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Archean mantle metasomatized by sediment melts recorded in mafic dykes of the Singhbhum Craton

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Large scale mass transfer from the Earth's crust to the mantle via subduction and associated dehydration and partial melting of subducted material leads to major metasomatic modification of the upper mantle. Evidence exists for widespread metasomatism of the upper mantle in the Phanerozoic and Proterozoic [1], but is comparatively scarcer for the Archean. Dyke swarms emplaced into different Archean cratons effectively track the secular evolution of the sub-continental lithospheric mantle (SCLM) beneath these cratons [2]. Mobility and stable isotope fractionation of the redox-sensitive element Mo combined with radiogenic isotopes (Sr, Nd, Hf), have the potential to track multicomponent recycling and thereby metasomatism of the mantle once overlying the subducting slab [3, 4].

Four dyke swarms belonging to the Newer Dolerite Dykes of the Singhbhum Craton, emplaced between 2.80 Ga and 1.76 Ga, indicate that their parental melts were in equilibrium with a mantle peridotite source and were not much modified by crustal assimilation and fractional crystallization during magma ascent and emplacement [2]. Nd-Hf isotope data from these dykes show progressively evolved crust-like signatures in their mantle source, along with large intra-swarm variability. Radiogenic isotopes, combined with trace element abundances, hint towards the existence of a compositionally heterogeneous and metasomatized SCLM beneath the Singhbhum Craton before 2.8 Ga. Trace element ratios indicate limited involvement of slab-derived aqueous fluids during metasomatism of the source(s) of the dykes in the SCLM of the craton. However, the covariation of $\delta^{98/95}$Mo with immobile element ratios indicate the involvement of hydrous melts of surface-derived materials in the metasomatism of SCLM. Multicomponent mixing models involving three isotope systems (δMo, εHf, εNd) and element abundances (Mo, Ce) affirm that metasomatism of SCLM in the Singhbhum Craton was facilitated by partial melts that were derived from anoxic sediment and oceanic crust during the Archean. This metasomatism could have been coeval with continental crust formation in the Singhbhum Craton.

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