ABSTRACT

In this thesis I present the stable and radioisotopic study of six Mesozoic carbonatite-alkaline complexes of India. (Amba Dongar, Mundwara and Sarnu-Dandali complexes of Deccan Flood Basalt Province, and Sung Valley, Samchampi and Swangkre of Assam-Meghalaya Plateau). This work is aimed at understanding the nature of mantle source regions, origin and evolution of carbonatites in general and the Mesozoic Indian complexes in particular. The geochemical tracers used for this purpose are stable carbon and oxygen isotopes, strontium isotopes and trace elements. In order to find out the emplacement ages of two of these complexes (Amba Dongar and Sung Valley), I have used ^{40}Ar-^{39}Ar method of dating. Theoretical models have also been developed to understand the isotopic and trace element effects generated by different magmatic and postmagmatic processes such as liquid immiscibility, crustal contamination, fractional crystallization and secondary alteration in carbonatites and associate alkaline rocks.

The results of this study revealed some important facts about the carbonatite-alkaline magmatism in general. I got an evidence for incorporation of recycled crystal carbon in carbonatites. Such a conclusive evidence was not available before because of the difficulty in deciphering the primary carbon isotopic composition of the carbonatite magma. Spatial and temporal relationship, and Sr isotopic ratios suggest that carbonatites and alkaline rocks are genetically related. This work also revealed that liquid immiscibility is probably the underlying process in generating carbonatites and associated silicate rocks. Modelling the effects of combined liquid immiscibility, fractional crystallization and crustal contamination, on strontium isotope systematics, I found that the carbonatites do not preserve the effects of crustal contamination, whereas alkaline rocks do. Rare earth element study in Amba Dongar complex also supports the generation of carbonatites and associated alkaline rocks by liquid immiscibility. Stable carbon and oxygen isotopic study of carbonatites revealed that the $\delta^{13}C$ and $\delta^{18}O$ variations of uncontaminated and unaltered carbonatites are a result of fractional crystallization of these rocks from fluid rich magmas. A theoretical model

has been developed in this work to treat C and O isotopic fractionation during such a process.

Amba Dongar and Sung Valley complexes have been dated to 65.0 Ma and 107.0 Ma, respectively These ages along with their Sr isotopic ratios suggest their derivation from Reunion and Kerguelen plumes, respectively. Stable isotopic studies in the three carbonatite-alkaline complexes of Deccan province suggest that these complexes were derived from isotopically average mantle except a particular group of calcite carbonatites of Amba Dongar, which shows evidence of incorporation of recycled crustal carbon. The strongest evidence of this kind of incorporation comes from the $\delta^{13}C$ and $\delta^{18}O$ values of the primary magmas for the complexes of Assam-Meghalaya Plateau. Extreme variations of $\delta^{13}C$ and $\delta^{18}O$ of carbonatites in all the complexes have been found to be a result of low temperature alteration processes involving CO_2 bearing aqueous fluids.