Geochemistry and Sr-Nd isotope studies of Proterozoic basic dykes, southern granulite terrain, India.

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The Southern granulite terrain (SGT) occurring to south of the Dharwar craton in southern India is dissected by several crustal-scale lineaments like Palghat-Cauvery, Moyar-Bhavani and Salem-Attur shear zones. In the north-eastern part of the SGT a series of post-tectonic ca. 1800 Ma old carbonatite and alkali syenite intrusions occur along Javadi Hills lineaments (JHL). This lineament is considered to represent rift-welded zone between the Dharmapuri-Krishanagiri (DK) terrain and Madras-Tiruvannamalai (MT) block occurring to the west and east respectively. Predominantly, two sets of dyke swarms, NW and NE trending are found in the MT block, where as, nearly E-W trending dyke swarms occur in the DK terrain and the JHL. Rb-Sr and Sm-Nd isotope studies have been carried out to determine the time of dyke intrusion and their petrogenesis.

The dykes are medium to coarse grained and least altered preserving the original igneous textures. Plagioclase feldspar and pyroxenes exhibit sub-ophitic or ophitic texture, titanomagnetite trellis and more advance replacement of titanomagnetite by pseudobrookite oxi-exsolution textures [1], which indicate slow rate of cooling of their magma. These dykes are of basaltic tholeiite composition and enriched in LILE and LREE relative to the primitive mantle. Initial Sr and Nd isotope ratios and trace element abundances indicate differences in the petrogenesis of the DK terrain and MT block dykes.

T_{DM} Model ages for the dykes of MT block range from 1911 to 2292 Ma, while for the JHL and DK terrain varies from 2121 to 2670 Ma. The Rb-Sr mineral isochron age for a NW trending dyke occurring in the MT block is 2295 ± 220 Ma and Sm-Nd mineral isochron using planefit [2] yields an age of 2318 ± 66 Ma. The earlier reported K-Ar whole rock age of 1630 ± 30 Ma [3] for the dyke from the same region may indicate that the K-Ar system was thermally disturbed. Hence the dykes occurring in the MT block might have crystallized ca. 2300 Ma ago while the shear zone dykes may be older as inferred from the T_{DM} model ages. This revised age may be considered for the reconstruction of the Apparent Polar Wander (APW) Path for this part of SGT.

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Probing the conditions of mantle melting with iron isotopes

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While extraterrestrial basalts have near-chondritic iron isotopic compositions (~0 ‰), mid-ocean ridge and ocean island basalts have heavy δ^{56}Fe (~+0.1 ‰ relative to IRMM-014) [e.g., 1]. This was interpreted to reflect kinetic isotope fractionation associated with vaporization during the Moon-forming impact [2] or equilibrium fractionation at core-mantle boundary conditions [3]. A more mundane interpretation is that Fe isotopes are fractionated during partial melting [4]. Indeed, fertile mantle peridotites define a δ^{56}Fe value of 0.02±0.03‰, indistinguishable from chondrites [4]. In addition, measurable isotopic fractionation between olivine and melt was recently documented in a natural example of magmatic differentiation [5]. Whether Eoarchean magmas had δ^{56}Fe similar to phanerozoic MORBs-OIBs is presently unknown. Dauphas *et al.* [6] suggested that such magmas could have had δ^{56}Fe closer to chondritic but analytical precision was insufficient to reach a definitive conclusion. We report high precision isotopic analyses of Fe [7] in chondrites and mafic igneous rocks. Several Eoarchean island arc basalts and boninites have Fe isotopic compositions similar to mantle peridotites. A quantitative model is presented that can explain Fe isotopic variations measured in mantle-derived magmas. While Fe isotopes may not be very useful for tracing processes of planetary formation, they provide invaluable information on the conditions of magma genesis through time.

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