11 Crustal Structure of the Indian Shield - A Deep Seismic Sounding Perspective

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Deep Seismic Sounding (DSS) experiments using refraction and wide-angle and narrow-angle reflections were conducted along a large number of profiles covering shield areas, orogenic belts, high-grade domains, sedimentary basins and plume effected flood basalt regions. They provided significant results related to shallow and deep structural features of the Indian continental crust and sub-crustal lithospheric mantle. The basic constraints derived from these studies are in the form of reflectivity and velocity structure, which are used to understand the crustal composition, dynamics, evolution and deformation of Indian shield . Crustal-scale thrust faults, oppositely dipping reflection fabric, Moho geometry and velocity configuration are some of the structural features that helped to identify various tectonic blocks of the Indian shield. Some of the structural features are identified as paleo-subduction, collision and suture zones. The structural details derived from DSS studies helped in developing evolutionary models for Aravalli-Delhi fold belt, Sausor orogeny, Southern granulite terrain and west Bengal basin. The DSS studies suggest that the crustal evolution of the Indian shield is due to various orogenic episodes involving convergence, collision and suturing of various cratonic blocks since late Archean by way of accretion of island arcs and magmatic underplating. Deep seismic studies from trap covered regions suggest wide-spread magmatic underplating as evidenced by high-velocity (>7.0 km/s) lower-crustal layer as a direct consequence of mantle plume activity. The DSS studies from a large number of sedimentary basins, signifying cover sequences, provided valuable details in the form of velocity structure, thickness of sediments and basement configuration which are essential for hydrocarbon exploration. The studies also identified huge thickness of Mesozoic and Gondwana sediments below the Deccan and Rajmahal traps and equilibrated younger Moho. The DSS studies played a key role in understanding the geodynamics of the Indian shield and provided insights into the relationship between the deep-seated geological processes and their surface manifestations. They provided a unique geophysical framework to understand the rheological structure, metallogeny and intercontinental seismicity from parts of the Indian shield. Some of the tectonic events and their structural features identified from the DSS studies of the Indian shield are also observed in different parts of the globe and helped in understanding the global tectonics and supercontinental episodes.