Dellaventuraite, NaNa$_2$(MgMn$_3$$^+$Ti$_4$$^+$Li)$_2$Si$_8$O$_{22}$O$_2$, a new anhydrous amphibole from the Kajlidongri Manganese Mine, Jhabua District, Madhya Pradesh, India

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INTRODUCTION

During mineralogical examination of amphibole assemblages from the Kajlidongri manganese mine, Jhabua District, Madhya Pradesh, India (Tait et al. unpublished), we encountered a sodic amphibole strongly enriched in Ti and Mn. Crystal-structure refinement indicated that the Ti was ordered at the M1 site, Li is the dominant cation at the M3 site, and that both Mn and Fe are in the trivalent state, suggesting that this amphibole should be enriched in O$^-$ at the O3 site. This suspicion was confirmed by analysis of H and Li by SIMS, indicating that this amphibole is strongly enriched in Ti and Mn. Crystal-structure refinement gives SiO$_2$ = 54.22, Al$_2$O$_3$ = 0.81, TiO$_2$ = 5.45, Fe$_2$O$_3$ = 6.44, Mn$_2$O$_3$ = 7.57, ZnO = 0.12, MnO = 0.16, MgO = 8.26, Li$_2$O = 1.53, CaO = 1.85, Na$_2$O = 8.12, K$_2$O = 2.12, H$_2$O = 0.80, Cr, V, F not detected, sum 97.41 wt%. The formula unit, calculated on the basis of 24(O,OH,F) is (K$_{0.40}$Na$_{0.61}$)(Na$_{1.71}$Ca$_{0.29}$)(Mg$_{1.81}$Zn$_{0.01}$Fe$_{0.01}$)$_{24}$Si$_{22}$O$_{70}$[(OH)$_{0.80}$O$_{1.20}$]; the ideal member composition Na$_2$Na$_2$(MgMn$_3$$^+$Ti$_4$$^+$Li)$_2$Si$_8$O$_{22}$O$_2$.

The crystal structure of dellaventuraite was refined to an R index of 3.8% using MoK$_\alpha$ X-ray intensity data. The M1 site is occupied by Ti$^{4+}$, Mn$^{3+}$, and Mg in approximately equal amounts, the M2 site is occupied primarily by Mg and Fe$^{3+}$, and M3 is occupied by Li with minor Mg and Mn$^{2+}$. Local bond-valence considerations suggest that O$^-$ at O3 is linked to Ti$^{4+}$Mg or Mn$^{3+}$. Mn$^{2+}$ at the adjacent M1 sites, and that OH at O3 is linked to MgMg at the adjacent M1 sites.

ABSTRACT

Dellaventuraite is a new amphibole species from the Kajlidongri manganese mine, Jhabua District, Madhya Pradesh, India. It occurs with leakeite, kornite, albrite, braunite, and bixbyite associated with cross-cutting epigenetic veins that have reacted with regionally metamorphosed rocks containing Mn-rich minerals (braunite, bixbyite, jacobsite, spessartine) to produce Mn-rich amphiboles, Mn-rich pyroxenes, Mn-rich mica, piemontite, and manganophyllite. Dellaventuraite occurs as anhedral grains, the color of which varies from pink to red, depending on Mn content. It is brittle, H = 5, D$_{calc}$ = 3.184 g/cm$^3$, has a pale pink streak, vitreous luster, and does not fluoresce in ultraviolet light; it has perfect cleavage on {110} and conchoidal fracture. In transmitted plane-polarized light, dellaventuraite is strongly pleochroic, X = pale mauve-brown, Y ~ Z = dark red-brown; Y $\sim$ Z = 9.808(1), b = 17.840(2), c = 5.2848(5) $\AA$, $\alpha$ = 104.653(1)$^\circ$, V = 894.6(2)$^3$, Z = 2. The strongest ten X-ray diffraction lines in the powder pattern are [d(hkl)]: 2.697(10,151), 2.542(9,–202), 3.127(8,310), 3.378(7,131), 2.154(7,261), 1.434(7,–661), 4.450(6,021), 8.459(5,110), 2.727(5,–331), 2.328(5,–351). Analysis by a combination of electron microprobe, SIMS and crystal-structure refinement gives SiO$_2$ = 54.22, Al$_2$O$_3$ = 0.81, TiO$_2$ = 5.45, Fe$_2$O$_3$ = 6.44, Mn$_2$O$_3$ = 7.57, ZnO = 0.12, NiO = 0.16, MgO = 8.26, Li$_2$O = 1.53, CaO = 1.85, Na$_2$O = 8.12, K$_2$O = 2.12, H$_2$O = 0.80, Cr, V, F not detected, sum 97.41 wt%.

OCCURRENCE

The Aravalli Supergroup of metasedimentary rocks of Precambrian age (sedimentation 2300 m.y., Crawford 1969) covers parts of Western India in the states of Rajasthan and Madhya Pradesh with extensions into the state of Gujarat. Post-tectonic granite and carbonate rocks of the area are younger than the phyllite and quartzite (Lahiri 1971). Manganese-oxide and manganese-silicate minerals occur as syngenetic bands concordant with the quartzose rocks. The manganese ores of Kajlidongri (Nayak 1966, 1969a; Ostwals and Nayak 1993) occur in syngenetic bands of manganese oxides and silicates enclosed in genetic bands of manganese oxides and silicates enclosed in...