Argon mobility in biotites

A. CAMACHO[1]*, J.K.W. LEE[2], T.D. ULLRICH[3],
J.D. FITZ GERALD[4], M. COOPER[1], J. WOODHEAD[5],
K. KYSER[2], J. ZHAO[2], R.A. CREASER[6] AND L. HEAMAN[6]

[1]Dept of Geological Sci., Univ. of Manitoba, MB, R3T 2N2, Canada (*correspondence: camacho@cc.umanitoba.ca)
[2]Department of Geological Sciences and Geological Engineering, Queen's University, ON K7L 3N6, Canada
[3]Department of Earth and Ocean Sciences, University of British Columbia, BC V6T 1Z4, Canada
[4]Research School of Earth Sciences, The Australian National University, ACT 0200, Australia
[5]School of Earth Sciences, University of Melbourne, VIC 3010, Australia
[6]Dept of Earth and Atmospheric Sciences, University of Alberta, AB T6G 2E3, Canada

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 m^2) 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 ^{40}Ar/^{39}Ar hornblende ages between 1125 and 1110 Ma [1]. The site contains pristine micas with a range of compositions reflected mainly by variations in Fe/Mg and F/(OH+Cl). These micas have undergone the same thermal history and were not deformed after peak metamorphic conditions. ^{40}Ar/^{39}Ar and Rb/Sr analyses on mica yield ages ranging between 950-1150 Ma and 950-1050 Ma, respectively. Although no correlation between chemical composition and Rb/Sr and ^{40}Ar/^{39}Ar age [2] or between crystal size and ^{40}Ar/^{39}Ar age [3] is observed, micas with the oldest ^{40}Ar/^{39}Ar 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 ^{40}Ar/^{39}Ar 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 ^{40}Ar/^{39}Ar mica ages not being older than the time of peak granulite facies metamorphism.

[1] Cosca *et al*. (1992) *Contrib. Min. & Petrol.* **110**, 211-225.
[2] Dahl (1996) *Contrib. Min. & Petrol.* **123**, 22-39.
[3] Dodson (1986) *In, Materials Science Forum* **7**, 145-153.

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

F. CÁMARA[1]* AND E. SOKOLOVA[2]

[1]CNR-Istituto di Geoscienze e Georisorse, Pavia, 27100, Italy (*correspondence: camara@crystal.unipv.it)
[2]Dep. of Geological Sciences, Univ. of Manitoba, Winnipeg, MB, R3T 2N2 Canada (Elena_Sokolova@Umanitoba.ca)

The crystal structure of bornemanite, ideally Na_6□Ba $Ti_2Nb(Si_2O_7)_2(PO_4)O_2(OH)F$, 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) Å^3, sp. gr. $P\bar{1}$, $Z = 2$, $D_{\mathrm{calc.}}$ 3.342 g.cm^{-3}, from Lovozero alkaline massif, Kola Peninsula, Russia, has been solved and refined to R_1 6.36% on the basis of 4414 unique reflections($F_o > 4\sigma F$). 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 (Si_2O_7) 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 (Si_2O_7) groups link to *trans* edges of a Ti octahedron in the O sheet. The O sheet cations give Na_3Ti (4 *apfu*) in accord with Group III. The TS block has two different H sheets, H_1 and H_2, where (Si_2O_7) 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 $\mathbf{I}_1$ block is a layer of Ba atoms; the $\mathbf{I}_2$ block consists of Na polyhedra and (PO_4) tetrahedra. The $\mathbf{I}_1$ and $\mathbf{I}_2$ blocks are topologically and chemically similar to the intermediate blocks in barytolamprophyllite and vuonnemite, respectively.

[1] Sokolova (2006) *Can. Min.* **44**, 1273-1330.