Geological stations filed selected from Germany

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Abstract:

Several geologic stations were visited and recorded in Germany during 2006 , especially around the area of upper Rhein Graben.
Tectonically, in this area the Paleozoic Basement was affected by the Variscan Orogeny . Due to this compression many folds and reverse faults and thrust were recognized and measured . they have a direction NE-SW. this direction coincide with the direction of compression which was NW-SE.
During Permian and Mesozoic the concerned area was affected by tension stress field. Many large normal faults were cutting in the area and bounded the upper Rhein Graben .The Tertiary deposits were laid down in side the rift and the tectonic activities due to tension was continuous in the present days . these activities were proved by the presence of active seismicity and elevated geothermal heat.

محطات حقلية جيولوجية مختارة من ألمانيا

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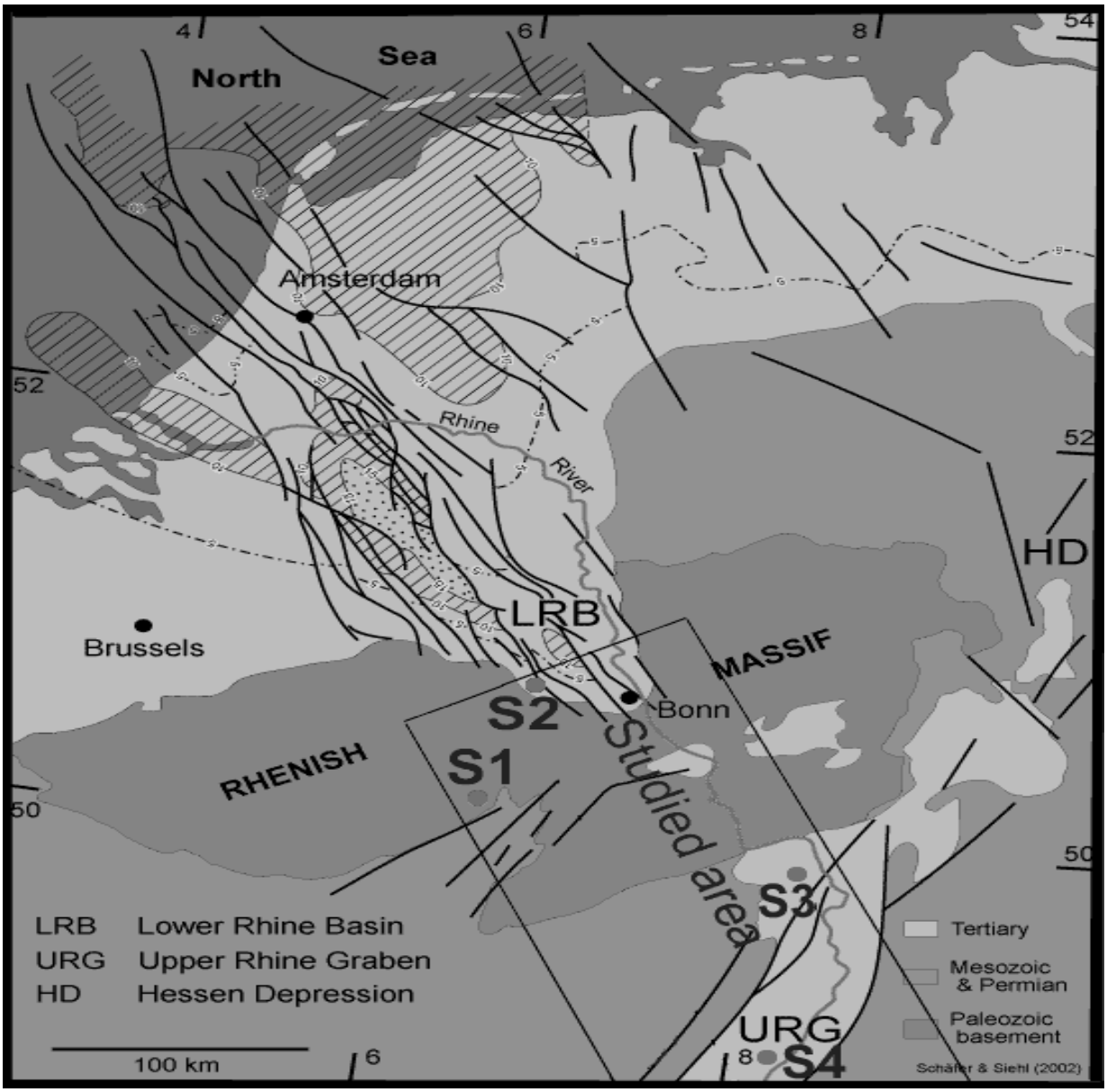
الخلاصة:

عدة مواقع جيولوجية تمت زيارتها وتسجيلها في المانيا في عام 2006 وخاصة المناطق المحيطة بمنخفض الراين الاعلى ، من الناحية التكتونية في هذه المنطقة فأن صخور القاعدة البلورية التي تعود لعصر الباليوزوك شوهدت متأثرة باجهادات الضغط التي سببتها عمليات بناء الجبال خلال موجة الفاريسكن (موجة بناء الجبال) في العصر الباليوزوي الأعلى، بسبب عمليات الضغط هذه تكونت عدة طيات وصدوع عكسية وزاحفة لها اتجاه شمال شرق-جنوب غرب ومتطابقة مع اتجاه الضغط العام (شمال غرب-جنوب شرق)، خلال العصر البيرمي والحقبة الوسيطة تأثرت المنطقة بقوى شد نتج عنها صدوع اعتيادية حددت الاتجاه العام لمنخفض الراين الاعلى، ان ترسبات العصر الثلاثي تجمعت في وسط هذا المنخفض وان قوى الشد لا تزال مؤثرة في المنطقة حتى الوقت الحاضر وذلك من خلال النشاط الزلزالي والنشاط الحراري الجوفي فيها.

Introduction:

Many geological localities were visited in Germany Fig.(1) and many geological examples were recognized and recorded. Some of these geological stations were well known especially that of mullion structures to the north of Eifel at about 120 km south west of Bonn city .



Figure(1) location map of the studied area with stations S1,S2,S3,S4 .

Other station were located at about 150 km to the south of Bonn .

The Devonian rocks are over lied by Permian clastic rocks of sandstone and claystone [9].

Triassic deposits were cut by several dykes.The tertiary sediments of Oligocene and Miocene were led down in the center of the Rhein Graben,while in the periphery coarse conglomerate and sands were found. They indicate that the beach was not too far from an elevated area which was highly affected by erosion Fig(2).

The tectonic and non tectonic effects on the rock was clearly identified .

Figure(2) sediments of Oligocene, the large gravels indicate rapped Erosion.

The aim of the study:-

In order to evaluate the stress type & its direction which affected the area that extended along the Rhein graben in Germany, this type of structural study was done.

The field geological stations studied :-

These fields stations can be discussed as follows:

1- The station of mullion structures [2,5,8]

This station was found at about 120km to the west of Bonn near the village of Dedon born on an out crop of Devonian rocks which consist of shallow marine sand and shale .

The mullion structures displays regular , repeated fold like forms ,ranging in wavelength from centimeters to meters to kilometers Fig(3). Fig(4).

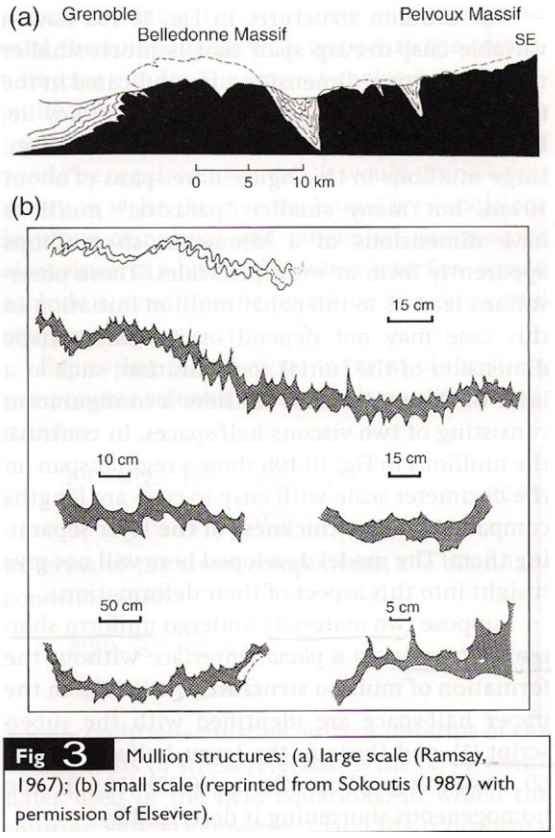


Fig 3 Mullion structures: (a) large scale (Ramsay, 1967); (b) small scale (reprinted from Sokoutis (1987) with permission of Elsevier).

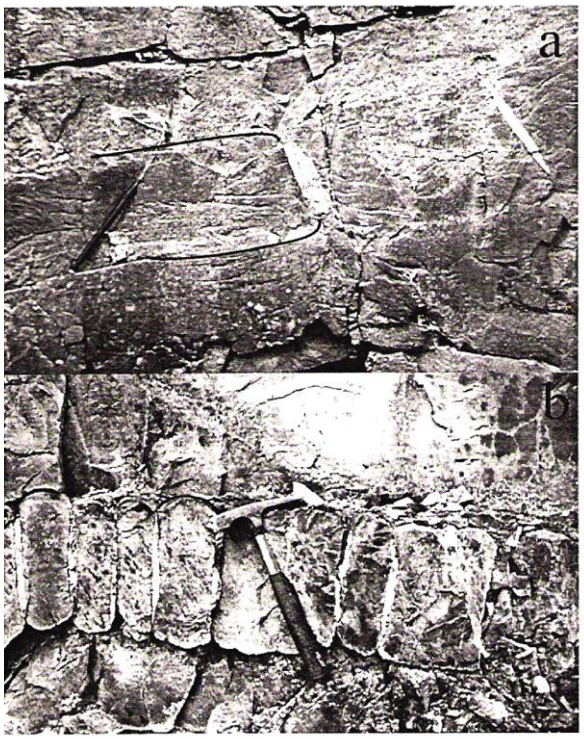


Fig. 4. Mullions in the Bastogne area (Carrière Mardasson) showing a large aspect ratio (height/width; pencil = 15 cm) (a). The curve of the mullion is less pronounced than mullions with a smaller aspect ratio for the psammite segments (hammer = 35 cm) (b).

The cuspate-lobate form are very distinctive consisting of linked circular or elliptical arcs mullion structures are not composed of newly introduced minerals like quartz but rather are always fashioned from the host rock itself .the most important descriptive relation ship bearing on mullion structure is its occurrence along the interface between mechanically soft and mechanically stiff layer, argillite and quartzite , respectively for example the fold like mullion forms are convex in the direction of the mechanically soft layer , with pinched cuspate fold like forms pointing toward the mechanically stiff layer Fig(5) .

Figure(5) mullion form preferentially at the interface between mechanically soft & mechanically stiff rocks from (J.G.Ramsay&al 1987)

Mullion structure arise from buckling instability produced by layer – parallel shortening of a contrast separating to rock layers of contrasting mechanical strength .Fig (6).

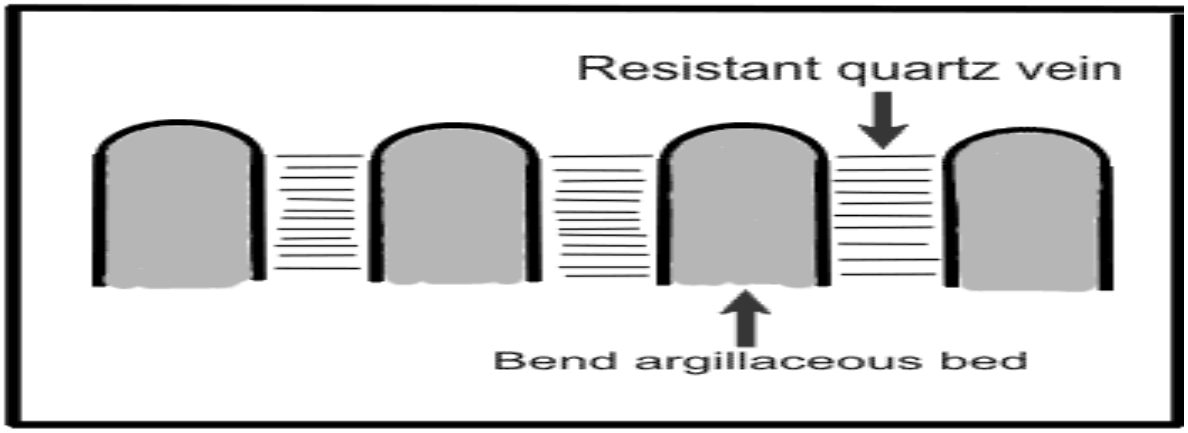
Figure(6) Mullion structures near the village of Dedenborn west Bonn

The visited outcrop consist of lower Devonian rocks . the mullion structures were formed during the first phase of variscan shortening[1] as a response to the mechanical structures of veined layers with competence contrast (Vein-psammite – pellite).
Psammite is a metamorphosed sandstone , arkose or quartzite extremely rich in mineral quartz . pellite is an aluminum rich metamorphic rocks formed by the metamorphism of clay–rich sedimentary rocks like shale and mudstone .

Vein quartz was the strongest element of the system due to its coarse grain size and due to its CO2 rich fluid content . the formation of mullion structures can be explained as follows :

a- the original lower Devonian shallow marine sand and shale (argillaceous sedimentary beds) are affected by tension. [10]

b- tension gashes were developed and filled by quartz due to tensile stress .



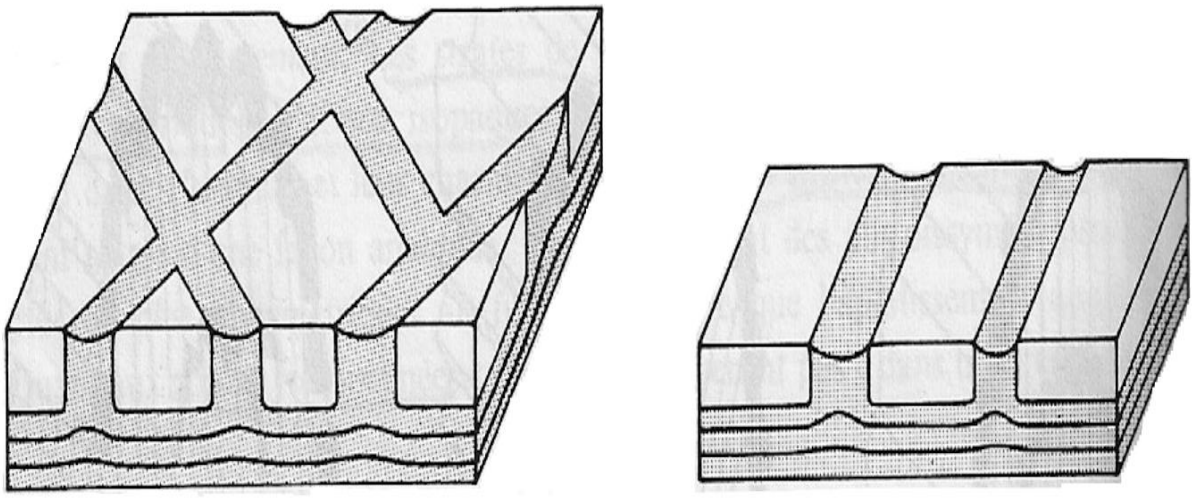
c- when the argillaceous beds and quarts veins were affected by compression , the argillaceous beds are affected and bended , while the quartz veins are not affected due to their higher resistance . [8]

During compression the argillaceous beds are compress while the quartz veins resist and mullion structures was developed

Due to this unequal competency the mullion structures were developed . the term budin structures is of the same meaning Fig(7) .[7]

These structures were the first geological structures to be investigated using the finite–element method (Dieterch&al.1969).

The more viscous rock layers were buckled , so as to under go little surface-parallel shortening .



Figure(7):blocks diagrams represent two types of Boudins. The left one represent Boudins like pieces of chocolat(from Mattauer 1980.)[7]

2- The station of slumping beds.[7]

This station was effectuated on quarry of Tertiary rocks near the village of Gollheim south of Germany . in this quarry the Oligocene sandy clayey beds are horizontal and not disturbed by any deformation , while the beds of Miocene rock which consist of silty clayey rock are highly tilted and folded Fig(8 a,b,c).this type of deformation was a superficial deformation beneath water and represent a special case of deformation (Mattauer 1980).

The deposits has the ability to recorded the different stages of deformation. the muddy deposits are not altered rock or they are not affected by the diagenesis process and they are still waited rocks . this type of rock is easily affected when it is subjected to deformation. the deformation act only on the superficial deposits that are still beneath water and led down recently. This type of deformation can be compared with that which occur in the deeper part of the earth crust where the rocks are molted and viscose .

This structure which was found in the quarry can be explicated as a slump structure or a sedimentary structures consisting of overturned folds formed by the mass sliding of the semi consolidated sediments down slope under the influence of gravity . these folds which are presented in this quarry are not of tectonic origin because the upper part of the sequence only was folded and undulated and the lower part of the sequence was not affected .

Fig(8-a) Minor anticline due to gravity in the Miocene rocks .

Fig(8-b) the Oligocene rocks are not tilted due to gravity in the same quarry.

Fig(8-c) Minor syncline due to slumping in Miocene rocks.

3- station in area of coal mining .

This station was located about 70 km to the west of Bonn in area of mining of coal which was found under Miocene rocks . the over burden was not more than 15m and the coal bed thickness was about 30m .these rocks are affected by normal faults of NW-SE direction which are pre-existent before Tertiary . these faults were rejuvenated post the deposition of Miocene sediments because the younger sediments post Miocene were tilted and cuts by these faults.

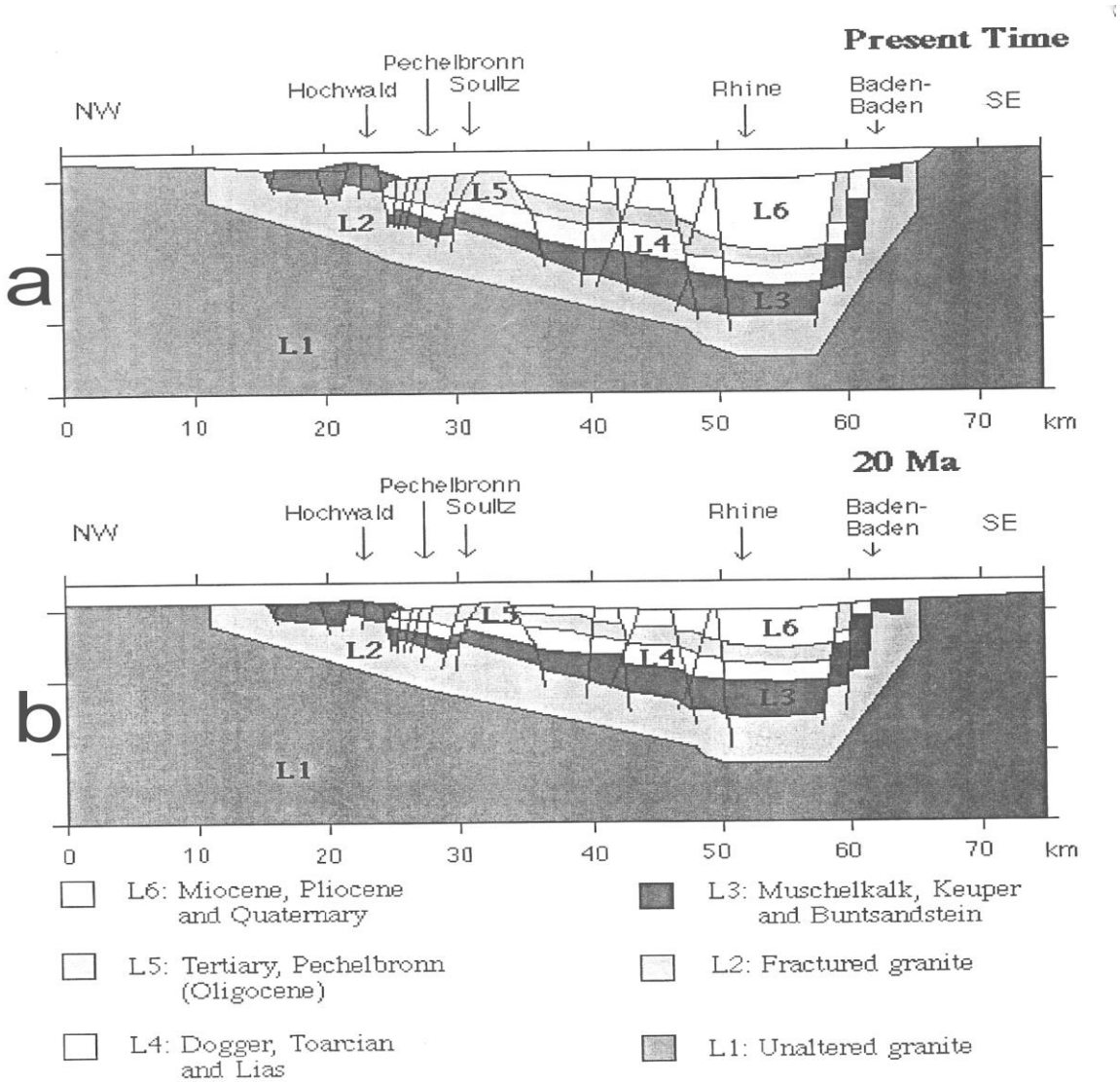
Due to the exploitation of coal from this area and due to the presence of activefault near the town of (Tageban Hambuch) many buildings were affected and broken especially those which are near the zone of normal fault(3,4). one of these buildings was a celebrated archeological castle was affected by normal fault. The displacement of this fault can be measured on the wall of this building and it was estimated to be about 30-40cm Fig(9a,b).

Fig(9-a) normal fault cut in the wall of the building

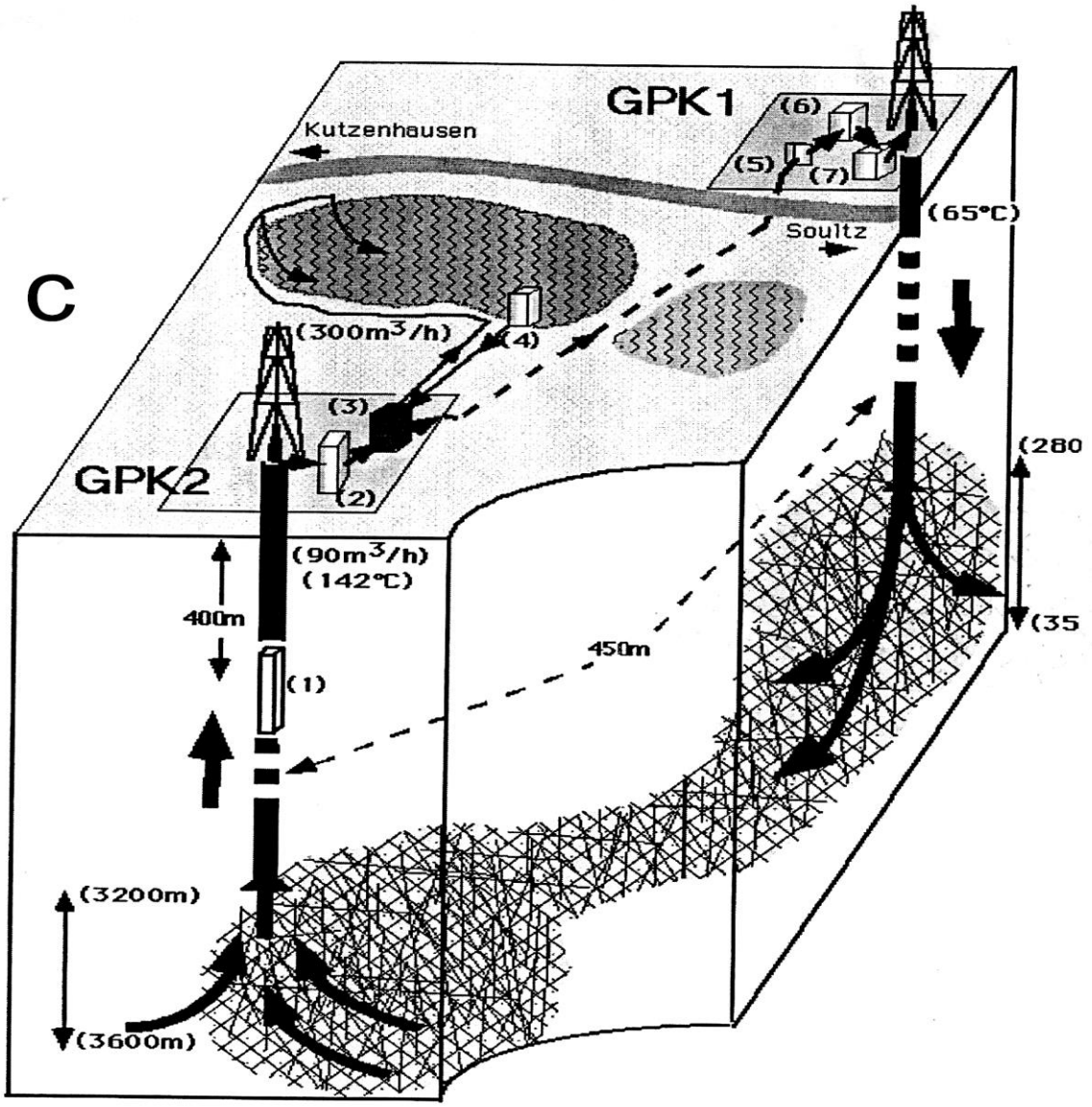
Fig(9-b) displacement of the fault normal in the sole of the building .

4- geological station in active geothermal area :

This station was effectuated near the France –Germany border. The area was characterized by high geothermal activities due to the presence of hot igneous body below the surface of this area(1,6) .the Rift activities was the essential cause of crust thinning along the Graben of upper Rhein .many normal faults was cutting in the rock of this area and their directions was parallel to the general trend of the upper Rhein Graben .Three deep wells were drilled in this area with depth of about 5000 m in order to reach a sub surface temperature of 240 CºThe idea was to get a steam of water at this depth in order to generate electricity by the energy of steam Fig(10 a,b,c).The cross sections and (fig.10c) were prepared by the department of geology of Bonn university.



Fig(10- a,b) two cross- sections in the studied station represent the different normal faults which cut deeply and causes the elevated temperature in the subsurface .



Circulation experiment between the 2 deep wells GPK1 and GPK2 at the HDR test site in Soultz in 1997.
(1: submersible pump, 2: pre-filter, 3: heat exchanger, 4: pumps for cooling circuit, 5: corrosion test chambers, 6: filter battery, 7: re-injection pump)

Fig(10- c)

Not far from the above mentioned area there is a well known mine opened since the fifteenth century . this mined was opened in order to gate the mineral of copper and cobalt. Iron oxide and selenium oxide .the mineral malachite was scattered and found on the surface of the area. many normal faults was cut inside the tunnel of this mine they were parallel to the direction of Rhein Graben. It is possible to recognize many strike slip faults which are older than the normal fault. This mine was closed before thirty years and it was used now for tourism purpose Fig(11).

Fig(11). Different mineral types from the mine in the station 4

Conclusion:

Field geological work in a wide area around the upper Rhein Graben in Germany ,it was quite clear for us that many tectonic phases was affected that area and left many indications on rocks about the direction and nature of stress .the oldest phase which was acted in the area was the Variscan phase of compression and due to this phase many structures were developed like folds and faults and mullion structures. The next phase of tectonic was a phase of tension which originated the Rhein rift system . this phase was associated with volcanism . it was possible also to diagnose many deformations of non tectonic origin like slumping and sliding due to the gravity .

Recommendation :

Field structural geological stations could be studied in selected areas in the stable & unstable shelf of Iraq in order to evaluate the structural history of the studied areas.

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