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Post-rift diapir growth above syn-rift transfer fracture zones in the northwestern Mediterranean

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Detailed mapping of the distribution of salt diapirs in the distal part of the Ligurian-Provençal Basin (northwestern Mediterranean) indicates that they are restricted to an area whose upslope boundary forms reentrants located above deep crustal transfer fracture zones associated with the opening of the basin in Oligo–Miocene times (Maillard et al., 2003). Because these basement faults were no longer active in Messinian and post-Messinian times, the geographic correlation between salt diapirs and basement faults cannot be directly attributed to slip along these crustal faults coeval with salt tectonics. Using several physical experiments, we examine how dormant (i.e. inactive) basement steps can affect the development of the overlying salt structures during combined gravity-driven gliding and spreading. Where a basement step trends obliquely with respect to the direction of the slope and initially offsets the base salt, grabens and salt ridges form above and downdip from the basement step, in turn forming a reentrant pointing upslope (Case 1). Where the basement step is buried under pre-Messinian compactable sediments, loading by Messinian and post-Messinian sediments causes differential subsidence above the step, forcing grabens and salt ridges to form above and updip of the basement step (Case 2). There, too, the salt structures are confined in a triangular, reentrant-shaped area pointing upslope. These two situations correspond to two end members of the process by which a basement step can influence salt tectonics. Deposition of both Messinian and post-Messinian sediments, and the resulting increase in lithostatic stress, must have caused a progressive increase in compaction of the subsalt sediments. The first post-Messinian sediments, being deposited above a salt layer having a flat base must have deformed by spreading–gliding in a way similar to that of case 2. The younger, post-Messinian sediments, being deposited when the base salt had a significant offset must have deformed in a way closer to that of case 1. The combination between the two deformation styles (cases 1 and 2) would lead to the formation of grabens and associated diapiric ridges located in a reentrant centered on the basement step and covering both its updip and downdip regions. The combination of these two mechanisms with passive diapir growth during Plio-Pleistocene times explains the striking geographic correlation between salt diapirs and basement structures in the Gulf of Lion. New interpretation of recent deep seismic reflection data allows to precise the relationship between the syn-rift thick-skinned transfer fracture zones and the post-rift thin-skinned salt tectonics.