STRUCTURAL EVOLUTION IN NUMERICAL MODELING OF PETROLEUM SYSTEMS

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Structural balancing is an essential tool to produce good numerical models of petroleum systems. The sedimentation process, the sediments accomodation and the syn-deformational events modify through the time the evolution of the oil kitchen. Most of the software use a numerical structure with restricted lateral rock translation, a simplified calculation for decompaction by backstripping and a compensation for the structural deformations by vertical thicknesses edition through time. This relative “vertical restriction” in the simulation meshes makes the mass translation restitution in normal faults or the tectonic thickening under compression difficult, demanding more creative solutions from users as well as more research and more development from the software builders.

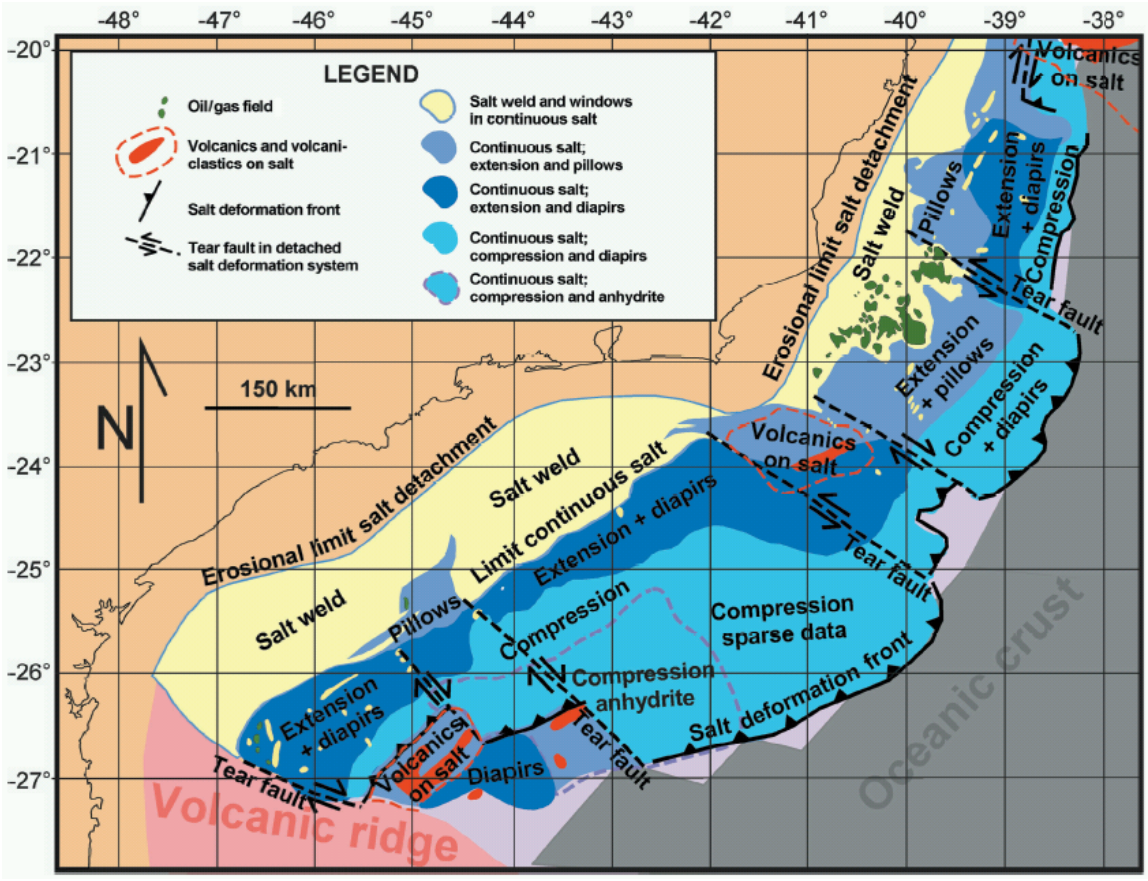
The complex gravitational tectonic over viscous layers (salt or shale) in marginal basins (e.g. South Atlantic marginal basins) modifies gradually the overburden geometry, controlling burial for petroleum generation, producing windows or new routes for migration and creating petroleum traps. The deformation processes in three-dimensional models for continental margin basins in the coast of Brazil and West Africa involve extension, transference, compression, inverse reactivation of structures, breaking, moving away or thickening of the sedimentary layers (Cobbold and Meisling, 2001; Paula and Mohriak, 2005). Figure 1 shows Campos and Santos basins halotectonic domains, with representative lateral movements of mass.

Some 2D numerical simulation programs, which are commercially available, already allow the structural movement of the mesh with an integrated simulation of fluid flow, heat flow, pressure and other needed calculations to be conjugated in a petroleum system modeling (Schneider, 2003; Wygrala et al., 2003; Lampe et al., 2005).

In the 3D commercial solutions, the structures are balanced basically by vertical layers decompaction in the structural mesh columns. In general, the plastic layers are solved by paleothickness and/or lithofacies replacement (false material intrusion). In this way, separated blocks in fragile events do not take the contiguous position that they had at any supposed time, nor during deposition time. The space that persists between them “is filled” by salt.

General cases illustrate and prove the urgency of commercial solutions ever more integrated with 3D capability to work with the normal structures and faults or reverse movements in a unstructured mesh, in a balanced way and simultaneously to deal with the maturation

processes, expulsion and migration of hydrocarbons. They prove implications of a restricted structural mesh applied to petroleum systems numerical modeling.



Picture 1 – Halotectonic domains of Campos and Santos basins, in Cobbold and Meisling (2001).

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