Petrogenesis of kyanite-bearing pelitic schists from the La France Formation, Murchison Greenstone Belt in the northern Kaapvaal Craton, South Africa

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The Murchison Greenstone Belt in the northern Kaapvaal Craton is composed of various metasedimentary and metavolcanic rocks that underwent lower to upper amphibolite-facies metamorphism. It is subdivided into four units based on lithologies and structural patterns: the Murchison Unit, the Silwana Amphibolites, Rubbervale Formation, and the La France Formation (Vearncombe et al., 1988). The La France Formation is known for the occurrence of huge (up to several cm) kyanite porphyroblasts in fine-grained matrix, although its petrogenesis is not known. In this study, we present detailed mineralogical and petrological data of various metapelitic rocks from the La France Formation, and discuss the origin of kyanite porphyroblast and the evolution process of the rocks.

The dominant mineral assemblages of the pelitic schists are;

(1) garnet + kyanite + staurolite + biotite + muscovite + quartz (garnet schist)

(2) staurolite + kyanite + biotite + muscovite + quartz (staurolite schist)

(3) kyanite + biotite + muscovite + quartz (kyanite schist)

(4) biotite + muscovite + quartz (biotite schist).

Bulk-rock geochemical data of the four types of pelitic schist suggest that the mineral assemblages are strongly controlled by the chemistry of the host rocks. For example, garnet-schist is enriched in FeO (15-28 wt.% FeO), whereas biotite-schist is depleted in FeO (7-8 wt.% FeO) and slightly enriched in MgO (7.2-9.2 %). Staurolite- and kyanite-schists are also depleted in FeO (8-9 wt.% FeO), although kyanite-schist shows slightly Mg-rich (MgO = 8.5 wt.%) than staurolite-schist (MgO = 6.3-7.7 wt.%). Metamorphic pressure-temperature conditions of the rocks were estimated based on conventional geothermobarometers as 530-550^{o}C (garnet-biotite geothermometry) and 4.1-4.2 kbar (GASP geobarometry), which is slightly lower than the results of previous studies (e.g., 8–9 kbar, 600–650^{o}C; Block et al., 2013), suggesting that the formation of kyanite could be a retrograde event. It is important to note that pelitic schists with kyanite porphyroblasts occur in high-strain zone of the La France Formation, due to which we infer that the growth of the kyanite might be related fluid activities along shear zones within the Murchison Greenstone Belt. Although the timing of the growth of the kyanite is not known, the northern margin of the Kaapvaal Craton is strongly affected by Neoarchean (ca. 2.7 Ga) high-grade metamorphism related to the collision of the Kaapvaal and Zimbabwe Cratons and the formation of the Limpopo Complex. The Southern Marginal Zone of the Limpopo Complex overthrusted onto the Kaapvaal Craton at ~2.69 Ga along the Hout-River Shear Zone (Smit et al., 2014; van Reenen et al., 2014). The formation of the shear zones in the Murchison Greenstone Belt might be related to the event.

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