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Block-diagram of the Variscan Cordillera in Central Europe

by Paul Wurster[1]

What did the Variscan mountain belt look like? Were there striking similarities to modern mountains? Did the Variscides look like the Andes, the Rockies, the Himalaya, the Alpine chains or the west Pacific island arcs? They should have, i.e.; if actualism rules our geologic reconstructions! But I suppose that these questions cannot be answered definitely, and they will remain open in many respects. According to our present geotectonic knowledge this Paleozoic mountain belt consists of deeply truncated structures. The roots have disappeared. The ranges are gone. The original dimensions of the belt are unknown. The rates of displacement, of extension, of compression, of deformation, of uplift, of erosion, are objects of poorly documented reconstructions and are highly speculative.

This should be taken into account when we discuss the geotectonic evolution of the Variscan mountain belt in Central Europe. Especially, when we consider the highly complicated nature of the Alps it seems to be hazardous to present an interpretative cartoon of the Variscan mountains. Nevertheless, the block-diagram (Fig. 1) presented here may be a first step in an attempt to establish new alternative models. It does not show a distinct epoch nor a special state or any metrical layout. In many aspects it is in line with the reliable geological work of ZIEGLER (1986). However, in some aspects it contrasts with the structural concepts of WEBER and BEHR (1983), and of MATTE (1986).

The prismatic blocks in front of the block-diagram represent the present structure of the crust in Central Europe. This frontal bench as drawn is extremely generalized and simplified. In reality, it is about 1000 km long and about 30 km thick between the North Sea and the Mediterranean Sea. It is extremely shortened and exaggerated.

The main section is oriented north-south, almost parallel to several (German, Swiss and Italian) deep seismic profiles and parallel to the European Geotraverse (EGT).

The upper surface of the frontal bench is the epi-Variscan peneplain. In the vertical scale of the block-diagram, it is an almost horizontal surface. This plane or platform is the most important reference level for structural and geotectonic reconstructions. Outside the Alps it was affected only by epirogenetic processes. This fact is very important for geological or paleo-geophysical considerations. Within the Alps, this old peneplain was dislocated and highly deformed. It marks the initial state of the younger Alpine orogenic events.

In the region of Central Europe outside the Alps, the present Mohorovicic discontinuity is situated almost parallel to the corresponding denudation level of post-Variscan times. It corresponds also to the sedimentation level of the Mesozoic era and to Cenozoic erosional planes. The facies and widespread distribution of post-Permian epi-continental sediments in Europe are well documented by paleogeographic maps. This record indicates that the crust remained stable since the Permian.

Mostly late Variscan structures are preserved within the frontal bench, but we do not know the original level, orientation and attitude of the different blocks within the entirety of the Variscan mountain belt. It is likely that the blocks of the frontal bench are relics of separated slices that were peeled off of the high cordillera shown in the rear of the diagram. The Variscan crust was originally much

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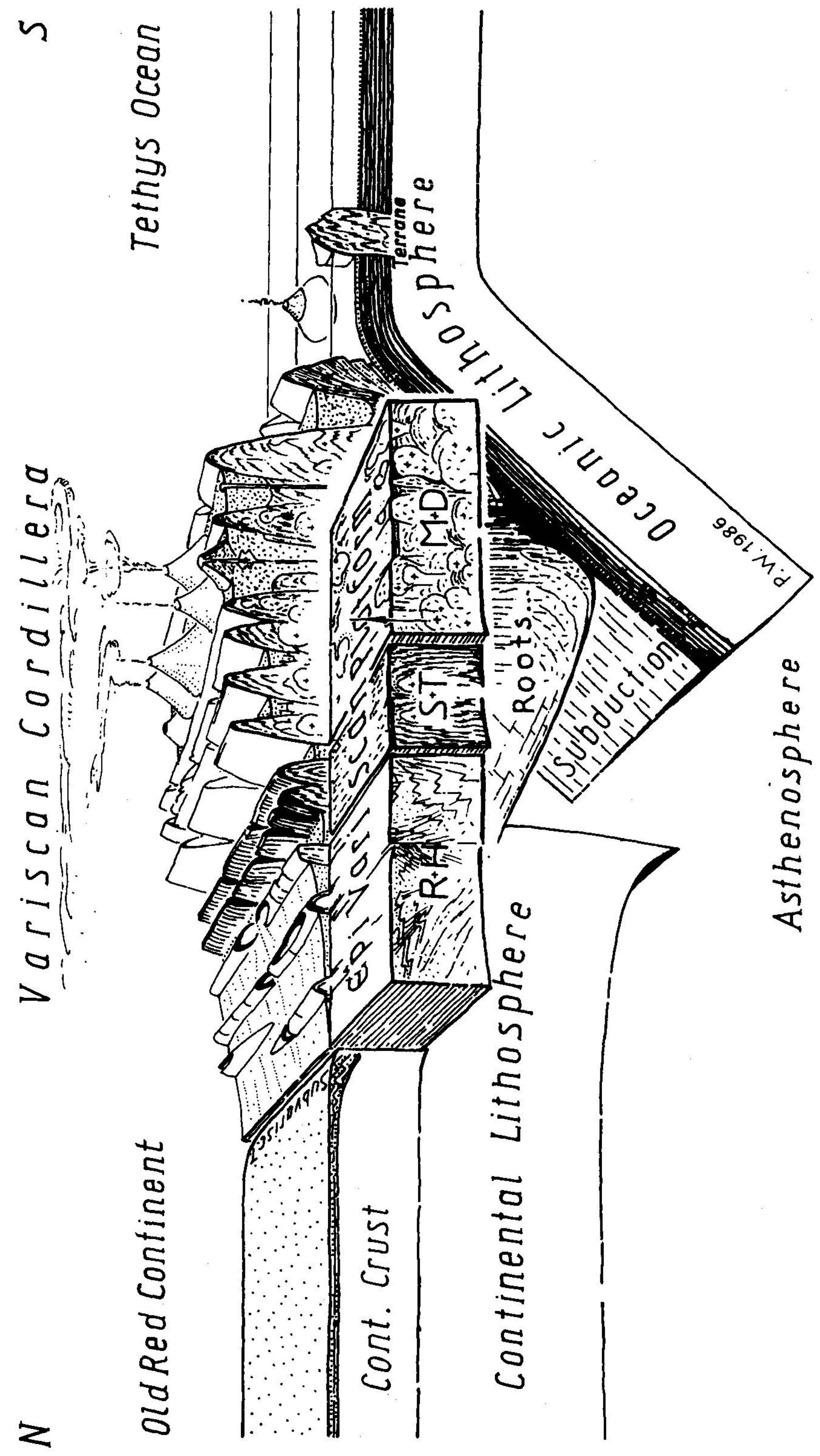
N
S
Old Red Continent
Variscan Cordillera
Tethys Ocean
Terrane
Cont. Crust
R+H
S+T
M+D
Roots
Subduction
Continental Lithosphere
Oceanic Lithosphere
P.W. 1986
Asthenosphere

thicker. Therefore, we should be very careful in interpreting Variscan kinematics as consisting of detached slices and nappe-like overthrusts.

The blocks of frontal bench represent the main zones of the Variscan mountain belt as defined by KOSSMAT (1929):

RH = Rhenohercynian Zone
ST = Saxothuringian Zone
MD = Moldanubian Zone.

They were peeled of at different levels and regions of the former mountains shown in the rear. From north to south the blocks represent deeper levels of the former crust. To simplify the drawing, the different blocks are separated by vertical planes. The relationship of the various blocks is still a matter of discussion.

The large "Old-Red" continent of Laurasia was to the north. Its boundary with the Variscan belt is marked by an accentuated belt of Upper Carboniferous coal. The Rhenohercynian Zone (RH) may be interpreted as a passive continental margin, fed by sediments from the interior of the Old-Red Continent. The structural pattern developed during Devonian times consisted of some accentuated structural highs and troughs. Most phenomena can be explained in terms of rifting and of back-arc tectonics. In my opinion, the entire Rhenohercynian Zone should be defined as a sub-Variscan area representing the external zone of the Variscan mountain belt.

The Saxothuringian Zone (ST) consists of a basement of gneiss domes of Proterozoic and Caledonian age, which was intruded by Variscan plutons. Some authors suggest that remnants of a Paleozoic "Rheic" ocean bottom have been subducted here. They postulate a south dipping subduction zone within this zone. I suggest that the Saxothuringian Zone represents an elevated part of the normal continental lithosphere of Central Europe situated between the external Rhenohercynian and the internal Moldanubian Zone. This may be proved by continental deep drilling activities (KTB).

The Moldanubian Zone (MD) represents the crystalline basement of the Variscan range. Very deep levels of the continental crust are exposed with extensive areas of granites. According to Gerhard Voll about 20–40 km of the upper crust are missing. Obviously, the main part of the former range was successively denudated during Paleozoic times. In rear portions of the cartoon the preexisting cordillera with active volcanoes, elevated mountain peaks and intermountain troughs is shown. Actually, this may be a provocative idea, but should be taken into account.

The Moldanubian Zone could be the core of former mountain roots. These roots are not correlated to distinct planes of subduction, but to accreting sequences of parallel subduction zones generally dipping north. As they are no longer preserved, we do not know if the "roots" plunged into the Asthenosphere at a depth of 50 km or more. The processes creating crustal thickening of the roots during the Devonian and Early Carboniferous (› 100 m.y.) have not yet been investigated and are highly speculative. The processes of reduction of the roots during the late Carboniferous and Permian (› 100 m.y.) are also unknown. Collapsing structures on top of a flattening or "Subfluence Zone" initiated the subsequent widespread volcanism.

The north-dipping Variscan subduction zone was situated on the southern border of the present Alps. Alpine and Mediterranean processes deformed and masked these old structures. We should reinvestigate the Pyrenees, the Montagne Noire, Liguria, the Po-plain, the Carnic Alps and the Dinarides. It may be in these ranges that we could find contorted fragments of the Paleozoic continental margin: Oceanic trenches, accretion wedges, coast ranges or exotic terranes could be detected and reconstructed as well.

The open sea of the Paleotethys was situated farther to the south or the southeast. Within the present heterogenous small ocean basins, drifted microplates and rotated terranes of the Mediterranean there are some suspicious

◁ *Fig. 1* Block-Diagram of the Variscan mountain belt in Central Europe, generalized and exaggerated.

Frontal blocks:	RH = Rhenohercynian Zone, ST = Saxothuringian Zone, MD = Moldanubian Zone, surface = epi-Variscan peneplain, subsurface = present Moho.
Left side (N):	Old-Red continent and continental lithosphere.
Right side (S):	Paleotethys ocean and oceanic lithosphere with drifting terrane.
Subsurface:	Main subduction zone, mountain roots and asthenosphere.
Background:	Hypothetical cordillera during Paleozoic times.

places where Paleozoic oceanic lithosphere could have been preserved. This suggestion is speculative but worthy of further investigation. The Mediterranean realm cannot be completely explained by Alpine plate tectonic reconstructions, processes and collisions. Our view of an asymmetric Variscan cordillera in Central Europe can be compared with representative global mountain chains. The Pacific cordilleras, the Appalachians and the Ural mountains show many similarities to the Central European Variscides in dimension, structure, segmentation and orientation. Generally, subduction operates from ocean basins directly or laterally beneath continental plates. And this is the main point to be remembered when constructing Variscan geodynamic models: The Old-Red-Continent (or Laurasia) was situated to the north, the Paleotethys Ocean to the south! Therefore, the probable attitude of the main Variscan subduction zone was dipping towards the north.

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