PETROLOGY / GEOCHEMISTRY

The geochemistry research group has been involved in deciphering the geochemical clues to the Earth's physical and chemical processes by analyzing the chemistry of terrestrial 7 materials. One of the primary foci is to understand the chemical geodynamics of the crust mantle system and the evolution of our planet Earth using open system box models by simulating the evolution of radiogenic isotopic systems (Rb-Sr, Sm-Nd, U-Th-Pb, Lu-Hf systematics, and short-lived ^{146}Sm-^{142}Nd and ^{182}Hf-^{182}W isotope systematics) in the Earth's terrestrial reservoirs over the age of the Earth (4.56 Ga). The team has estimated the average chemical composition (including Sr-Nd-Pb-Hf isotope composition) of the Indian upper continental crust that can be used as a proxy to understand the chemical evolution of the Indian subcontinent. They have estimated the major and trace element composition of average Indian Archean and post-Archean shale and attempted to determine the rate of growth of the Indian continental crust. Research is ongoing on the mantle melting process leading to the formation of continental flood basalts and associated alkaline and carbonatite rocks, and particularly the genesis of silicic rocks in the Deccan Traps province. One collaborative research uses carbonaceous aerosols' chemistry (stable carbon and nitrogen isotopic composition) for source apportionment studies. Another major direction of the Geochemistry group is centered around the applications of major, trace element concentrations, stable (e.g., Ca, Zn, Mg, S) and radiogenic (e.g., long-lived Sm-Nd, Rb-Sr and short-lived Hf-W systems) isotopic ratios of mantle-derived rocks. The research helped in understanding the cause and development of mantle heterogeneity, temporal and spatial evolution of Earth's mantle with implications on the long-term storage of subducted crustal material inside the mantle and deep carbon cycle. Additionally, the team has contributed to understanding deep Earth processes like core-mantle interactions and early differentiation of the Earth's mantle. Another research area is about the tectonics and crustal evolution of various shear/suture zones and crustal blocks. Origin and growth of earth's early crust is studied focusing on the Archean crustal evolution of cratons in India. Metamorphic history of various crustal domains is also studied and integrated with structural, geochemical and geochronological results to interpret the petrogenesis. These results are finally correlated with various shear/suture zones and crustal units of other continental fragments to understand the paleogeography. A very new component of the research team spans the fields of ore geology and mineralogy and uses field, experimental, and analytical techniques to understand the genesis and evolution of mineral deposits and the environmental impacts of metal discharges from mining and smelting areas. The research group focuses on: (i) understanding the behavior of precious and toxic trace metals during metamorphism and alteration; (ii) understanding the crystal chemistry of sulfides, with a particular emphasis on non-stoichiometry problems; (iii) understanding the role of As in gold transportation and precipitation in carline- and orogenic-type gold deposits; (iv) understanding the role of sulfur in enrichment of PGEs and REEs in magmatic systems; and (v) understanding the role of microorganisms in ore deposit formation and leaching.