T33E-0768: 3D Thermo-Mechanical Models of Plume-Lithosphere Interactions: Implications for the Kenya rift

Wednesday, 13 December 2017
13:40 - 18:00
New Orleans Ernest N. Morial Convention Center - Poster Hall D-F

We present three-dimensional (3D) thermo-mechanical models aiming to explore the interaction of an active mantle plume with heterogeneous pre-stressed lithosphere in the Kenya rift region. As shown by the recent data-driven 3D gravity and thermal modeling (Sippel et al., 2017), the integrated strength of the lithosphere for the region of Kenya and northern Tanzania appears to be strongly controlled by the complex inherited crustal structure, which may have been decisive for the onset, localization and propagation of rifting. In order to test this hypothesis, we have performed a series of ultra-high resolution 3D numerical experiments that include a coupled mantle/lithosphere system in a dynamically and rheologically consistent framework. In contrast to our previous studies assuming a simple and quasi-symmetrical initial condition (Koptev et al., 2015, 2016, 2017), the complex 3D distribution of rock physical properties inferred from geological and geophysical observations (Sippel et al., 2017) has been incorporated into the model setup that comprises a stratified three-layer continental lithosphere composed of an upper and lower crust and lithospheric mantle overlaying the upper mantle. Following the evidence of the presence of a broad low-velocity seismic anomaly under the central parts of the East African Rift system (e.g. Nyblade et al, 2000; Chang et al., 2015), a 200-km radius mantle plume has been seeded at the bottom of a 635 km-depth model box representing a thermal anomaly of 300°C temperature excess. In all model runs, results show that the spatial distribution of surface deformation is indeed strongly controlled by crustal structure: within the southern part of the model box, a localized narrow zone stretched in NS direction (i.e. perpendicularly to applied far-field extension) is aligned along a structural boundary within the lower crust, whereas in the northern part of the model domain, deformation is more diffused and its eastern limit coincides with the eastern side of a weaker unit within the upper crustal layer. This northward transition from more localized to more distributed strain bears some general similarity to the distribution of major faults within the studied area (Chorowicz, 2005).

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