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Evidence for the Ultra-Deep Subduction (≥10GPa) of the Continental Rock from the North Qinling Terrane: Constrained from the High Temperature and High Pressure Experiment

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A suit of felsic gneiss is discovered in the Songshugou area in the North Qinling terrane. The rock is mainly composed of porphyroblastic garnet (10-20%), kyanite (5%±), perthite (25-35%) and quartz (30%±), and was previously considered to be experienced high pressure (HP) granulite facies metamorphism (Liu et al.,1996). Recently, abundant fine-grained euhedral exsolutions of rutile + apatite + quartz needles have been observed in the core part of the garnet. Long rutile needles is about 0.5-1.0μm wide and 10-100μm long distributing parallel distinctly to each other in three directions, which oriented at 60º/ 120º and along four cubic <111> directions of garnet; Apatite (0.5 to 1.0μm in width and 5 to 10μm in length), quartz (0.5 to 1.0μm in width and 10 to 40μm in length) or quartz+rutile needles parallel to each other or to the exsolved rutile in three directions. This phenomenon is similar to that of garnet with exsolutions of Ru+Ap+Qz in UHP metapelite from Rhodope region of Greek (Mposkos and Kostopoulos, 2001), indicating that the precursor garnet before exsolution contain excess Si, Ti, and P, that is, of a "majoritic" garnet.

For better constraining the peak metamorphic condition of the rock, the high temperature and high pressure (HT-HP) experiment simulating the system of continental felsic rock at P=6-12GPa, T=1200-1400°C was carried out in this study. According to the mineral composition of the experimental production and the published HT-HP experimental data (Irifune et al., 1994; Ono., 1998; Dobrazhinetskya and Green., 2007; Wu et al., 2009), the minimum stable pressure of the obvious supersilicic garnet in the system containing independent SiO_2 phase (coesite or stishovite) is ≥10GPa . This is different from that the stable pressure of the supersilicic garnet is ≥5GPa in the ultra-mafic system without independent SiO_2 phase (Akaogi and Akimoto., 1977; Irifune, 1989).

According to the new experimental data and the garnet with SiO_2 exsolution in the felsic gneiss from Songshugou area in the North Qinling, the peak pressure of the rock is inferred to be ≥10GPa, indicating the depth of the continental subduction / exhumation is ≥300km. Therefore, combined the stishovite exsolved microstructure in the pelitic gneiss from the South Altyn Tagh (Liu et al., 2007), the continental subducted and exhumated depth of ≥300km might have a certain universality.

Key words: North Qinling, felsic gneiss, exsolved quartz needle in garnet, HT-HP experiment, "Majoritic" garnet, continental subduction / exhumation

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