Zeitschrift: Eclogae Geologicae Helvetiae
Herausgeber: Schweizerische Geologische Gesellschaft
Band: 85 (1992)
Heft: 3: Symposium on Swiss Molasse Basin

Artikel: The crystalline basement of Northern Switzerland
Autor: Mazurek, M. / Meyer, J. / Peters, T.
DOI: https://doi.org/10.5169/seals-167034

Gravimetry and Aeromagnetics in the Swiss Molasse Basin

By E. E. KLINGELE
Institute of Geodesy, ETH-Hönggerberg, CH-8093 Zürich

For the last twenty years the Institute of Geophysics of the University of Lausanne (IGPL) and the Swiss Geophysical Commission have been involved in the systematic gravity mapping of Switzerland. Almost 80% of the Molasse Basin is now covered with a density of stations ranging between 1 to 3 stations/km^2. The data of the western part of the Molasse Basin have already been published by the IGPL in the form of a gravimetric Atlas. From these data it was possible to identify the presence of a major structural feature situated in the crystalline basement. This feature is interpreted as a system of offset vertical faults situated at depth between 2.5 and 6 km.

Between 1979 and 1981 the Swiss Geophysical Commission conducted an aeromagnetic survey of Switzerland at two different flights levels (5000 m and 1680 m). The lower one covered the Molasse Basin and the Jura Mountains. With the data of this survey, it was possible to produce a map to the depth to magnetic basement. Some parts of the flight lines have also been quantitatively interpreted and the presence of more than one magnetic horizon have been identified.

The crystalline basement of Northern Switzerland

By M. MAZUREK, J. MEYER and T. PETERS
Mineralog.-Petrogr. Institut, Universität Bern, Baltzerstr. 1, CH-3012 Bern

1. General

The crystalline basement of Northern Switzerland is hidden beneath a sedimentary cover of variable thickness, generally on the order of several hundreds of meters. Therefore, our knowledge of the basement is based on a) deep crystalline boreholes, b) analogies to the Black Forest where the basement crops out, and c) remote sensing, mainly reflexion seismic data (Fig. 1).

2. Lithology

The basement consists of Pre-Hercynian gneisses and Hercynian batholiths and dykes to about equal amounts.

The **Pre-Hercynian gneiss series** comprises a Proterozoic metasedimentary sequence that was highly metamorphosed and partially migmatized prior to Hercynian magmatism. Metapelitic sillimanite – cordierite – biotite gneisses and migmatites are interlayered

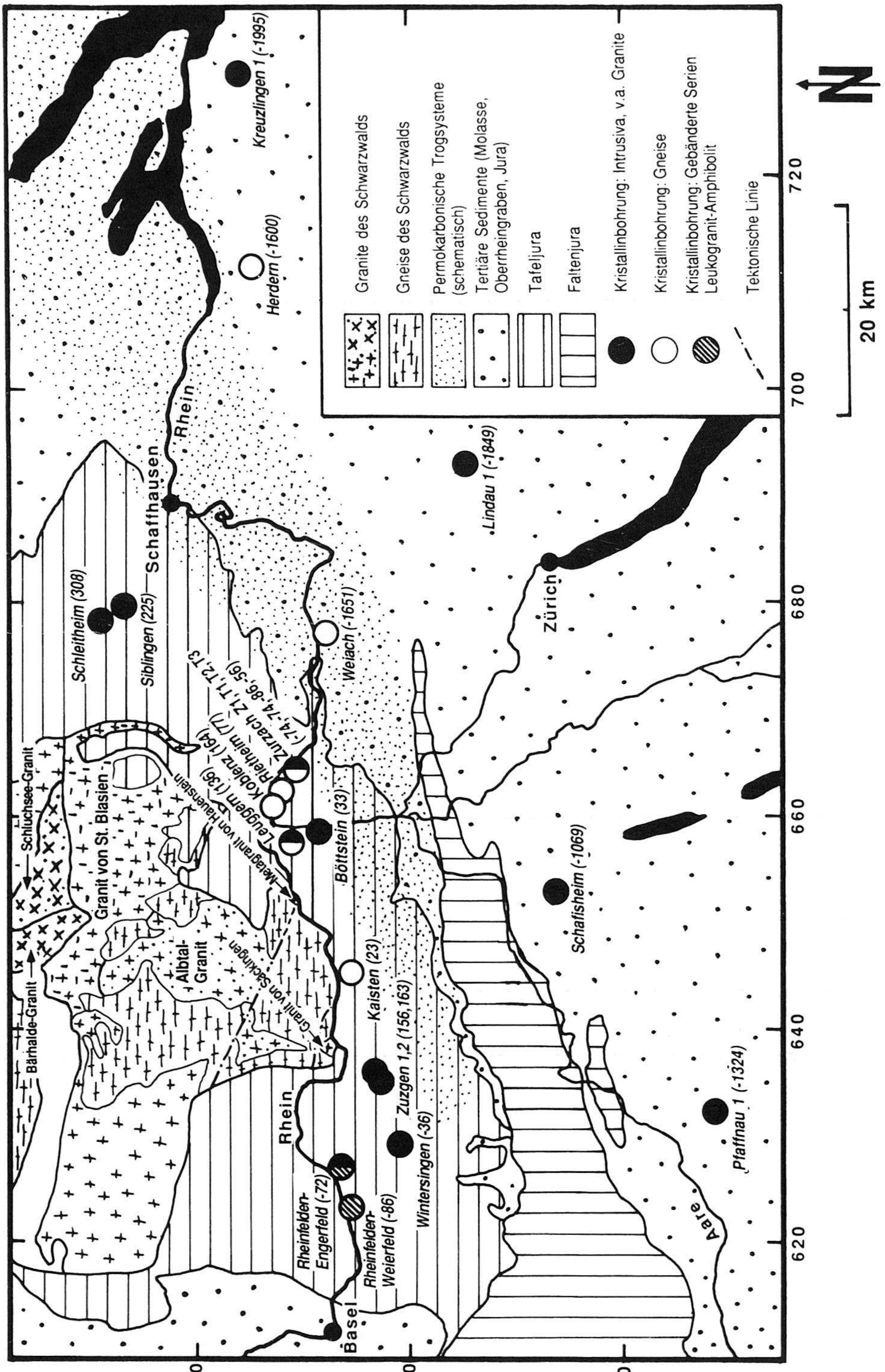

Fig. 1. Geologic sketch map of NW-Switzerland and SW-Germany.

with biotite – plagioclase gneisses (meta-graywackes) and minor calc-silicate and amphibolite intercalations. Only in the borehole of Herdern (W end of Lake Bodan) an orthogneiss was encountered.

The gneiss series was intruded by **Hercynian plutonites**, mainly granites. All granites N of the Permo-Carboniferous trough systems are S-types, i.e. products of crustal fusion of sediments. Their geochemical characteristics and ages (315–330 Ma) are similar to those of the granites of St. Blasien and Albtal which crop out in the SE Black Forest. The N Swiss granite series comprises a characteristic group of highly differentiated andalusite- and cordierite-bearing two mica-granites (boreholes of Zuzgen, Wintersingen, Zurzach, Siblingen). The SE part of the study area (between Zurich and Lake Bodan: boreholes of Lindau and Kreuzlingen) contains inhomogeneous, undifferentiated cordierite-biotite melagranites. Contrasting granite types are found in the SW part (boreholes of Schafisheim and Pfaffnau), where K-rich I-type granites and associated basic rocks (diorites – monzonites – syenites following an alkaline differentiation trend) were encountered. The intrusion ages of these rocks (316 Ma) are synchronous with those of the S-type granites N of the Permo-Carboniferous troughs. Acid and basic dykes (aplites, pegmatites, lamprophyres) are ubiquitous throughout the region.

3. Structure and post-emplacement history

Given the limited amount of data available, our knowledge of the large-scale internal structure of the basement is incomplete. In specific, we are utterly unable to provide a map of the areal distribution of granites and gneisses across the sediment-covered region. Seismic profiling is not sensitive to lithology. Much of the internal structure of the basement is inferred by extrapolating the relations in the Black Forest or deduced from the large-scale structures identified in the overlying cover rocks.

The basement rocks suffered several phases of **brittle deformation** and associated **hydrothermal alteration**. A *high-temperature phase* (300–400 °C) was associated with the intrusion and cooling of the Hercynian plutons as documented by radiometric age determinations of the alteration products. Deformation comprises cataclasis and joint formation. The typical mineral assemblage of this phase comprises albite, chlorite, sericite and K-feldspar. Ages of the second, *low-temperature phase* of deformation and alteration cluster around 280 Ma and are dominated by an intense cataclasis. Typical neoformations are clay minerals, mainly illite and illite/smectite mixed-layer structures. Structures of this phase either reactivate the preexisting, older structures or produce cross-cutting relations, depending on mutual orientation. Due to the very different scales and methods of observation, the correlation of the borehole data and the orientations of regional lineaments ("Variscan" or "Jurassic" trends) is difficult. *Younger phases* of alteration ± deformation can be identified, but their ages are badly established. They comprise a kaolinitic alteration and the formation of interconnected vugs in pre-existing structures, the latter being of prime importance for the present water flow through the basement.

REFERENCES

DIEBOLD, P. & NAEF, H. 1990: Geology and tectonics of Northern Switzerland (several articles). Nagra Bulletin 12/2.

LAUBSCHER, H. P. 1986: Struktur des Grundgebirges und des Paläozoikums in der Nordschweiz. Expertenbericht zum Projekt Gewähr. Hauptabteilung für die Sicherheit von Kernanlagen (HSK), Würenlingen.

MAZUREK, M. 1992: Phase equilibria and oxygen isotopes in the evolution of metapelitic migmatites: A case study from the Pre-Alpine basement of Northern Switzerland. Contrib. Mineral. Petrol. 109, 494–510.

MAZUREK, M. & PETERS, T. 1992: Petrographie des kristallinen Grundgebirges der Nordschweiz und Systematik der herzynischen Granite. Schweiz. mineral. petrogr. Mitt. 72, 11–35.

MEYER, J. 1987: Die Kataklase im kristallinen Untergrund der Nordschweiz. Eclogae geol. Helv. 80, 323–334.

MÜLLER, W. H., HUBER, M., ISLER, A. & KLEBOTH, P. 1984: Erläuterungen zur geologischen Karte der zentralen Nordschweiz 1:100000. Nagra Technischer Bericht NTB 84-25.

PETERS, T. 1987: Das Kristallin der Nordschweiz: Petrographie und hydrothermale Umwandlungen. Eclogae geol. Helv. 80, 305–322.

WIMMENAUER, W. 1984: Das prävariskische Kristallin im Schwarzwald. Fortschr. Mineral. 62, Bh. 2, 69–86.

The Permo-Carboniferous troughs of Northern Switzerland

By P. DIEBOLD
Schwerzleweg 11, CH-5027 Herznach

Geophysical surveys and deep coreholes by Nagra have revealed at least two major Late Palaeozoic sedimentary basins in the subsurface of Northern Switzerland; a northern trough referred to as the Permo Carboniferous Trough of Northern Switzerland or **NPT** and to the south, the adjacent Olten-Lenzburg Trough. The latter has not been confirmed, as yet, by drill holes and seismic data are insufficient for a regional compilation.

The overall shape of the **NPT** is that of an ENE-WSW trending asymmetric half-graben (trap-door basin) dextrally offset by WNW-ESE wrench faults (e.g. in Eggberg and Vorwald fault zones). The latter seem to divide the **NPT** into a western and eastern segment, which differ in depth and the direction of asymmetry. Seismic evidence indicates thrusting and folding in parts of the sedimentary basin-fill, mainly evident in the western segment, which is the result of a phase of lateral transpressive compression which can be dated as Early-/Middle Permian (Saalian). Tectonic events are also reflected by sedimentation in the **NPT**:

- The older basin-fill comprises Stephanian to Lower Permian coal measures and lake deposits which are overlain by a syntectonic suite characterised mainly by fan-deposits, with rapid lateral facies changes and synsedimentary deformation.
- The younger basin fill is made up to Permian redbeds which unconformably overlay the lower basin-fill. Its overall depositional pattern is indicative of an extentional tectonic regime involving low angle normal faulting. Sediments of the late basin-fill overstep the shoulders of the NPT and reach far beyond the older deposition-centre.