A comparison between the mafic dykes in the Western and Eastern Dharwar cratons, southern India: Implications for cratonization

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Some of the major Precambrian cratons of the world are found in the peninsular India. One such well-preserved craton is the Dharwar craton, which is mainly composed of basement Tonalite-Trondhjemite-Granodiorite (TTG) type gneiss called Peninsular gneiss (3.40–2.56 Ga), two different generations of greenstone belts (older 3.35–3.20 Ga and younger 2.90–2.54 Ga) and also intruded by high potassic granites (2.62–2.52 Ga) (French et al., 2010; Jayananda et al.,2006; Meert et al., 2010). Based on the age and lithological characteristics the Dharwar craton is divided into two as Eastern Dharwar craton (EDC) and Western Dharwar craton (WDC) along a N-S trending shear zone called Chithradurga shear zone. The entire craton is profusely invaded by mafic dykes. Mafic dyke swarms in Eastern Dharwar craton are reported to be mainly of three different age groups; oldest 2.3 Ga, 2.2-2.1 Ga and 1.8 Ga. However, the mafic dykes of the Western Dharwar caton has been not studied well and in the current study, one of the major dyke swarm of the Western Dharwar craton ie, Tiptur dyke swarm is considered.

Tiptur dyke swarm consists predominantly of NW-SE and NE-SW dykes along with a few N-S and E-W trending dykes. Petrological studies indicate that the studied dykes fall into two distinct groups. The NW-SE trending dolerite dykes were unaltered, composed of lath shaped plagioclase and euhedral to subhedral minerals of both clinopyroxene and orthopyroxene, clinopyroxene being more common and opaque minerals. In contrast, the NE-SW trending ones are metamorphosed doleritic dykes, showed high degree of alteration with the preservation of only 50% or less of original texture and mineralogy. The major, trace and rare earth element characteristics of dolerites are different as compared to the meta-dolerites. Rb/Sr and Sm/Nd Isotope geochemistry also has been carried out. Initial Sr87/Sr86 ratio of meta-dolerites is lower than dolerites (The initial Sr ratio for meta-dolerite is 0.7009 and for dolerites is 0.7025). Although with large errors, the isochron relations show an older age for the meta-dolerites (c.2.87Ga) and a younger age of c.2.3 Ga for the dolerites. The initial 143Nd/144Nd ratio is higher for meta-dolerites compared to dolerites. The ε Nd values are positive and are high for meta-dolerites compared to dolerites. A high ε Nd values indicates derivation of these dykes from a depleted mantle with meta-dolerites from a more depleted mantle source.

The difference in petrography, major, trace and rare earth element geochemistry between the dolerites and meta-dolerites lead to a preliminary inference that these two suit of rocks might not be co-genetic rather formed from different batches of melting or source magma. The dolerites of the current study are comparable to the dykes in EDC. Geochemically coherent suit of dykes has been found which has similar petrographic features as well. Meta- dolerites from the WDC has not been reported from the EDC. The evolution of the Dharwar craton suggests that the WDC is older than EDC and both the cratons were separate during the early Archean and amalgamated at around 2.5 Ga along the Chitradurga shear zone. It is possible to assume that the meta-dolerites might be a part of an earlier event, not reported in EDC and therefore might have emplaced prior to the amalgamation of WDC and EDC, although precise age dating and paleomagnetic data are required to confirm the same. Also, WDC, having a thicker crust than that of EDC due to the oblique convergence of the craton, exposes a deeper level of crust which could be thought to expose an older swarm, ie, the meta-dolerites in the study.

References: French and Heaman., 2010, Precambrian Research, 183, 416–441. Jayananda et al., 2006, Precambrian Research, 150, 1–26. Meert et al., 2010, Journal of Asian Earth Sciences, 39, 483–515.

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