Diapiric Influence on Channel Evolution in Deepwater Minibasins, Gulf of Mexico

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ABSTRACT

Submarine channel-levee systems are primary conduits for sediment dispersal to deepwater environments and form significant hydrocarbon reservoirs. Submarine channels can traverse over long distances and deliver sediment to their terminus through a torturous path influenced by eustasy, bathymetry, and active structural deformation. The submarine channel's response to these external controls can influence the stacking and lateral connectivity of thoroughgoing course-grained channel systems. To better understand the link between these controls and their resulting deposits, we utilize three-dimensional seismic-reflection data to investigate the downslope temporal evolution of a Pleistocene-age channel-levee system within three adjacent minibasins at the distal extent of allochthonous salt in the northern Gulf of Mexico. The Gulf of Mexico is dominated by minibasin development from sediment loading over an expansive mobile salt substrate. Detailed mapping and seismic attribute analysis of the channel-levee system revealed depositional architectures driven principally by local salt movement and the configuration of its deeper feeder systems, which varied from minibasin to minibasin. The most proximal minibasin (MB1) shows an asymmetric withdrawal of salt at depth below a rapidly subsiding depocenter adjacent to its partially grounded minibasin flank. This configuration produced a narrow channel belt with vertically aggrading channel axes in its depocenter. The central minibasin (MB2) is winged by two competing active salt diapirs sourced from alternate salt stocks. These two independently active diapirs contribute to periodic tilting of the minibasin that produced laterally migrating channel axes due periodic shifts in the local depocenter axis. The distal minibasin (MB3) and hosted channel system are strongly influenced by the buttressing of the allochthonous salt against older abyssal plain sediments giving rise to emergent salt diapirs and fold structures at the edge of salt. These structures and associated high rates of mass wasting promoting an increase in intrabasinal lateral channel migration and the resultant position of the channel system's minibasin exit point. This study

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highlights the influence and control of halo-kinetic systems and salt welding on the vertical and lateral stacking of submarine channel-levee deposits and lastly, for the broader hydrocarbon exploitation potential of these deep-water reservoirs.