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Cenozoic magmatism in the Alps with special reference to the Ligurian knot

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More than half a century of investigations on the chemical and isotopic compositions and on geochronological data of the Cenozoic magmatic rocks in the Alps and the transition to the Apennine will be summarized. The Alps itself are dominated by a calc-alkaline series between ~42 and 30 Ma, which we summarized as Periadriatic magmatism. This magmatism includes also eroded volcanic parts and several dykes in the Southern Alps and Tyrol. In addition, Sesia Zone magmatic rocks are characterized by ultrapotassic, shoshonitic and calc-alkaline rocks between 33 and 30 Ma. Two other magmatic provinces are located in between the Alps and the Apennine: (1) Veneto volcanic province (=VVP; nephelinites, basanites and alkali basalts between 52 and 30 Ma); (2) Mortara volcano (~28 Ma). Another group is the Esterél magmatic province, which is located in the Alps and their direct foreland, but are not related to Alpine geodynamics. These are basalts, andesites and dacites with mantle signature developed between 40 and 20 Ma. In the hanging plate of the early Apennine geometry, some minor volcanic activity is preserved in Sardinia. The major volume of Apennine magmatism itself (Elba etc.) is Late Miocene-Pleistocene in age and is related to roll back dynamics of the Apennine.

The Eocene/Oligocene Periadriatic magmatism of the Alps requires significant melt production in the crust combined with some ACF processes. This is possible by infiltration of fluids in the mantle wedge and the lower crust and a change of P-T conditions in the mantle. Their calc-alkaline character is related to Na-dominated input in the mantle and crust, which is commonly inferred to result from subduction of oceanic units. Ultrapotassic melts in the Sesia-unit most likely result from infiltration of K-dominated fluids, related to dehydration of continental material. The dynamics of Apennine and possible related forearc extension would allow an extensional related magmatism in the Esterél. This magmatism overlap in time with Alpine magmatism, and require a small-scale mantle dynamic due to the development of two slabs. In addition, the VVP and the Mortara volcano are located on the non deformed continental fragment of Adria between the Alps and Apennine. This area is characterized by overfilled basins and local magmatism inside the Adriatic continental plate.

The sometimes minor preserved volumes, but well constrain timing of magmatic rocks at the interaction between Alps and Apennine give insights in the lower crust/mantle dynamics at Oligocene/Early Miocene times. These interpretations may differ from models based on upper crustal tectonics, due to the decoupling between upper crust and lower crust/mantle.

