Geophysical Research Abstracts
Vol. 20, EGU2018-17669, 2018
EGU General Assembly 2018

Diachronous salt tectonics along the Gulf of Lions margin, Western Mediterranean

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Some of the world's most spectacular salt structures are located along salt-bearing continental margins along which large amount of sediments have prograded seaward. The structural style includes extensional, diapiric and contractional features, which implies that, there, both salt and its sediment overburden have been subjected to significant amounts of along-slope displacement. Contractional structures are typically found along the lower slope, whereas extensional structures are located along the upper slope and on the shelf. Around 6 Ma ago, the Mediterranean basin underwent spectacular paleo-environmental changes during the Messinian Salinity Crisis: the margins were deeply eroded in response to a sea-level drop of more than 1500 m, and thick evaporitic series were deposited in the deep basins. The Messinian mobile salt is therefore post-rift because the opening of the Liguro-Provençal basin formed during the Oligo-Aquitanian age (the main tilting of the margins due to the rifting had already happened, and the base of the salt layer was often sub-horizontal or even landward-dipping). Plio-Quaternary tectonics in the deep western Mediterranean is dominated by huge thin-skinned salt tectonics with gravity spreading and/or gliding above the Messinian décollement. It is typically characterized by proximal extension, mid-slope translation, and distal shortening. The distal region of the western Mediterranean, especially in the deeper region of the Gulf of Lions, comprises circular or elongate diapirs, whose initiation was traditionally attributed to combined shortening and sediment loading. Nevertheless, new seismic data and re-interpretation of older ones recently showed that salt tectonics there started very early in the deepest parts of the basin, immediately after deposition of the mobile salt, as is attested by lateral thickness changes and internal angular unconformities within the Messinian Upper Unit, while the Upper Unit in the upslope region remained isopach. This means that upslope extension started well after diapir initiation in the downslope region. We therefore propose two main steps to explain the birth of distal salt diapirs in this area: 1. First, salt in the deepest region of the basin was mobilized by gravity-spreading related to the deposition of sediment wedges; 2. Second, gravity gliding started later, as has been recorded by upslope fan-shaped Early Pliocene deposits adjacent to normal growth faults, the belt of previously-formed diapirs being reactivated by distal contraction. This scenario explains why the onset of updip salt diapirism was not coeval with downdip gliding and how so many diapirs can have pierced through in a brittle, i.e. strong, sedimentary cover, by simple downbuilding. The tilting responsible for this late slope could be due to basin thermal subsidence, to the rapid Pliocene re-flooding of the Mediterranean or to kinematics changes at that time in this geodynamically complex area. Some analogue models are presented to validate this new interpretation.