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Strengths and limits of analogue models involving fluid overpressures

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Fluid overpressures are commonly observed in many sedimentary basins, submarine deltaic fans and compressive environments (accretionary wedges). By modifying strength and orientation of effective stresses in sediments, overpressures favour failure (hydraulic fractures, listric faults etc…), gravitational instabilities on submarine slopes or efficient detachments in compressive tectonics. They are thus often considered as a first order parameter in thin skinned tectonics.

It is difficult to deal with fluid overpressures because they change in time. They are, for example, induced by high sedimentation rate and they disappear when fluids escape. As a consequence, there is a fundamental difference between a decollement in a salt layer and a detachment in overpressured shales. As overpressures fluctuate in shales, decollement efficiency varies in space and time.

For the last two decades, thin-skinned tectonics has been widely studied by sandbox modelling. There is a long history of using silicone putty to model salt or shale assuming that these materials are ductile when they deform. The use of pore fluids in sandbox models is more recent. Compressed air provides a practical source. This technique has been used to 1- verify the effects of seepage forces on tectonic stresses (Mourgues et Cobbold, 2003), 2- verify some of the theoretical predictions of thrust wedges containing fluid overpressures (Cobbold et al, 2001, Mourgues et Cobbold, 2006) and 3- to model slope instabilities (Mourgues et Cobbold,2006). For 5 years, this technique hasn't stopped upgrading. Now, it is possible, for example, to control fluid pressures, and so detachment efficiency, in space and time during the same experiment. The study of instabilities in prograding deltas has been a recent application of this upgrade.

In this talk, we will focus on this relatively new technique. We will discuss the strengths and limits of such a method and we will prospect the future and necessary developments in considering fluid overpressures in analogue models.