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Early Miocene to Pliocene multiphase extension in the Maltese Islands and implications for the geodynamic evolution of the Pelagian platform and of the Pantelleria rift system

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The Maltese Islands (Malta and Gozo) are located in the Pelagian platform on the shoulder of the Pantelleria rift system, in the foreland of the Sicilian – Apennines – Maghrebian belt (Western Mediterranean Arc). They are characterized by a sequence of Late Oligocene to Miocene platform carbonates that are dissected by two sets of normal faults, trending NW-SE and ENE-WSW, with displacements up to 120 meters. Moreover, Neptunian dikes associated with small normal faults (<5 m displacement) are present in the early Miocene units only (particularly in the Lower member of the Globigerina Limestone, Aquitanian) and are sealed by the overlying formations.
Different interpretations have been proposed for the tectonic evolution of the Maltese Islands. Illies (1981, TPh) distributed the evolution of the graben system in three different extensional phases started in the Late Miocene. Dart et al. (1993, J Geol Soc), suggested that fault sets are coeval and developed in response to N-S extension began in the Late Miocene. For the development of the Neptunian dykes and of the related normal faults, only few structural interpretations have been proposed. Dart et al. (1993, J Geol Soc) suggested that they were formed during the early sin-rift phase of the Pantelleria rift system whereas Illies (1981, TPh) proposed that they were formed during some independent movement before the rifting phase that led to the formation of the main faults.
These contrasting interpretations reflect the overall uncertainty about the geodynamic evolution of the Pantelleria Rift System, caused also by the paucity of outcropping structures that could yield useful kinematic and age constraints. The Maltese Islands represent one of the few "windows" that could shed some light on this system.
In this contribution, we present new kinematic data collected in Gozo both on the two major sets of normal faults (ENE-WSW and NW-SE) and on the small normal faults associated with Neptunian dikes in the Lower Globigerina. With a tectonic back-stripping approach, we have been able to associate these structures to two extensional events, separated by a period of tectonic quiescence: (D1) Early Miocene NW-SE extension; (D2) N-S extension developed from the Late Miocene onward.
Thanks to this new interpretation, we are able for the first time to bind the tectonic evolution of the area with the geodynamic evolution of the Central Mediterranean from the Late Oligocene onwards. Indeed, during both extensional events the Maltese Islands and the Pelagian Platform were located in a foreland position, with respect to the growing Sicilian – Apennines – Maghrebian belt (Western Mediterranean Arc), in a period of slab roll-back (Faccenna, 2001, Geoph J Int). We suggest that both tectonic events are an evidence of the extensional regime imposed on the forebulge area by the roll-back of the subducting slab. The switch in the main extension axis between D1 and D2 (NW-SE vs. N-S) can be interpreted as a result of the varying orientation of the trench due to the progressive development of the Western Mediterranean Arc, and provides an independent tool to "monitor" the slab roll-back.