Unassisted gravity modeling of geological structures at various scales

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Gravity is the main force acting at the Earth's surface and the genesis of many geological structures can be attributed, directly or indirectly, to gravity forces. This is particularly true when buoyancy is involved, as in the case of plume rise through the mantle, continental breakup, granite intrusions, normal and transtensional faulting, and salt tectonics. Following techniques initiated at the geotectonics laboratory at Rennes, we are using analog materials (silicone polymer and sand) to model these processes; unlike some laboratories, however, we apply no mechanical drive in our experiments and refrain from using any prefabricated fault surface, such as footwalls blocks made of wood, leaving the modeling system free to react to gravity by internal strain in an unconstrained manner. This approach has provided important insights into the operation of plate tectonic and salt tectonic processes. It has allowed us to successfully model continental breakup between South America and Africa by differential rotation about a pole contained in northeastern Brasil, and the consequent intracontinental deformation. In the field of salt tectonics, this method has allowed us to model the origin of large-scale antithetic normal faults in the Santos basin; reproduce the compensation of nearshore extension over the salt layer by simultaneous far-shore contraction, and model the complex interplay of convergent and divergent flow directions in three dimensions. Simultaneous underwater modeling of salt tectonics and turbidite deposition, a new technique developed by our group, is being presented by Marta C.M. Guerra at a separate symposium of this congress.