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On the History of the Gotthard Massif (Central Alps, Switzerland)

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SUMMARY

The Gotthard massif is situated between the Rhone valley in the south-west and the Rhine valley in the north-east. North of the Gotthard massif we find the Aare and Tavetsch massifs and to the south the Penninic nappes.

As well as the other massifs of the Central Alps it consists of a pre-Permian crystalline basement with late Hercynian intrusions and a late Paleozoic and Mesozoic sedimentary cover. The sedimentary cover now occurs in small zones around the massif.

The crystalline basement is generally divided into a pregranitic complex (orthogneisses, paragneisses, amphibolites, diorites, ultrabasics and other rocks), and late Hercynian granitic and granodioritic intrusives.

The pre-granitic complex consists of a central orthogneiss zone, the so called 'Streifengneis', surrounded by paragneisses, amphibolites and other rocks. These rocks are polymetamorphic with at least two phases of pre-Alpine metamorphism as well as the Alpine metamorphism.

On their contacts, the late Hercynian intrusive granites, granodiorites and their dike sequence cut the structures and textures of the rocks of the pre-granitic complex. The intrusives show only the Alpine metamorphism.

Using isotope age results and geological evidence, the following history of the crystalline basement can be developed.

Zircons from paragneisses analysed by different authors indicate an age of 1200–1500 m.y. for the oldest zircon fraction. The sedimentation of the paragneisses must be younger than 1500 m.y. and older than 450 m.y. Indeed, 450 m.y. ago the zircons from the paragneiss lost part of their lead, indicating an intensive metamorphism. This event can be connected with a pre-Hercynian metamorphism reaching locally granulite facies, probably during the Caledonian orogeny.

For the 'Streifengneis', U-Pb ages on zircons of 460–560 m.y. are given in the literature. Rb-Sr determinations on these orthogneisses give a total rock isochron age of 421 ± 17 m.y. and an initial $\text{Sr}^{87}/\text{Sr}^{86}$ of 0.7137 ± 0.0028 . These data indicate that, at this time, the bulk chemical system of the present 'Streifengneis' was formed. Since this time these granitic rocks have remained a closed system for Rb and Sr, even during the Hercynian and the Alpine metamorphism.

A muscovite from the 'Streifengneis' gives a Rb-Sr age of 275 ± 11 m.y. which is interpreted as the end of the Hercynian metamorphism.

There are several U-Pb zircon ages which indicate that the late Hercynian granites and granodiorites were formed around 300 m.y. ago. For one of these granites a Rb-Sr total rock isochron gives an age of 260 m.y.

Since the muscovite from the 'Streifengneis' gives a Rb-Sr age of 275 m.y., no Alpine mineral homogenisation for Rb and Sr can be found in these rocks. This is shown too by Rb-Sr analysis on biotite, K-feldspar, plagioclase and apatite. However, there are many young Rb-Sr and K-Ar age results on minerals in the Gotthard massif ranging from 13–50 m.y. These indicate the influence of the Alpine metamorphism.