The Metamorphism and Its Tectonic Implications of Indosinian High Pressure Granulites from the Badu Complex of the Cathaysia Block, Southwestern Zhejiang Province, South China

ZHENG Changqing1, 2, XU Xuechun1, 2, ZHOU Xiwen1, ZHOU Xiao1, 2, GUO Tengda1, 2, YANG Yan1, 2 and HU Pengyue1, 2

1 College of Earth Sciences, Jilin University, Changchun 130061, Jilin, China
2 Key Laboratory of Mineral Resources Evaluation in Northeast Asia of the Ministry of Natural Resources Changchun 130061, Jilin, China
3 Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, China

Abstract: The Badu Complex is the oldest metamorphic rock in Cathaysia Block which experienced several episodes of metamorphism, especially Indosinian metamorphic reworking in the southwestern Zhejiang Province, South China. The degree of Indosinian metamorphism reaches granulite facies. However, there is still insufficient understanding of the characteristics of the Indosinian granulite metamorphism in the Cathaysia and many interpretations of its tectonic significance. Therefore, we present detailed petrology, mineral chemistry and LA-ICP-MS zircon U-Pb age in this paper from pelitic granulites of the Badu Complex, which is composed of “sillimanite + garnet + cordierite + spinel + biotite + k-feldspar” assemblage and garnet pyroxenite with garnet amphibolite which is consists of “garnet + clinopyroxene + orthopyroxene + amphibole + plagioclase”. By comprehensive study we get following new findings: Pelitic granulites record four stages of metamorphic mineral assemblages, including prograde (M4), pressure peak (M3), Peak (M2) and post-peak decompressional and then cooling (M1) stages. The prograde M4 assemblage consists of garnet (core) + staurolite + kyanite + biotite + quartz ± rutile ± chlorite; The pressure peak M3 assemblage consists of garnet (mantle) + sudoite + rutile + kyanite + corundum + biotite + quartz; The peak M1 have garnet (rim-mantle) + biotite ± sillimanite + quartz ± K-feldspar ± plagioclase ± ilmenite assemblage; the M1 stage is consist of garnet + cordierite + biotite + sillimanite + quartz + ilmenite ± spine ± K-feldspar. The garnet pyroxenite and garnet amphibolites have experienced three stages of metamorphic evolution. Peak high-pressure granulite facies stage M2 consists of garnet + sahlite ± ilmenite ± quartz; Post-peak near isothermal decompression medium granulite facies stage M3 is characterized by typical decomposition reaction textures and assemblage of orthopyroxene + plagioclase (An=90–92); amphibolites facies retrograde metamorphic stage M4 is characterized by amphibole + plagioclase (An=33–35) ± ilmenite ± sahlite ± quartz mineral assemblage.

By means of phase equilibrium simulation and traditional thermobarometer, P-T conditions of 785–820 °C and 8.9–9.9 kbar for M1 stage, 780–860 °C and 5.7–6.2 kbar for decompressional M4 stage, 705–720 °C and 4.5–4.7 kbar for cooling M4 stage in pelitic granulates were obtained. And also 11.6–12.5 kbar and 780–840 °C for M2 stage, 7.4–8.2 kbar and 800–880 °C for M3 stage, 6.6–7.5 kbar and 500–560 °C for M4 stage were obtained in garnet pyroxenite and garnet amphibolite. A clockwise P-T path is confirmed in the two type rocks of the Badu Complex which reflected a near-isothermal decompressional metamorphic process. The peak metamorphism can reach high-pressure granulite facies. In addition, the mineral assemblage of garnet + rutile + kyanite + corundum in the peak metamorphic stage of pelitic granulate indicates that it may underwent ultra-high pressure metamorphism, and the acidic plagioclase exsolution of clinopyroxene in garnet pyroxenite also suggests that it may be retrograded eclogites, which indicates that the deeper Cathaysian block may have eclogite metamorphism.

Analyses of LA-ICP-MS zircon U-Pb dating indicate that the metamorphic age of pelitic granulate is 233.5 Ma–subduction/collision followed by rapid exhumation and cooling events. The events may relate with the amalgamation of the Indochina Block–South China Block North China Block in the paleo-Tethyan domain.

Key words: pelitic granulate, garnet pyroxenite, metamorphic evolution, phase equilibrium, Indosinian, Cathaysia block.

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About the corresponding author
ZHENG Changqing, male, professor in College of Earth Science, Jilin University, 2199 Construction Street, Changchun, Jilin 130061, China. Tel: +86 18843107851; E-mail addresses: zhengchangqing@jlu.edu.cn.