Geophysical Research Abstracts, Vol. 8, 02804, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02804

Significance of H and O isotopes inhomogenieties on microscale in UHP rocks from the Dabie mountains, China, for fluid exchanges during the subduction-exhumation cycle

Birtel, S. (*), Deloule, E.

Centre de Recherches de Pétrographiques et Géochimiques (CRPG-CNRS), BP20, 54501 Vandoeuvre-les-Nancy, France. (*) present address: Institut fur Geologie, Mineralogie und Geophysik, Ruhr Universität Bochum, Germany, (sandra.birtel@rub.de/ Fax: +49-234-32-14572 Phone: +49 234 32 23232)

Dabie Shan eclogites are well known for their low oxygen (δ^{18}O = -11‰ wr) and hydrogen isotopic signatures (δD= -60 to -100‰ for mica and amphibole, e.g. Rumble &Yui 1998, Zheng et al. 2003), the lowest ever observed in an UHP terrane. These low values are explained by an interaction with meteoric waters prior to subduction. The preservation of these early signatures suggests a fast subduction followed by a rapid uplift. The heterogeneity of the isotopic signatures at the outcrop scale gives evidence of later fluid events. In this study, O and H isotopic signatures have been investigated at the microscale to trace the behaviour of these fluids during subduction and exhumation in more detail. Therefore O-isotopes on garnets and H- isotopes on micas and amphiboles were analysed by ion microprobe on samples from Bixilling and Shuanghe after reconstruction of their PT paths.

Bixilling garnets are unzoned in main elements, whereas Shuanghe ones may be unzoned or zoned, with zonations associated with their retrograde path. O isotopes show constant values within each sample for Bixilling garnets, with a δ^{18}O variation from 0 to 6 ‰ on the whole sample set. Values 1-2 ‰ higher in rim than in core are occasionally observed. For the Shuanghe sample suite, δ^{18}O ranges from –7‰ to + 10‰ with variations up to 7 ‰ within a sample. Typical variations are observed 1) along veins with values decreasing of 2-3 ‰ away from the vein, 2) in single minerals with rims 3 to 6 ‰ higher than cores and 3) on mm and cm scale within samples without any clear association with a fluid pathway. The constant values for Bixilling support that the garnets preserved an initial mantle signature, with minor influence of meteoric water interaction prior to subduction. In contrast, the Shuanghe garnets negative δ^{18}O values indicate an early hydrothermal meteoric water overprint. Higher δ^{18}O values in the core or along veins are related to the retrograde evolution..

For hydrogen isotope the lowest δD values are observed in the UHP white micas for both localities (δD from -170 to -100 ‰ for Shuanghe and -190 to -70 ‰ for Bixilling). Amphibole and biotite show higher δD values (-110 to –30 for Shuanghe and -160 to -20 for Bixilling).

The extreme negative δD values for white mica also for Bixilling, point to an exposition of Bixilling rocks to a meteoric water, inspite of typical mantle values for oxygen in garnets. Hydrogen concentrations at HP and UHP conditions are low (200-1000 ppm Bell &Rossmann 1992, Ingrin &Skogby 2000) therefore small amounts of water are sufficient to change hydrogen isotope values, whereas oxygen isotopes remain unchanged. The retrograde phases such as biotite and amphibole seem to present a "mix-δD signature" in between the initial negative values and later more positive retrograde fluids.

In conclusion, fluid rock interaction was efficient with reference to O and H isotopes before subduction and during exhumation. Before subduction the isotopic signatures are related to a meteoric fluid (Shuanghe and Bixilling) and mantle fluid (Bixilling). During subduction, these primary values are preserved for both localities. Fluids during exhumation origin from the subducted crust or mantle (Shuanghe), for Bixilling the retrograde fluid print is weak.

References

Bell, D.R. &Rossmann G.R. (1992) Science 255, 1391-1397,

Ingrin &Skogby (2000) Eur. J. Mineral. 12, 543-570,

Rumble, D. &Yui, T.F..(1998) GCA, 62 No 19/20, 3307-332,

Zheng Y.-F., Fu, B., Gong, B. &Li, L.(2003) Earth-Science Reviews 62, 105-161