Boralsilite (Al$_{16}$B$_6$Si$_2$O$_{37}$): A new mineral related to sillimanite from pegmatites in granulite-facies rocks

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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 $P_{H_2O} < P_{H_4SiO_4}$. The name is from the composition, boron, aluminum, and silicron. Representative electron and ion microprobe (SIMS) analyses of Larsemann Hills are: SiO$_2$ 10.05 [12.67]; Al$_2$O$_3$ 71.23 [69.15]; FeO 0.48 [1.10]; MgO below detection [0.23]; BeO 0.004 [0.094]; B$_2$O$_3$ 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$_2$O$_3$ values appear to be systematically too high; boron contents calculated assuming B + Si = 8 and O = 37 atoms per formula unit (apfu) yield B$_{O,apfu}$ 18.53 wt% corresponding to Fe$_{10}$Al$_{15.0}$Be$_{0.6}$Si$_{1.9}$O$_{37}$, ideally Al$_{16}$B$_6$Si$_2$O$_{37}$ for Larsemann Hills. The analogous composition of M$_{O,apfu}$Fe$_{0.19}$Al$_{15.0}$Be$_{0.0}$Si$_{1.9}$Si$_{0.165}$O$_{37}$ for Almgjotheii appears to result from solid solution of boralsilite with sillimanite (or Al$_{15}$B$_6$Si$_2$O$_{37}$) 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 ($\alpha = 1.629(1)$, $\beta = 1.640(1)$, $\gamma = 1.654(1)$), $2V_{\text{calc}} = 81.8$ (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, $\beta = 91.96(1)^\circ$, $V = 1240.4$ (2) Å$^3$, $Z = 2$, and $D_{\text{calc}} = 3.07$ g/cm$^3$.

INTRODUCTION

The discovery of boralsilite began with the description and analysis of Huijsmans (1981) and Huijsmans et al. (1982) of an unknown columnar mineral from the Almgjotheii pegmatite. Subsequent study showed the unknown mineral to consist of two distinct minerals (Grew 1996): werdingite, from which Huijsmans’s (1981) anal-