

## ANNUAL REPORT ON GEOTRACES ACTIVITIES IN INDIA

May 1st, 2023 to April 30th, 2024

### *New GEOTRACES or GEOTRACES relevant scientific results*

- Understanding the source of mineral dust in the Indian Ocean.

Aeolian transportation of mineral dust is an important contributor of trace elements and nutrients to the ocean surface. Further, the Aeolian supply of mineral dust also influences the biogeochemical cycling of C and N. The effect of Aeolian mineral dust supply on the ocean biogeochemistry and nutrient and trace element cycling can be better understood through studies focussed on latitudinal variability of dust provenances and fluxes.

Working with these primary objectives, radiogenic Sr ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) and Nd ( $\epsilon_{\text{Nd}}(0)$ ) isotopic compositions of silicate fraction of mineral aerosols collected over the Indian Ocean (both pelagic northern and southern Indian Ocean regions) were studied. The samples were collected during GEOTRACES-India research expeditions (GI-01: March-April 2014 and GI-02: April-May 2014). The Sr and Nd isotopic compositions of the collected aerosol samples show the significant spatial distribution in different parts of the region: (i) the Bay of Bengal, (ii) the Arabian Sea, (iii) the equatorial Indian Ocean, and (iv) the southern sector of Indian Ocean.

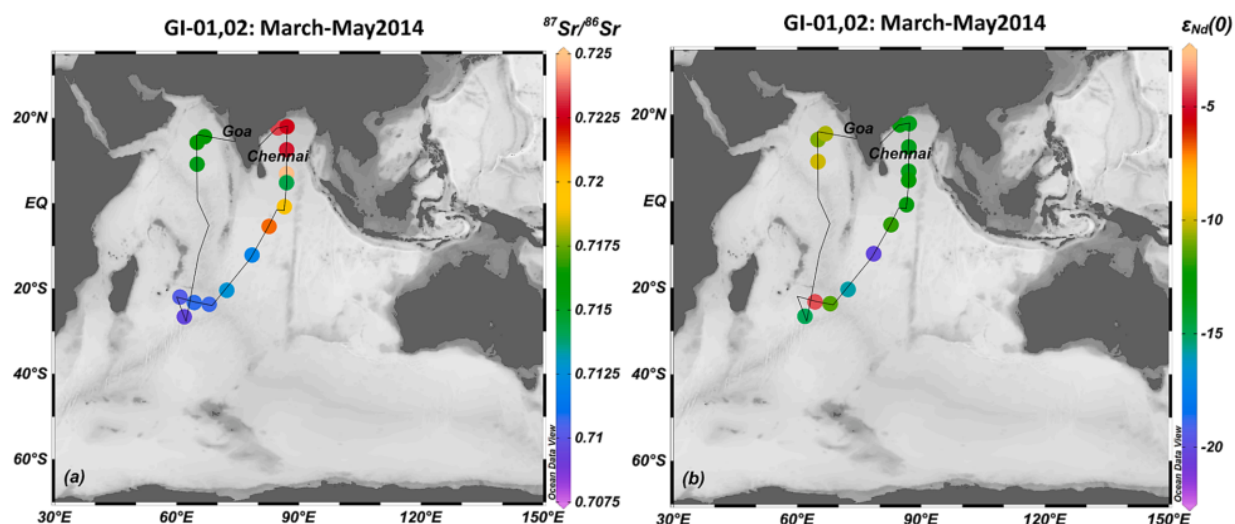


Fig. 1: Spatial distributions of (a)  $^{87}\text{Sr}/^{86}\text{Sr}$  and (b)  $\epsilon_{\text{Nd}}(0)$  in the silicate fraction of dust samples collected over the Indian Ocean (GI01 and GI02 cruises).

Major findings of this work are:

- Based on the Sr and Nd isotopic composition of the dust collected over the Bay of Bengal, the source region was identified to be from the Thar Desert.
- The dust falling over the Arabian Sea shows a very limited spread both in  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $\epsilon_{\text{Nd}}(0)$ , varying from 0.71520 to 0.71642 and  $-10.9$  to  $-10.1$ , respectively. The isotopic data in conjunction with the air mass back trajectories, indicates dust supply from the Arabian Peninsula.

(iii) For the Equatorial Indian Ocean, it was established that the region receives dust flux primarily from three different sources: The Thar Desert, sand dunes in northern Australia, and the Indonesian Archipelago.

(iv) The southern sector of the Indian Ocean region receives dust from three major source regions: Antarctica, western Australia, and South Africa/South America.

These results have great implications for understanding the pathway of dust deposition over the Indian Ocean region and modeling the dust transport and dispersal in the region.

- **Biogeochemical cycling of dissolved Nickel in the Indian Ocean**

The dissolved Nickel concentration (dNi) in the samples collected from the GEOTRACES-India research expedition GI09 was measured. The samples were collected across the latitudinal gradient in the Indian Ocean from 17 stations. Overall, the dissolved Ni concentration in these waters varies from 2.0 to 9.7 nM. In the surface and sub-surface layers (< 100 m), the dissolved Ni abundance varies from 2 to 4 nM. The dissolved Ni concentration in the intermediate waters (100 – 1000 m) was measured to be ~ 2 to 8 nM. In the deeper layers of the Indian Ocean waters (1000 – 6000 m), the dissolved Ni concentrations vary from ~6 to 11 nM. Overall, the dissolved Ni concentrations in the northern Indian Ocean are relatively higher (reaching ~10 nM) than in the equatorial and southern Indian Ocean. The relatively higher dNi in the northern Indian Ocean is possibly due to higher particulate remineralization in the relatively oxygen deficient waters of the northern Indian Ocean. Further, the amount of Ni released from the remineralization of the sinking particulate matter (Nixs) was estimated using an inverse modeling approach. Based on the inverse model, excess Ni (Nixs) in the water column of the Indian Ocean was estimated to range from 0.2 to 4.2 nM. The Nixs represent the part of Ni sourced from the remineralization of the sinking particles within the water column, unsupported by the water mass circulation.

***GEOTRACES or GEOTRACES relevant cruises***

- There was no new sample collection done throughout the last year. However, various water and sediment/particulate samples are being analyzed currently for their trace element and isotopic composition and other key parameters.

***New projects and/or funding***

- NA

***GEOTRACES workshops and meetings organized***

- NA

***Outreach activities conducted (please list any outreach/educational material available that could be shared through the GEOTRACES website) (We are particularly interested in recordings from webinars from GEOTRACES research)***

- NA

***Other GEOTRACES activities***

- NA

***New GEOTRACES or GEOTRACES-relevant publications (published or in press) (If possible, please identify those publications acknowledging SCOR funding)***

Singh N. D., Singh S.K., Malla N., and Chinni V., Biogeochemical cycling of dissolved manganese in the Arabian Sea, *Geochimica et Cosmochimica Acta* 343 (2023) 396–415.

Rahaman W., Singh S.K., Behaviour of barium in the tropical estuaries: Implications to its marine budgets and paleo-oceanographic applications, *Marine Chemistry* 254 (2023) 104278.

Bikkina S., Shukla A., Singh S.K., Karri D., Singh N.D., Sahoo B., Link of the short-term temporal trends of Sr and Nd isotopic composition of aeolian dust over the Arabian Sea with the source emissions, *Science of the Total Environment* 892 (2023) 164680.

A Shukla, SK Singh, DP Singh, A Sharma, AP Dimri, Strong climate control on the millennial-scale dust variability and sediment provenances in the Equatorial Indian Ocean inferred from Sr-Nd isotopes, *Paleoceanography and Paleoclimatology* 39 (3), e2023PA004808

D Karri, S Bikkina, SK Singh, Tracing the provenance of mineral dust over the northern and southern Indian Oceans during the GEOTRACES-India (GI-01, GI-02) expeditions, *Geochimica et Cosmochimica Acta* 366, 141-153

***Please indicate if there is any forthcoming or planned GEOTRACES special issue publication***

- NA

***Completed GEOTRACES PhD or Master theses (please include the URL link to the pdf file of the thesis, if available)***

- NA

***GEOTRACES presentations in international conferences***

- NA

Submitted by:

Vineet Goswami

[vineetg@prl.res.in](mailto:vineetg@prl.res.in)