Analog and Numerical Models of Fault Patterns in Continental Rifts

We have studied normal faults that develop in extensional analog models using wet clay. A main focus has been the development of sets of parallel dipping faults. Clay models give more realistic distributions of faults than do sand models. This is true of length-frequency distributions as well as offset-length ratios. The clay experiments have a tendency to form sets of parallel dipping faults similar to those inferred for some real rifts. However, wet clay can strain several tens of percent before localization begins, unlike rocks or sand layers. In the interest of determining what is occurring in the clay models to allow parallel faults sets we suggested that out Rutgers colleagues cut thin sections of some of the clay layer models. They have done so and the thin sections show very narrow fault zones with aligned fabric. Partly based on the thin section results and on the observed rate dependence of the results, we have developed an idea to explain some aspects of faulting in clay. The low permeability of clay may allow buildup of low pore pressures in response to local deformation in the model. This may explain why models run with higher extension velocities go to a larger total strain before localization on faults develop. We have added pore pressure simulation, including diffusion of pressures in our 2D numerical fault model. Preliminary results are consistent with the rate dependence of the lab models. We published a paper that deals with the geological constraints on and numerical models of parallel normal fault sets (Nagel and Buck, 2007) and a chapter about rifting (Buck, 2007).

Figure: Numerical models that including simulation of pore pressure changes due to strain-induced dilation and flow of water through a permeable media. The fast model was run at ten times the rate of extension as the slow case. The plots show the amount of plastic (i.e. brittle) strain in the models for 3 amounts of model rift opening. The bottom boundary condition mimics a rubber sheet extending the middle section of the model domain. The fast case has a more distributed pattern of brittle strain similar to what is seen in clay analog models.
