Salt Piercement Mechanics, Examples from the Southern Gabon Basin

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Abstract

Salt emplacement mechanisms for diapirs including piercing the roof pedant have been described mostly by physical modeling techniques, while seismic images of these processes are rarely documented. The South Gabon basin offers an excellent natural laboratory to study the development of diapirs and associated piercement of the roof section, which is based on newly reprocessed seismic data. The South Gabon basin belongs to the greater Atlantic passive margin system and forms part of the South Atlantic salt basin. The Gabon shelf is built on the peripheral sector of the Aptian salt basin with the study area situated at the up-dip section dominated by gravity spreading of the post-salt sequences. The salt provides the regional decollement for the extension process, which is localized along regional and counter-regional normal faults or conjugate sets of normal faults. Extensional faulting is associated with rollover structures in the post-salt, Albian carbonates and the magnitude of extension can be estimated by the separation of the sedimentary section above the salt. In any case, the salt accumulates at the footwall of the extensional faults where it forms elongated ridges of salt rollers. Salt is withdrawn from underneath the rollovers and frequently welded against the pre-salt substratum. The crests of the salt ridges are undulating to form dome-like morphologies from which salt and fluids appear to nucleate and penetrate shallower sediment sequences. 4 types of salt geometries have been delineated to capture stages in the salt mobilization process: Type 1 describes autochthonous salt rollers topped by conjugate normal faults that sometimes form collapse cones below the mudline. At these graben structures, circular flat spots with a distinguished soft response indicate fluid/brine accumulation. Fluid circulation is further evident by shallow

gas and velocity anomalies near mudline. Type 2 reveals a similar salt architecture, but small allochthonous salt bodies now replace the flat spots and are completely detached from the deeper salt ridge. Salt feeders are merely indicated by the discordant sediment signatures of the adjacent mini basins and reduced to tiny circular to elliptical irregularities in depth slices. Type 3 considers salt roller diapirs without any piercement though the reactive character is evident by the extensional fault system at its crest. Type 4 represents a classical hourglass salt diapir geometry with a salt pedestal connecting the shallow salt intrusion with the deeper salt ridge. The allochthonous salt structures do not show pronounced extensional features at its roof indicating a rather active stage of salt diapirism. The types 1 to 3 characterize stages of reactive diapirism and it is suggested that the fluid invasion of type 1 represents an early stage of the piercement process, while type 2 completes the process by emplacement of a shallow allochthonous salt body.