PHYSICAL MODELS OF STRUCTURAL PATTERNS ABOVE SALT DIAPIRS

Roger C. Brewer[1] and Richard H. Groshong, Jr.[1]

Abstract

Dry clay models were used to study fault systems that develop in strata above domal uplifts. Contemporaneous deposition and deformation was modeled by incrementally uplifting a model diapir and depositing additional layers of dry clay on the deformed strata. Variables observed to control structural patterns that developed in the arched and extended strata include: 1) the nature of the contact between the model diapir and the overlying strata, 2) the thickness of the pre-uplift sequence, and 3) the rate of sedimentation with respect to the rate of diapir uplift.

Boundary conditions between the model diapir and overlying strata proved very critical in controlling fault patterns. Naturally-occurring salt diapir-related faults systems seem best duplicated experimentally by allowing the pre-uplift strata to slide passively along the sides of the uplifting diapir, modeling a non-welded contact. With uplift, two related but distinct systems of extensional faults developed above the crest of the model diapir: 1) a surface-breaking graben complex bounding by inward-dipping normal faults and rooted in the upper levels of the pre-uplift strata, and 2) a blind system of normal faults rooted to the crest of the diapir.

The surface-breaking graben complex was observed only in experiments with thin pre-uplift sequences (pre-uplift thickness equaled one-half diapir diameter) and intermediate-thickness pre-uplift sequences (pre-uplift thickness equaled one-and-a-half times diapir diameter). In the thin pre-uplift experiments, the graben complexes were rooted to the top of the diapir. In the intermediate thickness pre-uplift experiments, inwards-dipping, graben-bounding normal faults intersected and diverged at depth, forming conjugate fault sets with grabens situated immediately above pyramid-shaped horsts.

The blind fault system was observed only in experiments with intermediate-thickness and thick pre-uplift sequences (pre-uplift thickness equaled three times diapir diameter). These fault systems, situated in the lowermost levels of the pre-uplift strata, were characterized by central outward-dipping normal faults (forming the pyramid-shaped horsts) flanked by inward-dipping normal faults.

Experiments were run using sedimentation rates equal to the diapir-uplift rate and then again at three times the diapir-uplift rate. In experiments using low sedimentation rates, an active graben complex developed and the syn-uplift sequence showed substantial growth across faults. Faulting was especially active after the diapir had been uplifted to half its diameter. In contrast, in experiments using high sedimentation rates, a system of inward-dipping fractures initiated in the area of expected graben development but little to no movement ever occurred on the fractures. With continued uplift and deposition, the fracture systems were buried and ceased to penetrate the surface.

[1] Department of Geology, University of Alabama, Tuscaloosa, Alabama 35487