Cenozoic magmatism in the Alps and the relation to geodynamics: A review

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We summarize 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 neighboring regions. Based on the tectonic units hosting the magmatic rocks and on their age and chemistry we distinguish the following groups: (A) Periadriatic magmatic rocks: calc-alkaline series between ~42 and 30 Ma, located in the immediate vicinity of the Periadriatic Fault; (B) Sesia Zone magmatic rocks: ultrapotassic, shoshonitic and calc-alkaline rocks between 33 and 30 Ma; (C) Dykes and stocks of the Southern Alps: basalts, andesites with ages bracket between 64 and 33 Ma; (D) Esterél magmatic province: basalts, andesites and dacites with mantle signature developed between 40 and 20 Ma; (E) Veneto volcanic province (nephelinites, basanites and alkali basalts between 52 and 30 Ma); (F) Volcanic and plutonic rocks at the Alps-Dinarides-Pannonian junction with agesyounger than 18 Ma; (G) Veins, dykes and stocks related to local, crustalmelting in the Central Alps (Novate granite), (H) Southern foreland related volcanic rocks (Mortara volcano, ~28 Ma).
The Periadriatic magmatism requires significant melt production and ACF processes. This is only possible by infiltration of fluids in the mantle wedge and the lower crustand 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.
It is difficult to invoke one and the same geodynamic process to explain all these magmatic provinces. Magmatism at both ends of the chain, in the Esterél and at the Alps-Dinarides-Pannonian junction are probably caused by along strike changes in the geodynamic–frame of the Alpine orogeny. The Veneto volcanic province is suggested to be related to local, E-W extension in the upper plate of Alpine subduction.
Interpreting the geodynamic setting of these magmatic provinces requires the assessment of their position in map view at the time of their emplacement, hence, retro-deformation of Alpine collisional shortening in map view. This shows a different map-view distribution of magmatic bodies, suggesting a significant distance between the Eocene magmatism of the Southern Alps and the Periadriatic magmatism. No simple age trend can be observed in map view. This indicates the transition from a more distributed Eocene, subduction related magmatism to later one whose ascent and emplacement is controlled by the collisional crustal structures.