Argon mobility in biotites


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A variety of physicochemical factors that may control Ar mobility in tri-octahedral micas are being investigated in samples from a small marble outcrop (~500 m²) in the Frontenac terrane, Grenville Province, Ontario. This terrane experienced low-pressure granulite metamorphism at 1180–1140 Ma, associated with the emplacement of felsic magmas of the Frontenac Suite. Post-magmatic cooling of the terrane appears to have been rapid with 40Ar/39Ar hornblende ages between 1125 and 1110 Ma [1]. The site contains pristine micas with the oldest 40Ar/39Ar ages of 1150 Ma are ~100 Ma older than Rb/Sr ages of the same samples. Transmission electron microscopy shows that these 1M micas contain significantly more layer stacking defects (associated with crystallization) than the younger micas. Although this result might not be surprising, all the 40Ar/39Ar ages fall into three groups (1150, 1050 and 970 Ma) that correspond with well-known thermal events in the Grenville Province. Moreover, the stable isotopic data for coexisting mica and calcite indicate that these rocks equilibrated in the presence of fluids with similar isotopic compositions. We are exploring the reasons for the oldest 40Ar/39Ar mica ages not being older than the time of peak granulate facies metamorphism.


The structure of bornemanite, a Group III Ti-disilicate mineral from Lovozero alkaline massif, Kola Peninsula, Russia

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The crystal structure of bornemanite, ideally Na6BaTi2Nb(Si2O7)2(PO4)O2(OH)F, Ti+Nb = 3 apfu (atom per formula unit), a 5.4587(3), b 7.1421(5), c 24.528(2) Å, α 96.790(1), β 96.927(1), γ 90.326(1)°, V 942.4(2) Å³, sp. gr. P 1, Z = 2, Dcalc 3.342 g.cm-3, from Lovozero alkaline massif, Kola Peninsula, Russia, has been solved and refined to R1 6.36% on the basis of 4414 unique reflections(Fo > 4σF). The crystal structure of bornemanite is as predicted by Sokolova [1]. Sokolova [1] established the relation between structure topology and chemical composition for 24 minerals with the TS (titanium-silicate) block, a central trioctahedral (O) sheet and two adjacent (H) sheets containing different polyhedra including (Si2O7) groups, and divided these minerals into four groups characterized by different topology and stereochemistry of the TS block. Each group of structures has a different linkage of H and O sheets in the TS block and a different arrangement of Ti (= Ti + Nb) polyhedra. In Groups I, II III and IV, Ti equals 1, 2, 3 and 4 apfu, respectively. Group III includes lamprophyllite, barytolamprophyllite, nabalamprophyllite, innelite, vuonnemite and epistolite.

In bornemanite, the TS block exhibits the stereochemistry of Group III: Ti occurs in the H and O sheets, two (Si2O7) groups link to trans edges of a Ti octahedron in the O sheet. The O sheet cations give Na6Ti4 (4 apfu) in accord with Group III. The TS block has two different H sheets, H1 and H2, where (Si2O7) groups link to (5)Ti and (6)Nb polyhedra and there are two peripheral sites, which are occupied by Ba and Na, respectively. The crystal structure of bornemanite is a combination of a TS block and an I (intermediate) block. There are two I blocks: the I1 block is a layer of Ba atoms; the I2 block consists of Na polyhedra and (PO4) tetrahedra. The I1 and I2 blocks are topologically and chemically similar to the intermediate blocks in barytolamprophyllite and vuonnemite, respectively.