Cordierite gneiss from the Wanni Complex, Sri Lanka: Petrology, phase equilibria modeling and U-Pb zircon geochronology

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Sri Lanka is regarded as one of the important regions for understanding complex collisional processes during Gondwana amalgamation because of regional exposures of various high-grade metamorphic rocks. The metamorphic basement of Sri Lanka has been subdivided into four major terranes based on Nd-model ages as well as lithological and petrological characters: the Highland Complex, the Vijayan Complex, the Wanni Complex, and the Kadugannawa Complex (Cooray, 1994). Although there are many previous studies of pressure-temperature estimation and geochronological investigation from the Highland Complex, limited work has been done for the Wanni Complex. Therefore, this study reports new petrological and geochronological data for rare cordierite-bearing gneisses from the Wanni Complex, and investigates the pressure-temperature evolution and the timescale of granulite-facies metamorphism for unraveling the timing and tectonics of the Neoproterozoic collisional processes in Sri Lanka.

The samples were collected from two localities; Walpita and Madulawa. Garnet-cordierite gneiss, garnet-bearing leucocratic rock, and cordierite-bearing leucocratic rock are exposed in Walpita in the western margin of the Wanni Complex, whereas garnet-biotite gneiss, leucocratic garnet gneiss, and cordierite gneiss were collected from Madulawa, located about 10 km south of Walpita. In Walpita locality, the garnet-bearing leucocratic rock (garnet + quartz + K-feldspar + plagioclase + biotite + sillimanite + Ilmenite) occurs as migmatitic phases parallel to the foliation of host garnet-biotite gneiss (garnet + biotite + quartz + K-feldspar + plagioclase), suggesting prograde partial melting and formation of the migmatite. In contrast, cordierite-bearing leucocratic rock (cordierite + quartz + K-feldspar + plagioclase + sillimanite + spinel + magnetite) occurs as discordant veins in the host garnet-cordierite gneiss, which implies post-peak intrusion of the leucocratic rock. In Madulawa locality, leucocratic garnet gneiss (garnet + cordierite + quartz + K-feldspar + plagioclase + biotite + sillimanite + magnetite) occurs as layers or lenses in garnet-biotite gneiss (garnet + biotite + K-feldspar + plagioclase + quartz + sillimanite + Ilmenite), whereas cordierite gneiss (cordierite + quartz + K-feldspar + plagioclase + biotite + sillimanite + spinel + Ilmenite) is coarse grained and foliated, and contains fresh blue-purple cordierite grains.

Application of phase equilibria modeling in the NCKFMASHTO system using PerpleX software for the cordierite gneiss from Walpita and garnet-biotite gneiss from Madulawa yielded the peak *P-T* conditions of 835-875 °C and 5.7-7.2 kbar, 800-870 °C and 8-10 kbar, respectively. The result from Walpita is nearly consist with those inferred by previous studies from the Wanni Complex (600-850 °C and 5-7 kbar; e.g., Schenk et al., 1991), whereas that of Madulawa is similar with those inferred by previous studies from the Highland Complex (700-950 °C and 5-11 kbar; e.g., Schumacher and Faulhaber, 1994) rather than the Wanni Complex. A clockwise *P-T* evolution was inferred based on inclusion mineral assemblages in garnet (prograde) and the stability of retrograde mineral assemblages. Zircon U-Pb geochronology of the two types of leucocratic rocks from Walpita shows ca. 590-500 Ma, which probably corresponds to the peak metamorphic age of the Wanni Complex. Santosh et al. (2014) and Takamura et al. (2016) reported metamorphic age from metagranodiorite and quartzite of the Wanni Complex as 546 Ma and 537 Ma, respectively. These ages are consistent with the result of this study. The duration of the high-grade metamorphism has been thus estimated as >90 million years, which is consistent with the proposed prolonged (~140 million years) high-grade metamorphism from the boundary of the Highland Complex and the Wanni Complex (He et al., 2018). The results of this study thus suggest long-lived high-grade metamorphism of the Wanni Complex possibly related to the final collisional event after double-sided subduction (Santosh et al., 2014) during Gondwana assembly.

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