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The Felsic Vein within the Garnet Pyroxenite from Shenglikou, North Qaidam: Episodic Fluid Flow During the Exhumation of the Rock

CAO Yuting[1], LIU Liang[1*], CHEN Danling[1], WANG Chao[2], YANG Wenqiang[1], KANG Lei[1] and ZHU Xiaohui[1]

1 State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an 710069, China
2 Xi'an Institute of Geology and Mineral Resource, Xi'an 710054, China

The North Qaidam terrane is located in northwestern China, and is classified as a Paleozoic HP–UHP metamorphic zone (Chen et al., 2008, 2009; Song et al., 2003, 2004, 2005; Yang et al., 2001; Zhang et al., 2008a, 2009a, b). Although the metamorphism, geochronology and subduction background of the HP–UHP rocks of the North Qaidam have already been thoroughly studied, the characteristics, the behavior and activity of fluid during the subduction and exhumation process in this zone have yet to be researched thoroughly. In the present study, felsic veins were found in the garnet (Grt) pyroxenite from the Shenglikou area, in the North Qaidam. The Grt pyroxenite near the vein is strongly amphibolized into the Grt amphibolite. Thus, a combined study of the petrology, geochemistry and geochronology of the felsic vein, as well as for the sideward Grt amphibolite and its host Grt pyroxenite is performed. The study results provide constraints on the ages of fluid flow within the Shenglikou terrane, as well as on the origin of the fluid for the vein, which may play a key in deciphering the fluid processes in subduction zones.

Geochemistry and chronology data indicate that the protolith of the Grt pyroxenite was basalt from a continental setting, and formed in the Neo–proterozoic (909±6 Ma) period. Petrographical, mineral chemical and geochronological studies imply that the Grt pyroxenite experienced a peak eclogite–facies (775–810 °C and >1.8 GPa) metamorphism at 440 Ma, subsequent granulite–facies retrograded metamorphism (774–814 °C and 1.07–1.24 GPa) at 420 Ma, and finally amphibolite–facies (619–694 °C and 0.55–0.68 GPa) metamorphism, suggesting that the Neo–proterozoic protolith of the rock experienced continental subduction and subsequently subjected to two stages of exhumations (Fig. 1). The formation age of the felsic vein in the Grt pyroxenite is yielded at 422±2 Ma (2σ), which is identical to the granulite–facies retrograded age (420 Ma) of the host Grt pyroxenite, suggesting that the principal vein–forming corresponds to the first exhumation stage of the rock. The fact that the Hf isotope compositions between the granulite–facies (type I) zircon rims from the host Grt pyroxenite and the zircon from the felsic vein are identical suggests that the fluid for veining is either locally sourced or internally buffered. The felsic veins have high contents of SiO_2, Al_2O_3, Na_2O, CaO and Sr, indicating that there are significant amounts of Na, Si, Ca, Al and Sr in the vein–forming fluid. Therefore, the dehydration of Omp is interpreted to be the dominated mechanism for releasing the fluid leaving the low-Na Cpx and Pl_1 as the residual phase in the Grt pyroxenite. In addition, the strong amphibolization of the Grt amphibolite near the felsic vein, as well as the compositional variation of the entire rock and amphiboles between the Grt pyroxenite and Grt amphibolite, the coarse–grained titanite occurring in the Grt amphibolite, the Kfs micro–veins in the Grt amphibolite and felsic vein, and the presence of biotite and muscovite in the vein, all indicate that a low flux of external pelite–derived fluid with high K, LREE, LILE and silica contents was added and transported along the vein, where it interacted with the host Grt pyroxenite. It is possible that this external fluid migration occurred before and continued until after the amphibolite–facies stage.

Therefore, it is shown that episodic fluid flow occurred during the exhumation of the Grt pyroxenite, and that the primary internal fluid for the felsic veining flowed at the transformation from peak eclogite stage to granulite stage (Fig. 1 I to II), then low flux external fluid was added before the amphibolite stage, corresponding to the final stage of the fluid flow (Fig. 1 II to III).

Key words: felsic vein; Grt pyroxenite; North Qaidam; dubduction and exhumation; Episodic fluid flow

* Corresponding author. E-mail: liuliang@nwu.edu.cn

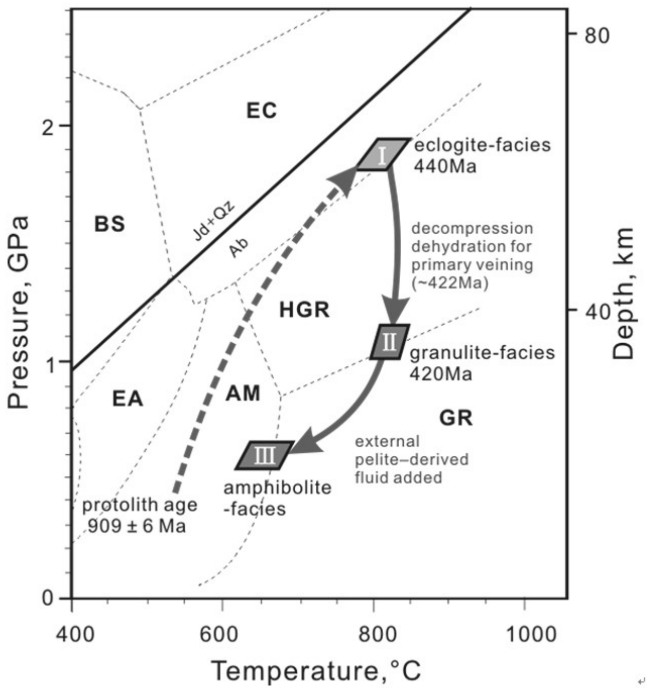

Fig. 1. Schematic P–T–t path for metamorphic processed concerning fluid activity during exhumation of the Grt pyroxenite in the Shenglikou area, North Qaidam.

Jd = jadeite; Qz = quartz; Ab = albite. Metamorphic-facies abbreviations: AM = amphibolite; BS = blueschist; EA = epidote amphibolite; EC = eclogite; GR = granulite; HGR = kyanite-granulite.

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