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# ÉTUDE GÉOLOGIQUE ET PÉTROGRAPHIQUE DE L'EXTRÉMITÉ MÉRIDIONALE DU MASSIF DES AIGUILLES-ROUGES (Haute-Savoie, France)

PAR

**Roger LAURENT**

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## RÉSUMÉ

### I. THE CRYSTALLINE BASEMENT OF THE "AIGUILLES-ROUGES"

Study of the crystalline basement of the "Aiguilles-Rouges" puts in evidence *a regional poly-cyclic metamorphism related to the Caledonian and Hercynian orogenesis.*

#### a) *The Caledonian cycle.*

The central and northern parts of the "Aiguilles-Rouges" constitute an elongated anticlinal dome, which existed prior to the Hercynian orogenesis. This dome comprises the series of migmatites of Fully (granodiorites with pinite)—perhaps representing a fragment of the precambrian basement—and the series of "Aiguilles-Rouges" s.s. of lower to middle paleozoic age (geochronometric ages by the total lead method). These series evolved during the Caledonian orogenesis in a deep level of the earth's crust; folded, granitized, they have been partially incorporated into the basement. Their main characteristics are:

- a multiple history, characterised by two distinct phases of metamorphism, Caledonian and Hercynian;
- an original anticlinal structure, oriented in fan-shape, still preserved;
- a deep mesozonal metamorphism with upper catazonal facies;
- a large variety of petrographic types.

#### b) *The Hercynian cycle.*

The southern part of the "Aiguille-Rouges"—the main object of this study—consists of a group of crystalline schists penetrated by an intrusive granite.

This southern series originated from the metamorphism of *a single geosynclinal sequence*, probably of devonian to lower carboniferous age, made up of sandy shales and of a volcanic complex of ophiolitic type. These evolved during the major phase of the Hercynian orogenesis (upper Devonian to middle Carboniferous) at a level of median depth of the earth's crust (8-12 kilometers). The granites, of carboniferous age, were emplaced during a late phase of this orogenesis; a secondary ore-vein emplacement (minor Hercynian phase) was associated with them, which showed itself by dykes of differentiated rocks and a Cu-Pb-Zn ore.

The main characteristics of the southern series of crystalline schists are:  
 a history characterised by one single metamorphism (diffuse migmatization), followed by a period of cataclasis with retromorphism in epizonal conditions, and finally completed by a partial recrystallization (neof ormation of different minerals: quartz, albite, myrmekite, micas, etc.);  
 a N-S trending isoclinal structure, made up of blocks limited by longitudinal, subvertical shearing-planes, which terminates in discordance against the Caledonian anticline of the "Aiguilles-Rouges";  
 a mesozonal to lower epizonal metamorphism (which allows the conclusion that the stratigraphical level of this series lies above that of the "Aiguilles-Rouges" s.s.).

From the petrological viewpoint, one can distinguish:

1. *The "Saint-Gervais-Aiguillettes series"*, deposited as sandy shales, but now metamorphosed to the amphibolite facies.

2. *The "Prarion-Pormenaz series"*, which is a heterogeneous serie with a lowermost unit of basaltic volcanic rocks, an uppermost unit of silty clay, perhaps including some rhyolitic material, and a middle unit formed by intermediary passage-beds. The whole appears now as rocks of the amphibolite and green schist facies.

These crystalline series have characteristics identical to, and correlating with, those of southern Belledonne described by C. BORDET. Their relations are as follows:

"Série de Saint-Gervais" (LAURENT)	=	"Série satinée externe" (C. BORDET)
"Série Prarion-Pormenaz" „	=	"Série verte" „
"Série des Aiguillettes" „	=	"Série satinée interne" „

The southern extremity of the "Aiguilles-Rouges" thus represents the exact continuation of Belledonne towards the north and belongs geologically to this chain; by its history, its tectonic structure, its metamorphism and its petrography, it is fundamentally different from the Caledonian anticlinal dome, which constitutes central and northern parts of the "Aiguilles-Rouges".

## II. SEDIMENTS OF UPPER PALEOZOIC AGE

At the end of the major Hercynian movements, the general rise of the structure provoked a change in the conditions of deposition and the installation of a continental regime, which continued until the beginning of the Mesozoic. This long period was characterised, for the crystalline basement, by block-faulting; a "horst-graben" style was superimposed on the style of the older structures.

Three successive minor orogenic phases of the Hercynian orogenesis, of decreasing amplitude, allow us to subdivide structurally these continental deposits into four groups:

1. *The Finely Detrital Formation* (Westphalian D—Lower Stephanian): this is fossiliferous, with predominant black shale sedimentation. These occur either as squeezed layers rooted in the crystalline basement, or as thin discordant masses.

*Pormenaz I phase*: this provoked the dynamometamorphism of the Finely Detrital Formation. This phase corresponded to a renewed rise of temperature in the basement rocks, marked by recrystallization (epimetamorphism) and ore-vein emplacement.

2. *The Coarsely Detrital Formation* (upper Stephanian ?) consists of predominant light sandstone-conglomerate sediments. Layers of these rocks form a crumpled veneer.

*Pormenaz II phase*: Folding of the Coarsely Detrital Formation, initially with rhyolitic volcanic activity (quartziferous porphyries of Mont-Blanc) continued throughout the Permian.

3. *Lower to middle Permian*: this was a period of oxidation with development of ferri ferrous pockets, followed by the deposition of the jasper of Saint-Gervais.

*Saint-Gervais phase*: This phase corresponds to the erosion of the Saint-Gervais jasper.

4. *Permo-Trias*: a sequence of variegated feldspathic sandstones, with conglomerate at the bottom with jasper pebbles, passes progressively to werfenian sandstone-quartzites of the lower Trias of "germanic reduced type" of the region.