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# Geothermobarometry of the Mogok pelitic gneisses from the Sagaing area, Central Myanmar

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The amalgamation of continental blocks that drifted from the northeastern margin of Gondwanaland from Late Paleozoic to Cenozoic formed the present landmass of eastern and southeastern Asia (e.g., Metcalfe, 2011). Myanmar is tectonically divided into eastern and western provinces by the Sagaing Fault, which is a 1200-km-long right-lateral strike-slip fault. The eastern province consists of the Sibumasu (Shan-Thai) Block and the western province consists of the West Burma Block and the Indo-Burma ranges. Both the Sibumasu and West Burma Blocks belong to the Sundaland. For the present study, samples were collected from the Mogok metamorphic belt (MMB), which borders the eastern province along the western edge forming a sigmoidal structure. It is 50 km wide and extends southwards from the eastern Himalayan syntaxis in the north to over 1500 km, where it joins the high-grade metamorphic belts of northern Thailand.

Our study area is situated at the central part of the MMB, north of Sagaing, and is bound by two parallel N-S trending ridges — Sagaing Ridge in the east and Minwun Ridge in the west. These two-parallel ridges are separated by the Sagaing fault valley, which varies in width from 0.5 to 1 km. Metamorphic rocks exposed in this area include gneisses, marbles, calc-silicates, schists, and amphibolites. Detailed mineralogical and petrological studies were conducted on garnet-biotite gneisses taken from the Sagaing Ridge (S30a, S26, S22a & b, and S39 from north to south). CHIME monazite ages indicate three possible crystallization events during the Paleogene period: 48.0 $\pm$ 2.4, 37.1 $\pm$ 0.8 and 27.6 $\pm$ 0.6 Ma (2-sigma level). The common mineral assemblages are garnet, biotite, plagioclase, and quartz with minor amounts of rutile, ilmenite, graphite, apatite, monazite, and zircon. Additionally, the sample S30a contains prismatic sillimanite in the matrix. In sample S26, garnets contain fibrolite inclusions and the matrix consists of prismatic sillimanite. The samples S22a and b contain fibrolite inclusions in garnet and K-feldspar matrix. In the sample S39, spinel occurs as inclusions in garnet. Garnet grains are mostly homogeneous and exhibited high Mn content and low Mg content locally at the grain boundaries: $Alm_{63-67}Prp_{28-30}Sps_3Grs_{4-5}$, $Alm_{55-72}Prp_{20-38}Sps_{1-5}Grs_{4-5}$, $Alm_{59-65}Prp_{30-35}Sps_{1-2}Grs_{5-7}$, $Alm_{58-63}Prp3_{0-33}Sps1Grs_{4-6}$, $Alm_{62-72}Prp_{17-28}Sps_{1-3}Grs_{6-10}$ in samples S30a, S26, S22a & b, and S39, respectively. Biotites were texturally categorized as (i) inclusions in garnet, (ii) isolated grains in matrix (iii) symplectitic aggregate with plagioclase around the garnet grains, and (iv) in veins through the garnet grains. Biotite inclusions and biotite content in matrix contain 5.6 wt% and 2.0 wt% of $TiO_2$ and F, respectively. Spinel contains 4.9 wt% ZnO and its $X_{Mg}$ [=Mg/(Mg+$Fe^{2+}$)] and $Y_{Al}$ [=Al/(Al+$Fe^{3+}$+Cr)] values are about 0.35 - 0.40 and 0.95, respectively.

The garnet-biotite geothermometer and two geobarometers characterized by garnet-biotite-plagioclase-quartz and garnet-plagioclase-sillimanite-quartz equilibria were employed for the pressure/temperature (P/T) estimations of the samples collected from Sagaing. Three groups of datasets were used for the calculations: (1) biotite and plagioclase inclusions and their garnet host, (2) garnet core along with biotite and plagioclase matrix, and (3) symplectite and garnet rim. The estimated equilibrium P/T conditions were 0.3 - 0.7GPa/580 - 700 ℃ and 0.6 - 0.9GPa/780 - 880 ℃ for the inclusion and matrix assemblages, respectively. Symplectitic assemblages around the garnets exhibit equilibrium conditions at 0.2 - 0.3GPa/580 - 610 ℃. The high $TiO_2$ content of the biotite grains coexisting with rutile and/or ilmenite indicate a temperature of crystallization of 800 ℃, when the Ti content of biotite is used as the geothermometer as proposed by Henry et al. (2005).

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