Neogene tectonics in the Rhenish Massif

in special consideration of earthquake-relevant fault zones and their indication by hill-building forest ants (Formicinae)

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Fig. 1: Localisation of the investigation area.

Introduction

Young tectonics of the Rhenish Massif are characterised by recent uplift [1] and seismically active fractures [2]. These subrecent to recent features originate from continental rifting (Central European rift system). According to this model the V-shaped opening of the Lower Rhenish basin takes place in a clockwise rotation of the eastern Rhenish Massif and demands for a multiplicity of dextral strike slip faults balancing the crustal movements [3]. The results of this crustal movements are NE-SW sinistral strike slip faults in the eastern Rhenish Massif and WNW-ESE dextral strike slip faults in the western Rhenish Massif. Recent faults are accompanied by ascending gases, ore zones and quartz zones [4].

The aim of this research project is to combine interdisciplinary aspects for better understanding of the postvariscian tectogenesis and the related issues of recent shear systems and earthquakes in the Rhenish Massif. Also the postulated model [3] should be verified.

The investigation area is located in the southern part of the Rhenish Massif in the Hunsrück area around 20 km south of Koblenz between the rivers Rhine and Moselle (Fig. 1).

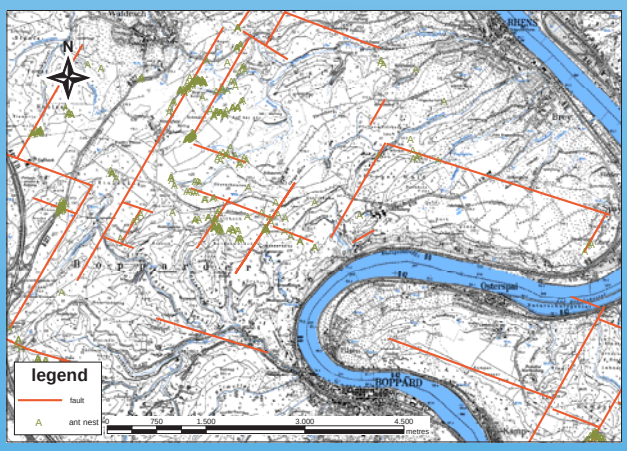

Fig. 2: Schematical map of fault zones and nests of hill building forest ants
(Map: Geobasisinformationen (TK 25) © Landesamt für Vermessung und Geobasisinformation Rheinland-Pfalz).

Methods

Several field campaigns have been carried out and are further on intended for acquiring the complex fault system of the Rhenish Massif. It is therefore necessary to take up structural data, ore and quartz zones and historical mine shafts.

In order to detect a supposed fracture zone covered by quaternary sediments, soil gas (Helium) measurements along a section perpendicular to a fault southwards Waldesch (Fig. 6) were accomplished.

Results

Up to now field works suggest the postulated WNW-ESE structures being dominant main fracture zones (Fig. 2). In addition to the main direction, conjugate shear zones occur in NE-SW, NNW-SSE and NW-SE direction (Fig. 2).

Fig. 3: Fault zone accompanied by quartz and ore mineralisation.

These fault zones, especially in the western part of the investigation area are accompanied by quartz- and ore mineralisation (Fig. 3). Such kinds of idiomorphic mineral blossom are revealing of postvariscian mineralisation [4]. Eastwardly those mineralisations step into the background, because the lithology changes from quartzitic sandstone, quartzite and siltstone to clay.

The dominant dextral transcurent faults strike between 100° and 110° and the dip is about 85°.

This dominant fault system will confirm by first motion studies, which are registered at the Neuwieder Basin by the observatory Bensberg. The dip of the NNE-SSW fault lies beyond 60°. The NNW-SSE faults may also be evidenced by the occurrence of quartz veins and dykes.

During the investigations of neogen tectonics of the Rhenish Massif in several hundred places, a distinct enhancement of nests of hill-building forest ants (*Formica rufa, F. polyctena, F. pratensis*) was observed (Fig. 4). These locations were bound to fault zones, which were mapped as strike slip faults.

Fig. 4: Hill-building forest ant *Formica rufa* (Linnaeus, 1761).

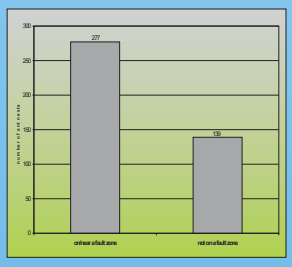

Fig. 5: Comparison of the number of ant nests on fault zones and inter fault zones.

Preliminary investigations of inter fault zones in the areas examined so far confirm the occurrence of the nests predominantly on fault zones (Fig. 2, Fig. 5).

But the volume of the ant nests, which represent the size of population is not significantly different on fault zones and inter fault zones (Mann-Whitney U-test, α=0.05). In the same way as the lithology changes, the density of ant nests appears to decrease eastwards (Fig. 2).

The soil gas measurement shows that the helium concentration of the taken soil gas samples close to the fracture lay above the helium concentration prevailing in the atmosphere (Fig. 6). Additionally to that the helium concentrations in the soil gas decreased with increasing distance from the fracture. The increased helium concentrations indicate gas permeability in the underground, which is interpreted as open fractures [5].

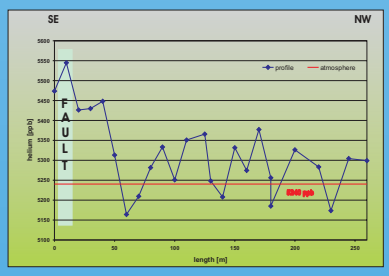

Fig. 6: Heilium profile one kilometer southwards Waldesch.

Perspectives

To bear out the statement of the postvariscian age of the fault zones additional investigations are planned. Fluid inclusions will be examined and age determination of the ore mineralization is aimed at.

To trace the fault zones which are overlaid by unconsolidated sediments across long distances, helium measurements to investigate the continuation of the fault zones on top of the plateau are planned in autumn 2005.

The remarkable coincidence of nests of Formicinae and recent shear zones is supposed to be a causal coherence and not only a stochastically accumulation. Therefore ascending soil gases were discussed to be a potential cause of habitat selection. It is assumed that the soil gases have a lasting effect on the habitat. Whether those fault zones are really the reason for habitat selection will be proved by statistical analyses.

Studies will conduct in other areas to verify whether the fault pattern of the investigation area could be found supra regional. Hereunto aerial views and field studies are planned at reference areas.

References

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