Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 401

Exchange Mechanisms, Fluid Flow and Fluid Evolution During Hydrothermal Alteration of Granites

Jens Fiebig (jens.fiebig@imp.unil.ch.)[1], **Klaus Simon**[2] & **Jochen Hoefs**[2]

[1] Institute of Mineralogy and Geochemistry, BFSH 2, 1015 Lausanne, Switzerland
[2] Geochemisches Institut, Goldschmidtstrasse 1, 37073 Göttingen, Germany

From "bulk" oxygen isotope analysis it is well known that large parts of the Hercynian St. Blasien granite, Schwarzwald, Germany, have been altered by a crustal fluid of meteoric origin (1). However, since Mg quantities of sample material are needed for conventional analysis, the mechanisms of fluid rock exchange and the style of fluid flow remained unclear. A newly developed microprobe allows *in situ* analysis of nmol quantities of silicate extracted oxygen (2). In order to study the kinetics of fluid-rock interaction a combination of *in situ* oxygen isotope- and electron microprobe analysis has been applied to four samples of the St. Blasien granite. Both data sets demonstrate that hydrothermal alteration occurred after the emplacement and solidification of the pluton. Chemical reaction (chloritisation of biotite, albitisation of plagioclase and K-feldspar) and dissolution-recrystallisation are the exchange mechanisms, while the fluid migrated preferentially along microcracks through the rock. Domains of primary mineral phases exhibit primary magmatic fractionations, whereas secondary minerals seem to have equilibrated with the fluid at T = 300ºC. Using the kinetic exchange theory of Criss et al. (3), fluid-granite interaction has been simulated over a scale of 10 kilometers assuming a temperature of 300ºC. Hydrothermal alteration of each sample locality can be successfully modelled with an initial $\delta^{18}O$ of the fluid of -5‰, suggesting that the initial isotopic composition of the fluid has been homogeneous over a range of 10 kilometers. Because of albitisation of plagioclase and K-feldspar the fluid must have had high initial Na/K-ratios. Integrated fluid-rock ratios varied within a factor of 60, the extent of which is related to the number of pre-existing microcracks. At high water-rock ratio, Na/K-ratios of the fluid nearly remained constant throughout the hydrothermal event, while Na/K-ratios at localities with low water-rock ratio continuously decreased with increasing duration of interaction. These local variations in numbers of pre-existing microcracks, water/rock ratios and Na/K-ratios are manifested in a variation of rate constants for oxygen isotope exchange between biotite/feldspar and fluid within a factor of 3.

Simon K, *Contrib. Mineral. Petrol*, **105**, 177-196, (1990).
Fiebig J, *Dissertation http://webdoc. sub. gwdg. de/diss/2000/fiebig*, (1999).
Criss RE, Gregory RT & Taylor HP, *Geochim. Cosmochim. Acta*, **51**, 1099-1108, (1987).