

CONTRIBUTIONS TO THE GEOLOGY OF THE MINERVOIS AND THE CABARDÈS (MONTAGNE NOIRE, SW FRANCE)

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The region studied is located several kilometers North of Carcassonne (Dept. Aude, SW France) in the Cabardès and Minervois mountains.

According to the classic interpretation of ARTHAUD (1970), the Variscan (Hercynian) chain of the Montagne Noire is divided in 3 zones which are aligned in a ENE – WSW direction. The southern zone is composed of several distinct nappes. The studied Minervois nappe is the lowermost nappe with a rather complete stratigraphical range from the Lowermost Cambrian to the Lower Ordovician (Arenigian):

GEYER (1986) described for the first time sponge spicules of primitive Porifera, interpreted as Chancelloriida, from the quartzitic sandstones of the "Marcory" Formation (Lowermost Cambrian) and discussed their regional spreading in the Western Mediterranean hemisphere. The "Limousis" Formation (alternating quartzitic sandstones and often dolomitic limestones) contains some undeterminable sections of Archaeocyathids. The upper part of the Lower Cambrian ("Lastours" Formation) consists mostly of dolomitic limestones and dolomites and therefore contains no fossils.

The Middle Cambrian starts with red and white limestones of the "Ferrals" Formation that may contain very few determinable sections of characteristic trilobites (COURTESOLE 1973). The sedimentation becomes very monotonous in the overlaying strongly-folded schists of the "Pardailhan" Formation.

Trilobites confirm the existence of fossiliferous calcareous Upper Cambrian, belonging to the East-Asian faunal province ("Val-d'Homs" Formation; FEIST & COURTESOLE 1984).

Some sparse nodules in the Lower Ordovician schists ("Barroubio" Formation) contain fragments of trilobites and brachiopods.

As a result of a recent mapping (GEYER 1984) a digitized geological map to the scale of 1:25.000 of the studied region is presented. The geological limits are different from older maps because the recent fossil discoveries have caused important modifications in the stratigraphical range of formations.

The stratigraphic succession of the Minervois and the Cabardès region is compared with other classic Cambrian areas, such as the outcrops in Sardinia, Normandy, Spain and Morocco.

GEOCHRONOLOGICAL AGE CONSTRAINTS FOR THE EVOLUTION OF A VARISCAN SUTURE IN SW SPAIN: THE BOUNDARY OF OSSA-MORENA-ZONE AND SOUTH-PORTUGUESE-ZONE

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The boundary of Ossa-Morena-Zone (OMZ) and South Portuguese Zone (SPZ) represents the main Variscan suture in the Iberian Hercynian Orogen. The geodynamic evolution of this suture can be subdivided into three main stages.

Onset of the Variscan deformation in the Lower / Middle Devonian is marked by a sedimentary gap and subsequent progradation of the first deformation phase in the OMZ. Crustal stacking, nappe emplacement and contemporaneous basin formation are related to this stage. ⁴⁰Ar/³⁹Ar whole-rock spectra of anchizonal slates display internally discordant age spectra, which suggest cooling prior to 375 Ma and younger Variscan rejuvenation.

The second stage represents a phase of transpression. It comprises the second and third Variscan deformation phase and results in the transpressional uplift of the high-grade metamorphic core of the suture zone. It is associated with the intrusion of basic melts and wide-spread migmatization in the granulitic countryrocks. ⁴⁰Ar/³⁹Ar and Rb/Sr isotope data of the suture zone are distinctly

younger and indicate rapid uplift and cooling during the late Visean (340 Ma to 325 Ma).

Ductile deformation is terminated at the end of the Lower Carboniferous. In the Upper Carboniferous the boundary of OMZ and SPZ forms an intra-continental shear zone with left-lateral displacement of up to 100 km.

The Variscan evolution is characterised by the progressive change from compressional to left-lateral strike-slip movements and the anti-clockwise rotation of previous Variscan structures.

VARISCAN AND POSTVARISCAN FLUID SYSTEMS AND THERMAL HISTORY IN THE NORTHERN PART OF THE LINKSRHEINISCHES SCHIEFERGEBIRGE

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In the northern part of the Linksrheinisches Schiefergebirge five distinct fluid systems were active during **Variscian time**. In the sense of the geological environment four systems might be similar to specific types of fluid systems:

- Basinal brines (Lower Devonian).
- Magmatically induced hydrothermal fluids (Middle Devonian).
- Tectono-metamorphic fluids (Upper Carboniferous)
- Tectonic brines (Upper Carboniferous to Permian)
- Hydrothermal fluids I (Permian)

Two fluid systems occur in **Postvariscian time**:

- Hydrothermal fluids II (Postpermian - Prequaternary)
- Hydrothermal fluids III (recent)

Basinal brines (Lower Devonian)

Distribution and shape of quartz and quartz-ankerite-chlorite veinlets and fissures, which are cross-cutting the sedimentary units of Lower Devonian age and the bedding parallel cleavage planes (compaction cleavage), point to a development during extensional movement. These veinlets and fissures are boudinaged, sheared and crosscut by younger en-Enchelon tension gash quartz veins, which were formed during the development of the second cleavage and the thrust faults.

Magmatically induced hydrothermal fluids (Middle Devonian)

The first well established **T-t markers** in the thermal evolution of the Linksrheinisches Schiefergebirge are the intrusions of the granodioritic to dioritic magmas at about 381 m.a. ± 16 m.a. (Kramm and Buhl, 1985). These intrusions caused the **contact metamorphic overprint** of the Cambrian and Ordovician sedimentary rocks in the central region of the Stavelot Venn Anticline.

The magmatic activities initiated the circulation of hydrothermal fluids. Enrichment processes led to the occurrence of NE-SW trending veins and porphyry type mineralization. All veins were deformed, boudinaged, sheared and crosscut by younger en-Enchelon tension gash quartz veins during the development of the second cleavage and the thrust faults. Using the alteration parageneses the fluid temperature might have been in the range of 360 °C and 200 °C and a lithostatic pressure below 2.5 ± 1 kbar (Schreyer & Abraham 1978).

Tectono-metamorphic fluids (Upper Carboniferous)

The development of folds, second cleavage, duplex structures and shear zones took place during Upper Carboniferous time. Together with the structural features quartz veins and fissures occur. Dating of the development of the second cleavage points to an Upper Carboniferous age (308 - 312 m.a. , Kramm et al., 1985).

Tectonic brines (Upper Carboniferous - Permian)

Migration of hydrothermal fluids in the Venn thrust zone have caused the alteration of sedimentary rocks of Gedinian age. The alteration front is irregular in shape, follows grain size differences, cleavage planes as well as crosscuts the cleavage planes. The original mineralogical composition has been changed from quartz, illite, hematite and minor amounts of chlorite to quartz, chlorite, illite, calcite, albite, pyrite and traces of magnetite.