Geophysical Research Abstracts
Vol. 17, EGU2015-15092, 2015
EGU General Assembly 2015


# Extension velocity partitioning, rheological crust-mantle and intra-crustal decoupling and tectonically inherited structures: consequences for continental rifting dynamics.

Kun Wang (1,2,3), Leila Mezri (2,3), Evgueni Burov (2,3), Laetitia Le Pourhiet (2,3)

(1) Key Laboratory of the Earth and Planetary Physics, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China (wangkun@mail.iggcas.ac.cn), (2) Sorbonne Universités, UPMC Univ Paris 06, UMR 7193, Institut des Sciences de la Terre Paris (iSTeP), F-75005 Paris, France, (3) CNRS, UMR 7193, Institut des Sciences de la Terre Paris (iSTeP), F-75005 Paris, France

We implemented series of systematic thermo-mechanical numerical models testing the importance of the rheological structure and extension rate partitioning for continental rift evolution. It is generally assumed that styles of continental rifting are mainly conditioned by the initial integrated strength of the lithosphere. For example, strong plates are expected to undergo extension in narrow rifting mode, while weak lithospheres would stretch in wide rifting mode. However, we show that this classification is largely insufficient because the notion of the integrated strength ignores the internal rheological structure of the lithosphere that may include several zones of crust-mantle or upper-crust-intermediate (etc) crust decoupling. As well, orogenic crusts characterizing most common sites of continental extension may exhibit inverted lithological sequences, with stronger and denser formerly lower crustal units on top of weaker and lighter upper crustal units. This all may result in the appearance of sharp rheological strength gradients and presence of decoupling zones, which may lead to substantially different evolution of the rift system. Indeed, strong jump-like contrasts in the mechanical properties result in mechanical instabilities while mechanical decoupling between the competent layers results in overall drop of the flexural strength of the system and may also lead to important horizontal flow of the ductile material. In particular, the commonly inferred concept of level of necking (that assumes the existence of a stationary horizontal stretching level during rifting) looses its sense if necking occurs at several distinct levels. In this case, due to different mechanical strength of the rheological layers, several necking levels develop and switch from one depth to another resulting in step-like variations of rifting style and accelerations/decelerations of subsidence during the active phase of rifting. During the post-rifting phase, initially decoupled rheological layers may tend to stick together resulting in step-like strengthening of the lithosphere and deceleration of subsidence. Hence, the entire rift system may exhibit polyphase subsidence behavior, which may be entirely conditioned by its internal structure and not by external factors. In addition, velocity partitioning may also have strong impact on rift evolution. For example, symmetric partitioning of half-velocities on both rift sides does not result in the same evolution as in the case when the same total extension rate is applied at one side only. In particular, asymmetric velocity partitioning results in the development of asymmetric rift evolution without any need in rheological softening. This differences in rift evolution stem from different thermal advection rates that both influence partitioning of thermally dependent rheological strength, phase transitions and buoyancy. The experiments confirm the importance of the above mentioned factors, which have strong implications for continental rifting processes and formation of passive margins.