



Geodynamic significance of Permian magmatism and HT-LP metamorphism in the continental crust of the Alps: validation from numerical modeling of Variscan subduction to Permian rifting.

A. M. Marotta and M. I. Spalla

Department of Earth Sciences "Ardito Desio", University of Milan, Italy

The pre-Alpine continental crust of the Alps preserves Permian-Triassic magmatic and HT-metamorphic evolutions, which overprinted the records of Variscan subduction (eclogites) and collision (granulites, migmatites and amphibolites). The occurrence of recurrent Variscan eclogites in the pre-Alpine continental crust of different structural domains indicates that the Alps comprises part of the Variscan suture zone, which have been disrupted and re-accreted during the Tethys opening and Alpine convergence.

The late Variscan evolution took place from 340 to 300 Ma, and therefore the igneous and metamorphic signatures up to Upper Carboniferous may represent the record of the late orogenic evolution, whereas younger ages, from 290 to 180 Ma, characterising the HT metamorphism associated with gabbro to granite intrusions, probably related to lithospheric extension and thinning (Mayer et al., 2000; Rebay and Spalla, 2001 and refs. therein). The magmatic products emplaced in this last period (290-225 Ma) have an important mafic component, are frequently associated with ultramafics and are mainly concentrated in the Austroalpine-Southalpine domain. Gabbros country rocks range from HT-LP metamorphics (granulites; Sills, 1984; Handy and Zingg, 1991; Lardeaux and Spalla, 1991) to consolidated metasediments (Borsi et al., 1968), suggesting that the emplacement took place both in the lower and upper crust.

The Alps Permian magmatism and HT-LP metamorphism diffused in the continental crust of are widely diffused can result from two different mechanisms:

- 1) late-orogenic collapse of a collisional belt, as proposed for the Variscan belt (Bonin et al., 1993; Malavieille et al., 1990);

2) continental rifting, as suggested for the Adriatic crust of the Alps (Rebay and Spalla, 2001; Schuster et al., 2001 and refs. therein).

We use a thermo-mechanic numerical model to model the lithosphere deformation during the Variscan subduction to Permian rifting in order to reduce the ambiguity about the geodynamic significance of the Permian-Triassic HT metamorphism and igneous activity in the Alpine continental crust.

References

1. Bonin, B. et al. (Editors), 1993. Late Variscan magmatic evolution of the Alpine basement. Pre-Alpine basement in the Alps. Springer-Verlag, Heidelberg, 171-201 pp.
2. Borsi, S., Ferrara, G., Paganelli, L. and Simboli, G., 1968. Isotopic age measurements of M.Monzoni intrusive complex. Mineral. Petrogr. Acta, 14: 171-183.
3. Diella, V., Spalla, M.I. and Tunesi, A., 1992. Contrasted thermo-mechanical evolutions in the Southalpine metamorphic basement of the Orobic Alps (Central Alps, Italy). J. metamorphic Geol., 10: 203-219.
4. Handy, M.R. and Zingg, A., 1991. The tectonic and rheological evolution of an attenuated cross-section of the continental crust: Ivrea crustal section, Southern Alps, Northwestern Italy and Southern Switzerland. Geol. Soc. Am. Bull., 103: 236-253.
5. Lardeaux, J.M. and Spalla, M.I., 1991. From granulites to eclogites in the Sesia zone (Italian Western Alps): a record of the opening and closure of the Piedmont ocean. Journ. metam. Geol., 9: 35-59.
6. Malavieille, J., Guihot, P., Costa, S., Lardeaux, J.M. and Gardien, V., 1990. Collapse of the thickened Variscan crust in the French Massif Central: Mont Pilat extensional shear zone and St. Etienne Late Carboniferous basin. Tectonophysics, 177: 139-149.
7. Mayer, A., Mezger, K. and Sinigoi, S., 2000. New Sm-Nd ages for the Ivrea-Verbano Zone, Sesia and Sessera valleys (Northern Italy). J. Geodynamics, 30: 147-166.
8. Rebay, G. and Spalla, M.I., 2001. Emplacement at granulite facies conditions of the Sesia-Lanzo metagabbros: an early record of Permian rifting? Lithos, 58: 85-104.
9. Schuster, R., Scharbert, S., Abart, R. and Frank, W., 2001. Permo-Triassic extension and related HT/LP metamorphism in the Austroalpine-Southalpine realm. Mitt. Ges. Geol. Bergbaustud. Oesterr., 45: 111-141.
10. Sills, J.D., 1984. Granulite facies metamorphism in the Ivrea Zone, N.W. Italy.

Schweiz. Miner. Petrogr. Mitt., 64: 169-191.