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Rheological Models of the Indian Continental Lithosphere

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Flow and deformation of rocks strongly depend on the prevailing pressure and temperature conditions, composition, and time scale of applied loading. At short time scales crust and mantle rocks mainly behave elastically whereas at large time scales viscous deformation prevails after a threshold pressure – temperature condition is exceeded. This property of change in the mode of deformation has been used to construct rheological models of lithosphere. For a continental lithosphere rheologically weak quartz- and feldspar-rich crust overlies a relatively strong olivine-rich sub-crustal lithosphere, giving rise to a stack of brittle and ductile layers within the continental lithosphere. Distribution of brittle and ductile layers in the lithosphere controls the mechanism of stress accumulation and failure and, thus, seismicity, and long term tectonic deformation. Therefore, an understanding of the rheological structure of lithosphere is required for studies related to earthquake mechanics and geo-tectonics. This presentation summarizes the work done on modeling of rheological structure of the Indian continental lithosphere and it implications on the deep crustal seismicity. Initial rheological models of the Indian continental lithosphere were based on olivine rheology and heat flow – heat generation data of six locations from the Indian shield. These models were modified to include more realistic quartz and felspar rheologies for the continental upper and lower crust, respectively, and grain boundary diffusion effects in olivine. More region-specific studies include development of rheological models of the central Indian shield using the constraint of deep crustal (focal depth > 35 km) seismicity and rheological models of the NE India.