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Ferri-kaersutite, $NaCa_2(Mg_3TiFe^{3+})(Si_6Al_2)O_{22}O_2$, a new oxo-amphibole from Harrow Peaks, Northern Victoria Land, Antarctica

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Abstract

Ferri-kaersutite, ideally $NaCa_2(Mg_3TiFe^{3+})(Si_6Al_2)O_{22}O_2$, is a new oxo-amphibole from Harrow Peaks, Northern Victoria Land, Antarctica. It occurs as brown prismatic crystals, up to 200 μm in length, with a vitreous luster, and a perfect {110} cleavage. Ferri-kaersutite is associated with forsterite, diopside, and Cr-bearing spinel. Chemical analyses, by a combination of electron microprobe, SIMS, and ^{57}Fe Mössbauer spectroscopy, gave the following results (in wt%): SiO_2 41.69, TiO_2 5.30, Al_2O_3 13.65, Cr_2O_3 0.09, Fe_2O_3 4.52, MgO 15.54, CaO 11.03, MnO 0.11, FeO 2.83, Na_2O 2.88, K_2O 0.96, H_2O 0.70, F 0.24, Cl 0.08, O=(F,Cl) –0.12, sum 99.50. On the basis of 24 anions per formula unit, the formula is $(Na_{0.816}K_{0.179})_{\Sigma 0.995}(Ca_{1.726}Fe^{2+}_{0.258}Mn_{0.014})_{\Sigma 1.998}(Mg_{3.383}Fe^{2+}_{0.088}Ti_{0.582}Fe^{3+}_{0.497}Al_{0.439}Cr_{0.011})_{\Sigma 5.00}(Si_{6.089}Al_{1.911})_{\Sigma 8.00}O_{22}[O_{1.187}(OH)_{0.682}F_{0.111}Cl_{0.020}]_{\Sigma 2.00}$. Ferri-kaersutite is monoclinic with space group $C2/m$. Its unit-cell parameters are a = 9.8378(8), b = 18.0562(9), c = 5.3027(4) Å, β = 105.199(9)°, V = 908.99(13) Å^3, Z = 2. The five strongest reflections in its X-ray powder diffraction pattern [d in Å (relative visual intensity, *hkl*)] are: 8.4 (s, 110), 3.379 (ms, 131), 3.115 (ms, 310), 2.707 (s, 151), 2.598 (ms, 061). The crystal structure of ferri-kaersutite has been refined on the basis of 1783 observed reflections [$F_o > 4\sigma(F_o)$] with a final R_1 = 0.038.

The relatively large equivalent isotropic displacement parameter at M(1), with respect to those at M(2) and M(3) sites, together with the short M(1)–O(3) distance, suggest the occurrence of Ti^{4+} at the M(1) site, whereas the small octahedral distortion at this site suggests a low Fe^{3+} occupancy. This element is mainly hosted at the M(2) and M(3) sites.

The occurrence of amphiboles in the magma source region is notably relevant. The melting of Ti-rich amphibole in the lithosphere and subsequent degrees of melt/host peridotite reactions are able to produce melts that account for the compositional spectrum ranging from extreme alkaline lavas to the most common alkaline basalts. In particular, when this amphibole is formed by reaction between a peridotite matrix and metasomatic melts/fluids with high Fe^{3+}/Fe_{tot} ratio, its subsequent melting can influence primary volatile contents and ultimately magma rheology.

Keywords: Ferri-kaersutite, new mineral, crystal chemistry, oxo-amphibole, Victoria Land, Antarctica