Mantle Convection Models of Subducted Slab Remnants Below Continental Collisions

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Cold patches as old as 130 Myr are observed at mid-mantle depths in tomographic slices below India. These are believed to be remnants of subducted slabs that were truncated by continental collisions at Earth's surface. Such slab remnants would sink to the Core-Mantle Boundary in times much less than 130 Myr, unless viscosities in the lower mantle increase very rapidly with depth. However, numerical models indicate that if the viscosity increase with depth is sufficient to slow the sinking of slab remnants, the convective flow in the mantle would become (relatively) sluggish throughout the deep mantle and heat transfer to Earth's surface would be significantly reduced.

I will give an introduction to numerical models of mantle convection in general and then present a series of models designed to address the specific problem posed by the persistence of cold slab remnants at mid mantle depths for so long in a vigorously convecting mantle.

Our most successful models use a viscosity profile similar to that suggested by Mitrovica & Forte (EPSL, 2004) incorporating viscosities in the lower mantle which are 300 times the viscosity of the upper mantle and a rapid decrease of viscosity with depth close to the Core-Mantle Boundary. These models allow slab remnants to cycle slowly in the mid-mantle regions while vigorous mantle wide circulation occurs elsewhere.