First report of ultrahigh-temperature sapphirine granulites from the Mesoproterozoic Irumide Belt in southern Africa

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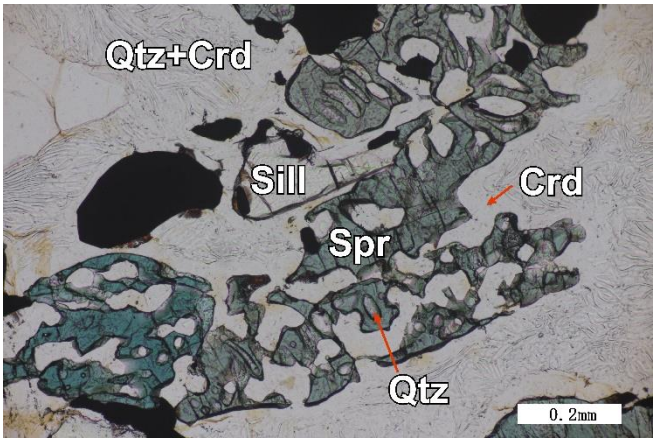
The dominant lithologies of the Paleoo- to Neoproterozoic basement rocks in Malawi exhibit semi-pelitic biotite gneiss with intercalated felsic to intermediate orthogneisses (e.g., charnockite and biotite-hornblende gneiss), metabasites (amphibolite and mafic granulite), and metasediments (e.g., khondalite, quartzo-feldspathic gneiss, calc-silicate rock, quartzite, and marbles) (e.g., Hanson, 2003; Tsunogae et al., 2021). The central part of Malawi corresponds to the boundary region of the Irumide Belt (1.1-1.0 Ga) and the Southern Irumide Belt (600-550 Ma) (e.g., De Waele et al., 2006; Johnson et al., 2006; Karmaker and Schenk, 2016). Therefore, the region is regarded as key to understanding multiple collision events during Paleo- to Neoproterozoic. However, available petrological and geochronological date from central Malawi is still limited and are not sufficient for predicting tectonic evolution of this region and allow the regional correlation of orogenic events. Therefore, we evaluated pelitic gneiss samples collected from Jenda area in the Irumide Belt situated between the Bangweulu Block to the north and the Kalahari Craton to the south, and obtained new petrological, geothermobarometric, and geochronological date from the samples.

Based on detailed petrographic and mineral chemical studies, we report here for the first time, the occurrence of sapphirine + quartz assemblage in textural equilibrium from a pelitic gneiss from the Irumide Belt. The pelitic gneiss is dark brownish gray in color and shows strong foliation. The foliation is defined by alternation of leucocratic band (which is rich in quartzs and feldspar) and melanocratic band (which is rich in Fe-Ti oxide, sillimanite, and cordierite). The rock is composed of K-feldspar, plagioclase, quartz, cordierite, sillimanite, biotite, spinel, orthopyroxene and sapphirine, with accessory monazite and zircon. Mineral equilibrium modeling has been done on the pelitic gneiss in the system NCKFMASHTO and the results gave peak *P-T* condition of >887ºC and 6.6 kbar for the sapphirine + quartz stability, suggesting ultrahigh-temperature metamorphism. In situ dating of monazite grains occurring in the gneiss revealed that the high-grade metamorphism took place at ca. 1.1 Ga, which coincides with the timing of the amalgamation of supercontinent Rodinia (e.g., De Waele et al., 2006; Johnson et al., 2006; Karmaker and Schenk, 2016).



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