Volatile transfer and recycling at UHP metamorphism; constraint from CCSD (Chinese Continental Scientific Drilling) eclogites

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Abstract

Study of dehydration and decarbonation processes of subducting oceanic crust is important to understand the island arc volcanism and recycling of water and carbon to deep mantle. Recent UHP experiments in C-O-H fluid-bearing MORB system have revealed that phase change and fluid composition depend on oxygen fugacity (e.g. Molina and Poli, 2000). If oxygen fugacities represented by the equilibrium NNO (Ni-NiO) or FMQ (fayalie-magnetite-quartz) are assumed to be the average condition of UHP metamorphism, then the phase assemblages of UHP rocks are expected to have graphite/diamond only, graphite/diamond +carbonates, or carbonates only depending on the bulk compositions (Poli and Fumagalli, 2004). C-species are well described in Chinese UHP eclogites (e.g. Zhang and Kai, 1996). However, carbonates can be easily leached from outcrop. Therefore in the worst case, only graphite could be recognized from surface exposures although drilled core samples represent carbonates with graphite. From this point of view, CCSD (Chinese Continental Scientific Drilling) samples are probably the best for identification of C-species in UHP rocks. We investigated nine eclogites from various depths (170 to 2000 m). Under the microscope, the eclogites contain garnet, clinopyroxene, quartz and rutile with or without phengite, graphite, apatite, zircon, pyrite, talc, and K-feldspar. Graphite is always recognized with pyrite, suggesting oxygen fugacity was low (NNO) at UHP stage. The presence of graphite suggests that the eclogites released H_2O-rich (CO_2-poor) fluids and melt at UHP stage. The studied eclogites contain CaEs component in clinopyroxene. Therefore, Fe^{3+} content can not be calculated based on EPMA analysis. With ignoring the Fe^{3+}, P-T conditions based on the assemblage of phengite-garnet-cpx-(coesite) can be estimated as P = 3-5 GPa, and T = 850–950 ^{o}C. However, the Fe^{3+} estimation from the clinopyroxenes based on Mössbauer and XANES analysis correct the P and T condition as 3-4 GPa, and 650 -780 ^{o}C, respectively. The geothermobarometry based on the kyanite-garnet-cpx-

phengite-coesite assemblage (Ravna and Terry, 2004) is reliable because temperature estimation is independent from Fe^{3+} content in clinopyroxene. The estimation from one eclogite gives P = 3.4 GPa and T = 750 ^{o}C quite consistent with the above estimation.

Reference

Molina and Poli (2002) EPSL, 176, 295.

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Ravna and Terry (2004) JMG, 22, 579.

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