

## Multiple sulfur isotope geochemistry of Dharwar Supergroup, Southern India: Late Archean record of changing atmosphere

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Sulfur isotope mass-independent fractionations (S-MIF) in sedimentary sulfides and sulfate provide strong constraints on the evolution of the early Earth's atmosphere. In the late Archean, the S-MIF signature changed dramatically: minimum  $\Delta^{33}\text{S}$  at around 2.9 Ga, subsequent large  $\Delta^{33}\text{S}$  variation culminated at 2.5 Ga and its sudden drop at the end of Archean. Moreover,  $\Delta^{33}\text{S}$ - $\Delta^{36}\text{S}$  relation shows characteristic slope of around -0.9 in the Archean period [1]. The change of  $\Delta^{33}\text{S}/\Delta^{36}\text{S}$  slope may reflect perturbation of atmospheric chemistry, though the mechanisms of the large  $\Delta^{33}\text{S}$  variations and the  $\Delta^{33}\text{S}$ - $\Delta^{36}\text{S}$  relation is still a matter of debate. We report multiple sulfur isotope data for sedimentary pyrite derived from the Dharwar Supergroup in the Western Dharwar craton, southern India. The lower unit (post-3.0 Ga) of the Dharwar Supergroup consists of basal conglomerate, stromatolitic carbonate, silici-clastics with diamictite, chert/BIF and pillow basalt in ascending order. The upper unit unconformably overlies the pillow lava, and consists of conglomerate/sandstone with  $\sim 2.6$  Ga detrital zircons, komatiite lava, BIF and silici-clastic sequence with mafic volcanics. Sulfur isotope analysis of extracted sulfide of these sedimentary rocks display clear MIF record of high  $\Delta^{33}\text{S}$  values up to +3.9%. The  $\Delta^{33}\text{S}/\Delta^{36}\text{S}$  slope changes from -1.52 to -0.96 in ascending stratigraphic order. The lowest slope value of -1.52 from Bababudan Group is stratigraphically just below the Talya diamictite, implying the link between shift of atmospheric chemistry and climatic system. On the other hand, carbonate rocks from Bababudan Group show very large variation  $\delta^{34}\text{S}$  values up to +19.4% with negative  $\Delta^{33}\text{S}$ , whereas other sedimentary rocks show near 0%  $\delta^{34}\text{S}$  value. The observed lithologic control possibly reflect geographical heterogeneity of S-MIF and sulfate reducing activity in the late Archean ocean.

[1] Farquhar (2000) *Science*, **289**, 756-758.

## Determination of U, Cs and Sr isotopes and their distribution coefficients in soil affected by Fukushima daiichi nuclear power plant accident

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Isotopic determination of U ( $^{238}\text{U}$ ,  $^{235}\text{U}$  and  $^{234}\text{U}$ ), Cs ( $^{137}\text{Cs}$  and  $^{134}\text{Cs}$ ) and Sr ( $^{90}\text{Sr}$ ) were carried out in soil samples around Fukushima daiichi nuclear power plant (FDNPP) to find out source and extent of contamination due to fallout activity resulted as a consequence of the nuclear accident caused due to a severe earthquake followed by tsunami.  $^{137}\text{Cs}$  activity was found to vary from  $930\pm 20$  Bq/Kg to  $62,200\pm 900$  Bq/Kg which is much higher than the global fallout in Japan.  $^{134}\text{Cs}/^{137}\text{Cs}$  activity ratio was found to vary from 0.84-0.87, comparable with other reported values.  $^{90}\text{Sr}$  activity found to vary from  $8.4 \pm 1.5$  Bq/Kg to  $21.2 \pm 2.6$  Bq/Kg. Distribution coefficients ( $K_d$ ) were measured using laboratory batch method to establish transfer of radionuclides.  $K_d$  values for U, Cs and Sr were found to be  $\log U-K_d \approx 3 > \log Cs-K_d \approx 2 > \log Sr-K_d \approx 1-2$  (Fig.1). Chemical characterization with respect to different soil parameters like particle size distribution, pH, organic content, cation exchange capacity,  $\text{CaCO}_3$ , elemental and oxide composition of soil has been carried out to understand the geochemical behavior of these radionuclides. A good correlation was observed for  $U-K_d$  with Fe and organic content of soil. Similarly  $Cs-K_d$  and  $Sr-K_d$  show good correlation with cation exchange capacity and fine particle concentration respectively.

Site specific  $K_d$  values can be used for contaminant transport model to predict the radionuclide migration and also the relationship between soil parameters and sorption behavior of radionuclides will be helpful for soil remediation and dose assessment.

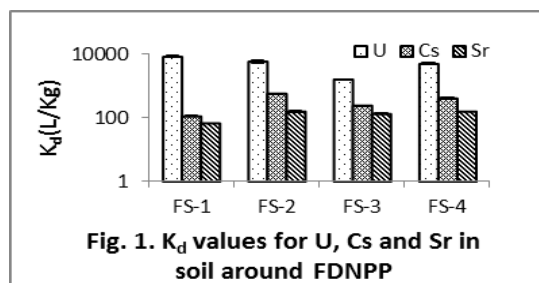


Fig. 1.  $K_d$  values for U, Cs and Sr in soil around FDNPP