

Three dimensional model of mantle convection with plate-like behavior

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We present the results of three-dimensional numerical experiments of mantle convection where the rheology depends on temperature and stress-history to confirm the existence of plate-like behavior in the Earth's lithosphere. The stress-history dependence viscosity is induced by a hysteresis owing to relationship between stress and viscosity. We find that the convective flow pattern which resembles plate-like behavior emerges when the mechanical strength of the lithosphere is the range between the rupture strength of the plate interiors and the mechanical strength of the plate margins. Cylindrical uprising plumes newly induce plate margins in the lithosphere as mechanically weak zones to maintain the stable plate motions.