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High Pressure Granulites from Eastern Himalayan Syntaxis: P-T Pseudosection and Zircon Dating

LIU Fenglin and ZHANG Lifei*

MOE Key Laboratory of Orogenic Belt and Crustal Evolution, School of Earth and Space Sciences, Peking University, Beijing 100871, China

The Eastern Himalayan Syntaxis consists of three tectonic units: Lhasa unit as the hanging wall, High Himalayan unit as the foot wall and Indus-Tsangpo suture zone separating them.

We collected samples from the High Himalayan. Peak stage assemblage of garnet-two pyroxene granulite is garnet + clinopyroxene + quartz + rutile \pm hornblende. The reaction plagioclase + orthopyroxene \rightarrow clinopyroxene + garnet + quartz indicates that peak pressure exceeded the orthopyroxene-out pressure. A prograde P-T path from 794.25 °C and 10.57 kBar to 904.13 °C and 13.75 kBar is calculated from the intersections of the compositional isopleths of garnet in the P-T pseudosection. The peak conditions of garnet-two pyroxene granulite are 904.13 °C and 13.75 kBar with the age of 20.7 ± 2.3 Ma by U-Pb zircon dating. Retrograde metamorphism overprinted HP granulites to form garnet-orthopyroxene granulite, and the P-T conditions for the retrograde assemblage of orthopyroxene + hornblende + plagioclase + quartz + ilmenite + magnetite are <6 kBar and 720-755 °C. The amphibolite facies metamorphism overprinted HP granulites and typical amphibolite facies assemblage is hornblende + plagioclase + quartz + ilmenite + magnetite. The P-T conditions of amphibolite facies metamorphism are <6 kBar and 745 °C. The mineral inclusions in the metamorphic zircon from garnet-orthopyroxene granulite include amphibole, plagioclase and quartz, and the average age of such zircon is 9.38 ± 0.22 Ma, which indicates that the age of amphibolite facies metamorphism is 9.38 ± 0.22 Ma.

Typical associated metapelite is sillimanite-garnet-biotite-K-feldspar gneiss. The peak PT conditions for the mineral assemblage of garnet + plagioclase + K-feldspar + kyanite + biotite + muscovite + rutile are 633 °C and 14.3 kBar calculated from the intersection of the compositional isopleths of garnet in the P-T pseudosection. P-T

pseudosection calculation and the discovery of the inclusion of dehydration-melting muscovite in zircon indicate that subsequent decompressional heating occurred with the dehydration-melting of muscovite. The HP granulite facies metapelite of sillimanite-garnet-biotite-K-feldspar gneiss is characterized by the mineral assemblage of garnet + plagioclase (ternary feldspar) + K-feldspar + kyanite + biotite + rutile + melts which was formed under peak PT conditions of 790 °C and 12.5 kBar calculated from the intersection of the compositional isopleths of garnet in the P-T pseudosection. In the zircon from this metapelite, we discovered a muscovite-aluminous (Al_2SiO_5)-K-feldspar inclusion indicating the dehydration-melting of muscovite: muscovite + plagioclase + quartz \rightarrow K-feldspar + Al_2SiO_5 (kyanite) + melts, and the growth of such zircon can be caused by the melts generated from the dehydration-melting of muscovite, which turned the dry rock into fluid or melt-bearing conditions. The average age of metamorphic zircon of this metapelite is 21.34 ± 0.56 Ma which represents the age of HP granulite facies metamorphism and is in consistent with the peak age of 20.7 ± 2.3 Ma of mafic HP granulites. The retrograde P-T conditions for the assemblage of garnet + plagioclase + K-feldspar + sillimanite + plagioclase + biotite + rutile + melts are 790-835 °C and 5.5-10.5 kBar for sillimanite-garnet-biotite-K-feldspar gneiss. Spinel occurs in the more retrograde assemblage: spinel + garnet + plagioclase + K-feldspar + sillimanite + plagioclase + biotite + rutile + melts, and the P-T conditions are 815-820 °C and 4.5-6.2 kBar.

The P-T path of HP granulites from Eastern Himalayan Syntaxis is a clockwise P-T path, representing the thickening of the lithosphere caused by the continental collision of India and Asia and subsequent isothermal-decompression or decompressional cooling retrograde metamorphism caused by exhumation. The mechanism of exhumation may be channel flow. From 12.5 kBar at 17.7 Ma to <6 kBar at 9.38 Ma, the estimated exhumation rate

* Corresponding author. E-mail: lfzhang@pku.edu.cn

of Tibetan Plateau in Miocene is >2.4 mm per year.

Key words: high pressure granulites, Eastern Himalayan Syntaxis, Tibetan Plateau, P-T pseudosection

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