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Self organized layering in the Earth's mantle, phase- and compositional boundary layers

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The thermal history of Earth an other planets, their chemical differentiation and reaction of the interior with the atmosphere was largely determined by convective processes. Convection does not always tend to homogenize the interior. Convection can rather establish structures and as such reservoirs which can stay intact for geological significant time. We employ. numerical models, ranging from simple 2D scenarios to fully 3D configurations with strongly temperature , pressure and compositionally dependent rheology , to explore the formation of such reservoirs. Layer formation plays a special role in the pattern formation process. . It will be shown that distinct convective layers can form as self-organized structures from non-layered states, without pre-existing density jumps., once effects of thermal – and compositional contributions to the density are taken into account. A stable compositional gradient, heated from below and/or cooled from above resembles one reasonable scenario for Earth-mantle after core formation. In this configuration a layered mantle structure emerges. the individual layers display different degrees of stability. Intermittent breakdown of individual layers leads to a strong episodicity in the thermal and chemical evolution. In a series of experiments we study the onset of plate tectonics in such a scenario by employing stress dependent rheologies We further investigate the effecfts of a pressure dependent thermal expansivity. Clearly, under these conditions even a small initial compositional density gradient strongly effects the dynamics We also investigate the scenario including a phase boundary and the combined effect of phase - and compositional boundaries on the dynamics .