Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01633, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01633
EGU General Assembly 2008

A late Cretaceous contamination episode of the European-Mediterranean mantle

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One of the most challenging issues about the Tertiary-Quaternary alkaline magmatism spreading across the Euro-Mediterranean region is the assessment of both the nature of its mantle source and the mechanism responsible for the common HIMU-like (High μ = high $^{238}U/^{204}Pb$) character of erupted lavas, enduring over about one hundred million years in diverse tectonic environments. In this paper we try to reconcile geochemical and geophysical data through a multidisciplinary investigation on geochemistry, timing and locations of the main Na-rich alkaline volcanic centers, seismic tomographic images and plate kinematics. We propose that the common component of the Euro-Mediterranean mantle derives from a contamination episode triggered by the rise of the Central Atlantic Plume (CAP) head. Plate reconstruction shows that at Late Cretaceous-Paleocene time the oldest magmatic centers of the Euro-Mediterranean region were located more than 2000 km SW of their present day position, in proximity of the CAP hot spot location, where seismic tomography detects a broad low seismic velocity region in the lower mantle. The north-eastward migration of the Eurasian and African plates could have involved also part of the CAP contaminated mantle, which moved in the same direction being coupled to the lithospheric plates, thus explaining the presence of geochemically-uniform material spread in the sub-lithospheric Euro-Mediterranean mantle. During the Tertiary, regional-scale convection and related processes such as rifting, back-arc spreading, slab detachment/windows, may have favored upwelling and partial melting of the frayed plume head material via adiabatic decompression, shaping the spatial and temporal distribution of HIMU-like volcanics.

The growing supply of subducted lithosphere may explain as well the increase of crustal isotopic signatures of alkaline magmas with time. In our opinion, the Euro-Mediterranean upper mantle contamination can be eventually related to a global event occurred during the Cretaceous as a consequence of a mantle avalanche caused by the Tethys closure.