Magmatism and mantle evolution in the Northern Apennines: a tale of rifting, oceanization and subduction

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The Apennine magmatism from Early Permian to present may be considered as the result of a Wilson cycle. Here, the main stages of this magmatic activity will be reviewed from a mantle source perspective in the framework of the Alpine-Apennine system. The oldest magmatic event is represented by gabbro-derived granulites of Late Variscan age, now occurring as blocks in Late Cretaceous orogenic melanges. Their protholiths were recognized as deep crustal cumulates derived from MOR-type tholeiitic liquids. This event may be related to the extensive magmatic underplating affecting SW Europe in conjunction with lithospheric thinning and orogenic collapse of the Variscan belt. The subsequent Mesozoic continental rifting preceding the opening of the Jurassic Ligurian Tethys was mostly amagmatic. Nevertheless, widespread evidence of melt migration in the ascending lithosphere during passive asthenospheric upwelling is testified in the exhumed mantle bodies from the Northern Apennine ophiolites. Mantle rocks showing a considerable geochemical and isotope heterogeneity were a dominant component of the Ligurian Tethys oceanic lithosphere. In contrast, the short-lived magmatism of the Ligurian Tethys (ca. 160-165 Ma) was characterized by uniform N-MORB signatures, both in marginal and oceanward domains of the basin, which were related to embryonic and slow-spreading ridge type oceanic lithosphere, respectively. The Nd-Hf isotopic contrast between magmatic products and associated mantle rocks (Rampone et al., 1998; Mc Carthy et al., 2015; Barry et al., 2017; this work) is a debated issue, which could reflect the occurrence of inherited subcontinental mantle or ancient depleted domains in the convecting upper mantle. The subduction initiation in the Northern Apennine was not related to igneous activity. No record of island-arc magmatism linked to the Alpine east-dipping subduction stage has been recognized, possibly due to dry, mantle-dominated, subducted lithosphere (Mc Carthy et al., 2018). On the other hand, the collisional calc-alkaline magmatism coeval with the west-dipping Apennine subduction system was found only as clasts in sediments from the nascent orogen (Aveto-Petrignacola Formation). Ancient modifications of mantle sources, possibly related to the previous subduction event, have been proposed for the origin of this magmatism (Mattioli et al., 2012). The imprint of Apennine subduction on mantle sources is strikingly attested by the recent volcanism (< 5 Ma), which includes the unique magmatic associations from Tuscany and Roman provinces. Here, leucite-free (lamproites, shoshonites) and leucite-bearing (kamafugite, leucitite, plagioleucitite) K-rich magmas, were erupted in the former domains, and locally hybridized with anatectic melts. Mantle melting was triggered by post-orogenic extension following the eastward migration of the Adriatic slab. Mantle
source modification through recycling of different sedimentary lithologies from the subducted slab may explain the extreme incompatible trace element enrichments and Sr-Pb-Nd-Hf isotopic signatures of the ultrapotassic magmas, coupled with their subduction-related geochemical affinity (Conticelli et al., 2015).

References

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