CONCLUSION

Post-Hercynian magmatic dykes outcropping in southern Calabria-Peloritani Orogen and western-central Sicily have been studied. They are part of the widespread magmatism developed in Europe at the end of the Hercynian orogeny, with extensive plutonic, volcanic and sub-volcanic manifestations, mostly related to extensional tectonics that took place soon after the final stages of continental collision and leading to the continental break-up and subsequent Jurassic opening of the Tethys ocean (e.g., *Wilson at al., 2004*).

Intermediate to felsic Calabrian dykes have been sampled in five different areas of the Serre Massif (Mammola (LMA-PDL samples), Antonimina (A samples), Foletti Valley (F samples), San Todaro (ST samples) and Villaggio Zomaro (VZ samples)), Dykes have lenticular or tabular shapes and individual thicknesses ranging between 0.3 and 10 m.

All samples suffered an extensive hydrothermal alteration causing partial or, in some cases, total replacement of the primary mineralogical assemblage by secondary phases (e.g., chlorite and/or actinolite after pyroxene; chlorite after biotite; albite after plagioclase). In VZ samples, total replacement of magmatic plagioclase by secondary K-feldspar has been recognized.

On the whole, Calabrian dykes show a porphyritic texture with a P.I. in the range 7 -25%. The most mafic lithotypes (LMA, PDL, A and F samples) are mainly formed by pyroxene phenocrysts (mostly augite and minor diopside) in a groundmass formed by plagioclase (mainly albitic in composition) and amphibole (Tschermakite and Mg-Hastingsite in LMA samples, Mg-Hornblende in F samples, Tschermakite and Mg-Hornblende in A samples). Noteworthy is the presence of *quartz-ocelli* in LMA and PDL samples, in some cases mantled by clinopyroxene and amphibole and occasionally embayed.

The most acidic dykes (ST and VZ samples) consist of albitic plagioclase, K-feldspar, quartz, chloritized biotite and white mica. ST samples separate in two different sub-groups, one (Group I) characterized by a fine to medium grained matrix, lack of primary white mica and low amounts of secondary one. The second sub-group (Group

II) is instead characterized by a medium-grained quartz-rich matrix and by presence of primary white mica.

Serre dykes range in composition from basaltic-andesites (LMA-PDL groups), andesites (A-F groups) to dacites-rhyodacites (VZ-ST groups), all showing a medium- to high-K calcalkaline affinity.

Significant differences in major and trace elements composition have been detected among the ST samples that may be divided into two subgroups, SiO_2- poor and SiO_2-rich, reflecting the observed petrographic features. The former group shows many similarities in terms of major and trace elements composition with the intruded metaluminous to weakly peraluminous Serre granitoids, generally interpreted as resulting from the interaction of mantle-derived magmas with lower-crustal melts (*Schenk, 1980; Rottura et al., 1990; Fornelli et al., 1994*).

On the whole, all dykes show similarities with the late Carboniferous – lower Permian calcalkaline dykes of the Sardinia-Corsica domain (SCD) (*Atzori and Traversa, 1986; Atzori et al., 2000; Traversa et al., 2003*) and show typical features of subduction-related magmas (e.g., *Pearce, 1983*), such as LILE enrichment, HFSE depletion, peaks at Rb, Pb and Th, and troughs at Nb-Ta and Ti, indicative of orogenic geodynamic contexts, strongly contrasting with the post-collisional tectonic setting envisaged for the emplacement of the dykes. In fact, the studied calcalkaline dykes, intruding Hercynian metapelites and late-Hercynian undeformed granitoid rocks, were likely generated in a post-collisional extensional context, characterized by lithosphere thinning promoting upwelling of hot asthenosphere (*Caggianelli et al., 2007; Angì et al., 2010*).

This is indeed the same general framework envisaged for dykes of roughly similar composition widespread in western Europe, such as those from the SCD (*Atzori and Traversa, 1986; Atzori et al., 2000; Traversa et al., 2003*), for which a transition from a compressive to extensional geodynamic setting and variable crustal contamination of mantle magmas derived from subduction-modified lithospheric mantle sources, have been invoked to explain their geochemical features.

A similar magmatic source is also suggested by the Sr–Nd isotopic composition of most of the studied dyke groups (basaltic andesites, andesites and silica-poor dacite-rhyodacites).

Conversely, the most acidic ST dacite-rhyodacitic group shows an isotopic composition broadly compatible with a direct crustal origin by partial melting of metasediments from the lower Serre crust (*Caggianelli et al., 1991*). Moreover, the comparison with experimental melts composition revealed similarities with a metapelitic crustal source.

Differently, the silica-poor sub-group of ST dacite-rhyodacites likely resulted from hybridization, at variable extent, of basaltic mantle magma with pelitic metasediments.

Group VZ dacitic dykes have mineralogical and geochemical composition strongly modified by post-magmatic modifications. For this reason, various attempts to develop reliable geochemical modeling, explaining the genesis and evolution of VZ samples, resulted unsuccessful. However, the strong similarities observed between the trace element composition of the VZ samples and the other studied Serre dykes as well as the SCD post-collisional dykes, allow us to envisaged a comparable post-collisional tectonic context and magma source. Additionally, the "disequilibrium" textures shown by VZ samples (e. g., quartz *ocelli* and dissolution textures) could be considered consistent with mixing processes between crustal- and mantle-derived melts.

FC-AFC and mixing calculations (*Ersoy and Helvaci, 2010*) have been carried out to define the processes involved in the evolution of the intermediate-basic Serre dykes. Results suggest that the basaltic andesites and group F andesites likely evolved by AFC processes involving stalling and fractionation of mantle-derived melts in the crust and concurrent assimilation of wall rocks similar to the lower crustal Serre metapelites.

On the other hand, group A andesites likely represent the result of simple fractionation process from the most primitive group A melts.

Sicilian dykes from two different localities have been studied: in central Sicily, in the Leonforte area (VG samples) and in western Sicily, in the Roccapalumba – Lercara – Margana area (MA and BM samples). They are intruded, with variable thicknesses (1.5 – 25 m), into the Ladinian and the middle Triassic – early Carnian sedimentary sequences of Lercara Fm., respectively.

Hydrothermal metamorphism affected extensively these samples, causing albitization of plagioclase, and in some cases, partial to total chlorite replacement of primary mafic mineral phases, as well as local growth of prhenite/pumpellyte grains.

Primary plagioclase composition (mainly labradoritic) is preserved in the BM samples of the Lercara area and fresh augitic, and minor diopisidic, clinopyroxene forming an ophitic texture with plagioclase, is observed in the Leonforte samples (VG)

Studied rocks have been classified as alkaline basalts (VG samples) and tholeiitic basalts and basaltic-andesites (BM and MA, respectively).

The VG alkali basalts have a distinctive OIB trace element character (OIB-like humped pattern, enrichments in LILE, HFSE and LREE, positive Nb-Ta and Ti anomalies) suggesting an anorogenic nature of the magmas with no involvement of crustal and/or subduction-related components. Additionally, trace element compositions are broadly similar to those of Spanish Central System alkaline suite (*Villaseca et al., 2004; Orejana et al., 2008*) and Triassic San Donato alkaline dykes (*Barca et al., 2010*), for which LILE-enriched mantle sources have been invoked.

Sr-Nd isotopic composition, largely similar to those of the late Permian alkaline rocks of the Pyrenees (*Lago et al., 2004*) and the SCS (*Villaseca et al., 2004; Orejana et al., 2008*), is compatible with a moderately depleted asthenospheric mantle source, that however had experienced a recent metasomatic enrichment event by LILE-rich fluids, likely related to convective motion in the mantle.

Finally, trace elements ratios and descending REE patterns, suggest a deep, maybe garnet-bearing, astenospheric mantle source and low degrees of partial melting.

Tholeiitic BM and MA samples from Lercara area (western Sicily), show E-MORB affinities, such as HFSE enrichment and high HFSE/LILE ratio, as well as Sr and Ti negative anomalies and Th and Pb troughs in normalized trace elements patterns, consistent with an enriched asthenospheric mantle source.

Sr-Nd isotopic composition confirms the enriched character of the mantle source coupled with the interaction with crustal rocks or alternatively the direct involvement of a mantle reservoir broadly similar to the *EM-II type*, characterized by incorporation of recycled crustal material through subduction processes (*Zindler and Hart, 1986*).

Similar compositions, in terms of trace elements and isotopic data, have been reported for the late Triassic SCS tholeiitic rocks, for which interaction between an metasomatically enriched mantle source-derived magmas and granulitic lower crustal

rocks (*Cebrià et al., 2003*) or the direct introduction of recycled crustal material in the mantle source (*Villaseca et al., 2004*), have been proposed.

In studied tholeiitic rocks, crustal signatures, indicatives of the lower crust involvement (such as Th/Yb, Ta/Yb, Nb/U and $(La/Sm)_N$), have been detected. Moreover, AFC calculations (*De Paolo, 1981*) carried out in this study, suggest that, although mainly fitting the pure mixing model line with the lower crust, the composition of many of the tholeiitic rocks would require an assimilation ratio of lower crustal rocks ranging from 20 to 40%.

In conclusion, studied magmatic rocks from southern Calabria and western and central Sicily testify the late Palaeozoic - Mesozoic transition, well documented in other regions of SW Europe, from a post-collisional context associated to the collapse of the Hercynian Belt to an anorogenic scenario related to sequential Pangea continent breakup and Tehyan basins opening.

Post-collisional calcalkaline magmas were produced by partial melting of an enriched lithospheric mantle, metasomatized by subduction-related fluids and, during the ascent, interacted at variable extents with the still thickened crust, undergoing AFC processes and triggering anatexis of the lowermost crustal levels.

The Triassic transition from the late- to post-Hercynian extensional stages to a purely anorogenic rifting context, consisting in lithosphere thinning and asthenosphere upwelling, is instead marked by production of earlier alkaline and subsequent tholeiitic magmatic rocks, the latter emitted in relation to major extensional rates. However, interaction with lower crustal rocks indicate that the lithospheric extension was not still complete at the time of this magmatic activity.