5 Source vs. Process Control on Magma Geochemistry: Some Indian Examples

K. Vijaya Kumar, School of Earth Sciences, SRTM University, Nanded – 431 606, Maharashtra, INDIA, E-mail: vijay_kumar92@hotmail.com

Parameterization of geochemical models on crustal growth involves evaluating mantle source reservoirs and their spatio-temporal variation. For example, attending post-accretion growth of the arc/backarc, subduction-related lithospheric sources are replaced by plume/asthenosphere upwelling and related mafic magmatism, finally culminating with the emplacement of potassic mafic melts. Thus the compositional timeline of erupted magmas in a given terrain reflect changing deep-seated mantle reservoirs. These geochemical changes in mantle source compositions and generation of new mantle reservoirs is the basis of plate- and plume-tectonics. However, geochemistry of the primitive basaltic magmas is a reflection of mantle source composition as well as melting mechanisms. Chemical heterogeneities in the mantle reservoirs are reflected by the erupted basaltic melts in mid-ocean ridges, ocean islands, island arcs and continental rifts. At the same time, type and extent of melting of a homogeneous mantle source is equally capable of producing glaring geochemical anomalies in the basaltic melts. Further, long term memories of subduction processes in the lithosphere mislead us in evaluating mantle sources. Distinction of the source vs. process control on the geochemistry of erupted melts is the cornerstone of igneous petrogenesis and fundamental to our understanding of crustal growth.

In the present study, we evaluate the role of mantle source and/or melting mechanisms on the basalt geochemistry citing examples from Proterozoic SE India. Mafic dykes from the Nellore schist belt illustrate enormous geochemical variations that can be explained by dynamic melting of a homogeneous mantle source. Mafic dykes and sills from the Palaeoproterozoic Kondapalli and Kandra terrains display clear subduction-modified mantle sources and also record major continental crust building event in the SE India. Alkali basaltic, lamprophyric and gabbroic dykes from Mesoproterozoic Prakasam rift exemplify plume/asthenosphere-lithosphere interactions. Alkali basaltic dykes display ocean island basalt-type characteristics whereas gabbroic magmas exhibit geochemical signatures akin to the subduction-related mafic melts. Lamprophyre-gabbroic melts reflect progressive vein + wall-rock melting process. Voluminous Palaeoproterozoic subduction-related and Mesoproterozoic rift-related magmatism within the SE India provides strong evidence for evolving mantle reservoirs in space and time.