Geophysical Research Abstracts
Vol. 12, EGU2010-13631, 2010
EGU General Assembly 2010

The Eocene Canopy of the Northwestern Gulf of Mexico explained by the Mechanism of Squeezed Diapirs – A Numerical Modeling Study

Sofie Gradmann (1,2) and Christopher Beaumont (1)
(1) Dalhousie University, Halifax, Canada, (2) NGU Geological Survey of Norway, Norway (s.gradmann@dal.ca)

Multiple salt canopies of variable size have developed in the Gulf of Mexico since the Palaeogene, and are now located at several different structural levels. Little is known about their emplacement and early evolution. In some cases, the underlying structures are shielded by salt from seismic imaging. In others, salt has been entirely evacuated from the canopies, and only a salt weld remains. Allochthonous salt structures can have a major influence on the structural evolution of a basin when they act as a detachment layer, and may also affect the sediment deposition patterns and the development of hydrocarbon systems.
This study focuses on the evolution of a salt canopy located in the northwestern Gulf of Mexico. This canopy developed during the Eocene in the center of an up to 350 km wide Mid-Jurassic salt basin. In its later stages, it acted as a detachment surface for large-scale Oligo-Miocene gravity spreading. By localizing gravitational instabilities at the allochthonous level, the canopy likely postponed gravity-driven deformation above the distal part of the allochthonous salt basin until the late Oligocene, at which time the Perdido Fold Belt began to form at the distal end of the basin.
We investigate the circumstances under which the Eocene canopy could have evolved via the mechanism of squeezed diapirs. During such a process, shortening of a region containing pre-existing diapirs will be absorbed by the salt (the weakest part of the system), which is then expelled upwards to the seafloor.
We use 2D finite-element models to study the evolution of an analogous canopy. The models comprise a viscous salt layer overlain by a frictional-plastic passive margin sedimentary sequence from shelf to deep water, thereby incorporating the dynamical interaction of gravity spreading caused by shelf progradation. Model experiments include sediment compaction, flexural isostasy, loading by the overlying water column, and parametric calculations of the effects of pore-fluid pressures in the frictional-plastic sediments.
The models integrate two phases of the basin evolution: Phase 1 in which diapirs develop during sediment aggradation, and Phase 2 in which sediment progradation leads to gravity spreading, shortening (squeezing) of the diapirs, expulsion of salt and the development of a canopy.
The Phase 1 modeling presents a new mechanism for diapir initiation and evolution, which has remained a poorly understood aspect of salt tectonics. This mechanism is based on the idea that local bathymetric expressions (such as channel-levee systems or turbidite deposits) can be preserved by sedimentation patterns. These structures need to adjust isostatically relative to the salt layer. In an aggradational environment in which the bathymetric profile is maintained, this local balancing can create sufficient pressure differences to drive diapirism. These diapirs can form in a neutral stress regime and can fully develop before they get squeezed by shortening.
The evolving model canopies show characteristics similar to the Eocene canopy of the northwestern Gulf of Mexico (such as its lateral extent, the structure of the underlying strata, and the postponing of deformation above the distal salt basin). They also share important characteristics with other canopies, for example, the Eocene canopy of the northern Gulf of Mexico.