Manganoo n kinoshitalite in Mn-rich marble and skarn from Virginia

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Abstract

A new locality for the Ba-rich trioctahedral mica, kinoshitalite [Ba(Mg,Mn,Fe,Al)3Si1.9–2Al2–O10(OH,F)2], has been found in a metamorphosed manganoo marble from Pittsylvania County, Virginia. Metamorphic grade is middle amphibolite facies, with documented P and T of 400 MPa and 575 °C. The locality is along strike not far from the well known Bald Knob, North Carolina, Mn-mineral locality, and appears to represent a silica-poorer analog of Bald Knob. The kinoshitalite occurs in a single layered hand sample containing both skarn and marble layers, and it shows significant compositional contrasts between the two lithologies. Kinoshitalite is scarce and fine-grained in manganoo marble and coexists with kutnahorite, manganoo calcite, fluorian alægahnite, fluorian sonolite, aluminous jacobsite, and alabandite. Kinoshitalite is both more abundant and coarser-grained in skarn where it coexists with kutnahorite, tephroite, fluorian manganhumite, spessartine, jacobsite, and manganoo magnetite. A-sites in kinoshitalite in skarn are about 3/4 occupied by Ba (with the remainder mostly K), whereas in marble, Ba occupancy of A-sites exceeds 90% and most of the remainder is Ca. X_Mg in octahedral sites is >0.6 and is higher in marble than in skarn, whereas X_Mn is significant (>0.2) and is higher in skarn than in marble. The ^VI Al is significantly higher in skarn kinoshitalite, as is total Tschermak content. The total Tschermak content of these barian micas (^VI Al + Ti + Fe^3+) is typical of all previously reported kinoshitalites and is significantly lower than that of clintonite and biotite. The X_F of kinoshitalite in marble is significantly higher than that in skarn.

The petrogenesis of kinoshitalite at the Hutter Mine locality is unclear due to the lack of context for the single mine-dump sample in which the mineral was found and the absence of textural evidence for reactions. However, the two likeliest source minerals for Ba that have been found in the deposit are barite and BaCa(CO_3)_2 (probably barytocalcite). One hypothetical reaction to produce kinoshitalite involves decarbonation, in which BaCa(CO_3)_2, rhodochrosite, Mn-garnet, and aqueous fluid as reactants, with barite and BaCa(CO_3)_2 (probably barytocalcite) as products. A second potential reaction to form kinoshitalite involves barite, Mn-garnet, tephroite, and aqueous fluid as reactants, and kinoshitalite, alabandite, jacobsite, SiO_2, and O_2 as products.

Introduction

Kinoshitalite, Ba-rich phlogopite, is a member of the brittle-mica group of sheet silicates (Guggenheim 1984). It was first reported by Yoshii et al. (1973) from the Noda-Tamagawa mine, Japan, an amphibolite- to granulite-facies metamorphosed Mn deposit (Watanabe et al. 1970). Ba-rich micas have been reported from various geologic settings: alkaline igneous rocks (e.g., Thompson 1977; Wendlandt 1977; Mansker et al. 1979; Gaspar and Wylle 1982; Edgar 1992; Zhang et al. 1993), metamorphic rocks (e.g., Pan and Fleet 1991; Harlow 1995), marbles or calc-silicates (e.g., Pattiarachi et al. 1967; Glassley 1975; Rice 1977; Bücher-Nurminen 1982; Solie and Su 1987; Bol et al. 1989; Tracy 1991), and metamorphosed Mn-bearing ore deposits (e.g., Fromdel and Ito 1967; Yoshii et al. 1973; Matsubara et al. 1976; Dargupta et al. 1989; Tracy 1991; Chabu and Baulege 1992; Frimmel et al. 1995; Dunning and Cooper 1999; Gnos and Armbruster 2000). There are three trioctahedral brittle micas for which natural representatives show substantial or total occupancy of the interlayer site by Ba^2+: (1) kinoshitalite, (2) anandite, which has S^2– and is rich in Fe (Pattiarachi et al. 1967; Filut et al. 1985), and (3) ferrokinoshitalite, an Fe-rich analogue of kinoshitalite (Tracy 1991; Frimmel et al. 1995; Guggenheim and Frimmel 1999). The South African “Fe-kinoshitalite” (Frimmel et al. 1995) is surprisingly F rich for such an Fe-rich mineral, with virtually no Cl, whereas the occurrence at Sterling Hill, New Jersey (Tracy 1991) shows very high Cl (up to 80% of the hydroxyl site occupied by Cl). Most kinoshitalites are Mn-bearing to Mn-rich, and have been found exclusively in middle amphibolite- to granulite-facies metamorphosed Mn deposits (Gnos and Armbruster 2000), however, an Fe-bearing Mn-poor kinoshitalite from Alaska was reported by Solie and Su (1987).

The kinoshitalite from the Hutter Mine deposit in Pittsylvania County, Virginia, occurs in manganoo marble and associated skarn. The Hutter Mine, an important locality for Mn minerals (Beard et al. 2002), is about 80 km along strike from the well known Mn-mineral locality at Bald Knob, near Sparta, North Carolina (Simmons et al. 1981). Although similar to Bald Knob in many respects, including metamorphic grade...