American Mineralogist, Volume 83, pages 1361–1365, 1998

Fe^{3+} distribution in oxidized olivine: A synchrotron micro-XANES study

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ABSTRACT

Synchrotron micro-XANES spectroscopy (SmX) is used to examine the amount and distribution of Fe^{2+} and Fe^{3+} in five samples of fayalite previously studied by Mössbauer spectroscopy. Rockport fayalite is homogeneous and the Fe in it is completely reduced. Olivine from Qianan is almost completely oxidized, and probably contains finely intergrown silica, laihunite, and hematite with hematite predominating. Pantelleria olivine has an oxidized rim around a reduced core, suggesting either a post-crystallization reaction with fayalite and oxygen going to laihunite and hematite or a change in prevailing oxidation during growth. The texture of olivine from the Mourne Mountains suggests exsolution from a fayalite-laihunite solid solution, based on the substitution of three Fe^{3+} atoms for two Fe^{2+} and one vacancy, that was stable at high temperature. Laihunite from the type locality (Lai-He village) shows 1–3 μm mottling between light and dark areas in backscatter images, but these areas cannot correspond to pure fayalite and laihunite exsolution because the bulk $Fe^{3+}/\Sigma Fe$ of such a combination would not correspond to the SmX value of 67% Fe^{3+}. Rather, the texture observed in backscatter is interpreted to represent alternating areas of magnetite-rich and laihunite-rich compositions with a similar (i.e., 67% $Fe^{3+}/\Sigma Fe$) extent of oxidation.