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

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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 (M_1), pressure peak (M_2), Peak (M_3) and post-peak decompressional and then cooling (M_4) stages. The prograde M_1 assemblage consists of $garnet_1$ (core) + staurolite + kyanite + biotite + quartz ± rutile ± chlorite; The pressure peak M_2 assemblage consists of $garnet_1$ (mantle) + sudoite + rutile + kyanite + corundum + biotite + quartz; The peak M_3 have $garnet_2$ (rim-mantle) + biotite + sillimanite + quartz ± K-feldspar ± plagioclase ± ilmenite assemblag; the M_4 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 M_2 consists of garnet + sahlite ± ilmenite ± quartz; Post-peak near isothermal decompression medium granulite facies stage M_3 is characterized by typical decompression reaction textures and assemblage of orthopyroxene + plagioclase (An=90–92); amphibolites facies retrograde metamorphic stage M_4 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 M_3 stage, 780–860 °C and 5.7–6.2 kbar for decompressional M_4 stage, 705–720 °C and 4.5–4.7 kbar for cooling M_4 stage in pelitic granulites were obtained. And also 11.6–12.5 kbar and 780–840 °C for M_2 stage, 7.4–8.2 kbar and 800–880 °C for M_3 stage, 6.6–7.5 kbar and 500–560 °C for M_4 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 granulite 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 granulite 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 granulite, garnet pyroxenite, metamorphic evolution, phase equilibrium, Indosinian, Cathaysia block.

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