*Annales de la Société Géologique de Belgique,* T. 113 (fascicule 2) - 1990, 137-138 Février 1991

# TECTONICS OF THE RHENISH MASSIF (ARDENNE AND RHEINISCHES SCHIEFERGEBIRGE)

## NOVEMBER 4, 1988

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## THE RHENOHERCYNIAN BELT EAST OF THE RHINE GEOLOGY AND GEOPHYSICS[1]

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**ABSTRACT**.- The Rhenohercynian Belt of Europe developed from a zone of crustal stretching within the northern part of Palaeo-Africa. It is underlain by continental crust of Cadomian and older origin, partly with a weak Caledonian overprint. The basin was probably formed, when a (formerly coherent) mid-European plate overrode the spreading axis of the Caledonian ocean which had separated, in pre-Silurian time, a northern continent (Laurussia) from the Gondwana-related crustal blocks in the south.

Crustal extension is documented in thick sequences of Devonian clastic sediments, in synsedimentary extensional faulting, and in several longstrike lineaments with synsedimentary volcanics (a spilite-keratophyre assemblage). As is documented in allochthonous MORB-type spilites of early Devonian age, the basin attained the stage of oceanization, but stratigraphic constraints suggest a limited width.

Variscan convergence is reflected in a northward prograding «wave» of Frasnian through Namurian flysch clastics, and in essentially northward facing folds and thrusts. Supracrustal nappes, consisting of MORB-type basalts, pelagic sediments and early flysch, are restricted to the southern part of the RH belt.

The seismic reflexion line DEKORP 2 North provides a transsect through these elements from the Taunus Mts. across the Schiefergebirge into the Cretaceous Münsterland Basin.

The northern part of the section shows the northward decreasing intensity of folding in the Devonian and Carboniferous. Stratigraphic reflectors can be identified at least down to the middle Devonian platform carbonates. A decollement, as it is often postulated in similar cases of external fold belts, is not detectable and can only be present in subcarbonate levels. The high reflectivity of the upper Carboniferous and Cretaceous prevents the recognition of deeper structures. Further south, the lower crust shows a transparent wedge, which probably represents an equivalent of the Brabant Massif basement. Strong NW-dipping reflexions at the southern margin of the wedge can be interpreted as backthrusts.

In the southern part of the section, the lower crust shows an intersection of subhorizontal and S-dipping reflexions. The flat ones probably represent relict bedding enhanced by shear-zones, the inclined ones indicate later thrust-faulting.

The upper and middle crust throughout the section is dominated by S-dipping reflexions, many of which can be identified as thrust faults. In the northern part, their offset is fairly limited, and they can partly be shown to terminate under anticlines. These elements probably compensate for folding at higher structural levels. One major thrust has brought the Ordovician rocks of the Ebbe Anticline to the surface.

As one proceeds southwards in the southern part of the Schiefergebirge, the thrust-faults known from the surface bring up older and older

*1.- Abstract of a paper delivered at the symposium «Tectonics of the Rhenish Massif» (Ardenne and Rheinisches Schiefergebirge), organized by the Société géologique de Belgique on November 4, 1988. (Organizers: J. Bellière and D. Laduron).*

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rocks, and, eventually, phyllites and higher-grade crystalline rocks. S-dipping reflections in this part of the profile probably correspond to more important thrusts, which together form an accretionary wedge at the northwestern front of the Mid-German Crystalline High.

The Moho rises from 11 sec to 8.5 sec TWT. Crustal thinning in the south probably relates to post-Variscan events such as rifting in the Rhine-Graben.

## STRUCTURAL ANALYSIS AND TECTONIC EVOLUTION OF THE RHENOHERCYNIAN FOLD BELT[1]

G. LANGHEINRICH[2]

**ABSTRACT**.- The Rhenohercynian (Rheinisches Schiefergebirge and Harz) section of the Variscan orogene is geometrically defined by a pattern of predominantly NW verging folds ranging from the 10 km to the 1 m size. The pre-existing sedimentary rock pile contains some well bedded rocks (e.g. turbidites) favouring the capability of the rocks to be folded. The other specific structural elements are some low angle thrusts and a penetrative tectonic deformation following the folding of rocks and leading to the well known phenomena of transverse (slaty) cleavage ($S_1$). The $S_1$ patterns vary strongly depending on the lithology, structural level within the orogene and the local finite strains within individual folds. The Rhenohercynian belt offers unique conditions of studying the progressive development of $S_1$ patterns within single folds and on a regional scale correlated both geometrically and genetically with fold geometries, finite strain markers as fossils, pressure shadow fillings of the micro-scale, and X-ray texture analyses of the rock forming phyllosilicate minerals. The formation of a second schistosity ($S_2$) together with refolding is restricted to the southernmost part of the Rhenohercynian.

Extensive in situ studies of tectonically deformed fossils and other finite strain markers lead to the result that BREDDIN's model of «planar cleavage» involving «true flattening» and consequently a finite elongation of the rocks roughly along the strike of the fold axes is no longer valid. Instead «apparent flattening» (finite uniaxial strain) predominates in high crustal levels grading into finite triaxial strains of deeper crustal levels.

The folding of the Rhenohercynian is due to one single tectonic event (predominantly during Upper Carboniferous times). There is no evidence for some precursory tectonic events (Caledonian) within the older Paleozoic rocks east of the river Rhine (Schreiner, 1982).

Geodynamic models for the Rhenohercynian belt presented in the literature reach from simple fixistic models of diapirism (Krebs & Wachendorf, 1973, 1974) to sometimes speculative plate tectonic models. Instead a modified simple shear kinematic model for the Rhenohercynian section triggered by plate tectonic and magmatic activities from the internal part of the whole orogene has been favoured by the author. This model based upon kinematic analyses of single folds, drilling and seismic evidence has to be modified at least by the effects of high syntectonic pore fluid losses of pelitic rocks in low crustal levels and low to very low angle thrusts partly leading to decoupling effects within deeper crustal levels.

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