upper mantle ferrikaersutite megacrysts from the scoria cones of the Ash Sham alkaline volcanic field, northeastern part of the Arabian plate. Mössbauer spectra, collected at 298 K, indicate that the kaersutites are highly oxidized and all iron occurs as Fe^{3+}. Two components were detected within the Fe^{3+} quadrupole splitting distribution of the C-type sites and were assigned to M1 and M2-3 sites. The quadrupole splitting (QS) varies between 0.73–0.87 mm/s (Fe^{3+} M1) and 1.28–1.45 mm/s (Fe^{3+} M2-3). The kaersutite has a large oxy component in the amphibole OH-site (1.49–1.85 O^{2-} apfu) similar to the mantle-derived kaersutites. The very high ferric concentration in the kaersutites would suggest crystallization from a relatively oxidizing magma, perhaps with f_{O_2} close to the fayalite-magnetite-quartz (FMQ), and may be a function of the high Fe^{3+}/Fe_{tot} of the metasomatic fluid that crystallized these amphiboles.

Keywords: Mössbauer, microprobe, ferrikaersutite, upper mantle, Arabian plate, oxidation, metasomatism