EXCURSION 5

Continuing the route along the eastern margin of the Calcareous Alps the main topics are the stratigraphy and the facies succession of the Triassic sediments from north to south.

In the Middle Triassic the Wetterstein Formation with its large thickness and variety differs from northern Calcareous Alpine sections (facies change between stops 4/8 and 4/9).

The Upper Triassic facies turns from a continentally influenced and lagoonal one (Hauptdolomit and Dachstein Limestone) in the northern and middle sections of the Calcareous Alpine nappes to a reefoidal and basin facies in the southern nappes.

Finally, remains of a deep water development have been detected recently, pointing to an oceanic environment towards the south. These are additional arguments that the sediments of the Calcareous Alps originally have been deposited south of the Central Alps with their continental Keuper facies in the Upper Triassic.

The tectonics of uppermost Calcareous Alpine units is further under discussion, but in connection with results from the subsurface of the Vienna Basin (part I of this guidebook) solutions may be expected.

STOP No. 5/1

LOCATION: Hohe Wand, road cut between Kohlröserlhaus and Herrgottschnitzer-Hütte (Figs. 182,121).

TECTONIC UNIT: Calcareous Alps, Juvavicum.

FORMATION: S: Norian carbonate platform "Wandkalk".

AGE: Upper Triassic.

The Hohe Wand is composed of Triassic rocks (Fig. 182,183). Investigations and compilations of this area have been made by E. KRISTAN (1958), B. PLÖCHINGER (1963, 1964b, 1967). Newest works have been done during mapping of the geological sheet "75 Puchberg" (H. SUMMESBERGER, 1991). Especially in its northwestern part the Hohe Wand shows a complex tectonical mosaic of Middle Triassic Steinalm Dolomite, Reifling limestone, Carnian shales and limestones and Norian to Rhätian Pedata beds and Zlambach beds overthrusted to the Upper Triassic Hohe Wand carbonate platform. Most significant are light gray or reddish Norian carbonates that developed as lagoonal patch reefs (SADATI, 1981). They form the main ridge and the southeastern walls of the Hohe Wand. Evidence for a lagoonal environment is indicated by the low diversity of reef patches, low sedimentation rate (abundant open space structures), particular foraminiferal associations and by interfingering of a biolithe facies and a grapestone facies. SADATI assumes, that the postulated lagoon, with its patch reefs, might have been separated from a southern basin by a reef belt, which is now eroded. In southwestern parts coquinas consisting of *Daonella* and *Halobia* (PLÖCHINGER, 1967) point to a pelagic incursion. The detailed stratigraphical relations between lagoonal, reefal and pelagic facies are still a matter of discussion.

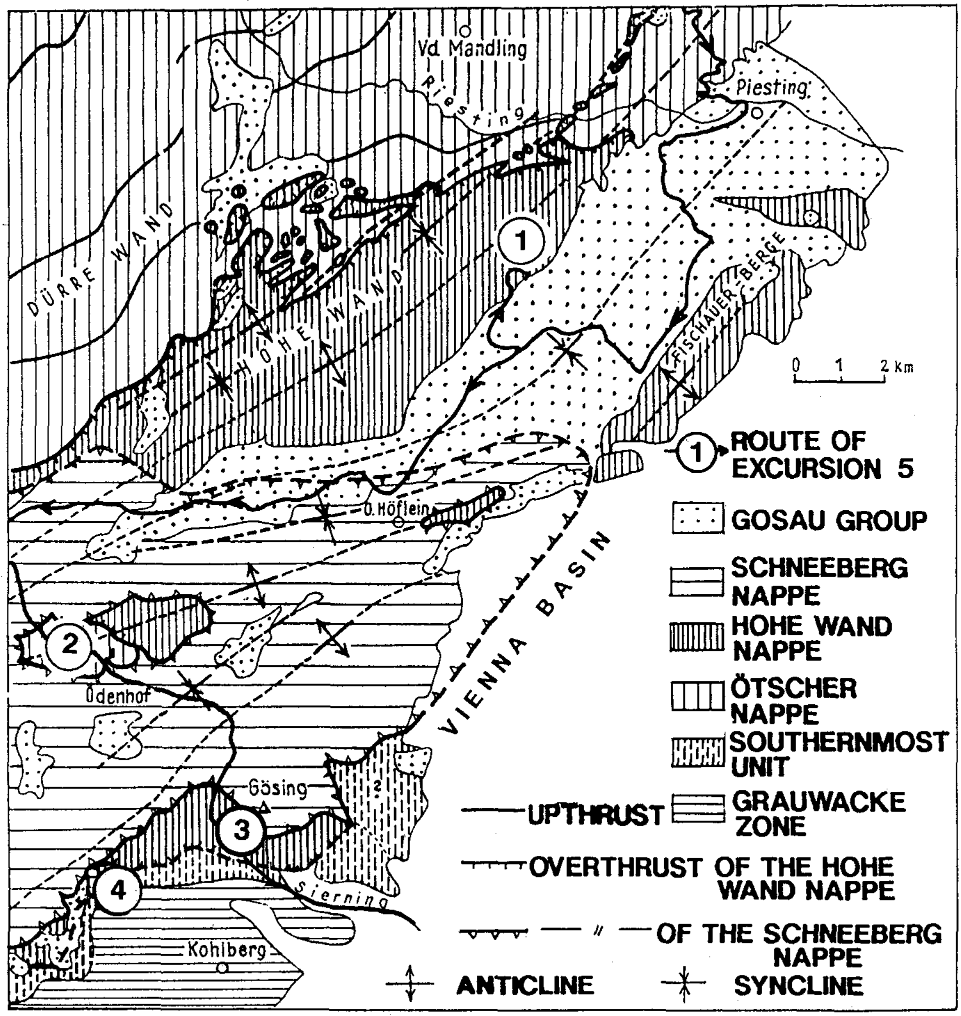


Fig. 182: Tectonic overview over the Hohe Wand-Ödenhof area (B. PLÖCHINGER, 1967).

The reef development, as it is visible in Stop 4/10 between Kohlröserlhaus and Herrgottschnitzerhütte is rich in corals, sponges (Fig. 184), algae, etc. Open space structures are frequent (Fig. 185) and several types are distinguished. They are interpreted as submarine features. The reef development may pass into the Rhaetian.

The Hohe Wand complex overlies Liassic basinal sediments to the NW. Below the ridge to the SE Gosau beds were transgressively deposited on the Triassic limestone. They form a deep syncline, intensively investigated by former coal mining.

From the Hohe Wand there is an excellent view over the Grünbach syncline, the Fischau Mountains, the Southern Vienna Basin to the Leitha Mountains (Fig. 187).

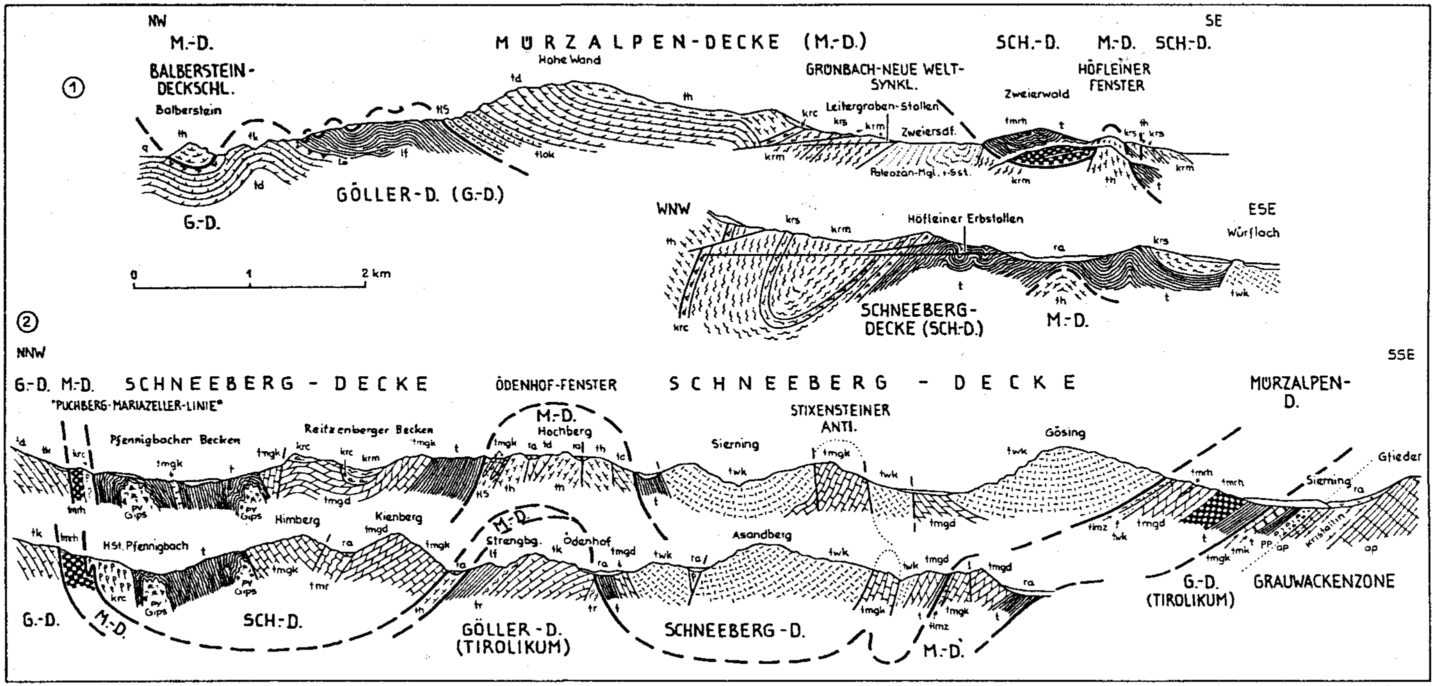


Fig. 183: Cross sections through the upper Calcareous Alpine Nappes (Mürzalpen and Schneeberg Nappe) in the area of the Hohe Wand and the Ödenhof window (B. PLÖCHINGER, 1967, in A. TOLLMANN, 1976).
q = Quaternary; va = Alluvium. **Cretaceous:** krm = Gosau marl; krs = Gosau sandstone; krc = Gosau conglomerate. **Jurassic:** lf = Allgäu beds (Liassic–Dogger). **Triassic:** tr = Kössen beds; th = Hallstatt Limestone; tk = Dachstein Limestone; td = Hauptdolomit, tlmz = Mürztal beds (Carnian–Norian); tls = Lunz Sandstone; twk = Wetterstein Limestone; twd = Wetterstein Dolomite; tmk = "Muschelkalk", tmr = Reifling Limestone; tmgk = Gutenstein Limestone; tmgd = Gutenstein Dolomite. **Permotriassic:** tmrh = Reichenhall beds; t = Werfen beds; py = "Haselgebirge", gypsum; pp = Prebichl beds. **Paleozoic:** ap = Lower Paleozoic.

Fig. 184: Weathered surface of a reefoidal limestone (Wandkalk) with cavity filling.
Hohe Wand, road cut SW Herrgottschnitzer Hütte.

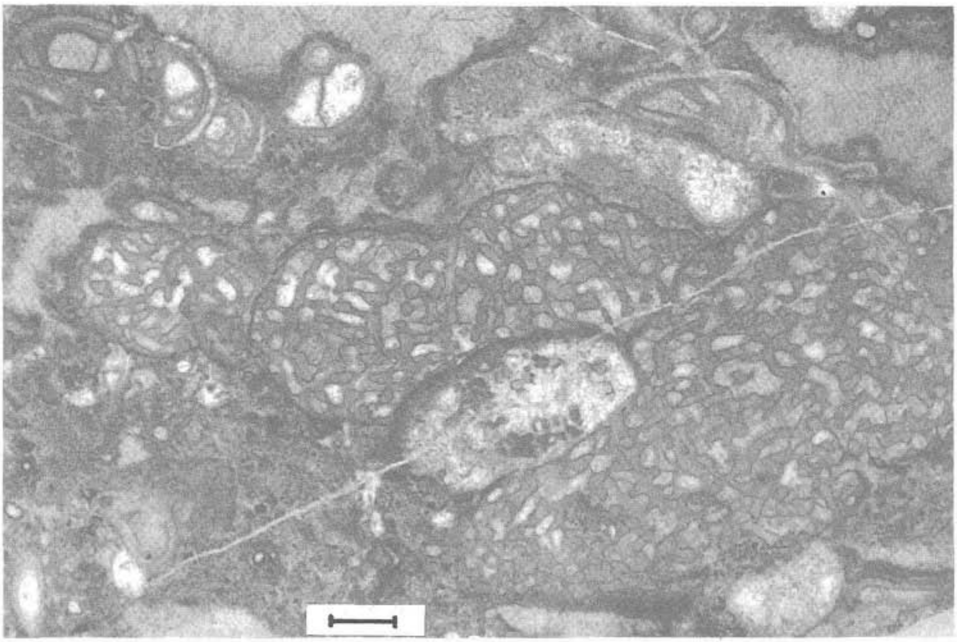


Fig. 185: Thin section of reefoidal limestone ("Wandkalk") with sponge fragments.
Hohe Wand, road cut SW Herrgottschnitzer Hütte; scale = 1,1 mm.

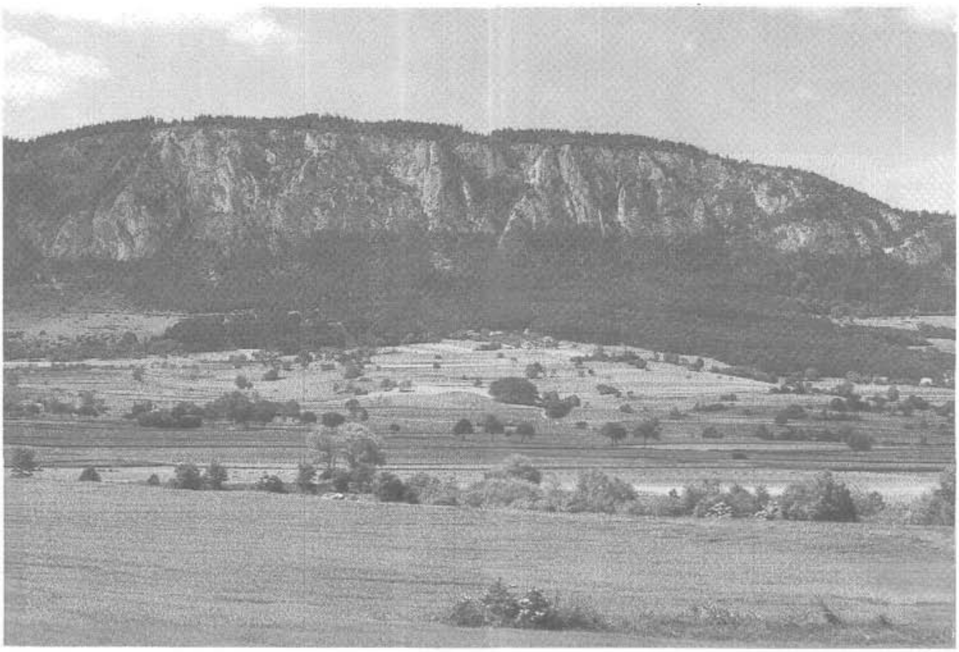


Fig. 186: Hohe Wand, south-eastern showing wall of the "Wandkalk", a lagoonal patchreef limestone.
In the foreground the soft terrain of the Grünbach Gosau sediments ("Neue Welt").

The route to Stop 5/2 (Fig. 182) goes westwards along the Gosau syncline of Grünbach (Fig. 188). The syncline consists of basal Santonian conglomerates, breccias and rudist reefs, Campanian Actaeonella beds and coal bearing marls and sandstones, Maastrichtian clastics with two Orbitoid horizons and Inoceramus marls, and finally, in Zweiersdorf, Paleocene turbidites (B. PLÖCHINGER, 1961, 1964, 1967). The Permoscythian base of the Schneeberg Nappe contains a large gypsum deposit within the area of Pfennigbach. Driving southward from Puchberg the walls of Middle Triassic carbonates of the Schneeberg Nappe (left side) are exposed. Together with Werfen beds they form the western border of the Oedenhof window.

STOP No. 5/2

LOCATION: Oedenhof NW, Sierning valley, 2 km SE Puchberg (Fig. 182).
TECTONIC UNIT: Window of the Göller Nappe (southernmost part of the Ötscher Nappe system) below the Schneeberg Nappe.
FORMATION: Dachstein Limestone.
AGE: Upper Triassic.

Norian Dachstein limestone and Jurassic rocks of the Göller Nappe appear in the Ödenhof window. They are surrounded by Permotriassic and Middle Triassic

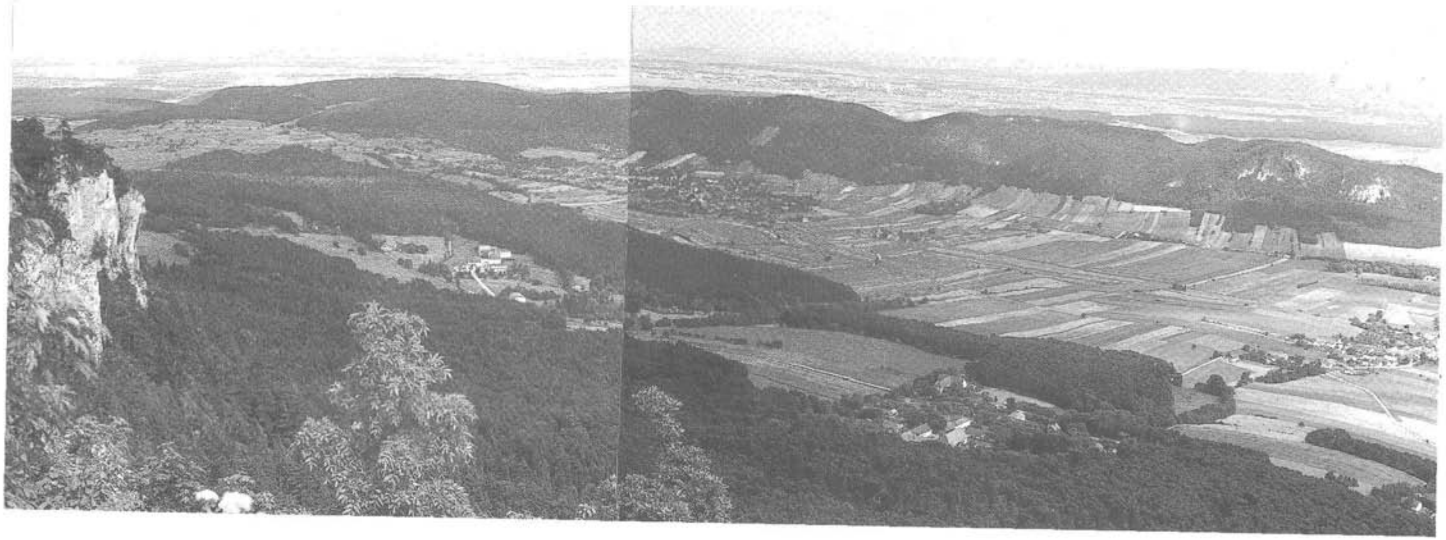


Fig. 187: View from the Hohe Wand in eastern direction.
Below the Wandkalk (visible left) and the Fischau Mountains (woody range) the Grünbach Gosau in extending (fields and meadows). East of the Fischau Mountains the southern Vienna Basin and along the horizon the Central Alps (Leitha- and Rosalia Mountains) are visible.

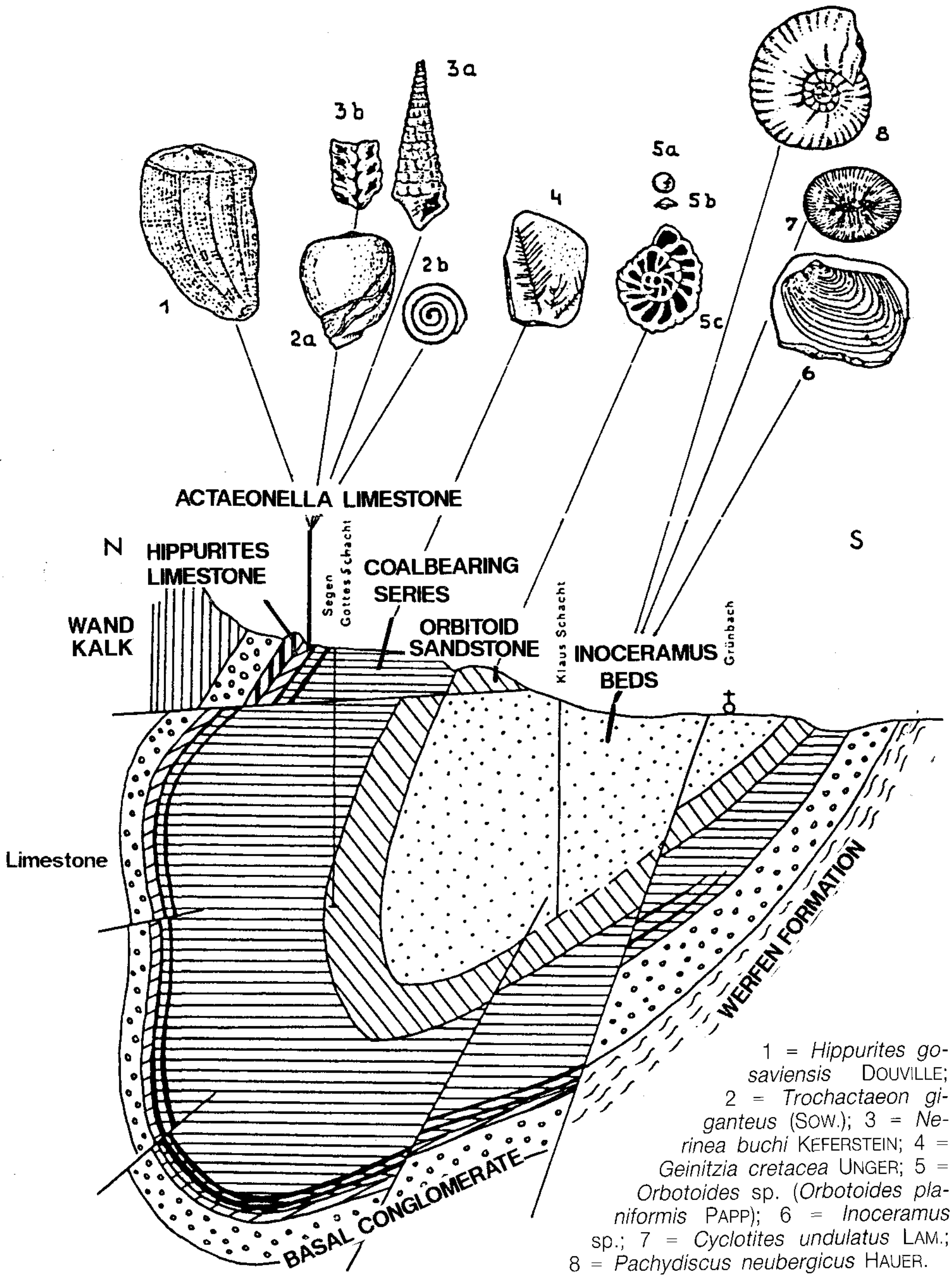


Fig. 188: Cross section through the Gosau syncline of Grünbach.
All fossils drawn diminuished; only 5c is enlarged.
After LEIN (1984), according to PLÖCHINGER (1961) and THENIUS (1962).

Fig. 189: Bedded Dachstein Limestone with Lofer cyclothemes.
Members A and B between 2 members C in foreground.
Ödenhof Window.

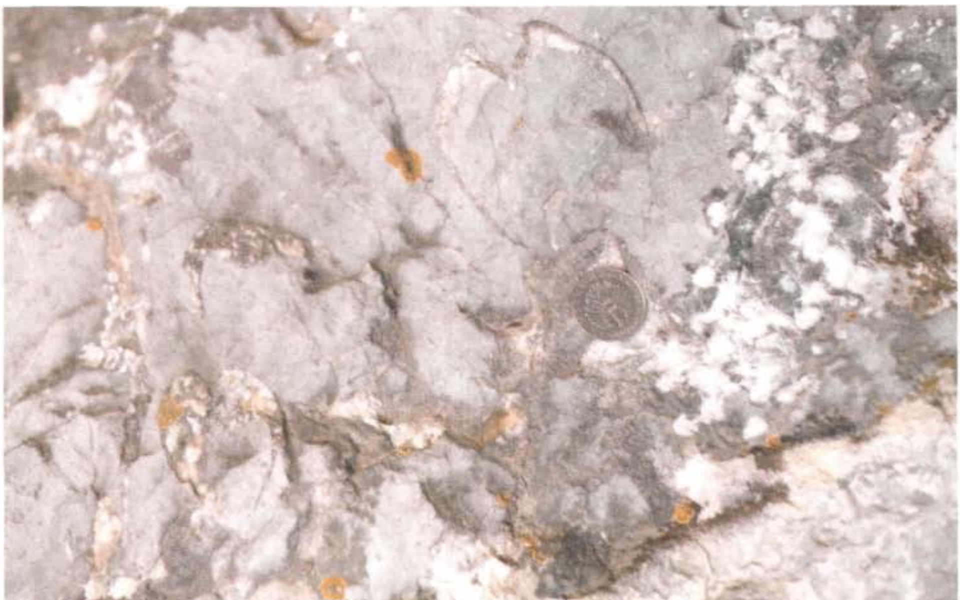


Fig. 190: Dachstein limestone; member C with megalodonts.
Ödenhof Window, detail of Fig. 189.

Fig. 191: Dachstein limestone; above member C follow the members A (red horizon) and B (laminated part).
Ödenhof Window, detail of Fig. 189.

rocks of the Schneeberg Nappe. Also the Hohe Wand Nappe is exposed in the same window to the Northeast (Figs. 182,183).

In this location, NE dipping Dachsteinkalk (Fig. 189) is exposed on both sides of the Sierning river. Typical members of the Lofer cyclothemes (after A.G. FISCHER, 1964) can be identified: The supratidal member A shows breccias and shaly reddish remains which are the result of dissolution (Fig. 191). It is followed by laminated dolomitic Algal mats of the intertidal member B and finally by member C, thick beds of subtidal limestones, rich in organic detritus and with large Megalodonts (Fig. 190). Near the top sheet cracks are filled with calcite or material of member A.

South of the Ödenhof, past the Ödenhof window and the Permoscythian base of the surrounding Schneeberg Nappe, Wettersteinkalk of this nappe can be seen.

STOP No. 5/3 (G.W. MANDL)

LOCATION: Sieding E (Fig. 192).

TECTONIC UNIT: Calcareous Alps, Juvavicum (Hohe Wand Nappe system), Geyerstein slices.

FORMATIONS: Gutenstein Dolomite, Steinalm Limestone, Hallstatt Limestone, Raming Limestone, Carnian shale/limestone sequence, Pötschen limestone.
AGE: Middle Anisian to Lower Norian.

The impressive rocky cliffs at the western slope of Mt. Gösing near the village of Sieding expose some of the best sections of the Geyerstein slices. These slices are arranged along a main overthrust plane and separate the Permoscythian siliciclastics of Werning zone ("Südrandelement"; PLÖCHINGER, 1967) below from the Middle Triassic carbonates of Schneeberg Nappe above.

Despite tectonical fragmentation the complete sequence from Anisian to Upper Carnian can be reconstructed, all carbonates are visible in good outcrops.

The section (Fig. 193/section 16)) starts with about 100 meters dark grey Gutenstein dolomite. It shows occasionally lamination and birdseye structures of a shallow water environment, fossils are lacking. At the top the dolomite becomes light-coloured and grades into Steinalm limestone of about 10 meters thickness. Its common microfacies is a dasycladacean grainstone with *Physoporella dissita, Physoporella pauciforata pauciforata, Physoporella pauciforata undulata, Oligoporella pilosa, Teutloporella peniculiformis* and a few foraminiferas as *Meandrospira dinarica* and *Glomospirella semiplana*. The fossil content points to an anisian age. After questionable block tilting and an erosional discordance the pelagic sedimentation of Hallstatt facies starts with lightgrey and yellowish thickbedded pelmicritic limestones. At the boundary often decimeter sized lenses of a yellow crinoidal wackestone occur, rich in ostracodes, holothuroidean sclerites, echinid spines, radiolarians and "filaments". This basal horizon is proved by conodonts as Upper Anisian. The total thickness is affected by tectonics but should exceed 15 meters. The following 6 meters consist of violet nodular limestones with chert nodules and green tuffitic intercalations. Due to strong recristallisation the primary micritic microfacies is mostly not preserved. Only a coarse grained mosaic of calcite and beginning dolomitization is visible. According to conodonts this nodular facies is of Langobardian age. Still in uppermost Langobardian an evenbedded lightgrey limestone with thin yellow marly layers is following. It contains fine-grained carbonate turbidites which become macroscopically visible after about 10 meters. Chert nodules and layers are frequent. Thickness is strongly affected by folding, it will be in the range of 40 m. According to its allodapic character this limestone refers to Raming limestone. It represents mainly Cordevolian time.

The Julian sequence is composed of two horizons of black shales with a few thin biodetritic limestone layers and an interbedded horizon of 18 meters dark allodapic limestones. Characteristic bioclasts are fragments of calcisponges. The age is proved by conocont samples, containing *Gondolella auriformis*.
The sequence is finished by Tuvalian black micritic limestones.

The lower Norian shown in Fig. 193/section 16 is a poorly exposed tektonized limestone near the overthrust of Schneeberg Nappe. The Norian is much better exposed at the Geyerstein cliff near the village Payerbach. Also the Middle Triassic to Carnian is visible there. It differs from the sequence described above in its lack of allodapic intercalations. The Cordevolian is represented there by Hallstatt-type grey and pinkish thickbedded micritic limestone.

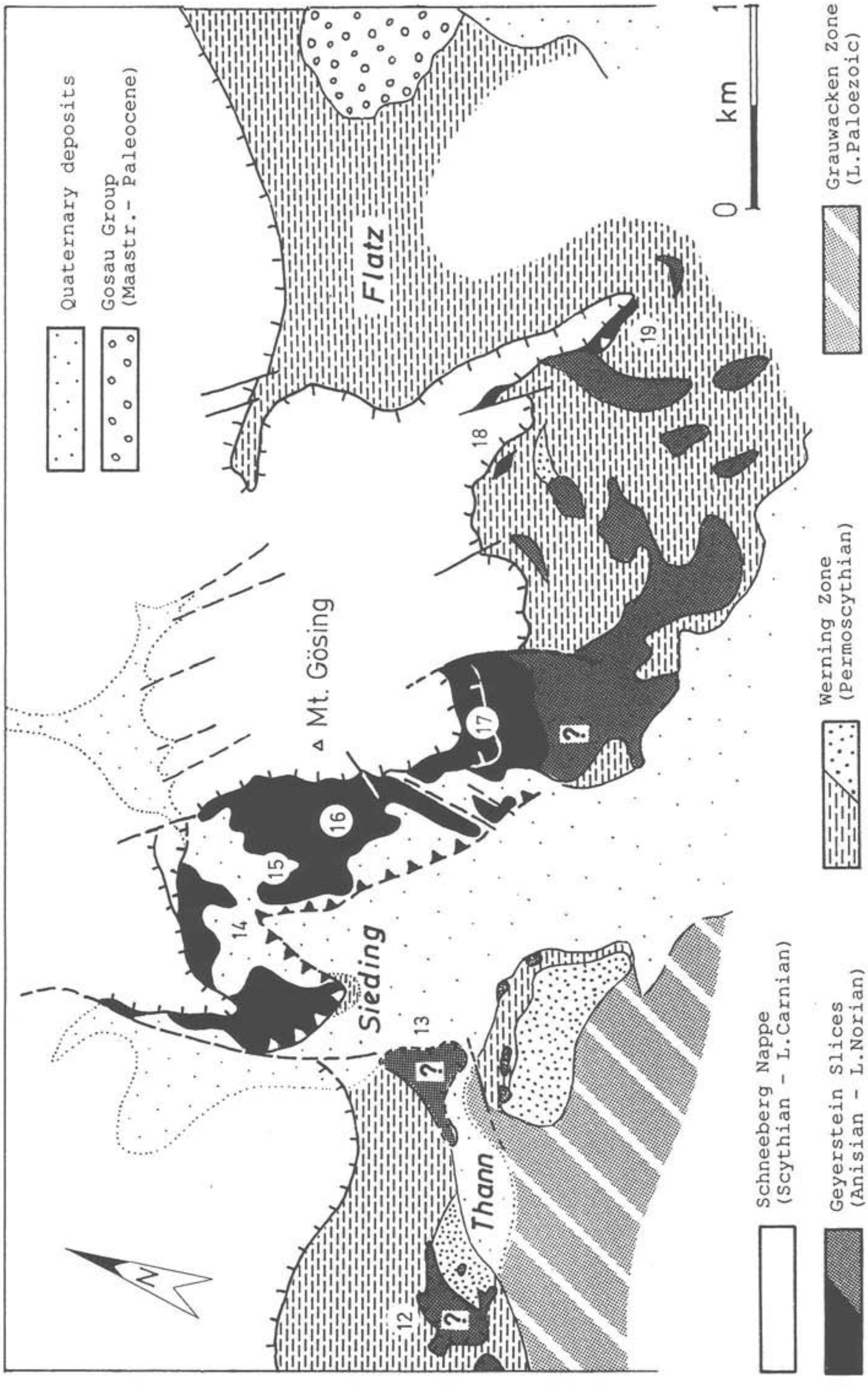


Fig. 192: Tectonic sketch of the Geyerstein slices (Juvavicum) near the village of Sieding (G.W. MANDL).

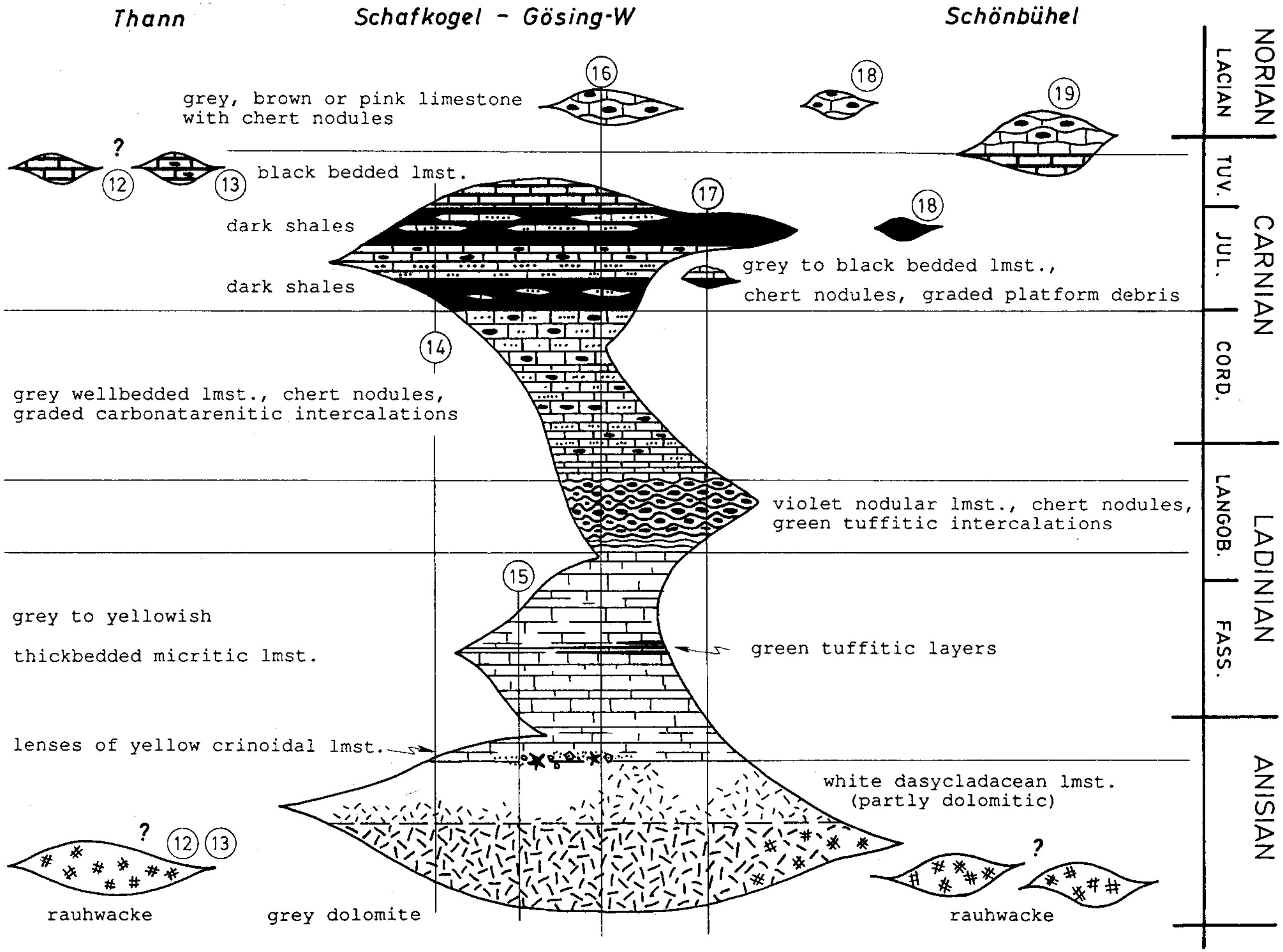
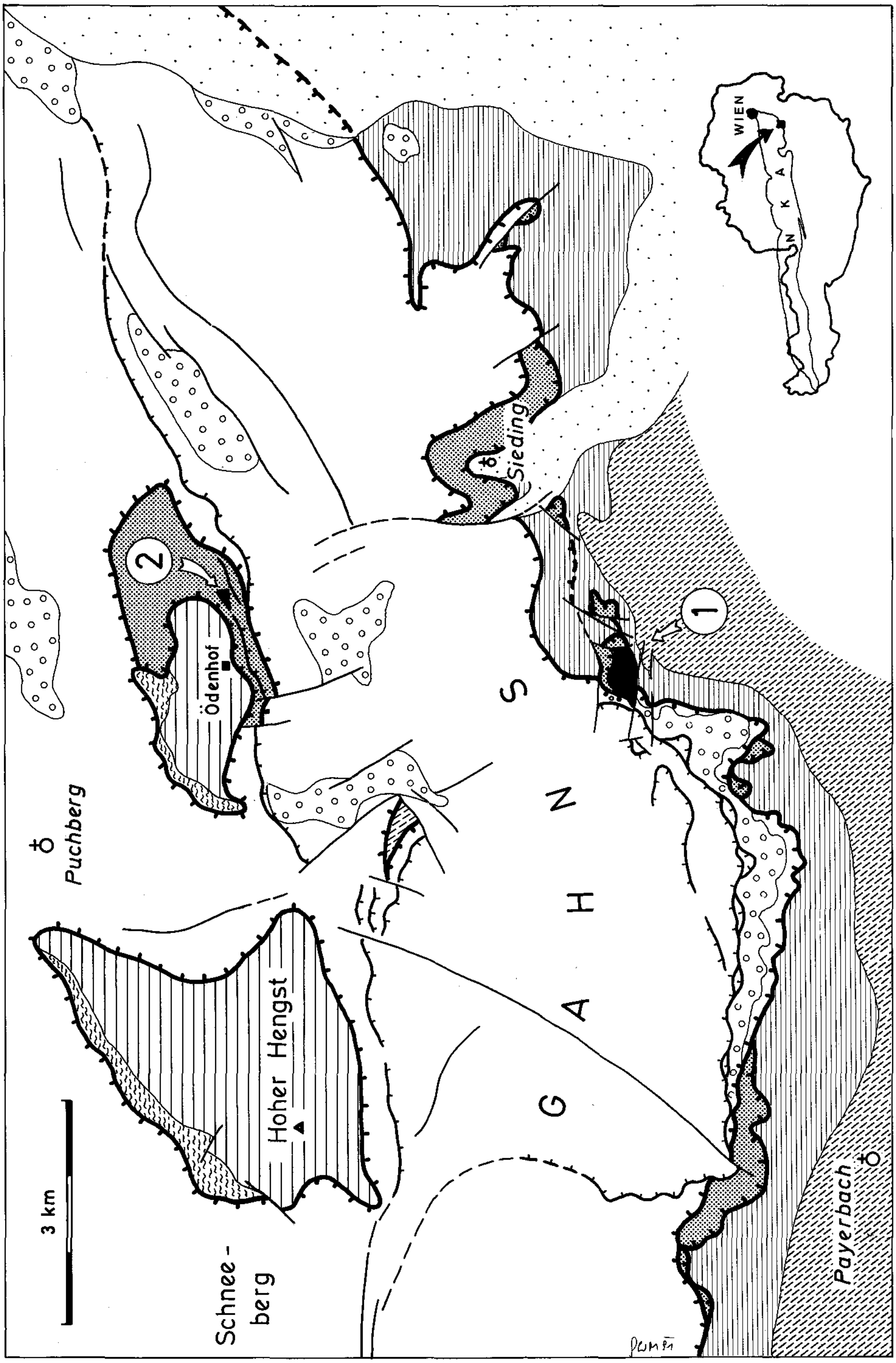


Fig. 193: Lithological sequence of Geyerstein slices (Juvavicum; G.W. MANDL).
Location of numbered sections see Fig. 192.


3 km
Schnee-
berg
Hoher Hengst
Puchberg
Ödenhof
2
G A H N S
1
Sieding
Payerbach
WIEN
N K A

STOP No. 5/4 (G.W. MANDL)

LOCATION: Florianikogel (Fig. 194).
TECTONIC UNIT: Calcareous Alps, Meliaticum.
FORMATION: "Floriani Olistolite Group".
AGE: Triassic olistolites in Jurassic matrix.

Recently two occurrences of radiolarite and associated carbonates have been proved to be of Middle Triassic age (MANDL & ONDREJIČKOVA, 1991; KOZUR & MOSTLER, 1991/92). This was the first proof of Triassic deepwater facies in the Eastern Alps, comparable with the Meliaticum of Western Carpathians.

Contrary to the first interpretation as a stratigraphic sequence (Fig. 195) of Anisian limestone, Ladinian radiolarite and Upper Triassic shales with local olistolites KOZUR & MOSTLER have shown a Jurassic age of the black and the greenish cherty shales by means of rich radiolarian faunas. Therefore all Triassic rocks are olistolites from centimeter size up to several meters.

The sequence is tectonically embedded between Permian Prebichl conglomerates of the Werning zone below and the Schneeberg Nappe above, having the same tectonical position as the Geyerstein slices (see Fig. 194). Anisian so called "Flaser limestone" and rauhwackes on the northern slope of Florianikogel may be part of the Schneeberg Nappe or Geyerstein slices, the latter interpretation is favoured in Fig. 194.

The contrast in Triassic facies between Geyerstein slices, Floriani Group and Schneeberg Nappe points at the significance of the overthrust plane between Werning zone and Schneeberg Nappe. It can not be interpreted as a local and secondary, post-Cretaceous backthrusting within a primary sedimentary succession.

Quaternary – Neogene of Vienna Basin
Gosau Group
JUVAVICUM: Schneeberg nappe; Geyerstein slices, pelagic facies of Ödenhof window
MELIATICUM: Exotic slices of Florianikogel (1) and Ödenhof (2)
TYROLICUM: Göller nappe: Allgäu Fm., Dachstein Fm.; Werning zone
Grauwacken zone

Fig. 194: Tectonical sketch of south-eastern Schneeberg area (G.W. MANDL & A. ONDREJIČKOVA, 1991).

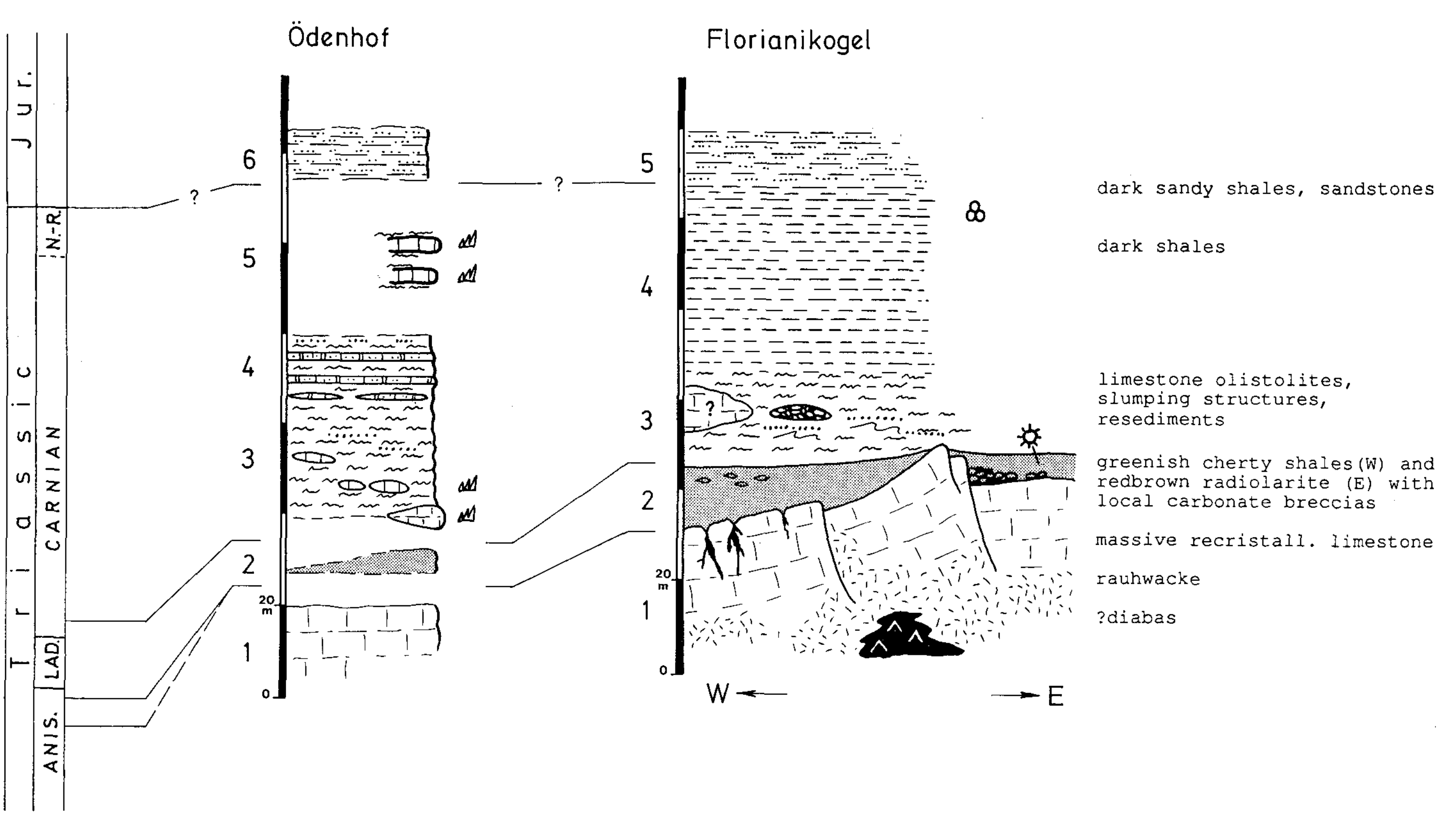


Fig. 195: Lithological sequence of Meliaticum in Northern Calcareous Alps (G.W. MANDL & A. ONDREJIČKOVA, 1991).
Due to current investigations of KOZUR & MOSTLER (in press) the greenish part of radiolarite (2) and the whole sequence of dark shales (4) are of Jurassic age – prooved by radiolarians. Therefore all Triassic rocks are large olistolite bodies in Jurassic matrix.

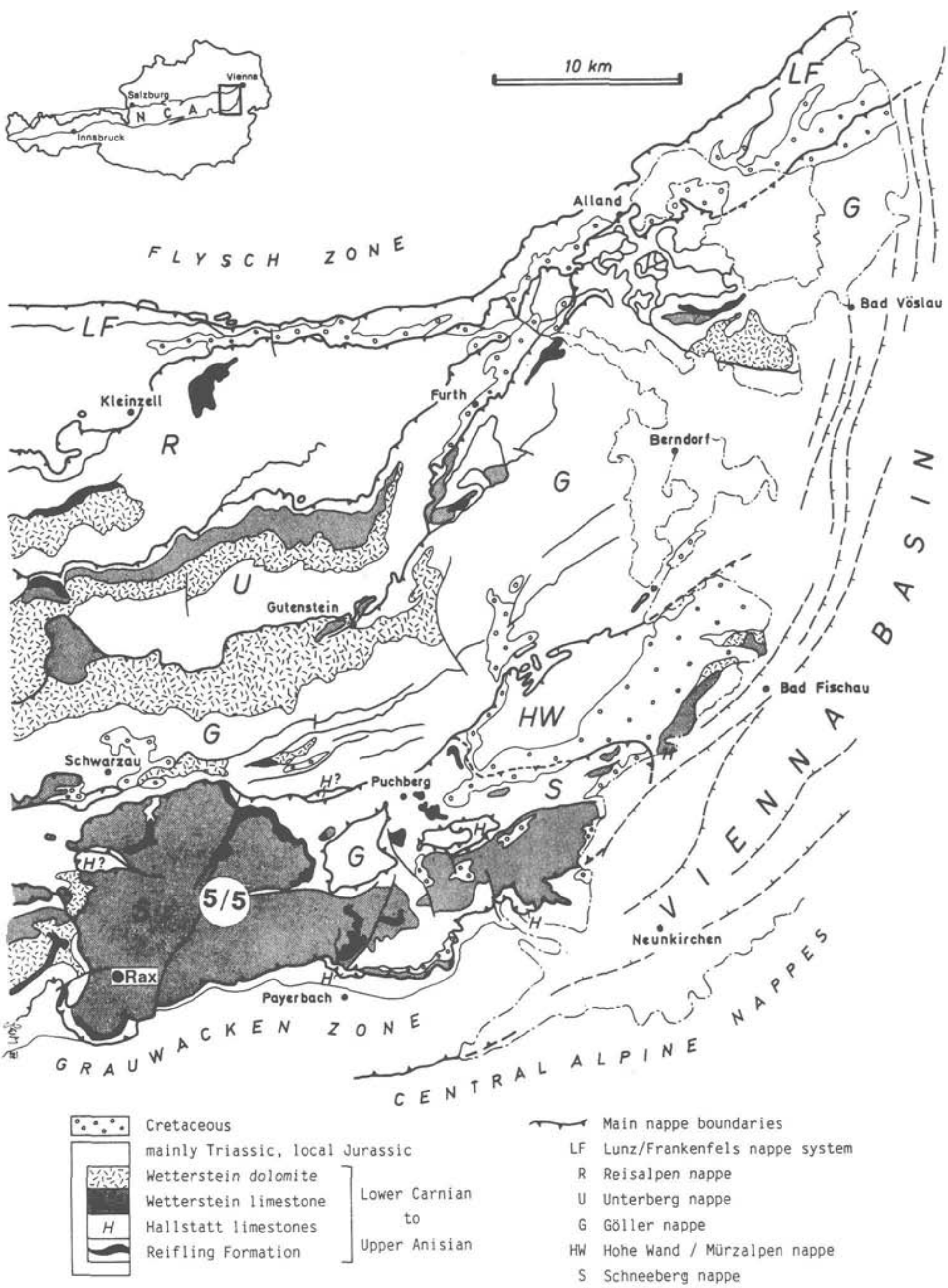


Fig. 196: Location map of Wetterstein carbonate platforms and coeval basin deposits in the eastern part of the Northern Calcareous Alps.
Compiled from AMPFERER & SPENGLER (1931), CORNELIUS (1936), BRIX & PLÖCHINGER (1982), TOLLMANN (1976b), WESSELY (1983), FUCHS & GRILL (1984) and own mapping (G.W. MANDL, 1983–1986, unpubl.).

STOP No. 5/5 (H. LOBITZER, G.W. MANDL)

LOCATION: Rax Mountain (Fig. 197).
TECTONIC UNIT: Calcareous Alps, Juvavicum, Schneeberg Nappe.
FORMATION: Wetterstein Limestone.
AGE: Middle Triassic to Lower Upper Triassic.

The Rax Mountain (Fig. 196), belongs to the Schneeberg Nappe which is the uppermost nappe in the eastern Calcareous Alps. To the south, the Schneeberg Nappe is underlain by north dipping Lower Calcareous Alpine elements, whose tectonic range is currently under discussion. They are connected with Greywacke Zone overthrusting Middle and Lower Austroalpine units (Fig. 196).

This massif forms the highest mountains of the eastern Calcareous Alpine section having elevations of over 2000 m. It also has the largest exposure of Wetterstein Limestone, as seen in the overview (Fig. 197).

Lower Middle Triassic formations appear along some parts of the tectonic boundary, surrounding the Ladinian Wetterstein Limestone massif of the Schneeberg Nappe. These are Gutenstein Limestone and -Dolomite and, to the east, also the Steinalm Limestone (Figs. 198, 199).

The Rax Plateau provides an excellent exposure of a prograding carbonate platform over slope sediments (LOBITZER, MANDL, MAZZULLO & MELLO, 1990). In the southwest, an extensive platform edge reef (the Heukuppe-Predigtstuhl reef complex) interfingers towards the south with upper slope limestones and towards the northeast with near-reef lagoonal sediments, which are in part peritidal limestones. The slope sediments are comprised of various allodapic limestones and variegated micrites. These often have pronounced deeper water biota, including ammonites, conodonts, "filaments" and radiolarians. The "reef-belt" stretches from the uppermost slope well into the platform. In the field the intensive cementation by radiaxial fibrous calcite, often of grossolithic character, is noticeable. Larger biota are scarce, the maximum being in the decimeter size range. A variety of calcisponges (inozoans and sphinctozoans), Tubiphytes and, to a lesser extent corals predominate. Brachiopods are the most important reef-dwellers. Small lenses of pinkish micritic limestone of Hallstatt-type, occasionally with "zebra"-neptunian dykes or stromatactis-shaped fabrics occur within the reef. They clearly indicate deeper-water biota and also contain stratigraphically valuable conodonts and foraminifera (LOBITZER, 1986; LOBITZER et al., 1988). Northward or to the northeast, the reef belt interfingers with grainstones or with birdseye limestones. Both contain the characteristic dasycladacean alga *Teutloporella herculea* and often abundant solenoporaceans and/or porostromate algae and sphinctozoans. Corals may also occur. Patchy dolomitization affects the reef as well as the lagoonal sediments. The stratigraphic and facies arrangement of the Middle Triassic and lowest Upper Triassic is illustrated by two schematic sections (Fig. 199).

Different sedimentary facies of the Middle Triassic depositional system in this area have been identified in detail: peritidal, lagoonal, reef and grossoolite facies. A depositional (Fig. 200) and diagenetic model has been reconstructed.

The main environments can be observed along the E–W lenght of the Rax Plateau. Zones of dolomitization and considerable karstification contain large water reserves important for supplying the city of Vienna with drinking water.

Fig. 197: The Rax ridge from south showing the route of excursion (Stop 5/4) from east (station of the cable car) to west (platform below Heukuppe).
In the foreground the soft terrain of the Greywacke Zone.

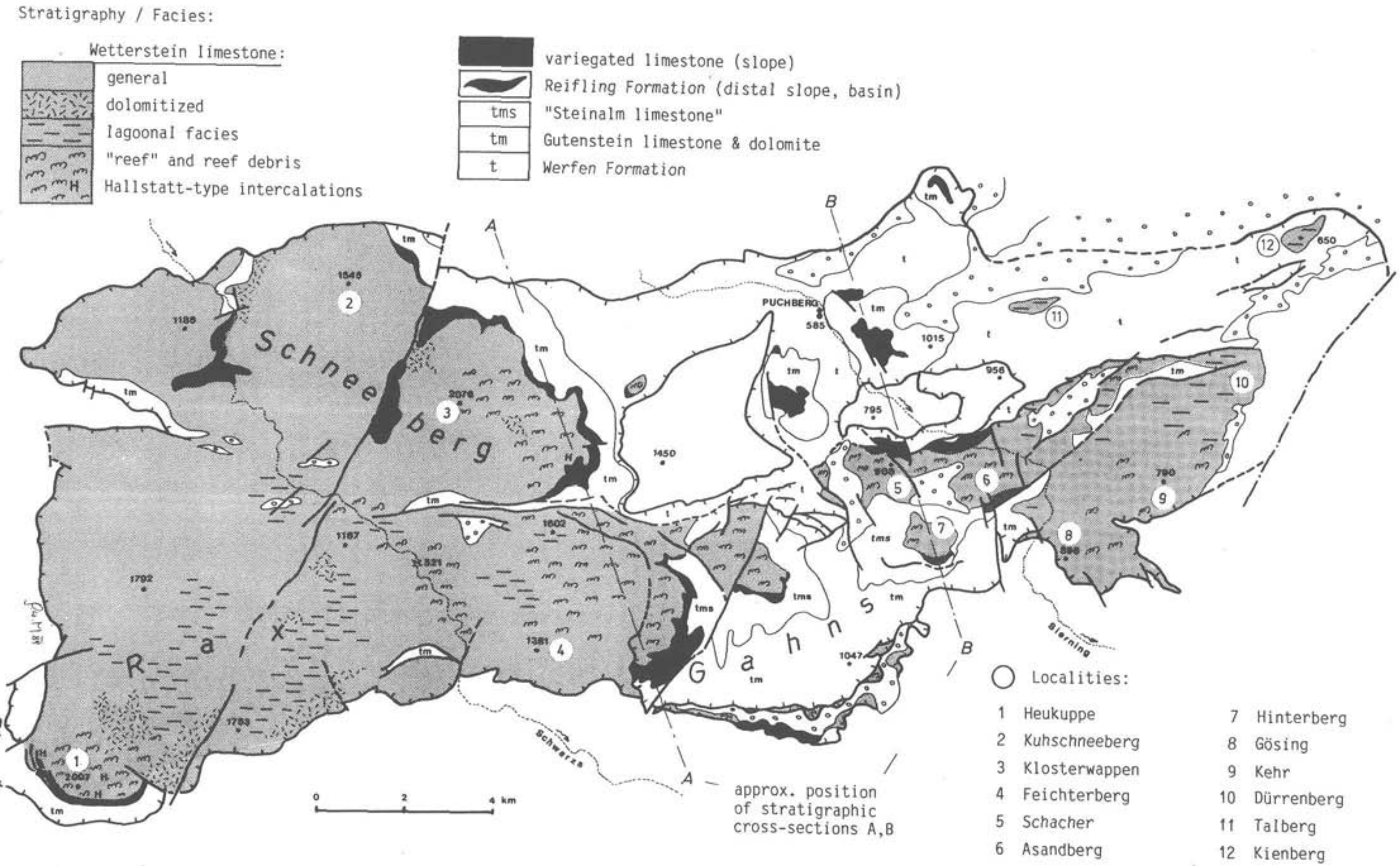
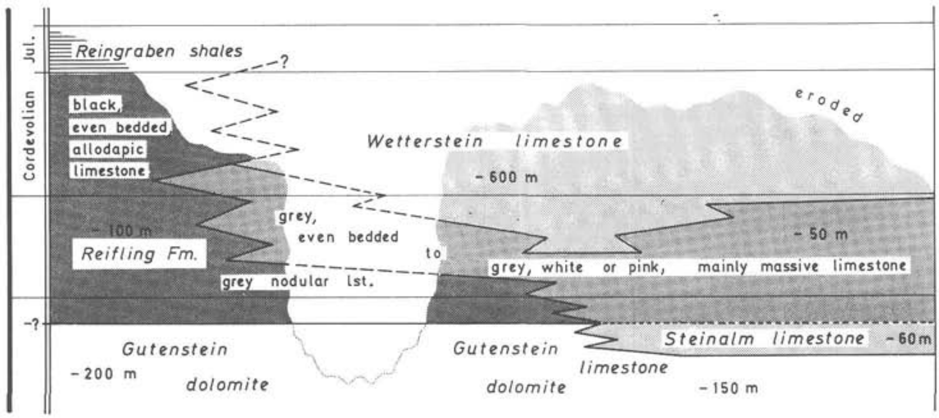


Fig. 198: Facies distribution within the Wetterstein limestone of Schneeberg nappe.
H. LOBITZER, G.W. MANDL, S. MAZULLO & J. MELLO (1990); compiled after CORNELIUS (1939, 1951), LOBITZER (1971–1988) and G.W. MANDL (1984–1987).

Section B



Section A

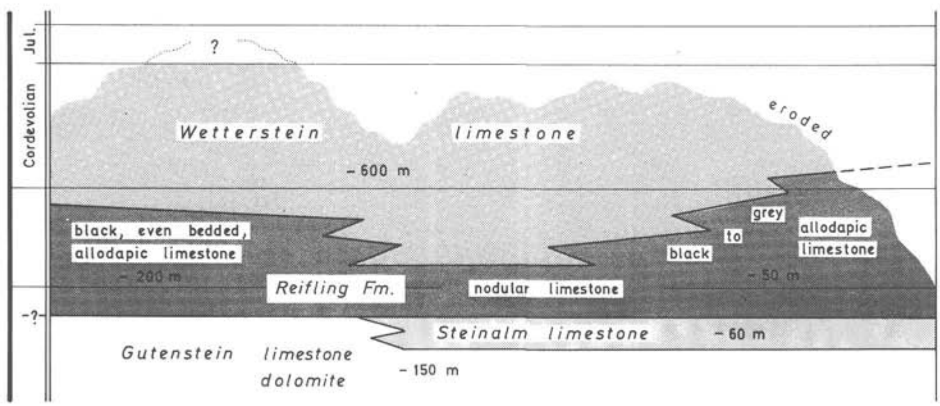


Fig. 199: Stratigraphic scheme (Anisian to Lower Carnian) of Schneeberg nappe.
Note lateral variability of platform to basin transition.
For location of cross section A, B see textfigure of facies distribution (H. LOBITZER, G.W. MANDL, S. MAZULLO & J. MELLO, 1990).

Remains of a Miocene river system "Augensteinschotter" indicate to the elevated position of the southern Calcareous Alps, relative to the Vienna Basin (H.P. CORNELIUS, 1936).

Descending the "Schlangenweg" from the Plateau south of the Heukuppe, the slope limestones can be seen. The base of the Calcareous Alps is passed and the route finishes in the Greywacke Zone at the Preiner Gscheid.

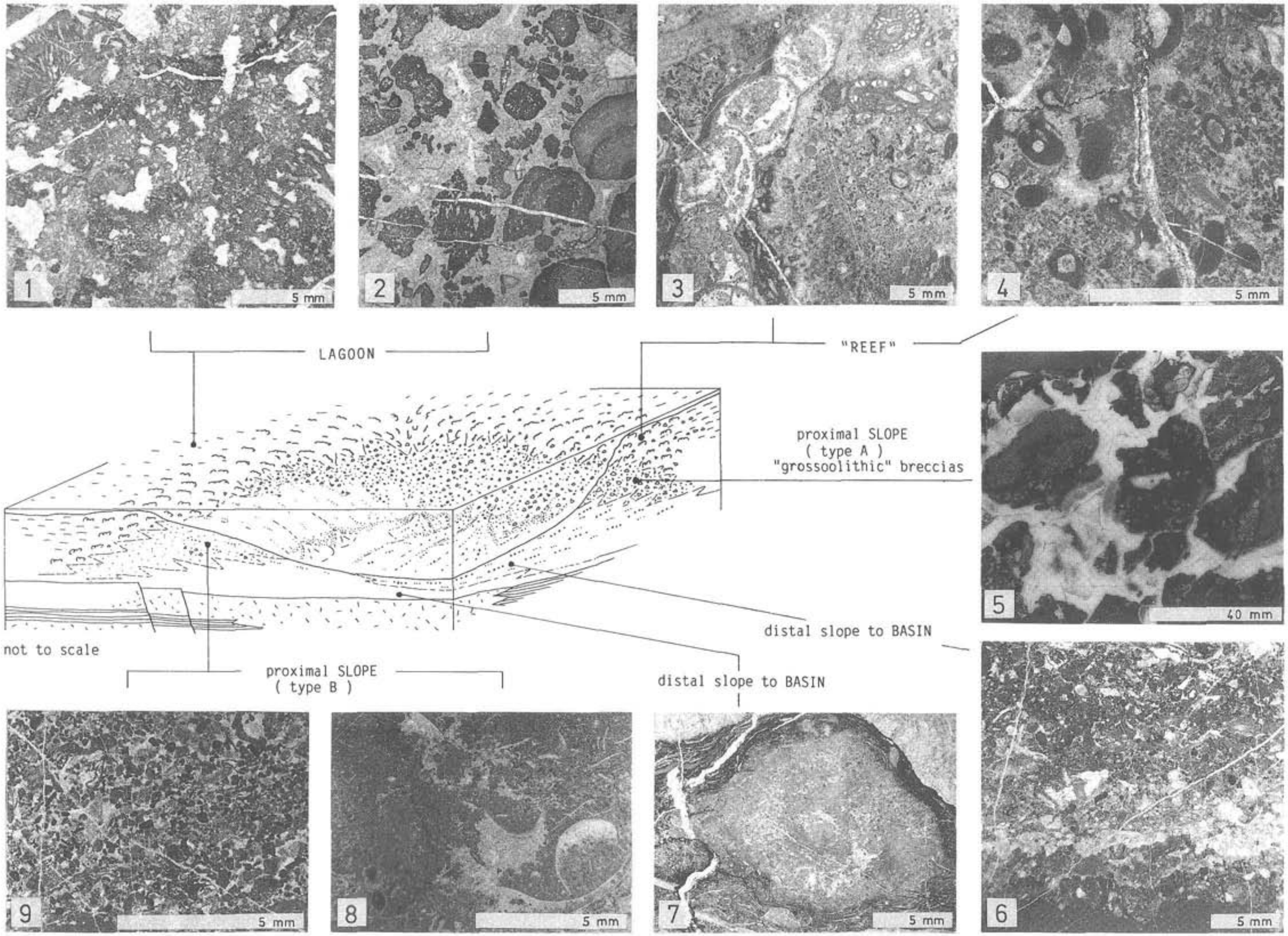

1
5 mm
2
5 mm
3
5 mm
4
5 mm
LAGOON
"REEF"
5
40 mm
proximal SLOPE
(type A)
"grossoolithic" breccias
distal slope to BASIN
6
5 mm
not to scale
proximal SLOPE
(type B)
distal slope to BASIN
9
5 mm
8
5 mm
7
5 mm

Fig. 200: Deposition model of the Middle Triassic (H. LOBITZER, G. MANDL, S. MAZULLO & J. MELLO, 1990).

1) Near-reef lagoonal Wetterstein Limestone in birdseye facies with solenoporaceans.
   Between Friedrich-Haller-Haus and Feichterberg.
2) Lagoonal Wetterstein Limestone with abundant solenoporaceans.
   South of Haslitz-Adriganbauer.
3) Wetterstein Limestone in reef facies with sphinctozoan sponges, "tubes in the reef debris" sensu OTT. Strong biogenic encrustation.
   Schacherberg.
4) Wetterstein Limestone in reef facies with abundant *Tubiphytes obscurus*.
   Asandberg, top plateau.
5) Großoolite facies of Wetterstein Limestone. Clasts (dark) composed of marine-cemented calcispongal reef lithology.
   Schneeberg plateau.
6) Grafensteig Limestone: graded allodapic intercalations of platform-derived debris within black micritic basinal limestone.
   Himberg.
7) Reifling Limestone. Light grey nodular limestone of pelmicritic composition, abundant filaments and sparse platform debris (*Tubiiphytes*).
   Himberg.
8) Variegated limestone, arenitic layer of platform debris.
   Himberg.