AAPG Datapages/Search and Discovery Article #90285 © 2016 AAPG Gulf Coast Association Geological Society, Corpus Christi, Texas, September 18-20, 2016

Extensional Salt Keels Detached on Eocene-Oligocene Sediments in the Deepwater Northern Gulf of Mexico: Insights into CanopyAdvancement, Salt-Sediment Interplay, and Evidence for Unrecognized Mass Sediment Displacement

J. Carl Fiduk[1], Vivian Robertson[2], Marianne Clippard[2], George A. Jamieson[2], and Sarah Power[3]

[1]Freeport McMoran O&G, Houston, Texas, U.S.A.
[2]Schlumberger, Houston, TX, U.S.A.
[3]Schlumberger, Denver, Colorado, U.S.A.

ABSTRACT

Extension-related salt keels observed in the deepwater northern Gulf of Mexico can be organized into three categories based on the stratigraphic level at which associated extensional movement occurs. The first category of keels have faults which detach within Oligocene-to-Eocene (O–E) strata. The second category of keels have faults which detach into deep salt. The third category appears to be directly associated with basement level deformation. O–E detached keels are the most important economically and the main focus of examination.

The distribution of O–E detached keels can itself be subdivided into two groups. Group 1 keels are well delineated by mapping of the base salt canopy. These keels form a trend parallel to the Sigsbee Escarpment but offset shelfward (updip). The trend extends over 200 km (125 mi) across the Keathley Canyon outer continental shelf (OCS) area and into the Alaminos Canyon OCS area. The canopy over these keels was em-placed in the late Miocene to early Pliocene. Group 2 keels, previously unrecognized as keels, lie updip of the Sigsbee Escarpment but basinward of the ascension zones where salt rises from the primary autochthonous salt basin(s). This group of O–E keels is not easily delineated by mapping of the base salt canopy. The canopy in this area was em-placed in the early to middle Miocene.

The distance between the group 1 O–E keel trend and the Sigsbee Escarpment varies from 10–30 km (6–18 mi). The trend as mapped is not a single discrete continuous structure but a series of linked shorter keel segments with a few gaps. Linkage style between keel segments appears similar to that seen for growth faults (i.e., relays). In eastern Keathley Canyon, the location for detachment initiation is often found in close relationship with deeper salt structures. Some of these deeper salt structures appear to have moved/adjusted at about the time of O–E keel faulting. In western Keathley Canyon, deep salt is absent below the O–E keels. Available well data and mapping constrain the timing for displacement, which must occur after emplacement of the shallow canopy, to late Miocene–early Pliocene but initial movement could be younger. Observations suggest that the canopy needs to reach a thickness of ~1–1.5 km (~0.6–1 mi) before the underlying weak O–E detachment layers near the Sigsbee Escarpment fail. Failure at shallower levels may occur early as frontal thrusts under minimal cover near the sea floor.

Salt loading (gravity) on a weak detachment is the main driver of extension forming O–E keels. Another component believed critical is the absence of deep structures basin-ward of the detachment. Non-critical but contributing components include the ability to detach towards basement and/or bathymetric lows, the ability to detach onto basinward flanks of deeper structure, and drive from updip sediment loading. One result of strata displacement by keels may be the creation of overpressured or gumbo zones below the canopy.