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The Western Tyrrhenian Sea: A rifted basin during the Messinian Salinity Crisis

Gaël Lymer (1), Johanna Lofi (2), Virginie Gaullier (3), Agnès Maillard (4), Isabelle Thinon (5), Frank Chanier (3), and Bruno Vendeville (3)

(1) Univ. Birmingham, U.K. (g.lymer@bham.ac.uk), (2) Univ. Montpellier, Géosciences Montpellier, France (johanna.lofi@gm.univ-montp2.fr), (3) Université de Lille, LOG - UMR 8187, Villeneuve d'Ascq, France (virginie.gaullier@univ-lille1.fr), (4) Univ. Toulouse / GET, France (maillard@get.obs-mip.fr), (5) BRGM Orléans, France (i.thinon@brgm.fr)

In the last fifty years, the Messinian Salinity Crisis (MSC) has been widely investigated through the Mediterranean Sea, but a major basin remains fewly explored in terms of MSC thematic: the Western Tyrrhenian Basin. The rifting of this back-arc basin is considered to occur between the Middle-Miocene and the Early-Pliocene, thus including the MSC, giving a unic opportunity to study this crisis in a context of active geodynamics. However the MSC seismic markers in the Western part of the Tyrrhenian Sea have only been investigated in the early eighties and the MSC event in the Western Tyrrhenian Basin remains poorly studied and unclear. In this study, we revisit the MSC in the Western Tyrrhenian Basin, i.e. along the Eastern Sardinian margin. We present results from the interpretation of a 2400 km long HR seismic-reflection dataset, acquired along the margin during the "METYSS" research cruises in 2009 and 2011. Based on the distribution and depths maps of the MSC seismic markers we show that the MSC units have precipitated in palaeo-bathymetric lows, whereas the MES develloped on the basement highs. We also demonstrate that across the margin the syn-rift deposits are pre-MSC in age (Tortonian or older), because they are located below the MSC seismic markers, which do not show any evidence for syn-rift deformation. The MSC seismic markers thus provide powerfull time-markers to bracket the age of the rifting in the Western Tyrrhenian Basin. These observations reveal that the Eastern Sardinian margin was already segmented in horsts and grabens during the MSC and imply that the rifting of the East-Sardinia Basin and the Cornaglia Terrace ended before the MSC. As a consequence we conclude that the East-Sardinian Basin and the Cornaglia Terrace already structured in a stair-stepped geometry before the MSC, which is consistent with the absence of strong post-MSC fault crustal activity at the transition between both basins. Then this pre-existing topography combined with base level changes during the deposition of the MU and UU can explain the present-day differences of thickness of the MSC units that we evidence between the East-Sardinian Basin and the Cornaglia Terrace. The present-day difference in elevation between these units can possibly be explained by differential post-Messinian vertical deformation (compaction, differential post-MSC thermal subsidence). However the deposition of the MSC units below different water depth in both basins cannot be ruled out, with the consequence that, for now, we cannot confidently use the present-day onlaps of the UU as marker to quantify the post-rift subsidence of the Eastern Sardinia margin. Locally, the MSC series show some signs of synsedimentary deformation, but this can be attributed to thin-skinned salt tectonics. An implication is that most of the Western Tyrrhenian Basin was already a deep basin with significant water depth (1000 m and more) when the MSC started. This is also supported by the comparison of the MSC records with known deep MSC basins, for instance the Algero-Provencal Basin.