



Lower plate serpentinite diapirism in the Calabrian Arc subduction complex

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Mantle-derived serpentinites have been detected at magma-poor rifted margins and above subduction zones, where they are usually produced by fluids released from the slab to the mantle wedge. We show evidence of a new class of serpentinite diapirs within the external subduction system of the Calabrian Arc, derived directly from the lower plate. Mantle serpentinites rise through lithospheric faults caused by incipient rifting and the collapse of the accretionary wedge. Two oppositely dipping fault systems, i.e. the Ionian (IF) and Alfeo-Etna (AEF) faults, deform the subduction system offshore Eastern Sicily along a complex strike-slip/transensional pattern producing deep fragmentation of the Western Ionian domain, in agreement with geodetic models suggesting plate divergence in this region.

Multibeam and seismic reflection data call for incipient deformation of four areas of the accretionary wedge marked by buried sub-circular features aligned along the AEF. Rising material in subduction complexes might be ascribed to different processes and we attempted to discriminate between these processes using magnetic and gravity field data. Magnetic and gravity anomalies are not consistent with a salt/mud compositions of the diapirs nor with a volcanic or magmatic source, in agreement with heat flow data showing a lower than normal thermal regime for the Ionian basin. Since the basal detachment of the subduction system is deformed and segmented in correspondence with these diapirs, we argue that the source of the rising material is below the detachment. Gravity/magnetic modelling best fit was obtained considering the intrusions as serpentine diapirs in agreement with the presence in the Ionian upper mantle of two layers with high seismic P-wave velocity, low S-wave velocity and high V_p/V_s values, interpreted as partly serpentinitized peridotites. Pore waters from gravity cores were analyzed from above the diapiric structure to check for potential geochemical anomalies that may be related to the advection of deep-source fluids. The observed pore water signature indicates active fluid migration related to subsurface dewatering and this is associated with fluid flow related features within sediments such as patchy cloudy facies, sediment layers disruption, mud injections and vertical fluid paths.

Mantle-derived diapirism is not linked directly to subduction processes. The serpentinites, formed probably during Mesozoic Tethyan rifting, were carried below the subduction system by plate convergence; lithospheric faults driving margin segmentation act as windows through which inherited serpentinites rise to the sub-seafloor. Serpentinite diapirs in the Ionian Sea provide evidence on how altered mantle rocks may be transferred from rifting, to basin floor, to subduction where they can give rise to large-scale diapirism, enhancing shear processes and margin disruption during the final closure of the ocean. These findings may lead towards a more complete understanding of the structure of the Ionian lithosphere and of the role of inherited serpentinites in driving neotectonic and continental collision.