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Experimental Approach to Megaflap Development during Passive Salt Diapirism: Controlling Factors and Kinematics

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Abstract

Megaflaps represent the original thinned roofs of inflated salt that have been rotated to steeply dipping flanking positions on the margins of steep diapirs or their equivalent welds. These strata may have an important impact on trap and reservoir definition and an accurate characterization of their geometry and the properties of the related reservoirs are crucial for oil companies. Nevertheless, in most cases the seismic images of these structures are very poor, thereby hindering their interpretation. Using an experimental approach, this research investigates how megaflaps develop by differential loading, establishing the main mechanisms controlling their growth and kinematic evolution. The experimental results show that, although roof strength plays a role, the main factor controlling megaflap development is the pressure gradient produced by the different sedimentary loads between two adjacent minibasins. Thus, similar sedimentation rates everywhere initially produced polymer withdrawal from beneath the depocenters and the development of a pillow of inflated polymer in which the polymer then pierced the overburden to create a passive wall. During this stage and the early stages of passive diapirism the thinner prekinematic strata rotated up to 900 and extended only a short distance up the flanks In contrast, a higher sedimentation rate in one basin resulted in two evolutionary stages. The first one was characterized by polymer withdrawal from beneath the thicker depocenter and polymer inflation in all other areas, including uplift of the top of the polymer below the thinner basin and piercement of a polymer wall between the two basins. The second stage began once a primary weld formed below the subsiding minibasin. At that moment the thinner basin located above the previously inflated polymer immediately collapsed. Polymer withdrawal resulted in rising of the adjacent wall and development of an allochthonous polymer sheet. Combined minibasin subsidence and diapiric rise promoted the development of a tall, overturned megaflap in the diapir flank facing the second-stage basin. This kinematic evolution resembles megaflaps imaged on seismic data from the deepwater Gulf of Mexico and the Paradox Basin.