THE TUSCAN SEGMENT OF THE ITALIAN HERCYNIAN CHAIN FROM THE VARISCAN BELT TO THE ALPIDIC PERI-ADRIATIC EXTENSIONAL MARGIN

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An analysis of the Hercynian belt and of the sedimentary-volcanic fill of the pre-Alpine and early-Alpine basins outcropping in Tuscany (Central Italy) allows us to hypothesize the geodynamic history of a segment of the Italian Hercynian Chain from the Late Paleozoic to the Mid Triassic.

Its geodynamic evolution can be as outlined:

— The structural and lithological evidence suggest that at the end of the Sudetian event of the Hercynian orogenesis, the remains of the Variscan event of the Hercynian orogenesis, the remains of the Variscan belt that now outcrop at the base of the Tuscan metamorphic units of the Apenninic nappe definitely belong to the European Hercynian chain and were located on the southeastern of Stable Europe (Italian Hercynian Chain, sensu Vai and Cocozza, 1986).

— The Farma Group Formations (Mid-Upper Visean to Lower Cantabrian) indicate the presence of piggy-back basins on the westvergent Sudetian Nappe Chain during the time interval between the Sudetic and the Asturic Hercynian events.

— Since the Late Carboniferous the Italian Hercynian Chain has also been affected by a transcurrent tectonic regime closely connected with the megashear system that crossed the European Continental Mass (North Pyrenean fault an Insubric paleo-lineaments). This regime, characterized by alternations of transtensive and transpressive continental or shallow marine ephemeral basins (Stephanian to Permian, Tuscan Permo-Carboniferous, sensu Bagnoli et al., 1980) that could be interpreted as pull apart basins. These basins are characterized by more shallow marine conditions from west to east. Further east the marine conditions prevail. The thickness and areal extension of the Late Paleozoic sediments suggest a possible connection with the Paleozoic Tethyan Eurasia.

— Between the Permia and Lower Triassic the prevalent tangential movements continue; one of the transcurrent faults sets the course for the separation of the Tuscan Variscan segment from the Italian Hercynian Chain.

When crustal extension and tensional movements later prevail, in the Mid-Upper Triassic, the opening of the arm of the Mesozoic Tethys occurs along this tectonic lineament, between the Stable Europe and the Adria microplate, and the Tuscan Variscan segment finally separates from the Italian Hercynian Chain.

The Tuscan Variscan segment then becomes the Western passive margin of the Adria microplate and the basal continental crust or the Tuscan-Umbrian sedimentary Domain.

Tha chemism of the rare occurrences of Parmian and Triassic magmatic rocks also corroborate this hypothesis.

FURTHER EVIDENCE OF A HIGH THERMAL GRADIENT OPERATING ON A REGIONAL SCALE DURING THE VARISCAN METAMORPHISM IN THE EASTERN ALPS

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Conflicting ideas exist bout the pressure values and thermal gradients which prevailed on a regional scale during the Variscan metamorphism in the Austridic basement. The difficulty to clarify this problem is largely related to the polymetamorphic nature of the Austridic basement, large parts of which also underwent a two-stage Alpine metamorphic overprint. This complex situation has lead many authors to refer all pre-Alpine features to the Variscan metamorphism: consequently, metamorphic mineral assemblages possibly crystallized in different time ranges and under different physical conditions were put together, virtually obscuring the complex pre-Alpine metamorphic evolution.

In order to contribute to the solution of these problems, the thermal gradient operating during the Variscan metamorphism within the Austridic phyllitic sequences of proven Upper Ordovician to Devonian age and not affected by Alpine metamorphism was estimated on a regional scale. These estimates were based on the mineral compatibilities and related petrogenetic grids as concerns temperature, and muscovite composition as estimated through XRD as regards pressure.

These phyllitic sequences are considered here as an original cover of the underlaying basement. This interpretation is consistent with field observations, microtextural data and garnet chemistry. In particular, two crystallization stages (a prograde stage followed by a lower-grade stage) are recorded in the garnets from the basement, whereas garnets from the phyllites only record a single-stage growth history.

As shown by the mineral compatibilities, the Variscan metamorphism recorded in the considered phyllitic complexes covers the whole temperature range of the greenschist facies. As regards pressure, the muscovite b cell dimension in the metapelites indicate low pressure values. Basing on these new data, a thermal gradient of about 40^0C/Km was estimated for the Variscan metamorphism.

Considering that identical values of pressure and thermal gradient were obtained