Dynamical Mechanisms Behind Periodic and Episodic Phenomena in the Earth's Interior

Ulrich Hansen, Institute of Geophysics, University of Münster, Germany,
Alex Loddoch, Chevron ETC, Technical Computing, Houston, TX, USA

The evolution of many planets and the Earth in particular is clearly influenced by convective processes in the interior. Convection in the strongly nonlinear regime, as to be expected in planetary interiors, typically exhibits time dependent behavior, ranging from simple periodic to chaotic signatures. What are relevant mechanisms producing periodic and/or episodic events and what are typical scales. We employ numerical models allowing for realistic rheologies, i.e. temperature, pressure and stress-depenent visocities in order to identify key-mechanisms leading to time varying behavior. Clearly plumes, developing from the 670 km/ and or the Core mantle boundary develop periodically in a realistic strong temperature dependence of the viscosity is assumed. With an appropriate rheology surface plates form naturally in our model, being an integral part of the convective system. We observe changes in the style of plate tectonics, showing transitions from periods of plate tectonics to stagnant lid convection and vice versa. This can potentially explain global changes in the surface dynamics of planets. We further demonstrate that separately convecting layers can originate from the interplay of compositional and thermal contributions. The creation of layers and their final destruction also induces periodic and episodic fluctuation in the planetary evolution.