Modelling the rise and fall of rafts in salt diapirs

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Abstract

Salt diapirs in the middle east or in Southern Permian Basin often shows allochtonous blocks at outcrop and in salt mines, known as ‘stringers' in subsurface data, composed of anhydrite, dolomite, marls and carbonates. These stringers may reach a few km in size and constitute major structure inside the salt diapirs. Stringers in Omanese salt diapirs produce oil, but they also constitute a major exploration risk due to large technical difficulties of structural and seismic imagery, complexity in deciphering their evolution steps, and possible unexpected overpressures. For Gaz de France, the salt diapirs are an ideal location for salt cavities, and to optimise the leaching, it is necessary to predict the stringers distribution.
Analogue modelling imaged with X-ray tomography offers the possibility to understand the 4D structural evolution of a sandbox model. Salt is modelled with Newtonian silicone putty and the internal rock layer by a granular Mohr-Coulomb material, either sand or coryndon. Models are appropriately scaled, the stringers being denser than the surrounding silicone. The growth and geometry of the salt structure is entirely controlled and only driven by the overburden deposition. After a certain amount of ascent, the diapir is killed by the rapid deposition of a thick sand layer, and time is given to the floating stringers to fall inside the diapir. The 3D internal geometry is reconstructed at different steps using a geomodeller, showing the progressive rise, tearing apart, and fall of the stringers. Complex geometry are observed and compared to natural examples, and the potential of the method for the prediction of structure and their understanding will be discussed.