



The analysis of vertical axis rotations in the Calabrian Arc to unravel the tectonic evolution of a curved mountain belt on top of a retreating slab

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Paleomagnetism, combined with structural analysis, represents a unique tool in discriminating the primary or secondary nature of arcs and understanding the kinematics of curved orogens. Among the different arcs of the Mediterranean region, the Calabrian Arc has long been considered a classical example of orocline, assuming that its curvature was acquired throughout bending of an originally almost straight orogenic chain. However, the analysis of the spatial and temporal distribution of paleomagnetic data collected in the last 30 years shows that a simple orocline model is not sufficient to describe the complex tectonic evolution of the Calabrian Arc. Paleomagnetic data indicate that opposite tectonic rotations occurred progressively during the Neogene to early Pleistocene along the two edges of the arc, CW in Sicily and CCW in the Southern Apennines. These rotations were coeval with the main phases of compressive deformation of the belt and their sense and amplitude strongly correlate with the present-day orientation of compressive tectonic structures in Southern Apennines and Sicily. Conversely, the core of the arc, the Calabria-Peloritani Domain (CPD), underwent a rigid CW rotation only during the early Pleistocene, showing any relationships with the structural trend.

The different rotational domains that characterize the Calabrian Arc clearly mirror the deep configuration of the lithosphere, as the CPD is located on top of the Ionian slab, whereas the Southern Apennines and Sicilian Maghrebides represent the part of the Calabrian Arc where continental collision processes occurred. The presence of lateral heterogeneities in the subducting lithosphere and the subsequent progressive decrease in width of the trench during subduction may be considered the main cause of Calabrian Arc formation and of its present-day narrow and tight shape. In particular, the end of the Calabrian Arc bending, occurring during the Quaternary, marks a decrease in the efficiency of the tectonic processes related to the long-lived subduction of the Ionian slab, which caused the halting of the back-arc opening in the Southern Tyrrhenian Sea.