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Relations between tectonics and sedimentation along the Eastern Sardinian margin (Western Tyrrhenian Sea) : from rifting to reactivation

Virginie Gaullier (1), Frank Chanier (1), Bruno Vendeville (1), Gaël Lymer (1), Agnès Maillard (2), Isabelle Thinon (3), Johanna Lofi (4), Françoise Sage (5), Pierre Giresse (6), and Maria-Angela Bassetti (6)

(1) UMR 8217 - Géosystèmes, Université de Lille 1, Villeneuve d'Ascq, France, (2) UMR 5563 - GET, Université P. Sabatier, Toulouse, France, (3) BRGM- DGR/GBS, Orléans, France, (4) UMR 5243 - Géosciences, Université de Montpellier 2, Montpellier, France, (5) UMR 7329 – GéoAzur- Université Paris 6, Valbonne, France, (6) UMR 5110 - CEFREM, Univ. de Perpignan Via Domitia, Perpignan, France

The offshore-onshore project "METYSS-METYSAR" aims at better understand the Miocene-Pliocene relationships between crustal tectonics, salt tectonics, and sedimentation along the Eastern Sardinian margin, Western Tyrrhenian Sea. In this key-area, the Tyrrhenian back-arc basin underwent recent rifting (9-5 Ma), pro parte coeval with the Messinian Salinity Crisis (MSC, 5.96-5.33 Ma), sea-floor spreading starting during Pliocene times. Thereby, the Tyrrhenian basin and the Eastern Sardinian margin are excellent candidates for studying the mechanisms of extreme lithospheric stretching and thinning, the role of pre-existing structural fabric during and after rifting, and the reactivation of a passive margin and the associated deformation and sedimentation patterns during the MSC. We looked at the respective contributions of crustal and salt tectonics in quantifying vertical and horizontal movements, using especially the seismic markers of the MSC. Overall, we delineate the history of rifting and tectonic reactivation in the area. The distribution maps respectively of the Messinian Erosion Surface and of Messinian units (Upper Unit and Mobile Unit) show that a rifted basin already existed by Messinian time. This reveals a major pre-MSC rifting across the entire domain. Because salt tectonics can create fan-shaped geometries in sediments, syn-rift deposits have to be carefully re-examined in order to decipher the effects of crustal tectonics (rifting) and thin-skinned salt tectonics. Our data surprisingly show that there are no clues for Messinian syn-rift sediments along the East-Sardinia Basin and Cornaglia Terrace, hence no evidence for rifting after Late Tortonian times. Nevertheless, widespread deformation occurred during the Pliocene and can only be attributed to post-rift reactivation. This reactivation is characterized not only by normal faulting but also by contractional structures. Some Pliocene vertical movements caused localized gravity gliding of the mobile salt and its Late Messinian and Early Pliocene brittle overburden. "METYSAR" fieldwork onshore was conducted in the Orosei region and showed that the main present-day Cedrino river follows the trend of a paleo-valley that cuts through the underlying granitic basement and alterites. These deposits, along with the basement, were likely eroded during Messinian times, then reworked during a marine transgression. Micro-fauna in these fine-grained marine sediments are of Upper Pliocene age. The strata dip by 20° to 30° and trend NNE-SSW, a direction which is sub-parallel to the main tectonic structures involved in the rifting of the margin. The tilted Pliocene strata were overlain by volcanic flows, some dating from Upper Pliocene time. Field mapping has evidenced that there was a paleo-topographic relief, trending NNE-SSW, that controlled the sediment deposition. These results indicate that the post-Messinian tectonic activity, which is also visible offshore, controlled the sedimentary architecture and the paleogeography of this area. Onshore, there are signs of neither Lower-Pliocene marine deposits nor Gilbert deltas. The absence of such sedimentary edifices, which are characteristic of the Pliocene refilling of the Mediterranean basin are clues about significant post-rift vertical movements in the Tyrrhenian sea.