

Synthetic $P2_1/m$ amphiboles in the system $\text{Li}_2\text{O}-\text{Na}_2\text{O}-\text{MgO}-\text{SiO}_2-\text{H}_2\text{O}$ (LNMSH)

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ABSTRACT

We describe here the synthesis of amphiboles along the nominal $\text{Na}(\text{NaMg})\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2-\text{Na}(\text{LiMg})\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$ join, at 800 °C, 0.4 GPa. High amphibole yields (>90%) plus minor quartz and enstatite have been obtained at all compositions; amphibole crystals are acicular and their size rarely exceeds $20-30 \times 0.5-3 \mu\text{m}$. TEM analysis shows the presence of $h+k$ odd reflections in all samples, indicative of a P -lattice. By similarity with closely related amphiboles from the literature (e.g., Oberti et al. 2000; Cámaras et al. 2003) a $P2_1/m$ space group was assigned to the amphiboles synthesized here. Refined cell-parameters from X-ray powder-patterns show a linear decrease as a function of increasing Li at M4, a and β being the most affected parameters. The four infrared OH-stretching spectra all show two main bands at 3741–3748 and 3712–3716 cm^{-1} , respectively. They are assigned to two independent O-H groups in the $P2_1/m$ structure, interacting with a strongly delocalized $^{\text{A}}\text{Na}$. The spectra show in addition two minor absorptions at about 3688 and 3667 cm^{-1} , respectively; these bands are assigned to vacant A-sites in the structure and indicate slight departure of the nominal composition toward cumingtonite. The present work shows that one apfu of $^{\text{B}}\text{Na}$ can also be completely replaced by one apfu of $^{\text{B}}\text{Li}$ (M^+), in synthetic $\text{Na}(M^+\text{Mg})\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$, and that all compositions have $P2_1/m$ symmetry at ambient conditions.

Keywords: amphibole synthesis, FTIR spectroscopy, TEM, XRPD, amphibole symmetry