

The influence of temperature on partitioning of fluorine and chlorine between biotite and granitic melt

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Dehydration melting is the most important geochemical process in the predominantly fluid absent lower crust, as it controls the differentiation of the crust through granite melt generation and segregation. Biotite is the main hydrous mineral involved in dehydration melting, because it is stable to high temperatures. Biotite breaks down over a broad temperature interval, so the partitioning behaviour of elements with respect to this mineral is likely to vary. Chlorine and fluorine are important constituents of biotite because they are ligands that combine with cations in hydrothermal fluids and melts [1], and thus control uptake of various economic metals into granitic melts. Furthermore, addition of F lowers the viscosity of silicate melts [2], allowing for more effective melt extraction, and magma migration and fractionation. Some experimental data already exist on F and Cl partitioning behaviour between biotite and melt at low temperatures, before the onset of widespread dehydration melting [3]; however, there is no information for the entire temperature range of biotite breakdown that is seen to occur in natural systems.

Here, we report electron microprobe analyses of biotite in rocks from the Ballachulish and Rogaland contact metamorphic aureoles to determine the preference of F and Cl for biotite from 600°C to over 1000°C. Results show a positive correlation between temperature and F concentration in biotite (up to 5.04 wt.% F) up until 850-900°C, above which F content decreases (down to 0-2.5% F). Cl is low (<1 wt.% Cl) in all biotite above 750°C. The results show that significant amounts of F may be added to melt from the breakdown of high temperature biotite, which is consistent with the F-rich compositions of hot dry anorogenic granites.

[1] Keppler & Wylie (1991), *Contributions to Mineralogy and Petrology* **109**, 139-150. [2] Giordano, Romano, Dingwell, Poe & Behrens (2004), *Geochimica et Cosmochimica Acta* **68**, 5159-5168. [3] Icenhower & London (1997), *Contributions to Mineralogy and Petrology* **127**, 17-29.