Geophysical Research Abstracts
Vol. 21, EGU2019-1008, 2019
EGU General Assembly 2019
© Author(s) 2018. CC Attribution 4.0 license.

Structural inheritance without reactivation: Insights from analogue modelling

Anindita Samsu, Alexander Cruden, Nicolas Molnar, and Steven Micklethwaite
Monash University, School of Earth, Atmosphere and Environment, Australia (anindita.samsu@monash.edu)

Reactivation of pre-existing basement faults and shear zones during rifting produces new faults in cover rocks that strike parallel to the reactivated structures. However, reactivation is only one form of structural inheritance, and we investigate here an alternative mechanism based on stress rotations in cover rocks due to anisotropy in the basement.

ENE ($\sim$60°) striking Early Cretaceous syn-rift faults are present in the western part of the Gippsland Basin, southeast Australia. These faults are oblique to E-W striking faults in the eastern part of the basin, which are more consistent with the inferred N-S paleo-extension direction. In addition, there are no ENE trending basement structures that could have been reactivated. Previous workers have speculated that the 'misorientation' of faults in the west reflects the presence of an anomalously strong lower crustal block with a NNE structural grain underneath the western part of the basin.

We use scaled analogue experiments of a multi-layer, brittle-ductile lithosphere to investigate the effects of lateral variations in (1) the strength of the lower crust and (2) the spacing of vertical boundaries between different strength domains in the lower crust. We monitor deformation in the upper crust, at high spatial and temporal resolution, during orthogonal extension using particle image velocimetry. Faults in the models strike perpendicular to the extension direction above a homogeneous lower crust. However lower crustal domain boundaries result in oblique faults above those boundaries in the overlying upper crust, which we attribute to local stress rotations. We also find closely-spaced strength heterogeneities (i.e. a fabric) within a lower crustal domain are required to produce oblique faults above the entire domain, not just at the boundaries. Our results highlight that variable fault orientations across a rift basin can occur above basement terranes with different structural grains without the need for reactivation. These results explain field observations from the western part of the Gippsland Basin and have implications for interpreting the mechanism of structural inheritance during rifting.