Multiple sulfur isotope geochemistry of the Precambrian mafic dyke swarms in the Dharwar craton, South India.

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Archean rock units are perfect tracers of various events occurred in the early Earth systems. The records of the anoxic atmosphere in the Archean and the interaction of the lithosphere-hydrosphere and atmosphere has been recorded in these units as Mass Independent Fractionation (MIF) of sulfur isotopes until about 2.4 Ga. The recycling of these Archean materials in the mantle leads to the occurrence of sulfur isotopic composition with Mass independent fractionation in the mantle-derived rocks. However, isotope fractionation can also occur in high-temperature high-pressure conditions, possibly associated with deep mantle dynamics. As per the cosmochemical records, a prime share of the Earth’s sulfur is present at the core [1]. This implies that the magma reservoirs in the deep mantle should also have fractionated sulfur isotopes although it has been considered to have chondritic sulfur isotopic ratio. In the mantle, sulfur is found predominantly in the form of sulfides [2]. Significant equilibrium isotopic fractionation occurs in the deep Earth under the higher pressure-temperature conditions, however, recently recycling of surface sulfur has been considered as well using multiple sulfur isotope signatures [3].
In the current study, the mafic dyke swarms in the Dharwar craton are considered. A detailed geochemical characterization of the dykes were carried out, including Sr and Nd isotopic composition. The results indicate a prominent enriched mantle component in younger paleoproterozoic dykes, whereas older Archean dykes preserve primitive mantle signatures [4]. Reconnaissance analysis of representative dyke of various ages have been carried out for the multiple sulfur ($\delta^{34}S$, $\Delta^{33}S$ and $\Delta^{36}S$) isotope composition. $\delta^{34}S$ for all the samples were negative, whereas $\Delta^{33}S$ and $\Delta^{36}S$ shows only nominal, but distinct variations. The samples are showing a scattered distribution in the variation diagrams of both $\delta^{34}S$ versus $\Delta^{33}S$ and $\Delta^{33}S$ versus $\Delta^{36}S$ and are suggesting a mantle signature in most cases. The distribution of the multiple sulfur isotope and their relative abundances in the form of $\Delta^{33}S$, $\delta^{34}S$, and $\Delta^{36}S$ leads to a better understanding of the Archean sulfur reservoirs and the possible isotopic fractionation in the deep earth. Further detailed studies are ongoing, and we present a comprehensive evaluation of recycling vs. mantle components in the Archean to Paleoproterozoic lithospheric mantle beneath the Dharwar craton.

References

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