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Towards really useful physical models of tectonic deformation

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A very large number of natural-looking "scaled" physical models have shown that the first order tectonic style and deformation patterns are only weakly dependent of the details of the rheology of the model materials. These models are useful to explore the effects of different boundary conditions, but could be seen to indicate that detailed knowledge of rheology is not important in understanding tectonic deformation. The effect of these details in rheology on the evolving deformation patterns is largely unexplored. This is mainly due to the lack of detailed rheological data on the model materials used. A new generation of physical models will use materials with accurately characterized rheology, and provide high resolution 4D data on the displacement field and stress in the models. This will allow investigation of effect of rheology on the finer differences in deformation patterns, and quantification of the limits of validity of the models' scaling. More importantly, these models will form an opportunity (and challenge) to validate numerical models against measurements, and show the requirements for accuracy in our understanding of the rheology of rocks in the subsurface.