

STOP 5:

- * Fraham–Eisenharting, 1 km N of Seeham at the lake Obertrumer See, old overgrown quarry. Mapping point of Gohrbandt (1963).
- * Helvetic Zone, Nordhelvetikum. Stockletten, Late Eocene.

In the Nordhelvetikum, sedimentation started after a gap (E.Maastrichtian – M. Eocene) with *Assilina*-marls: the Adelholzen Beds. A deepening of the basin caused pelagic sedimentation of the "Stockletten". Bioclastic limestone layers, mainly calcareous algae, originated from gravity slidings. The marls contain abundant globigerinas (*G. eocaena*, *G. gortanii*) and rich benthic fauna comparable with Guembel's (1868) description and the excursion point Katzenloch in Bavaria (Hagn, 1981).

A nearby RAG drillsite, CF Nussdorf 6, showed the transition from the Eocene calcareous pelagic facies to the E. Oligocene clay facies with pyritic preservation and stagnant *Bulimina* facies (*B. sculptilis*, *B. cf. pupoides*). Nannoplankton determinations by C. Müller (Paris) demonstrate NP 19 to 20 in the drill site and NP 18 in the outcrop.

The overthrust of the Helvetic Zone on the Molasse was exposed only 60–80 m to the N.

The route continues to Mattsee, Seekirchen, and over highway A1 along the Alps to Enns. Along the Enns river we drive south, crossing the Flysch, and enter the Northern Calcareous Alps.

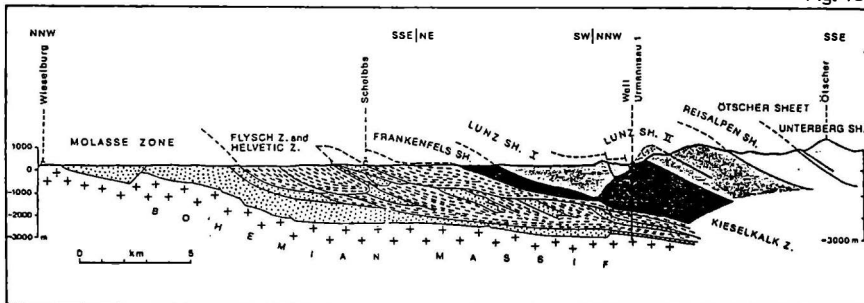
GEOLOGY OF THE NORTHERN MARGIN OF THE EASTERN ALPS, SECTION BETWEEN THE RIVERS ENNS AND TRAISEN (EASTERMOST UPPER AUSTRIA – WESTERN LOWER AUSTRIA).

W. Schnabel, Geol. Survey of Austria, Vienna.

Similar to the structure of the whole northern border of the Eastern Alps, this part is also dominated by the three main tectonic units: the Helvetic Zone, the Flysch Zone (=Reno–Danubian Flysch) and the northern tectonic elements of the Northern Calcareous Alps. Special features within this section are the Klippen–Zone and the exposures of the Inner Alpine Molasse within the Alpine system. It is expected that the reason for these remarkable structures in this particular area is the south spur of the Bohemian Massif reaching beneath the Alpine body with only a thin cover of autochthonous Molasse. It is overthrust by the Alpine nappe system composed of:

highest	Ötscher sheet	}	Northern Calcareous Alps
	Lunz sheet		
	Frankenfels sheet		
	Cenoman–Randschuppe		
	Reno–Danubian Flysch		
	Helvetic Zone		
lowest	Inner Alpine Molasse		

Fig. 18.



Cross-section through the Molasse Zone, the Ultrahelvetec Zone, the Flysch Zone, and the Northern Calcareous Alps in the area of the window of Rogatsboden and the well Urmannsau 1. Demonstrated are the submerging Foreland Molasse, the thrustlices of the Sub-Alpine Molasse within the Ultrahelvetec Zone, the Flysch Zone, the internal structures of the Northern Calcareous Alps, and the location of the well Urmannsau 1

(from JANOSCHEK & MATURA, 1960)

Due to the generally flat south dipping overthrusts this sequence of nappes is exposed not only in the northern front part, but also in a considerable number of tectonic windows and "semi-windows" as for instance:

the window of Rogatsboden-Schelbbs and Texing: Molasse beds together with units of the Helvetic Zone exposed within the Flysch-Zone

the window of Brettli: Flysch-Zone with "Klippen" exposed within the Frankenfels sheet of the Calcareous Alps

the window of Urmannsau: the Frankenfels sheet exposed under the Lunz sheet

The well Urmannsau 1, situated in the window of Urmannsau, drilled through 1900 m rocks of the Frankenfels sheet before penetrating Flysch with "Klippen", Helvetic Zone and disturbed Molasse and finally reaching the crystalline basement at a depth of 3015 m (fig 18).

The "KLIPPENZONE" is a highly deformed, folded and imbricated zone and has fault contact with all adjacent units. Therefore the original position in the sedimentation area has not always been clear. It includes the Helvetic Zone (=Gresten Klippen-Zone), but also parts of the Rheno-Danubian Flysch with remnants of its primary basement (SCHNABEL, 1979). The Klippen-Zone is characterized by the occurrence of the Jurassic/Early Cretaceous "Klippen" surrounded by younger soft rocks, termed "Klippenhülle" (i.e. Klippen cover, see also Helvetic Zone and Rheno-Danubian Flysch).

The INNER ALPINE MOLASSE of Late Eocene to Oligocene age occurs in several windows within the Flysch Zone, imbricated with the Buntmergelerde of the Helvetic Zone.

The HELVETIC ZONE as the paleogeographic external unit of the Alps is in this sector entirely included in the Klippen-Zone. The Helvetic "Klippen" are essentially represented by the Liassic Gresten Beds (arkose, siltstone, marls, coal beds), Posidonia marls, siliceous limestones, radiolarites and Aptychus

Limestone of the Malmian and Neokomian. The "cover" is the Buntmergelseerie (Variegated marl serels) of the upper part of the Early Cretaceous to Middle Eocene, representing the Southern Ultrahelvetic Realm. Its deposits under the CCD contain a rich fauna of agglutinated foraminifera. The original basement of the Helvetic Klippen can be assumed to consist of crystalline rocks comparable with the Bohemian Massif, as shown by dislodged slices of granite exposed in this area. The largest of these outcrops became a monument for the famous geologist LEOPOLD VON BUCH (1774-1852).

The RHENO-DANUBIAN FLYSCH in that area comprises Neokomian to Paleocene age. The younger formations (i.e. Campanian Zementsmergelseerie and Maastrichtian to Paleocene Altengbacher Schichten) form the main unit of the Flysch Zone, a nappe which has entirely overridden the Helvetic Zone from here to the east. The older series (Neokomian Flysch, Gaultflysch, variegated shales and siliceous flysch of Cenomanian to Santonian age) are included in the Klippen Zone. They are in close contact to Jurassic "Klippen" of deep sea deposits (radiolarites, Aptychus limestone) and ophiolites, which can be considered to be remnants of the previous Flysch basement (SCHNABEL, 1979).

The NORTHERN CALCAREOUS ALPS are preserved by the so-called fore-Alpine nappe system (Frankenfels, Lunz and Ötscher sheet) and dislodged slices of the Cenoman-Randschuppe. In the area of the River Enns they form one of the most interesting features of the Northern Calcareous Alps, the Weyerer Bögen Structure, where the continuously east-west trending belts are obviously disturbed.

(Parts of this article are taken from Janoschek & Matura, 1980).

STOP 6:

- * Pechgraben W of Grossraming, old quarry at the 2nd Pechgraben-gorge.
- * Northern Calcareous Alps, Ternberg-Frankenfels Nappe, Vilsener Kalk - Ammergau Beds - Schrammbach Beds, Dogger to Early Cretaceous.
- * References: Holzer, 1968, 1969
Kristan-Tollmann, 1962
Rosenberg, 1964

This outcrop presents a steep NNE dipping sequence of layered limestones. The SW part consists of reddish and grey-green recrystallized "crinoid" limestone, the Vilsener Kalk. A fault causes a gap below the red calpionella limestones (Ammergau Beds), which has layers measuring 2-33 cm, totalling 8.7 m in thickness. An agglutinated fauna of the insoluble residue was described from this site by Holzer. *Tolypammina*, *Glomospira*, and *Trochammina* dominate. The higher sequence is not well exposed. The Schrammbach Beds (Aptychus limestones) are grey to grey-green mottled limestones and are overlain by grey marls (Albian).

STOP 7:

- * Leopold von Buch memorial, Steinbauergraben, an eastern side branch of the Pechgraben.
- * Helvetic Zone, southern Ultrahelvetikum, Buntmergelserie.
- * References: Faupl, 1975
Lögters, 1937
Matura & Summesberger, 1980

The memorial is part of a huge granite mass, a sheared off basement cliff resembling red granites in the Moravian Zone of the Bohemian Massif. The accompanying soft marls and clays are strongly faulted and imbricated into a kind of tectonic breccia. Lithology and ages vary within a range of only a few meters. This area is therefore well suited for collecting different samples. This formation, the "Buntmergel-Serie" (variegated marl formation), is part of the Ultrahelvetic subunit, the southernmost part of the European plate. The sediments are rich in agglutinated foraminifera, which are partly deposited below the CCD. The time range spans from Late Aptian to Eocene.

Leopold von Buch (1774–1853), one of the fathers of European geology, was honored here by the society of German natural and medical scientists.

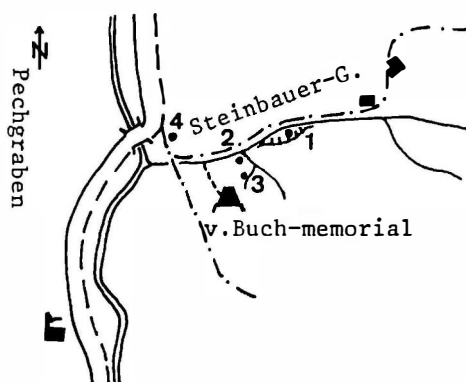


Fig. 19: Outcrops of the Buntmergelserie near the v. Buch memorial.

POINT 7/1: Early Eocene, dark grey to black clays with layers of fine-grained glauconitic sandstones. Very rich in agglutinated foraminifera, e.g. tubiformes, *Glomospira*, *Recurvoides*, occasionally rich occurrences of *Cyclammina ampectens*.

Planktonics: *Globorotalia aragonensis*, *G. marginodentata*, *Globigerina li-naperta*.

POINT 7/2: Early/Middle Cenomanian, layered light grey biotubated calcareous marls with soft clayey intercalations. Very rich in planktonic foraminifera, only few benthics, some calcified radiolaria.

Planktonics: *Rotalipora appenninica*, *Rt. reicheli*.

POINT 7/3: Early Middle Eocene, reddish-grey marls with rich but recrystallized planktonic fauna; agglutinated forms are common, e.g. *Recurvodes*, rare *Cyclammina amplexans*.

Planktonics: *Globorotalia caucasica*, *Acarinina bullbrooki*. According to nanoplankton (det. H. Stradner, Zone NP 14).

POINT 7/4: outcrop near the parking lot (entrance of the valley). Early Campanian, reddish to light grey laminated marls and silty clays with rich planktonic fauna and large agglutinates. Tubiform species, *Tritaxia*, and *Dorothia* are common.

Planktonics: *Globotruncana elevata*, *Gt. fornicata*, *Gt. linneiana*.

The route follows the road to Maria Neustift and turns toward Waidhofen an der Ybbs.

STOP 8:

- * Waidhofen an der Ybbs, suburb Zell, northern bank of the Ybbs river near the electric power station.
- * Helvetic Zone, Gresten Klippen belt, Jurassic to Early Cretaceous.
- * References: Trauth, 1954.
Schnabel, 1970

Aptychus limestone with intercalations of argillaceous marls (Arzberg Beds), Tithonian to Neocomian;

radlolarite, Early Malmian;

Zell Beds, sandy to silty, marly clays, Dogger;

The outcrop at the river bank exposes a sequence extremely folded and dissected by faults. Thereby it gives an impressive example of the Klippen belt tectonics.

The excursion turns back to Vienna, crossing the Molasse Basin and the Vienna Woods along highway A1.