Linking Observations to Subduction Process Modelling

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Abstract

Understanding the initiation and processes governing subduction remains one of the greatest challenges in geodynamics. Subduction affects every aspect of the earth system and it is generally agreed to be one of the primary driving forces of plate tectonics and mantle convection through slab pull and the addition of raw materials into the mantle. Previous attempts to numerically model the initiation and development of a self-sustaining subduction system have relied on instantaneous snapshots and theoretical boundary conditions not well constrained by geological and geophysical observations. However, subduction zones are extremely dynamic and have continuously changing shapes, locations, orientations and physical properties through time. While computer simulations have provided useful insights into some of these problems, the lack of well-integrated observational constraints has limited previous models to various 2D or 3D simplifications. We have created a subduction database comprising a detailed global study of various subduction zone parameters, including: the age of the subducting oceanic lithosphere; convergence rate and direction; back-arc spreading rates; the absolute motion of the overriding and downgoing plates; and the dip angle of the subducting slab. These observational constraints are used as boundary layer input into 3D spherical mantle convection models using CitComS to achieve more realistic models of subduction initiation and development. The results of our models will have implications for our understanding of the subduction factory, mantle convection and will have applications for the exploration of ore deposits in convergent margin settings.

Keywords: Subduction; Back-arc Basins; Mantle Convection