1 Recent Trends in Researches on Continental Evolution

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The turn of the last century witnessed phenomenal growth in our understanding of the geodynamic and geochemical constraints on continental evolution through time, largely due to extensive petrological and geochemical studies on mantle derived xenoliths and xenocrysts, progress in seismology achieved through both improvements in instrumentation and techniques and establishing a larger seismic station coverage across the world and numerical modeling techniques. A key factor that emerges from these researches is the intimate role of the interaction through time between the several layers in the Earth's interior across physical and chemical discontinuities, exemplified by the crust, the sub-crustal lithospheric mantle (SCLM), the Upper and Lower mantle and the Outer and Inner core. Understanding the manner in which the deep earth processes operate across these discontinuities has a potential to generate fruitful directions of future research on continental growth.

We have today more definitive information on the SCLM and its role in modeling continental structure is focused here. Recent researches reveal that the early history of the earth was probably attended by several episodic thermal overturns of the mantle or plume episodes possibly in pulses through time, at ca 4.2 Ga, 3.8 Ga and 3.3-3.4Ga. The SCLM was perhaps, rapidly built up peaking around 2.7-2.8-2.5 Ga. The crust and the SCLM in all continents share a secular, more or less contemporaneous evolution, which, therefore, renders their composition and structure interdependent and co relatable. The structure and composition of the SCLM has evolved in time, and is distinctive in different tectonothermal regimes distinguished by tectonic setting. Archaean lithosphere (Archon), having tectono-thermal ages of >2.5 Ga is characterized by the highest degree of depletion in Fe, Ca, Al and other magmatophile elements, Proterozoic lithosphere (Proton), having ages of 1.0 to 2.5 Ga and showing intermediate degrees of depletion and Tectons with ages of <1.0 Ga. and being the least depleted. The degrees of depletion modify the density and thereby the velocity structure resulting in distinctive seismic parameters and progressively reducing thickness down to the Thermal Boundary Layer (TBL). Episodic thermal upheaval of the convecting mantle and transfer of water-rich fluids from the depths of the mantle into the continental lithosphere render them chemically enriched and heterogenous. The SCLM below the Indian continent has a general Proterozoic stamp retaining several segments and pockets of the Archaean lithosphere (Archon). The impact of crustal evolution in the Phanerozoic (Tecton) is registered in areas affected by the Rajmahal and Deccan Volcanism.

Current approaches in Earth Sciences in India while generating massive geochemical and a sizable geophysical data on the Continental interiors suffer from a lack of understanding of the above trends in the evolution of the continents and the limitations they set on the wavelength of data generated and their interpretation. There is a need to integrate modeling of continental evolution through integration with the thermal and chemical evolution of its deep interiors.