Ferri-kaersutite, NaCa$_2$(Mg$_3$TiFe$^{3+}$)(Si$_6$Al$_2$)O$_2$O$_2$, a new oxo-amphibole from Harrow Peaks, Northern Victoria Land, Antarctica

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**ABSTRACT**

Ferri-kaersutite, ideally NaCa$_2$(Mg$_3$TiFe$^{3+}$)(Si$_6$Al$_2$)O$_2$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$_2$O$_3$ 13.65, Cr$_2$O$_3$ 0.09, Fe$_2$O$_3$ 4.52, MgO 15.54, CaO 11.03, MnO 0.11, FeO 2.83, Na$_2$O 2.88, K$_2$O 0.96, H$_2$O 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$_2^-$[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, $\beta = 105.199(9)^{\circ}$, $V = 908.99(13)$ 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$^{2+}$ 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

**INTRODUCTION**

Among the 93 currently valid mineral species within the amphibole supergroup (http://ima-cnmnc.nrm.se/imalist.htm; IMA list of minerals), only seven belong to the oxo-amphibole group (Table 1), i.e., amphiboles having $^{\text{8}}$O$^{2-} > ^{\text{9}}$(OH+F$^+$+Cl$^-$).

A mineralogical and petrological study of amphiboles occurring in mantle xenoliths from Harrow Peaks, Victoria Land, Antarctica, revealed the presence of an amphibole approaching the end-member formula NaCa$_2$(Mg$_3$TiFe$^{3+}$)(Si$_6$Al$_2$)O$_2$O$_2$, i.e., ferri-kaersutite according to the new amphibole nomenclature (Hawthorne et al. 2012).

Previously a mineral belonging to the oxo-amphibole group was submitted to the IMA CNMNC and approved with the name ferrikaersutite (IMA 2011-035; Zaitsev et al. 2011). Shortly thereafter, following the new IMA report on the nomenclature of the amphibole supergroup (Hawthorne et al. 2012), both the assigned name and the end-member formula were found to be wrong. Therefore, IMA 2011-035 was renamed oxo-magnesio-hastingsite, with ideal formula NaCa$_2$(Mg$_2$Fe$^{3+}$)(Si$_6$Al$_2$)O$_2$O$_2$ (Zaitsev et al. 2013).

The aim of this paper is the description of the new mineral ferri-kaersutite from Harrow Peaks, Victoria Land, Antarctica. The mineral and its name have been approved by the IMA-CNMNC, under the number IMA 2014-051. The holotype material is deposited in the mineralogical collections of the Museo di Storia Naturale, University of Pisa, via Roma 79, Calci, Pisa, Italy, under catalog number 19689.