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The Eastern Sardinian Margin (Tyrrhenian Sea, Western Mediterranean) : a key area to study the rifting and post-breakup evolution of a back-arc passive continental margin

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The Eastern Sardinian passive continental margin formed during the opening of the Tyrrhenian Sea, which is a back-arc basin created by continental rifting and oceanic spreading related to the eastward migrating Apennine subduction system (middle Miocene to Pliocene). Up to now, rifting in this key area was considered to be pro parte coeval with the Messinian Salinity Crisis (MSC, 5.96-5.32 Ma). We use the MSC seismic markers and the deformation of viscous salt and its brittle overburden as proxies to better delineate the timing of rifting and post-rift reactivation, and especially to quantify vertical and horizontal movements. On this young, highly-segmented margin, the Messinian Erosion Surface and the Upper and Mobile Units are systematically associated, respectively, to basement highs and deeper basins, showing that a rifted deep-sea domain already existed by Messinian times, therefore a major pre-MSC rifting episode occurred across the entire domain. Data show that there are no signs of Messinian syn-rift sediments, hence no evidence for rifting after Late Tortonian times. Moreover, because salt tectonics creates fan-shaped geometries in sediments, syn-rift deposits have to be carefully re-examined to distinguish the effects of crustal tectonics (rifting) and salt tectonics. We also precise that rifting is clearly diachronous from the upper margin (East-Sardinia Basin) to the lower margin (Cornaglia Terrace) with two unconformities, attributed respectively to the necking and to the lithospheric breakup unconformities. The onshore part of the upper margin has been recently investigated in order to characterize the large crustal faults affecting the Mesozoic series (geometry, kinematics and chronology) and to decipher the role of the structural inheritance and of the early rifting. Seaward, we also try to constrain the architecture and timing of the continent-ocean transition, between the hyper-extended continental crust and the first oceanic crust. Widespread post-breakup deformation also occurred during the Pliocene. Some Pliocene vertical movements have been evidenced by discovering localized gravity gliding of the salt and its Late Messinian (UU) and Early Pliocene overburden. To the South, crustal-scale southward tilting triggered along-strike gravity gliding of salt and cover recorded by upslope extension and downslope shortening. To the North, East of the Baronie Ridge, there was some post-salt crustal activity along a narrow N-S basement trough, bounded by crustal faults. The salt geometry would suggest that nothing happened after Messinian times, but some structural features (confirmed by analogue modelling) show that basement fault slip was accommodated by lateral salt flow, which thinned upslope and thickened downslope, while the overlying sediments remained sub-horizontal. Along the inner domain of Eastern Sardinian margin, the post-rift deformation style greatly varies. Compressional structures (reverse faults and folds) are observed both onshore and offshore while post-rift extensional structures are mainly identified offshore. Such late deformation could be attributed to mechanisms acting alone or combined, such as : i. the reactivation of the margin, as already described for the Ligurian, Algerian or South-Balearic margins due to the Eurasian-African convergence ; 2. the Zanclean reflooding and the resulting water overload on the elastic lithosphere ; 3. an episodic mantle upwelling.