

Igneous activity of Paleoarchean TTGs around Chitradurga, western Dharwar craton, India

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The western Dharwar craton (WDC) comprises mainly of TTG-type peninsular gneiss, greenstone belts, and high-potassium granites (e.g. Chadwick et al., 2000; Jayananda et al., 2013). The TTGs are widely distributed in the WDC as 3.4-3.2 Ga basement rock and occasionally contain more older sediments and volcanics (i.e. the Sargur Group) (e.g., Peucat et al., 1993). The greenstone belts, named the Bababudan Group and the Chitradurga Group, unconformably overlies the TTGs as 2.9-2.6 Ga sedimentary covers (Hokada et al., 2013). These groups consist mainly of conglomerate/quartzite, BIFs, and mafic to felsic volcanics (e.g. Chadwick et al., 1981). The high-potassium granites crop out as several isolated intrusions in both the TTGs and the greenstone belts. The intrusive ages of the granites are mostly around 2.61 Ga (e.g. Jayananda et al., 2006). The aim of this study is to discuss the igneous activity in the Paleoarchean TTGs based on the petrographic and geochemical characteristics of the peninsular gneiss around Chitradurga in the WDC, southern India.

Although the TTGs are generally composed of granitic to tonalitic gneisses, we can group them into two types in correspondence with their petrographic features; Kfs-poor meta-trondhjemite and Kfs-rich meta-granite. The Kfs-poor meta-trondhjemite has suitable petrographic feature of slab-derived TTGs. On the other hand, the Kfs-rich meta-granite contains abundant K-feldspar, a mineral phase that is not common in the TTGs.

The Kfs-poor meta-trondhjemite (SiO₂: 65-75 wt%) have typical TTGs in composition, with high Al₂O₃ (14.7-19.1 wt%) and Na₂O contents (3.6-5.2 wt%), and correlated low K₂O/Na₂O (0.27-0.74) as well as moderately high Sr (195-527 ppm) and Sr/Y (21-109), although the REE patterns have fairly variable from flat to fractionated ((La/Yb)_n=1.2-26), with no Eu anomaly. However, the Kfs-rich meta-granite (SiO₂: 69-78 wt%) shows different geochemical characteristics than that of TTGs. In particular, their Al₂O₃ (13.4-15.7 wt%) and Sr (68-310 ppm) contents are not enriched, and their K₂O/Na₂O (0.5-1.9) ratios are higher. The REE patterns are largely sub-divided into two types, one is fractionated ((La/Yb)_n=10-64) with no Eu anomaly, the other is moderately fractionated ((La/Yb)_n=1.8-21) associated with significant negative Eu anomaly. Probably, the Kfs-rich meta-granite had been formed by several different types of magmatic activities. In Paleoarchean, the western Dharwar craton was intruded by many slab-derived TTGs. In addition, it is probable that the various granitic activities were derived from strong magma differentiation and/or crustal reworking operated simultaneously to form a stable continental crust.

References: Chadwick et al., 1981, Precambrian Research 16, 31-54, Chadwick et al., 2000, Precambrian Research 99, 91-101, Jayananda et al., 2006, Precambrian Research 150, 1-26, Jayananda et al., 2013, Precambrian Research 227, 55-76, Hokada et al., 2013, Precambrian Research 227, 99-119

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