AOGS 2005

Underplating and its tectonic implications in the Indian shield

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One of the outstanding questions regarding tectonic processes on the early earth is whether large-scale vertical displacements ,through dipirism magmatism, took place in the evolution of Archean continental crust. Another debatable question is weather the addition of heat either by magma underplating or in response to mantle plume has a role in the evolution of Precambrian terrains. The role of underplating and its tectonic implications finds greater support in the Phanerozoic terrains, but its evidence is almost entirely indirect and comes from diverse set of observations and deductions.

With this backdrop, we have tried to search the pockets of underplating in the Indian shield and analyzed its role holistically in the tectonic manifestations of the region. We discuss and analyze the seismic results of eight DSS profiles in the Indian shield, where underplated material was interpreted. These profiles cut across various cratons, platforms, rifts, Mobile belts; orogenic mobile belts and basalt covered regions.

We find that magma underplating exists in almost all the geological terrains and shows different geological/ tectonic manifestations that range from profound metamorphism, uplift , extension, seismicity, exhumation of lower crust, high heat flow, anti clock P-T-t - causing heat and thickening of the crust, occurrence of granitic melt, metasomatism, geological differentiation- causing loss of reflectivity, crust-to-mantle transition zone.

We have also found that underplating causes changes in tectonic styles and in parameters such as geothermal gradient, densities, and thickness of crustal layers from Pre-Cambrian to Cenozoic time. We further suggest that underplated material, depending upon the composition (including fluids) and viscosity, thermally weakens the deforming rocks thereby suitably increasing the strain ratio which links with the shear zone/faulted-fractured zones in the crust. In the presence of compression and /or extension the tectonic processes get manifested in different order and dimension.