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Post-Hercynian subvolcanic magmatism in the Serre Massif (Central-Southern Calabria, Italy)

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In the Serre Massif (Central-Southern Calabria, Italy) dykes and subvolcanic bodies intrude diffusively both Hercynian metamorphic rocks and late-Hercynian granitoids. They range in composition from basaltic andesites to dacite-rhyodacites and can be ascribed to the extensive magmatic activity that affects the entire Hercynian orogenic belt in late Paleozoic – early Mesozoic time.
The geodinamic framework of the magmatic activity is still matter of debate, nevertheless most authors agree in correlating magmatism both to the late-orogenic collapse of the Hercynian belt and to the lithosphere thinning responsible for the subsequent continental rifting.
In this work, we propose a petrogenetic model for acidic to basic hypabissal bodies from southern Calabria in order to define the nature of sources, discriminate magmatic processes and supply a contribution in the geodynamic reconstruction of the Late Palaeozoic in the Calabria-Peloritani Orogen.
In relation to their geochemical affinity, studied dykes have been divided in two groups: a medium- to high-K calc-alkaline and a tholeiitic one.
Dykes belonging to the former group, andesitic and dacitic-rhyodacitic in composition, show typical features of subduction-related magmatism, such as LILE and LREE enrichments, depletions in HFSE, peaks in Rb, Th and Ce, accentuated troughs in Ba, Nb-Ta, P and Ti (White and Dupré, 1986; McCulloch and Gamble, 1991), contrasting with the late Hercynian collisional context. On the other side, features typical of intra-plate magmatic activity, such as a moderate enrichment in Ta, Nb, Ce, P, Zr, Hf and Sm relative to MORB composition are also present in studied rocks (Shimizu & Arculus, 1975; Pearce, 1982).
REE-patterns are strongly to weakly fractionated for the andesitic rocks (Lan/Ybn = 10.03-13.98) and the dacitic-rhyodacitic ones (Lan/Ybn = 6.00 to 2.82), respectively. The latter rocks exhibit a very slight negative Eu anomaly, whereas no Eu anomaly is recognizable in the andesite patterns.
For the andesite rocks an origin by partial melting of an enriched lithospheric mantle source in a post-collisional context is proposed. For dacitic-rhyodacitic dykes a strong involvement of crustal material is suggested by geochemical features such as Nb-Ta trough, Th enrichment, low Nb/La rate (0.37 avg value) and high Th/La rate (0.68 avg value) (Taylor & McLennan, 1985).
Tholeiitic dykes include basaltic andesites with geochemical characteristics (REE and incompatible elements) very similar to those of continental tholeiites. Nb and Ti anomalies, less marked of those observed in calc-alkaline dykes, also occur in the tholeiitic ones, as well as the enrichment in LIL elements. Besides, with respect the calc-alkaline ones, tholeiitic types are slightly more HFSE-enriched.
REE patterns are sub-parallel and slightly fractionated (Lan/Ybn = 2.62 and 2.65), Eu negative anomaly is strongly pronounced.
These geochemical evidences are explained invoking a derivation from an enriched mantle source, possibly in connection with early stages of continental rifting processes. Crustal contamination or magma mixing processes probably occurred during magma ascent, as suggested by petrographic evidences (“quartz ocelli” and xenocrysts of plagioclase). Indeed, even by comparing N-MORB – normalized patterns of tholeiitic dykes with E-MORB (Sun, 1980) and upper continental crust (Taylor and McLennan, 1981) compositions, a derivation from an E-MORB source type and interaction with continental crust both appear as processes strongly involved in the genesis of the studied rocks.

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