# THEME 1: THE DYNAMIC SOLID

## Session 1.2: Light elements in igneous and metamorphic processes

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Light elements (H, Li, B, C, N, O, the halogens, and perhaps also including the geochemically similar S, despite its higher mass) have behaviour that is diverse and generally different from the more common lithophile and siderophile elements. Most of the light elements also have two or more stable isotopes that are strongly fractionated during geological processes. Finally, some of these elements exert disproportionate control on the rheology, melting properties and/or oxidation states of rocks. Therefore, they provide unusual constraints on the origin and evolution of the Earth's interior. This session focuses on: The current state and evolution of light-element abundances and isotopic composition in the mantle, including sources of oceanic basalts; the origins, scale and information content of light-element distributions and isotopic variations in igneous rocks; uses of light element abundance and isotope distribution for geothermometry and measurements of vapor partial pressures; uses of light elements to trace mass transfer in subduction zones. More generally, we encourage submissions relating the geochemistry of light elements to that of more well-understood lithophile elements in igneous and metamorphic systems.

### 1.2.11

## Li, Be and B in amphibolites from the Schwarzwald (Germany)

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The abundances of Li, Be and B in mineral grains of amphibolites from the Schwarzwald were measured by SIMS. Average Li contents in *amphibole* from 18 samples range from $1.0 \pm 0.2$ to $7.2 \pm 1.2$ ($1\sigma$) µg/g; extraordinarily high abundances of $47 \pm 18$ µg/g were found in one additional sample. Zoning patterns of amphibole grains are variable and both core-to-rim increases and decreases in Li occur. Be abundances range from $0.1 \pm 0.2$ to $2.3 \pm 0.3$ µg/g and most grains are only moderately zoned. B concentrations range from $1.2 \pm 0.5$ to $8.9 \pm 1.1$ µg/g whereby no systematic core-to-rim zoning was found.

*Plagioclase* displays highly variable abundances of Li between $0.02 \pm 0.01$ and $2.0 \pm 0.2$ µg/g. The abundances of Be und B range from $0.2 \pm 0.2$ to $3.2 \pm 0.1$ µg/g and from $0.20 \pm 0.08$ to $10.8 \pm 2.2$ µg/g, respectively. No systematic zonation patterns were found.

*Biotite* has high contents of Li ranging from $81 \pm 8$ to $202 \pm 33$ µg/g, while the abundances of Be vary from $0.10 \pm 0.01$ to $0.5 \pm 0.3$ µg/g and those of B from $5.4 \pm 2.0$ to $28.6 \pm 1.7$ µg/g. Some samples contain *clinopyroxene* with $11.8 \pm 1.2$ to $17.8 \pm 3.7$ µg/g Li, 0.2 to 0.3 µg/g Be and $1.7 \pm 0.3$ to $3.4 \pm 0.6$ µg/g B.

The partitioning of Be and B between amphibole and plagioclase is relatively constant over more than one order of magnitude of element concentrations. $D_{Be}$(am/pl) ranges from 0.2 to 0.9 and $D_B$(am/pl) from 0.3 to 1.3. Li partitioning, however, is highly variable with $D_{Li}$(am/pl) ranging from 2.6 to 182.

Some samples show partial retrogression under (sub)greenschist-facies conditions. Isotopic dating of sericite suggests a late Jurassic to early Cretaceous age of this overprint [1]. The infiltrating hydrous fluids were rich in Li and B. Secondary chlorite, for example, is characterized by high abundances of Li (135–329 µg/g) and B (6–12 µg/g). Prehnite contains c. 140 µg/g B, and sericite formed at the expense of plagioclase has 19–61 µg/g Li and 50–240 µg/g B. These results are in concordance with the occurrence of B-rich clay minerals and cookeite in hydrothermally metamorphosed upper Carboniferous to Permian clastic sediments overlying the Variscan basement [2,3].

### References

[1] Lippolt HJ, Kirsch H (1994) *Chem Erde* **54,** 128-134.
[2] Zuther M, Brockamp O (1998) *Chem Geol* **71,** 22-33.
[3] Schlegel A, Brockamp O, Zuther M, Clauser N (2002) *Ber Deutsch Mineral Ges Beih 1 zu Eur J Mineral* **14,** 144.