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field trips

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## Report of the 73th annual Meeting of the VSP/ASP in Rheinfelden

### Field trips, Werner Bolliger

The reports on the various field trips and cultural visits reflect the author's (or his wife's, Renate Bolliger's) impressions as previously little informed participants. They do not claim to be complete and merely attempt to describe the participants' impressions and the guides' opinions as perceived. More detailed descriptions and analyses of the geological background will be published in a later edition of the bulletin.

Eine deutsche Version des Exkursionsberichts wird zusammen mit zahlreichen Bildern auf der VSP-Homepage aufgeschaltet.

#### 17th June: Partners' Programme

A short, hot bus ride brings us to the antique Roman city of Augusta Raurica. It was once inhabited by over 20,000 Celts and Romans, and had one of the very few bridges across the river Rhine. The excavated ruins, theatres, temples, aqueducts etc. and the museum are very impressive.

The group is split into a German speaking section led by Dr. R. Schultz-Rehberg, and an English speaking one led by Mrs. A. Sasse. Both leaders don't just present dry facts but many details about the excavations and the daily life of the former inhabitants. This in turn provokes many questions and speculations by the visitors. They suggest, for instance, various purposes, such as construction statics, love nests, spaces for flower pots, urinals – for niches in the upper parts of the theatre, whose actual function is unknown... It makes the tour very lively and, combined with the relaxed pace and the occasional rest under a shady tree, it creates a thoroughly enjoyable afternoon.

#### 18th June: Field Trip to the Region of Porrentruy

##### Dinosaur tracks and Neotectonics near Courtedoux

(Field Guides: Wolfgang A. Hug and Daniel Marty)

After an hours' drive from Rheinfelden via Basel through the Jura mountains we arrive at the excavations of Courtedoux, in the area of the planned motorway «Transjurane». Our guides W. Hug and D. Marty are heading a palaeontological-geological team, which forms part of the «Office de la Culture» of the canton of Jura. This team is charged with the task to study and preserve as much as possible the palaeontology along the projected line of the motorway. Their project is financed to 95% by the Swiss Federal Roads Authority and to 5% by the canton of Jura.

The first excavation visited is at Courtedoux-Tchafoué (Fig. 1), where several hundred footprints of saurians are visible on various surfaces – tidal flats – of laminated beds of Kimmeridgian age. Tracks of small to large Theropods (carnivorous dinosaurs) and small to medium-sized sauropods (plant-eaters) are present (Fig. 2). Daniel Marty enacts convincingly, as a «man-sauri-

an», the movements of the animals that resulted in the observed tracks.

The series of rockbeds with tracks of dinosaurs is topped by a hard-ground and capped by «Virgula Marls» that represent the transgressive beginning of a new depositional cycle. These marls are rich in small and larger shell fossils, above all «virgulas» (*Exogyra virgula*) that resemble the comma-symbol in writing (hence the term virgula). We learn to our amazement that numerous ammonites were found in the basal marls – in an alien environment for these fossils – which permitted the establishment of a reliable Kimmeridgian age.

At this point Wolfgang Hug explains the geological setting of the region, the palaeogeography during Kimmeridgian times, and details of the ecology and sedimentology. The participants of the field trip also benefit from a distributed hand-out, in which the two field-guides summarize the geological background, activities and results of the work of their team «Palaeontology A16» (A16 being the name of the planned motorway).

The next visited excavation, Chevenez/Com-

be Ronde, shows further dinosaur tracks on calcareous laminated beds, which are slightly older than the ones previously seen. 1167 footprints in 69 tracks have been registered and documented from this location. Seven individual track-bearing beds have been exposed, with the principal horizon at the base, now visible. With the sun high in the sky at this time of day, the relief of individual footprints is often difficult to discern. However, artificial staining of imprints shows an impressive picture of 43 tracks, heading in various directions (Fig. 3) and also containing tridactyl footprints. Individual imprints range in length from 7 to 30 cm. 14 tracks contain very small to medium-sized sauropod footprints and are evidence of a gregarious behaviour of juvenile animals within a dinosaur family. Individual pace-lengths reach hardly 20 cm.

Later, during the lunch at Mormont, answers to some questions are still open and give rise to discussions: there is evidence of dinosaurs wandering on tidal flats of the «Jura Platform», but answers to questions such as where they were living and feeding are still lacking...



**Fig. 1:** Courtedoux-Tchafoué: Excavation for the planned Motorway A16, where Dinosaur tracks were discovered. [Foto: Ch. Pümpin]



**Fig. 2:** Courtedoux-Tchafoué: Sauropod imprint (and human feet). (Foto: B. Gunzenhauser)



**Fig. 3:** Chevenaz-Combe Ronde: Numerous (stained) tracks of sauropods and theropods – dinosaur families. (Foto: Ch. Pümpin)

After lunch the party is split into two groups:

- 1) Neotectonics at the southern end of the Upper Rhine Graben, and
- 2) Vist to the medieval town of Porrentruy

### **Neotectonics in the border zone between Tabular Jura and southernmost Upper Rhine Graben**

[Field Guides: Kamil Ustaszewski and Stefan Schmid]

A discussion on the basis of today's observations focuses on the question, if in this area basement was involved in the latest tectonic movements («thick skin tectonics»). Answering this question is a key issue for seismic hazard assessment studies in the light of the disastrous earthquake of Basel in 1356.

At the first afternoon stop at Lugnez we see at a distance the southern flank of a gentle anticline which, based on cartographic evidence, started to be formed after the deposition of «Sundgau gravels» (i. e. later than a minimum of 2.9my bp, the biostratigraphical age of the Sundgau gravels; Fig. 4).

The second stop is in the disused quarry of Réchésy, where conglomerates of an age straddling the border between Eocene and Oligocene were once exploited. These conglomerates represent sediments of the edge of the Rhine Graben during the time of rifting («Sannoisian») and were deposited along an E–W trending extensional flexure, during the incipient phase of rifting.

At the third stop, in an abandoned gravel pit at Seppois-le-Haut in the Largue Valley, we come face-to-face with the outcropping Pliocene Sundgau Gravel. In the wall of the pit a distinctive sand bed is visible within the coarser sediment, which is displaced by a



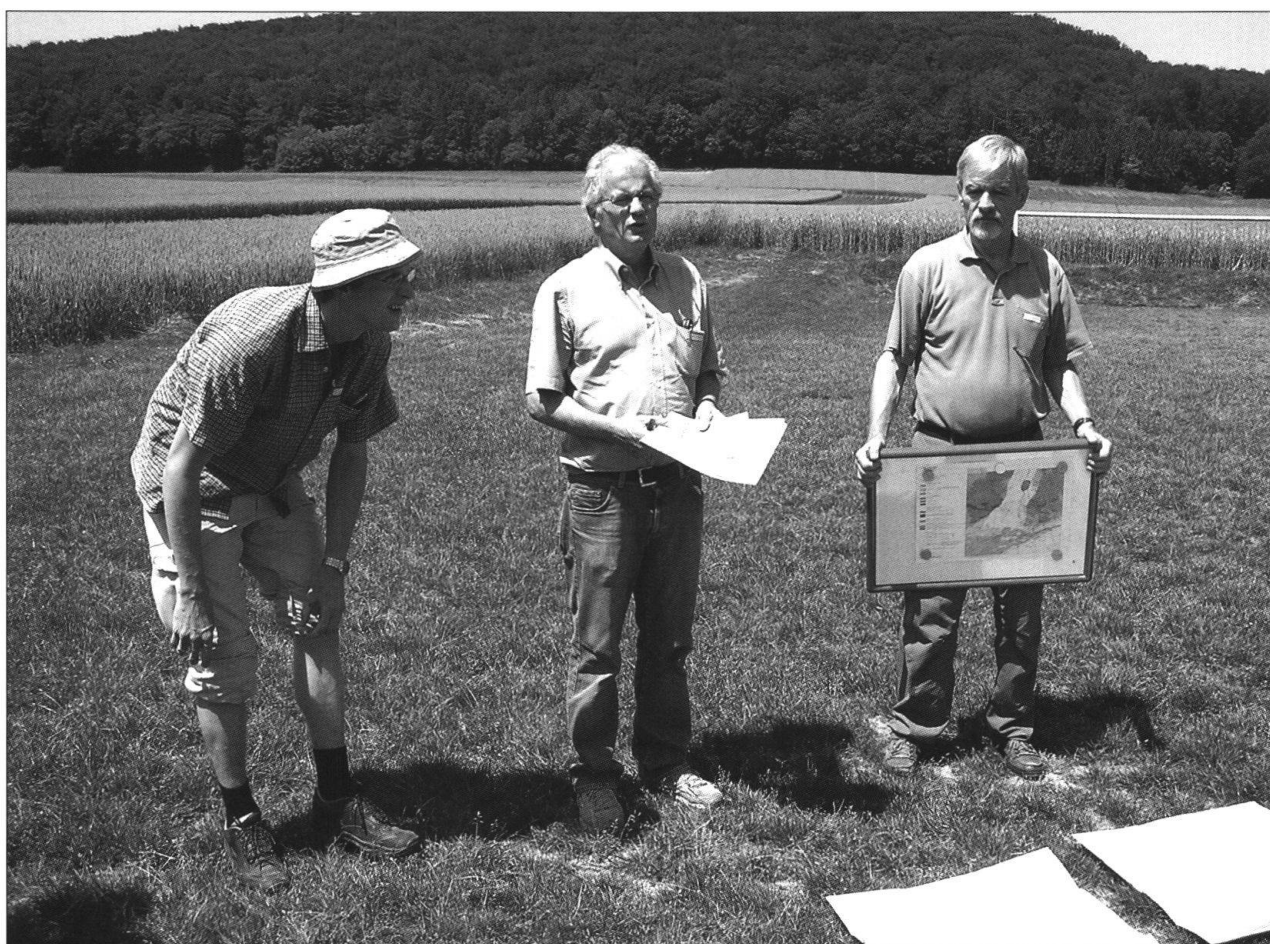
normal fault and its conjugate: evidence of tensional movement (Fig. 5).

The following explanation was offered by our field guides: During the phase of Oligocene rifting Rhine and Bresse Graben systems were displaced in a WSW direction by a dextral strike-slip fault zone. This was re-activated and reversed into a sinistral zone by a new SE–NW oriented field of principal stress from Pliocene times onwards (from the deposition of the Sundgau gravels and probably up to the present). Due to the curvature of this new system (following the original southern border flexure of the Upper Rhine Graben) compressional features (en echelon anticlines) co-exist with tensional features (as exemplified by the normal fault in the Seppois–le-Haut pit). These young tectonic movements likely involve basement and are therefore «thick-skin» in contrast to the folding phase of the Jura

Mountains in Mio–Pliocene times. They are seismogenic and could be responsible for the great Basel earthquake as well as for later smaller earthquakes, possibly through incipient inversion of the Permo–Carboniferous trough system at depth.

Between the last two outcrops we have an opportunity to take a quick look at the old monumental Wilhelmian railway station of Pfetterhouse, which was built by the Germans at the beginning of the 20th century, when the Alsace and with it Pfetterhouse was part of Germany and the authorities wanted to build a connection between Germany and the then new Simplon railway line to Italy.

During the entire day we could enjoy beautiful weather with a lot of sun and heat. Thundery showers started only during the bus trip back to Rheinfelden before 6pm.



**Fig. 4:** Lugnez: Dr. Kamil Ustaszewski and Prof. Stefan Schmid (field guides) point out Pliocene compressional tectonics at gentle anticline in background (post Sundgau gravel). On right is our new president Dr. Peter Burri. (Foto: W. Heckendorn).

## **Guided Tour in the Medieval Town of Porrentruy**

The participants of the non-geological afternoon programme are again split into two language groups, led by the guides Mme. H. Girardin and Mme. T. Bertaud in English and German.

Porrentruy, which has Roman roots and had become a free city of the German Empire already in 1283, had its heyday after the Reformation, when prince bishop Blarer of Basel relocated his residence to the still catholic Porrentruy. He then renovated and extended the castle and built a Jesuit college. During the tour we see the large castle from the outside (nowadays it is used for civil services) and then walk down to the old town in its episcopal splendour. We visit not only beautiful Baroque buildings, but have also a glance into narrow medieval alleyways and even a private courtyard.

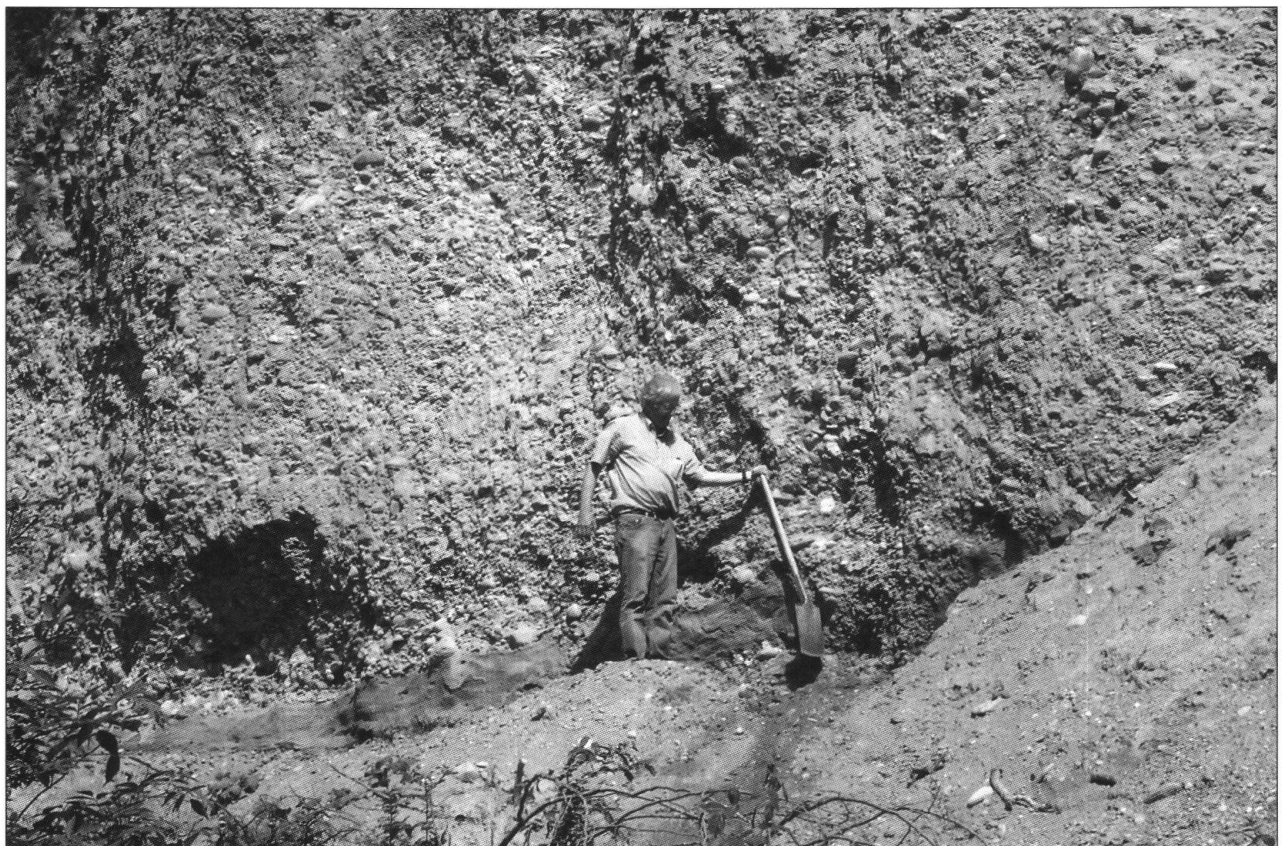
As the weather is very hot and since Porrentruy offers no shady Roman ruins to sit on, an unscheduled detour into the cool church is just too inviting for part of the group. Unfortunately the lost sheep are quickly chased out of this paradise, but can soon enjoy a cold drink with the German-speaking group to round off the tour.

## **19th June: Visit to the Geothermal Deep Well in Basel and Return on the River Rhine to Rheinfelden**

### **Deep Heat Mining**

(Field Guide: Markus Häring)

Most participants reach the drilling site at Kleinhüningen in Basel by bus from Rheinfelden. All are welcomed at the drilling site by Heinrich Schwendener, the President of the



**Fig. 5:** Seppois-le-Haut: Prof. Stefan Schmid, high on the outcrop of Sundgau gravel, points out a normal fault (behind handle of shovel), which displaces a sand bed (behind his lower leg) down to the right, thus evidencing tensional tectonics. (Foto: B. Gunzenhauser)

Advisory Board of «Geopower Basel AG», a syndicate comprising the two Swiss Cantons of Baselstadt and Baselland, and eight energy companies (among others the IWB – Industrielle Werke Basel – who sponsor our lunch today). This group provides the funds for the project (total costs expected at 120 million CHF), called «Deep Heat Mining». The project has pioneering character: if successful, Basel will host a geothermal power station unique in the world. Until 2009 deep geothermal energy would supply 10'000 households with electric energy, and 2700 with heated accommodation.

Markus Häring from «Geothermal Explorers» is responsible for the technical-geological activities of the project. He introduces the visitors to the workings and potential of the drilling rig, the largest electrically driven land rig in Europe (see cover of this Vol.). Special difficulties were initially caused by the urbane location of the well. This required particular noise-reducing measures, such as the installation of noise-proof windows in adjacent dwellings. The well was spudded on 20th May this year and is expected to reach a total depth of 5000 m by end September. Recovered drill-cores and cuttings from previous reconnaissance wells down to the Rotliegend are displayed and shown to the visitors in an adjacent store. For current drilling a silicate gel mud is used. Water from the nearby river Rhine will later replace this mud in the deeper granite (under strict environmental control).

Further operational plans are as follows: After reaching total depth in the first well the Hot-Fractured-Rock method will be applied. High pressure hydraulic «fracking» should enhance permeability at 5000 m by opening fissures, expected to be present in the vicinity of the flexure of the Rhine Graben. Geophones in 6 already drilled relatively shallow monitoring boreholes will record this process and should produce a micro-seismic map showing the distribution of opened fractures. Two further deep production wells will then be deviated from the cur-

rent surface position to the best deep locations, and should later serve as producers of steam (expected temperature at 5000 m is 200°, according to regional thermal gradients observed in the Rhine Graben area). As we also understand from the lectures of Saturday (L. Rybach and M. Häring) the project is very promising. However, apart from technical risks associated with deep drilling, geological and commercial risks must be considered:

The expected temperature of 200° C at a depth of 5000 m requires an abnormally high temperature gradient. Such a gradient has indeed been observed in the Rhine Graben (geothermal well Soultz-1) with its relatively thin earth crust. However, the gradient is geographically variable (L. Rybach speaks of irregularly distributed convection cells in the granite) and may be less than expected in the Basel well. A lot will also depend on the stimulated permeability of the deep granite, which could be insufficient for a decent water flow between wells (expected flow rates of 50 l/sec, i.e. some 27'000 bbls/day). The current price of electricity is furthermore marginal for the commercial viability of the project, which will, however, improve with increased future energy costs. (At present electricity prices are fixed arbitrarily; the shareholders of the project are mostly electricity companies and are thus partly «in control» of this variable.)

#### **Lunch at the «Dreiländereck» and boat trip back to Rheinfelden**

Near 12 noon the visitors walk through the streets of Kleinhüningen to the so called «Dreiländereck» (corner of the three countries), where France, Germany and Switzerland meet. This is also the location of a uniquely situated restaurant, on a peninsula between the harbour basin of Basel und the main channel of the river Rhine. Not only its situation, but also the quality of the four-course meal enjoyed in the restaurant is

excellent. (There is also a much appreciated choice between a vegetarian meal and beef for the main course, as by now customary for this convention.)

We use this opportunity to extend our thanks to IWB («Industrielle Werke Basel» and partner in the Geopower Group), for sponsoring our meal and drinks.

Coffee is served later on board of the passenger ship «Basler Dybli». Before going up-river, we tour the harbour basin, through which – combined with some other basins in the surroundings – 20% of all Swiss imports enter the country. During the subsequent passage through Basel the old city presents itself from this unusual perspective. The guests also learn about the consequence of the earthquake in 1356, which among other buildings destroyed the upper parts of the old Romanesque cathedral high above the Rhine. These were subsequently rebuilt in Gothic style, thus combining the two styles in the present building. Up-river from Basel we have a last glimpse of geology: on the hilly German bank there is a prominent outcrop of Triassic Muschelkalk, marking with its steep turn of dips the flexure of the Rhine Graben. Occasional rain and the passage through two locks at hydro-powerstations cause the guests on the various decks to move and mix, thereby facilitating personal contacts.

The participants of the 73rd VSP Convention arrive in Rheinfelden in late afternoon. It is finally time to bid farewell, if only for one year.



