American Mineralogist, Volume 103, pages 989–992, 2018

Sodium amphibole in the post-glaucophane high-pressure domain: The role of eckermannite

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Abstract

An amphibole close to eckermannite in composition, ideally $Na_3Mg_4AlSi_8O_{22}(OH)_2$, was encountered in experiments on a bulk composition close to that of glaucophane at 6.2 GPa, ~550–650 °C. The synthetic amphibole has an average composition corresponding to $^{A}Na_{0.96}{}^{B}(Na_{1.80}Mg_{0.20})^{C}(Mg_4Al)^{T}(Si_{7.85}Al_{0.15})O_{22}(OH)_2$. This composition is displaced from that of end-member eckermannite by exchange vectors $+0.15\ {}^{B}Mg^{T}Al^{B}Na_{-1}{}^{T}Si_{-1}$ and $+0.05\ {}^{A}\square{}^{B}Mg^{A}Na_{-1}{}^{B}Na_{-1}$ ($\square$ = vacant site). In terms of end-members, it corresponds to 80% eckermannite + 15% Mg-katophorite, $Na(NaMg)(Mg_4Al)(Si_7Al)O_{22}(OH)_2$, + 5% Mg-winchite, $(NaMg)(Mg_4Al)Si_8O_{22}(OH)_2$, and as such is essentially binary. The absence of a glaucophane component implies that the stability of sodium amphibole at very high pressures (>4 GPa) involves eckermannitic rather than glaucophanic compositions. The stabilization of the eckermannite-pyrope tie line allows this highly Na-rich amphibole to occur even in bulk compositions that are not particularly Na-rich. In blueschist facies metabasites, it is possible that eckermannite forms by the reaction 9 jadeite + 7 talc → 3 eckermannite + 3 pyrope + 13 coesite + 4 H_2O, above the stability limit of glaucophane that is defined by the reaction glaucophane → 2 jadeite + talc.

Keywords: Glaucophane, eckermannite, high pressure, blueschist, subduction