ABSTRACT

The Proterozoic Eon (2500-541 Ma) is the longest and one of the most eventful periods in the history of the Earth. Significant biological and geological changes such as the oxygenation of the atmosphere and ocean, evolution of multi-cellular life, and assembly and breaking up of several supercontinents occurred during this Eon. Sedimentary rocks of the Proterozoic serve as record keepers of such events which have shaped our planet to its present state. In spite of the fact that the Proterozoic sedimentary basins of India are storehouses of such information, limited attempts have been made to decipher these records. In an attempt to decode these, I worked on two of the largest Proterozoic sedimentary successions of India, the Neoproterozoic Marwar Supergroup (750 - 540 Ma) and the Mesoproterozoic Chhattisgarh Supergroup (1450 - 1000 Ma). Attempts were made to answer some of the outstanding questions in global and regional geology such as the preservation of chemical signatures of glaciations, provenance of sediments, tectonic control on depositions and evolution of such basins. I made use of geochemical and isotopic tracers to achieve these.

My work provides age constraints for the initiation of sedimentation and evolution of the Marwar basin. The Rb-Sr whole rock isochron of a felsic tuff from the lower part of the Marwar Supergroup yielded an age of 703±40 Ma, which suggests that the sedimentation in the Marwar basin started in the Cryogenian period. The result of Sr isotope stratigraphy suggests a depositional age of ~570 Ma for the carbonate sequences in the middle part of the Supergroup, indicating a depositional hiatus of ~100 Ma between the lower and middle Marwars. I report a basin-wide $\delta^{13}C$ negative excursion in the ~570 Ma middle Marwar Gotan Limestone which can be correlated to the Ediacaran Negative excursion – 2 (EN2), the chemical signature of the Gaskiers glaciation. Quantitative provenance analysis using Neodymium (Nd) isotopes and trace elements shows that sediments in the lower Marwars were contributed by the Delhi Supergroup (~1.6 Ga), Banded Gneissic Complex-2 (>1.8 Ga) and possibly the Erinpura Granites (~850 Ma), whereas the siliciclastics deposited in the middle and upper Marwars were predominantly sourced from the Delhi Supergroup. Interestingly, the contribution from the Malani Igneous Suite (MIS) to the sedimentation was limited only to the basal formation near the basin margin.

The geochemical study of rocks of the Chhattisgarh Supergroup have provided age constraints on the evolution of the basin and provided insights into the Mesoproterozoic Ocean. The $\delta^{13}C$ stratigraphy along with the other available age constraints from the Supergroup places the age of formation of the upper Chhattisgarh carbonate sequences between 1.3 and 1.0 Ga. The presence of ^{13}C enriched carbon in the Raipur carbonates ($\delta^{13}C$ = 2.6 to 3.6 ‰) suggests an increase in the organic carbon burial fluxes during the Mesoproterozoic. My data support the view that the deep ocean had remained anoxic during Mesoproterozoic; whereas euxinia existed in the cratonic basin margins where organic carbon burial fluxes were high. The quantitative provenance analysis of the Chhattisgarh siliciclastics revealed that the lower Chhattisgarh sediments were largely supplied by the Sonakhan Greenstone Belt and the basement Bastar granitoids, whereas the upper Chhattisgarh formations received sediments from the mafic granulite belts and Mahakoshal rocks of the CITZ. The provenance analysis has also revealed that the basin received substantial detritus from the younger Paleoproterozoic sources located at the CITZ in the north, which in turn suggests that the amalgamation of the North Indian and South Indian Blocks had already taken place at ~1.6 Ga, much before the initiation of sedimentation in the Chhattisgarh basin. Trace element and Sr-Nd isotopic study of the Sukhda Tuff attributes its origin to the partial melting of a mafic source. Also, the tuff had assimilated significant amount of Archean or early Paleoproterozoic continental crust, likely from the basement Bastar granitoids, during its evolution.