ples gained in the surrounding sea of the northern part of the Antarctic Peninsula the fraction of more than 1 cm in diameter (SKERIES), the fraction of sand size (HOFSTETTER) and the fraction of silt and clay (MATTHIES) were investigated in regard to transport paths, origin and in addition to submarine streams.

The coarse rock fragments, here called "drop stones" or "ice rafted rocks", at first were classified into 68 rock groups. Some of these groups, due to some noticeable petrographic features, indicate obviously to their origin in outcrops on the Antarctic Continent. Furthermore these groups were collected into eight rock societies. The spatial distribution of their determined weight relations correspond to the paths of the iceberg drift and in nexus with already known iceberg routes this distribution point to possible source areas in the ice covered hinterland.

According to the heavy mineral assemblages in the sand fraction the following provinces are distinguished: minerals of mainly metamorphic origin culminate in the northwestern Weddellsea and nearby Elephant Island; a province dominated by volcanic material is evident north and south of the South Shetland Islands and minerals of typical intrusive origin are distributed along the western coast of the Antarctic Peninsula.

The grain size distribution in the finest fraction, in nexus with the input from melting icebergs, gives a hint for turbiditic processes. On the South Orkney Island Plateau, in the Powell Basin and in the Bransfield Strait such processes are common, due to distinct submarine slopes.

Comparing culminations within the distribution of rock groups and societies with those in the heavy mineral assemblages a good causal conformity in the following three areas is obvious :

- off shore the northwestern coast of the Antarctic Peninsula:
  acid volcanic rocks ⇐⇒ tourmaline,rutile,zircon
- South Shetland Islands:
  pumice and pyroclastic rocks ⇐⇒ leucoxene,sphene,olivine
- northwestern Weddellsea:
  granulitic gneisses ⇐⇒ red spinel, garnet, kyanite, sillimanite

# VARISCAN AND POST-VARISCAN FLUID FLOW IN THE RHENOHERCYNICUM OF THE ARDENNES (SOUTHERN BELGIUM) AND IN THE EASTERN PART OF THE BOHEMIAN MASSIF

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During the several stages of the evolution of a sedimentary basin, different groundwater flow systems may dominate. Large fluid flow systems were active in Variscan foreland basins and may have formed important mineral and hydrocarbon accumulation. In order to determine the fluid flow patterns during and after the Variscan deformation of the northernmost belt of the Variscan orogen, fracture systems in the Dinantian (Vesdre and Namur synclinorium, southern Belgium) and in the Famennian and Tournaisian limestones (Moravia, CR) have been investigated.

Several generations of calcite veins have been distinguished in the Dinantian of the Vesdre area and of the Namur synclinorium. Volumetrically the most important fracture system in the Namur synclinorium is characterized by non-ferroan calcites which formed during Variscan folding and thrusting. The stable isotopic composition of the veins is similar to the isotopic composition of the enclosing limestones, indicating precipitation of the calcite cement from a fluid whose composition was buffered by the surrounding rock. This implies a low water-rock ratio during the Variscan tectonic deformation stage and is in contrast with the model that large volumes of basinal waters are expelled during deformation.

Subsequent ferroan calcite generations are associated with MVT mineralizations which developed during the Permian and/or Mesozoic. A microthermometric study of the fluid inclusions indicates that ferroan calcites formed at a temperature around 50 °C in the Namur synclinoriurn and at decreasing temperatures (from 125 °C to < 50 °C) in the Vesdre area. The sphalerite occurs after the calcites which precipitated around 125 °C. These temperatures together with the stable isotopic composition of the calcites (in the Vesdre area) suggest precipitation from fluids with an oxygen isotopic composition varying between ≤ −3.5‰ and + 71.4‰ SMOW. The highly variable oxygen isotopic composition of the fluids, the low $\delta^{18}O$ value of −3. 5‰ SMOW and the intense waterrock interaction necessary to leach the metals imply that the original fluids had a meteoric origin. The envisaged fluid flow pattern is the migration of meteoric waters from the uplifted area to the south (Ardennes) towards the edge of the foreland basin.

MVT mineralizations are well known from the southern part of Poland (Krakow area) where they occur in Devonian and Triassic carbonates. They are also present further to the south in the Moravia area (CR). Ferroan calcite cements are also here associated with Pb–Zn sulphides in Tournaisian (Ostrava region) and Famennian (Brno region) limestones. A microtermometric study of the calcites and sphalerites suggests that similar fluids were active as in Belgium. The salinity of the fluids from which the sulphides and ferroan calcites precipitated ranges between 13eq. wt. % and 23eq. wt. % NaCl. However, precipitation generally took place at a lower temperature, i.e. between 40° and 80 °C. Sphalerite formed around 80 °C.

## ASPECTS ON THE EVOLUTION OF THE RHENISH BASIN (EARLY DEVONIAN; RHEINISCHES SCHIEFERGEBIRGE; FRG)

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During the Early Devonian, the Rhenish Basin which is a part of the Variscan Rhenohercynian belt was filled in by huge quantities of siliciclastic detritus. The sediments mostly consist of sands and silts, carbonates and clays are lacking. Consequently, the composition of the rocks was uniform throughout that time. Facies distribution and basin evolution were controlled by different facts. Thus, a basin analysis can be made using different aspects.

**The sedimentological aspect.** In the northern part of the Rhenish Basin, the sedimentary facies of the Siegenian to Emsian is predominantly of deltaic type. Here, paleoflow is directed towards the Southwest. In the central part, a fully marine subtidal environment was established by marked suspension sedimentation or even by turbidity currents. Up to the Early Emsian, this part of the basin was progressively filled in and overwhelmed by the deltaic type of sedimentation from the North. Near to the southern margin of the Schiefergebirge, a neritic to nearshore fully marine environment developed during the Siegenian. Paleoflow was mainly directed towards the Northwest. Thus, sedimentological research results in a conservative model for the Lower Devonian Rhenish Basin.

**The geological aspect.** Using sedimentological, petrographical and geological data, a transsect running North–South through the Schiefergebirge may demonstrate the basin evolution in Early Devonian time. From the northern margin of the Schiefergebirge, the sedimentary thickness prograded towards the centre of the basin. Sudden differences in thickness and facies are evident in the central and southern part and by this identify the influence of synsedimentary tectonics, the role of which is discussed. Towards the southern margin, thickness decreases again. By this, the basin is subdivided in a more or less stable and thick northern part, a highly mobilized central part and a rifted southern margin. Thus, the evolution of the basin and of its fill was balanced by differential but constant subsidence, by huge input of detritus from the hinterlands, and by eustatic sea–level changes. This evolution ended with the Upper Emsian "Emsquarzit". From now onward, the basin was subdivided into several subbasins and highs following preexisting structures. Rise of the sea level and tectonic mobilization of marginal parts in the South and North of the basin widened the sedimentation area considerably. Together with this, the clastic input diminished and calcareous sediments generated. In addition, volcanic activity increased up to the Early Carboniferous.

**The geodynamic aspect.** The development of the Rhenish Basin will be discussed under the auspices of the plate tectonics scenary of the Devonian using the hypotheses of A.BERTHELSEN, of W. FRANKE, and of P.A.ZIEGLER. During the Siegenian and the Early Emsian, the sedimentary basin was established on a continental crust within the Caledonian continent in the North and the Mid–German–Crystalline Rise (MCR) in the South. Beginning in the Late Emsian and up to the Early Carboniferous, a highly mobilized and partly oceanic crustal belt generated in the South of the Schiefergebirge at the today position of the Phyllite Zone. This constellation initiated and enabled the deformation during the Variscan orogeny at the end of the Early Carboniferous.