Physical Research Laboratory

Tuesday Seminar

Speaker: Dr. Anupam Banerjee
Date & Time: 22nd September, 2020 @ 16:00 Hrs
Venue: Online Platform (Google Meet)
Title: Applications of radiogenic and non-traditional stable isotopes to investigate silicate weathering, crustal recycling and mantle geodynamics

Abstract

Weathering of silicate rocks releases cations which are transported to the oceans by rivers where calcium carbonate precipitates from the seawater; resulting in the net consumption of atmospheric CO_2. These marine carbonates are eventually subducted resulting in mantle heterogeneity, sampled by mantle-derived magmas. Long-lived radiogenic and non-traditional stable isotopes provide insights into both the surface and deep mantle processes.

Significant variations in the long-lived radiogenic Nd, Sr and stable Ca isotopic compositions of a 2.5 billion years old weathered basalt suggest that selective weathering of rock forming minerals (plagioclase versus pyroxene) could change the isotopic compositions of silicate rocks in a hand-specimen scale. Such mechanism is likely to be more pronounced in temperate climatic conditions where incongruent weathering is more dominant. This process has important implications for the isotopic variability in global rivers draining through the temperate climate region (e.g., Icelandic rivers).

Stable calcium isotope (expressed as $\delta^{44/40}$Ca w.r.t NIST SRM 915a) is also a potential tracer of crustal recycling since surface carbonates have much lower $\delta^{44/40}$Ca (0.1-0.6‰) than Earth's mantle (0.94 ± 0.10 ‰). Calcium isotopic compositions of carbonatites, magmatic rocks with more than 50% carbonate minerals, provide insights into the crustal recycling due to its high calcium and carbonate contents. The correlated variation of $\delta^{44/40}$Ca with $^{87}Sr/^{86}Sr$ of global carbonatite samples, of age 2.61 Ga until recent, suggests the presence of recycled carbonates in their mantle source regions. However, a closer inspection reveals that crustal recycling is more prominent in the last 300 million years. The prevalent Ca and Sr isotope signatures observed in carbonatites younger than 300 Ma could reflect the following: (1) an increased amount of subduction flux and high convergence rates due to amalgamation and subsequent break-up of the Pangea supercontinent; (2) enhanced weathering of aragonitic shelf carbonates linked with the Siberian Trap magmatism at 251.9 Ma.

The Speaker

Dr. Anupam Banerjee is currently a postdoctoral researcher at Niigata University in Japan where he is carrying out research on the applications of Sulfur isotopes on magmatic rocks. He completed his PhD in 2018 from the Indian Institute of Science, Bangalore. Prior to this, he obtained his bachelor's degree in Geology from Presidency College under the affiliation of University of Calcutta, followed by a master's degree in Applied Geology from the Indian Institute of Technology, Kharagpur. His main research interest lies in high-temperature isotope geochemistry although he started his PhD which involved understanding low-temperature processes. Dr. Anupam has first-hand experience in setting up a clean lab and calibration of ICPMS and TIMS at the IISc. He has published in internationally acclaimed journals and has four first authored articles. Although he has worked on multiple stable and radiogenic isotope systems, his main expertise is the applications of stable calcium isotopes on magmatic rocks.

All are invited to attend and participate in discussion

A .K. Sudheer, Geosciences Division