# Polyphased contractions inside the Sicily Channel Rifting Zone: new evidence from seismic reflection profiles analysis and geodynamic implications

Mariagiada Maiorana [a*], Andrea Artoni [b], , Nicolò Chizzini [b], Eline Le Breton [c], Attilio Sulli [a], Luigi Torelli [b]

[a] Department of Earth and Marine Sciences, University of Palermo, Via Archirafi 22, 90123, Palermo, Italy

[b] Department of Chemistry, Life Sciences and Environmental Sustainability University of Parma, Parco Area delle Scienze, 157/A, Parma, Italy

[c]Institute of Geological Sciences, Freie Universität Berlin, Berlin, Germany

*Corresponding author.

*E-mail address*: mariagiada.maiorana@unipa.it (M. Maiorana)

## Abstract

The Sicily Channel, located in the foreland area of the African plate, is a very interesting geological area in the Western-Central Mediterranean, as it has undergone different tectonic processes because of its proximity to the convergence zone with the European plate. Extension and opening of a rift zone (Sicily Channel Rift Zone, including the Pantelleria, Malta, and Linosa grabens) occurred in the lower plate of the subduction zone marked by the Gela Thrust System and the Calabrian Accretionary Wedge, respectively located south and south-east of Sicily, and the Maghrebian chain to the west. We analyzed geological and geophysical data, such as variable penetration seismic reflection profiles integrated with borehole data; these allowed us to investigate subsurface structures down to the crust-mantle boundary. The crustal profile shows a Moho deepening down to 11.8 s/(TWT) under the Gela Thrust System and going up to 8 s/(TWT) under the Linosa Graben. Moreover, the presence of several hyperbolae zones and signal anomalies have been linked to a rise of deep fluids associated with mantle uplift and, upward, to magmatic intrusions. The sub-surface also shows evidence of a N-S oriented zone, from the Gela Thrust System to the Malta and Linosa grabens, which has undergone contractional tectonic events superimposed on previous extensional structures. Throughout this area, from the Early-Middle Miocene to the Early Pliocene, an extensional event occurred in association with the slab roll-back of the African Plate. In this phase, several volcanic intrusions concentrated near the grabens' rims suggest a relation between the extension, the Moho rising, and the magmatic manifestations. Afterward, a compressional event in the Madrepore and Malta Grabens was registered. This event has been correlated to the advance of the Gela Thrust Front, which, according to literature bio-chronostratigraphic analysis, had three stages of advancement in Zanclean, Piacenzian and Chibanian. Furthermore, a recent contractional event caused the folding of the seafloor in the central part of the Malta Graben. This latter phase has been related to a potential change in the subduction polarity. These results provide new insights into the regional kinematic setting of the Sicily Channel, suggesting that strain located within the African Plate can be explained through the overlapping of both intra-plate (localized asthenospheric rise) and inter-plate (compression transmitted from surrounding mountain belts) processes ongoing between Europa and Africa. Indeed, the Sicily Channel structural setting resulted from the interplay of the rollback of the African slab, the consequent changes in the asthenospheric flow that caused extension and local magmatic intrusions, and the active subduction front and its potential polarity reversal that caused local and polyphased compressional pulses.