Wednesday Talk Series
Date: Wednesday, September 10, 2025
Time: 04:00 PM-5:00 PM
Venue: Mithal Hall, Department of Earth Sciences, IIT Roorkee

Indian monsoon driven N_2O emission in the Arabian Sea during the last two interglacial cycles

Speaker: Rahul Pawar

Abstract: Under a 2˚C future warming scenario, calculating the total Carbon budget becomes imperative. In this context, estimating other greenhouse gases, such as nitrous oxide (N_2O), is crucial. This study aims to delineate the long-term variability of atmospheric N_2O. Modern estimates suggest that oceans contribute nearly 40% of natural N_2O emissions to the atmosphere, primarily through denitrification in oxygen-deficient waters. The Arabian Sea, with its intense Oxygen Minimum Zone (OMZ), accounts for almost one-third of these emissions. The strength of the OMZ is controlled by enhanced primary productivity during the strong monsoon seasons, leading to higher denitrification and increased N_2O production. To understand the role of the Arabian Sea denitrification in N_2O dynamics, we analysed the relative abundance of planktic foraminifera *Globigerina bulloides*, total nitrogen, and $\delta^{15}N$ of the bulk sediments from the marine sedimentary core SSD004 GC11 (6.0°N, 78.9°E; 2901 m), spanning 167 kyr BP. Our $\delta^{15}N$ record shows strong covariance with *G. bulloides* values, closely resembling atmospheric N_2O observed in ice core records. Higher $\delta^{15}N$ and *G. bulloides* during interglacials indicate higher denitrification linked to increased productivity and higher atmospheric N_2O levels, while lower values during glacials suggest the opposite.

We compiled published $\delta^{15}N$ records from across the Arabian Sea, revealing synchronous denitrification fluctuations regionally. However, the magnitude of these variations differed, influenced by the spatial distribution of the OMZ core and changes in subsurface ventilation on glacial-interglacial timescales. This study highlights the Indian Monsoon's role in driving Arabian Sea denitrification and its contribution to atmospheric N_2O levels.

Brief introduction: Rahul Pawar is pursuing his doctoral research under the guidance of Prof. Dharmendra Pratap Singh. He holds an Integrated MTech in Applied Geology from Kurukshetra University. His Ph.D. work focuses on palaeoceanographic reconstruction of the tropical Indian Ocean during the Late Pleistocene, using a combination of geochemical and faunal proxies.