Genesis and evolution of the enriched subcontinental lithospheric mantle beneath South India

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The Dharwar craton of South India was a main part of the earth's oldest continental assembly named Ur (-3000Ma) and also existed in later supercontinents emerged during earth history (Rogers and Santosh, 2003). Revealing the histories of the Dharwar craton and added periphery crust are profitable for tracing the history of supercontinents (their amalgamation, evolution and dispersion). Similar to the geological and geochlonological evidences of crastal rocks, the geochemical information from lithospheric mantle keel beneath the craton is also an important constraint for unraveling the long history of the Dharwar craton. The existence of long lived enriched lithospheric mantle is known beneath the Dharwar and periphery area. It is anticipated that the genesis and evolution of this enriched mantle reflect the major geological event in the history of the Dharwar craton.

The existence of alkali metal- and LREE-enriched lithospheric mantle beneath southeastern periphery of the Dharwar craton has been inferred based on Sr-Nd-Pb isotopic data on carbonatites and alkaline silicate rocks (Kumar et al., 1998; Schleicher et al., 1998; Miyazaki et al., 2000; Pandit et al., 2002; etc.). The Sr and Nd isotopic data also suggest that the sub-continental enriched lithospheric mantle remained a closed system from 2.6-2.5 Ga to 800-750 Ma and survived from convective disruption (Kumar et al., 1998; Miyazaki et al., 2003). The tholeiite dyke swarms of 1.6 and 1.8 Ga in this region also have evidence deriving from this enriched mantle source (Radhakrishna and Joseph, 1998). On the basis of difference in the isotopic signatures between coexisting carbonatites and syenites, Miyazaki et al (2003) have envisaged isotopically different enriched mantle sources and indicated mantle heterogeneity.

The event of mantle enrichment occurred at the late Archaean is now controversial, but it is significant topic to reveal the early history of the Dharwar craton. Although Jayananda et al. (2000) proposed the existence of an enriched mega-mantle-plume during the Late Archaean, there are many evidences approving the mantle enrichment by earlier subduction event. Miyazaki et al. (2003) indicated that the Neoproterozoic syenites and other mantle-derived intrusives have diagnostic trace-element signatures, typical to the magmas erupted in convergent margin. They inferred that slab-derived component played a major role for the genesis of long-lived enriched lithospheric mantle. The C isotope of the carbonatites also shows subduction related signature. Pandit et al. (2002) indicated that the relative enrichment of 13C in the Neoproterozoic carbonaties as compared to the Paleoproterozoic carbonatites is a result of the equilibration of CO2 derived from the ocean crust with existing carbon reservoir. Geological evidence of late Archaean subduction was summarized by Chadwick et al. (2000) who interpreted the whole craton in terms of accreted island arc. Moreover, in southeastern periphery of the Dharwar craton, several types of basement gneiss with age about 2.5 Ga have geochemical composition similar to the sanukitoids or average TTG(tonalite-trondhjemite granitic rock), favoring the active subduction event of late Archaean (Moyen et al., 2001). According to the view points mentioned above, it is understood that the late Archaean subduction was major event in the history of the Dharwar craton and generated the long lived enriched lithospheric mantle.

The spatial extent of the enriched lithospheric mantle may reflect the scale of the late Archaean subduction. Nd isotope investigations of the charnockites and basic granulite from the Eastern Ghats Belt and eastern Antarctica revealed prolonged development of enriched lithospheric mantle (Arima et al., 2001). Although detailed investigations are required, the late Archaean subduction might occur in large area of old continental assembly.