Babingtonite with epitaxial hedenbergite whiskers

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Babingtonite, $Ca_2Fe^{2+}Fe^{3+}[Si_5O_{14}(OH)]$, is a hydrous pyroxenoid group mineral consisting of chains built from five twisted SiO_4 tetrahedra. It typically occurs in hydrothermally altered zeolite-dominant veins and cavities in basic igneous rocks, and in skarn deposits. Clinopyroxene with diopside-hedenbergite component, $Ca(Mg, Fe^{2+})Si_2O_6$, also occurs in skarns. Although it does commonly not coexist with babingtonite, clinopyroxene whiskers rarely grow on babingtonite. However, their relationship has not been confirmed directly because of the difficulty of simultaneous determination of atomic arrangement in both minerals. In this study, the platy babingtonite (dark green in color) overgrown by clinopyroxene whiskers from two different localities were investigated: (1) Arvigo, Grisons, Switzerland and (2) Kreimbach/Kaulbach, Kaiserslautern, Germany, using transmission electron microscope (TEM) to understand their relationship and formation process. In the both specimens, the boundary between babingtonite and hedenbergite was sharply defined. The relationship of babingtonite (Bab) and hedenbergite (Hd) was determined as Bab[100]//Hd[112] in the Arvigo and Bab[-100]//Hd[1-12] in the Kreimbach/Kaulbach specimen. Diffractions derived from Bab(031) and Hd(02-1) in the Arvigo, and Bab(031) and Hd(021) in the Kreimbach/Kaulbach sample were observed at the identical position. Their topological relationship can be explained by their crystal structures. The reciprocity between babingtonite and hedenbergite is governed by the direction of the SiO_4-tetrahedral chain, and the configuration of octahedra and meets the requirement to associate both structures. A five-periodic chain of babingtonite harmoniously transitions into a two-periodic chain of hedenbergite. The octahedral cluster consisting four octahedra of babingtonite continuously transforms to the octahedral chain in hedenbergite. Therefore, hedenbergite is apparently an epitaxial phase grown on {010} of the platy babingtonite basal. The occurrences of babingtonite with epitaxial hedenbergite imply that they are essentially formed within the babingtonite stability field. At the initial stage, babingtonite formed under high fO_2 and water saturated condition. Subsequently, slight fluctuation, in particular in fO_2, possibly promoted the nucleation of hedenbergite crystals on {010} of pre-existing babingtonite, leading to the epitaxial relation. Hedenbergite whiskers tend to be getting shorter from the centre to the edge of the babingtonite plate in both Arvigo and Kreimbach/Kaulbach specimens, suggesting that the crystal growth of babingtonite continued during hedenbergite formation.

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