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Boralsilite ($Al_{16}B_6Si_2O_{37}$): A new mineral related to sillimanite from pegmatites in granulite-facies rocks

Edward S. Grew,[1,*] James J. McGee,[2] Martin G. Yates,[1] Donald R. Peacor,[3] Roland C. Rouse,[3] Joep P.P. Huijsmans,[4] Charles K. Shearer,[5] Michael Wiedenbeck,[6] Douglas E. Thost,[7] and Shu-Chun Su[8]

[1]Department of Geological Sciences, University of Maine, Orono, Maine 04469, U.S.A.
[2]Department of Geological Sciences, University of South Carolina, Columbia, South Carolina 29208, U.S.A.
[3]Department of Geological Sciences, University of Michigan, Ann Arbor, Michigan 48109, U.S.A.
[4]Netherlands Energy Research Foundation, P.O. Box 1, NL 1755 ZG Petten, The Netherlands
[5]Institute of Meteoritics, University of New Mexico, Albuquerque, New Mexico 87131, U.S.A.
[6]Advanced Materials Laboratory, University of New Mexico, Albuquerque, New Mexico 87106, U.S.A.
[7]Australian Geological Survey Organization, G.P.O. Box 378, Canberra A.C.T., Australia
[8]Hercules Research Center, 500 Hercules Road, Wilmington, Delaware 19808, U.S.A.

Abstract

Boralsilite, the first natural anhydrous Al-B-silicate, is a high-temperature phase in pegmatites cutting granulite-facies metapelitic rocks at Larsemann Hills, Prydz Bay, east Antarctica (type locality) and Almgjotheii in the contact aureole of the Rogaland Intrusive Complex, southwestern Norway. Stable assemblages include: (1) quartz-potassium feldspar-boralsilite-schorl/dravite (Larsemann Hills); (2) potassium feldspar-plagioclase(An_{22})-boralsilite-werdingite-dumortierite-grandidierite (Almgjotheii); (3) quartz-potassium feldspar-boralsilite-dumortierite-andalusite ± sillimanite (Almgjotheii). Boralsilite is estimated to have formed between 600 and 750 °C and 3–5 kbar at conditions where $P_{H_2O} < P_{tot}$. The name is from the composition, *bor*on, *al*uminum, and *sil*icon. Representative electron and ion microprobe (SIMS) analyses of Larsemann Hills are: SiO_2 10.05 [12.67]; Al_2O_3 71.23 [69.15]; FeO 0.48 [1.10]; MgO below detection [0.23]; BeO 0.004 [0.094]; B_2O_3 19.63 [18.11] wt%, totals 101.39 [101.35] wt% where the numbers in brackets were determined from Almgjotheii material. However, the SIMS B_2O_3 values appear to be systematically too high; boron contents calculated assuming B + Si = 8 and O = 37 atoms per formula unit (apfu) yield B_2O_3 18.53 wt% corresponding to $Fe_{0.08}Al_{15.98}B_{6.09}Si_{1.91}O_{37}$ ideally $Al_{16}B_6Si_2O_{37}$ for Larsemann Hills. The analogous composition of $Mg_{0.07}Fe_{0.18}$-$Al_{15.66}Be_{0.04}B_{5.565}Si_{2.435}O_{37}$ for Almgjotheii appears to result from solid solution of boralsilite with sillimanite (or $Al_8B_2Si_2O_{19}$) and subordinate werdingite. Boralsilite forms prisms up to 2 mm long $\|b$ and 0.25 mm across and is commonly euhedral in cross section. It is colorless and prismatic cleavage is fair. Optically, it is biaxial (+); at λ = 589 nm, the Larsemann Hills material has α = 1.629(1), β = 1.640(1), γ = 1.654(1), $2V_{meas}$ = 81.8 (6), $r > v$ extremely weak, and $\gamma \| b$. It is monoclinic, space group $C2/m$ with lattice parameters for Larsemann Hills of a = 14.767(1), b= 5.574(1), c = 15.079 (1) Å, β = 91.96(1)°, V = 1240.4 (2) Å^3, Z = 2, and D_{calc} = 3.07 g/cm^3.