Geophysical Research Abstracts
Vol. 20, EGU2018-10172, 2018
EGU General Assembly 2018

Exhumation of Alpine HP rocks revealed by magnetite (U-Th)/He dating

Stephane Schwartz (1), Cecile Gautheron (2), Rosella Pinna-Jamme (2), Frederic Haurine (2), Fabrice Brunet (1), and Richard Ketcham (3)

(1) Université Grenoble Alpes - CNRS - ISTerre, Grenoble, France (stephane.schwartz@univ-grenoble-alpes.fr), (2) GEOPS, Université Paris Sud, France, (3) The University of Texas at Austin, USA

The (U-Th)/He method is based on the 4He production and accumulation in the crystal lattice during the 238U, 232Th and 147Sm alpha radioactive decay. Published He diffusion data in magnetite from volcanic rocks(1) and from ore deposits(2) demonstrates that produced He is retained in the crystal, with a closure temperature of around 250±50 °C(1). This method applied to magnetites associated with HP rocks allows can be used to obtain constraints on the exhumation timing of metamorphic rocks and fluid-rock interactions(3).

We applied (U-Th)/He chronometry on magnetite crystals, sampled in the internal zones of the western Alps (Zermatt, Monviso and Queyras), where the related pressure-temperature (P-T) paths are well documented. The magnetites are associated with mafic and ultramafic rocks deformed and metamorphosed during the Late Cretaceous-Early Eocene subduction of the Tethyan oceanic lithosphere. The related high-pressure metamorphic conditions for the three units vary from blueschist to eclogitic, implying metamorphic temperatures higher than 350°C.

The crystals were first characterized by MEB and microprobe analysis to determine their chemical purity. Grains were optically selected and analyzed by CT scanning to detect any potential inclusions. Selected crystals were packed for (U-Th-Sm)/He analysis. Obtained He ages are dispersed but compatible with the retrograde P-T paths. The range of magnetite (U-Th)/He ages suggests a continuous recording due to magnetite crystallization in relation with fluid circulation during exhumation. In the case of the western Alps, the magnetite (U-Th)/He is an additional tool to reconstruct the low temperature exhumation of the mafic to ultramafic rocks but also the physical conditions associated with retrograde fluid circulations.

References

1. Blackburn, T.J., Stockli, D.F., Walker, J.D., 2007. Magnetite (U-Th)/He dating and its application to the geochronology of intermediate to mafic volcanic rocks. Earth and Planetary Science Letters, vol. 259, pp. 360-371.
2. Fanale, F., Kulp, J.L., 1962. The helium method and the age of the Cornwall, Pennsylvania magnetite ore. Economic Geology, vol. 57, pp. 735-756.
3. Cooperdock, E.H.G., Stockli, D.F., 2016. Unraveling alteration histories in serpentinites and associated ultramafic rocks with magnetite (U-Th)/He geochronology. Geology, vol. 44, pp. 967-970.