

BOOK REVIEW

The Lithosphere beneath the Indian Shield: A Geodynamic Perspective by A.G. Dessai.

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Solid Earth Science, which predominantly addresses the interior of the Earth, constitutes a significant component to understand the foundation of our continents and thus of human life. The rigid ~300 km of crust and upper mantle, consisting of highly depleted and buoyant Archaean roots have served as “pontoons” for the continental crust on which we live. The tectonomagmatic processes, especially of the Phanerozoic, have been instrumental in bringing about modification to the cratonic roots and this has affected their long-term stability. What is more, the differential cooling of the subcontinental lithospheric mantle (SCLM) and its interaction with the asthenospheric upwelling has implications for the widespread seismicity and the neotectonics activity in general, witnessed by the shield during the Anthropocene.

Composition of the SCLM can be studied directly either through orogenic peridotites, obducted ophiolites or from accidental inclusions of mantle rocks, generally referred to as xenolith or nodules, in other magmatic rocks such as basalts, tuffs, kimberlites, lamprophyres among others. They serve as a window to provide glimpses of the deep interior at the time of their entrainment and extrusion, and the only means which provide direct information of the lithologies at depth. In India since the early description of Fe-Ti oxide-silicate inclusions in nephelinites from Kutch (De, 1964; 22nd IGC, pt.III, pp.126-138), the report of ultramafic silicate xenoliths from the Deccan Traps was from Murud-Janjira, in Maharashtra (Dessai, 1985; *Curr. Sci.*, v.54, pp.1235-1238).

Lithosphere studies involve a gamut of disciplines including geology, geochemistry, geophysics among others, however, an interdisciplinary outlook across sciences is desirable for a comprehensive and inclusive approach to knowledge and its applications between and among disciplines.

The book under review fulfils the lacuna of the subcrustal geology of the Indian shield based on petrological characteristics of samples of the deep crust and mantle and which is easy to fathom and simple to understand. Towards that end the book “The Lithosphere beneath the Indian Shield: A Geodynamic Perspective” by A.G. Dessai, is timely and much needed, useful contribution to the lithosphere studies in India. The author is an excellent teacher who has more than three decades of research experience in a variety of terrains including the Precambrian magmatic ore deposits to the Phanerozoic ophiolites of Ladakh to Quaternary lateritic ore deposits of the peninsula.

The book clearly underscores the paucity of geochemical information on the xenoliths particularly in comparison to the abundance of geophysical data. The geochemical data, though rudimentary in comparison to the wealth of sophisticated data available, for instance, on the mantle xenoliths from the Kaapvaal craton, none the less of significance to categorise the mantle beneath the Indian shield.

The book offers a glimpse of the petrological characteristics of the deep crust, crust-mantle transition and the shallow lithosphere in terms of the variation in lithological composition, thermal structure and its secular variation, the petrological and geochemical characteristics of the SCLM, and the interaction of the latter with asthenosphere derived magmas from direct samples of deep crust and the SCLM. These data are reconciled with seismic, electrical, heat flow data among others to understand the evolution the cratons.

The book comprises six chapters. Chapter 1 briefly introduces the

lithosphere, its conceptual subdivisions and their characteristic features. Bimodality of the crust, the significance of the crust-mantle boundary and their relevance in deep crustal studies is highlighted. The mineralogical and chemical composition of the SCLM is discussed and its role in the evolution of the crust and the subjacent mantle is emphasized. The later part of the chapter unfolds the salient features of the methods and techniques employed to study the lithosphere.

Chapter 2 provides a concise account of the geology of the various cratons comprising the Indian shield. The following chapter offers petrographic details of the on- and off-craton xenoliths from the Indian shield. Report of xenoliths is itself rare in India and craton-wise account is still difficult to obtain. On that count the book for the first time provides a good account of the compilation on xenoliths highlighting their characteristic features. The chapter 4 on lithosphere architecture highlights the seismic structure of the crust and the variation in lithosphere architecture not only among cratons but even intra-cratons. Chapter 5 describes the thermal architecture of the shield. It has its own peculiarities across the shield, some cratons are thermally anomalous whereas the adjoining ones are not. The present-day heat flow picture of some does not correspond to the thermal structure derived from the xenolith suite.

The last chapter of the book synthesizes the petrological, geochemical, geophysical and the heat flow data of the cratons to present a consolidated picture of the evolution of the shield and its marginal domains. The picture that emerges is far from the conventional stability of the shield but presents the remobilised state of the subcontinental lithospheric mantle which has been subjected to accretion and reworking to varying degrees. A distinct evolutionary pattern is evident among the collage of cratons comprising the shield. The cratons have the footprints of decratonisation to varying extents, more along the western margin than along the eastern, during the Phanerozoic. The polygenic complex of xenoliths provide evidence for mixing between a cold, magnesian, viscous, depleted mantle and a hot, dense and fertile mantle. The evidence for the shallow lithosphere accretion by Phanerozoic asthenospheric contributions is clearly outlined in this book.

The narrative is simple, concise, well-researched, balanced, simple to peruse and comprehend, and offers a good account of the integration of various datasets towards an improved understanding of the complex processes of lithospheric evolution. The book is well presented and comprises useful and appropriate tables and figures. It would serve as a basic text on Indian lithosphere and would provide an impetus for integrated studies in the continuing investigation of the evolution of the Indian shield and cratonic areas the world over.

The book would be useful for post-graduate and research students and professional geologists for a basic petrological framework of the deep lithosphere and to understand the spatiotemporal variation in the thermal architecture of SCLM in response to the tectono thermal events witnessed by the Indian shield.

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