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The Mediterranean trapped mantle plume: a lateral arm of the Atlantic plume?

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Tomographic data evidence a low-velocity region that underlies the Atlantic, the African continent and much of Europe over a depth of 1000 km. This may be interpreted as image of a deep mantle plume, e.g. the African superswell, linked to the opening of the Atlantic. A long-lived asymmetric mantle upwelling phenomenon associated with extensional tectonics and with alkaline/ultra-alkaline magmatism is well known in the eastern central Atlantic realm. It initiated in western north Africa and south-western Europe during late Cretaceous times and propagated northeast-ward reaching the central Europe rift system area during Paleocene times. Based on the compared analysis of geological, geophysical and geochemical constraints, it is possible to hypothesize that starting with early Oligocene times, a lateral arm of the Atlantic plume begun to grow eastward leading to the progressive asymmetric opening of the western and central Mediterranean area. The latter may be therefore interpreted as an independent microplate developed in the last 35-40 Ma above a growing head plume. An alternative interpretation of available tomographic data allow to confine such a plume head within the transition zone (410 to 670 km depth); its progressive growth would have determined asthenospheric asymmetric expansion and consequent stretching of the overlying lithosphere. Two discrete plume pulses would have lead to the opening of the Ligurian-Balearic rift basins between 30 and 15 Ma ago and of the Tyrrhenian Sea between 13 My and recent. Rift push forces might have generated compression at the outer border of the thinned lithospheric zone, leading to the nucleation of the Apennine-Maghrebian fold-and-thrust belt system. Metasomatic and radiogenic elements, carried from the deep mantle and released from the plume head

within the overlying asthenosphere, would have produced a suitable mantle source for the pery-Tyrrhenian ultra-alkaline magmatic products.