Geophysical Research Abstracts
Vol. 19, EGU2017-6194, 2017
EGU General Assembly 2017

Role of tectonic inheritance for passive margin formation: insights from thermo-mechanical modelling

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Observations gathered from field, geological and geophysical studies highlight the heterogeneous character of the continental lithosphere. These heterogeneities are expressed by spatial variations of lithologies, structural style, or thermal gradients and are the consequence of tectonic inheritance. Despite these common observations, most geodynamic models of passive margin formation rely on initially homogeneous lithosphere and therefore overlook the role of tectonic inheritance.

Here we present high-resolution two-dimensional numerical models of lithospheric rifting that take into account mechanical heterogeneities. In a first series of models, we explore the effects of mechanical layering at the kilometer-scale. During extension, strong lithospheric levels are progressively affected by boudinage, ultimately leading to lateral disconnection and extraction of strong levels. Although our models do not include any material softening, we show that structural softening induced by deformation of heterogeneities is sufficient to trigger polyphase and asymmetric rift evolution.

In a second stage, we investigate the impact of a more complex initial lithospheric structure that may better reflect natural heterogeneities (pluton-like morphologies). While such models can produce more complex passive margin architecture, they involve similar processes than multi-layer models (local boudinage and extraction of strong levels) and further highlight the key role of tectonic inheritance on passive margin evolution.