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Palaeogeographic setting versus petrologic features of mantle peridotites from the Ligurian Tethys, a Jurassic ultra-slow spreading ocean.

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Western Alps-Northern Apennine (NW Italy) ophiolites are remnants of the oceanic lithosphere of the Ligurian Tethys ocean which separated Europe and Adria continental blocks during Jurassic-Cretaceous times. Ophiolite-bearing units from Ocean Continent Transition (O.C.T.) settings of the Adria margin [i.e. sectors of External Ligurides (EL)] show the close association of mantle peridotites, MOR pillowed basalts and continental crust material. Ophiolite sequences from More Internal Oceanic (M.I.O.) settings [i.e. W.A. Pennidic Units, Lanzo (LA), sectors of El and Erro-Tobbio (ET), Internal Ligurides (IL), Corsica (MM)] show a peculiar stratigraphy, which indicates that: i) the oceanic basin was floored by tectonically exhumed mantle peridotites; ii) MORB gabbroic bodies were intruded into mantle peridotites; iii) the peridotite basement was discontinuously covered by MOR basaltic flows. Palaeogeographic distribution of the different M.I.O. units evidence the along-axis alternance of: 1) NON-VOLCANIC SECTORS, characterized by direct exposure of mantle peridotites below the oceanic sediments; 2) VOLCANIC SECTORS, characterized by the presence of a volcanic cover on top of mantle peridotites. Accordingly, the Jurassic Ligurian Tethys was closely similar to modern ultra-slow spreading oceans (i.e. Gakkel and SWIR ridges).

Recent studies on Alpine-Apennine ophiolitic peridotites evidence their extreme structural and compositional heterogeneity and the close relationships between paleogeographic setting and petrologic features. Three groups are distinguished: 1) LITHOSPHERIC, 2) TRANSITIONAL (melt-modified), and 3) OCEANIC (melting residua) PERIDOTITES. Lithospheric peridotites were exposed at pericontinental

O.C.T. zones whilst transitional and oceanic peridotites were exposed at M.I.O. settings.

Lithospheric peridotites are fertile spinel lherzolites with diffuse garnet/spinel pyroxenite banding. Transitional peridotites are pristine lithospheric peridotites strongly modified by melt-peridotite interaction and transformed to granular, pyroxene-depleted spinel harzburgites, impregnated and refertilized plagioclase peridotites and replacive spinel harzburgites and dunites. Oceanic peridotites are depleted refractory residua after Jurassic asthenospheric partial melting.

O.C.T. lithospheric peridotites (sectors of EL and ET) show structural, petrographic and geochronological characteristics which indicate that they underwent exhumation from the sub-continental mantle lithosphere starting from Triassic as a consequence of lithospheric extension in the Europe-Adria realm. Nd model ages suggest that they were isolated from the convective asthenosphere and accreted to the thermal lithosphere from Proterozoic times and were equilibrated at spinel-facies conditions (T in the range 900-1100˚C), on an average continental-type geotherm.

Most of M.I.O. peridotites (LA, sectors of EL and ET, IL) represent subcontinental lithospheric mantle which underwent MORB melt interaction and melt intrusion during Jurassic times. Some M.I.O. peridotites (MM) represent residual peridotites after Jurassic asthenosphere partial melting.

Across-axis variations of mantle peridotites in the ancient Ligurian Tethys, from O.C.T. to M.I.O. settings, describe the different evolution stages of the basin, i.e. :

1) exhumed subcontinental mantle (E.S.M.) characterizes the O.C.T. zones and represent the rifting to drifting stages; 2) percolated subcontinental mantle (P.S.M.) mostly characterized the more external M.I.O. settings and represent the spreading stage after complete failure of continental crust; 3) percolated oceanic mantle (P.O.M.), cogenetic with the Jurassic MORB melts, mostly characterized the More Internal M.I.O. settings and represent the oceanic stage, after complete failure of the percolated subcontinental mantle.

In conclusion, our studies allow to reconstruct the following scenario:

1) Lithosphere extension, presumably starting during Triassic (it was already active at 220 Ma in EL), caused exhumation of the sub-continental lithospheric mantle (as old as Proterozoic), by means of km-scale shear zones, which led to its sea-floor exposure during Late Jurassic times;

2) Lithosphere extension and thinning induced almost adiabatic upwelling of the underlying asthenosphere and its partial melting on decompression, which started most

probably during Early Jurassic times (as suggested by the 180 Ma age of the oldest MORB gabbro in O.C.T.);

3) Asthenospheric MORB-type melts percolated the extending sub-continental mantle lithosphere and reacted with pristine lithospheric peridotites, forming melt-modified, depleted/enriched transitional peridotites: interaction with deformed rocks of the extensional shear zones suggest that percolation of MORB-type melts occurred during lithosphere extension;

4) During Jurassic, prior to sea-floor exposure, both lithospheric and transitional peridotites were intruded by aggregated MORB, starting from 180 Ma in O.C.T. peridotites to 160 Ma in M.I.O. peridotites;

5) Oceanic refractory peridotites, coeval and cogenetic with the Jurassic MORB melts, were accreted to the thermal lithosphere, were percolated by newly formed MORB melts upwelling from the underlying molten asthenosphere and were exposed at the sea-floor during Late Jurassic times.