
Cation Distribution, Mössbauer Spectra, and Magnetic Properties of Ferripyrophyllite

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Abstract: A sample of ferripyrophyllite, a mineral with ideal composition $\text{Fe}_2\text{Si}_4\text{O}_{10}(\text{OH})_2$, was analyzed by Mössbauer spectroscopy, magnetization and magnetic susceptibility measurements. The iron is entirely ferric, and the main feature of the Mössbauer spectrum at room temperature is a single absorption line with isomer shift $\sigma = 0.36(1)$ mm/sec due to iron in M2 sites. The line is broadened by a slight quadrupole splitting $\Delta = 0.18(1)$ mm/sec, the smallest yet reported for a sheet silicate. Weaker features corresponding to quadrupole doublets with relative intensities of 7% and 8% having $\sigma = 0.43(1)$ mm/sec; $\Delta = 1.22(2)$ mm/sec and $\sigma = 0.14(1)$ mm/sec; $\Delta = 0.59(2)$ mm/sec are assigned to ferric iron in nonequivalent octahedral and tetrahedral sites, respectively, giving the following formula, based on published chemical analysis: Ca 0.05 (Fe 3+ Mg 0.11 Al 0.09) VI (Si 3.80 Fe 3+ Al 0.04) IV O 10 (OH) 2, where Ca is in interlayer sites. Ferripyrophyllite orders antiferromagnetically at $18(2)^\circ$ K. The Mössbauer spectrum at 4.2° K consists of a single, resolved magnetic pattern with hyperfine field $B_{\text{hf}} = 51.8$ T. The relatively high Néel temperature compared with other dioctahedral ferric phyllosilicates provides further evidence that Fe^{3+} cations tend to be ordered on M2 sites within the octahedral sheet.

Key Words: Cations • Ferripyrophyllite • Iron • Magnetic properties • Mössbauer spectra • Pyrophyllite

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