The Borinka limestone (redefined lithostratigraphic unit) is characterized by dark-grey thick-layered clastic, prevailingly organoclastic limestone, which is found in the Propadlé valley (village Borinka). The Middle Liassic age of the Borinka limestone is proved by macrofauna. Lamellibranchs were found in dark-grey organoclastic limestones in the Propadlé valley — cut of the road to the cottage Košariská (Kochanová M. in Maheľ M., 1962). Brachiopods were investigated from the outcrop west of the rock below the Borinka castle (Pevný J. in Maheľ M., 1962). Belemnites determined by Činčurová M. (in Maheľ M., 1962) come from the locality mentioned.

In the area of the village Devín the Borinka limestone occurs in the upper part of the Devín castle rock and at the abandoned quarry at the western slope of Devínska Kobyla. Fragments of ammonites from the group Arietitidae are mentioned from the locality Devínska Kobyla by Mišík M. (1986).

The Borinka limestone in the Hainsburg Mts. is found in joint fillings of dolomitic limestones with brecciated texture. At the outcrop west of Braunsberg in joints of Middle Triassic brecciated dolomitic limestones belemnites are found (figs. 1,2).

It results from the mentioned that the masses of grey limestones, dolomitic limestones and brecciated limestones in the Hainburg Mts. are of Middle Triassic age. They are identical with the Middle Triassic limestones, dolomitic limestones with quartz spherolithes and brecciated limestones in borehole 70 A in the Propadlé valley and at outcrops at the S slope of Devínska Kobyla, which form the underlier of the Borinka limestone. The Borinka limestone has greatest thickness in the Propadlé valley (about 200 m) and in southern direction its thickness diminishes. At outcrops in the village Devín it attains thickness of about 60 m, in the Hainburg Mts. it is found in form of relicts in joint filling.

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Abstrakt

Borinský vápenec, redefinovaná litostratigrafická jednotka liasového veku, vystupuje na JZ a J svahoch pohoria Malé Karpaty, kde predstavuje charakteristický litologický člen tatrickej jednotky pohoria Malé Karpaty.

Najväčšieho plošného rozšírenia dosahujú borinské vápence v oblasti obce Borinka (dolina Propadlé). Južnejším smerom borinský vápenec sa vyskytuje v oblasti obce Devín (J a JZ svah k. Devínska Kobyla), kde má menšie plošné rozšírenie.

Západný svah Hainburských vrchov je budovaný prevažne tmavosivými dolomitovými vápencami brekciovitej štruktúry a dolomitami. Totožné horniny sú v oblasti obce Borinka a Devín, kde tvoria podložie borinského vápenca.

Borinský vápenec (detritický a organodetritický vápenec) sa v Hainburských vrchoch (pravdepodobne v dôsledku erózie) vyskytuje vo výplni puklín strednotriasových dolomitových vápencov brekciovitej štruktúry. Liasový vek je potvrdený výskytom belemnitov. V odkryve Z od kóty Braunsberg, vo výplni puklín tvorenej organodetritickými vápencami, sa vyskytujú úlomky belemnitov a krinoidové články.

Zusammenfassung

Der Borinka-Kalk, eine redefinierte lithostratigraphische Einheit liassischen Alters, tritt an den SW- und S-Hängen des Gebirges der Kleinen Karpaten auf, wo er ein charakteristisches lithologisches Glied der tatrischen Einheit darstellt.

Die größte flächenmäßige Verbreitung erreicht der Borinka-Kalk im Raume der Ortschaft Borinka (Propadlé-Tal). In südlicher Richtung kommt der Borinka-Kalk im Raume der Ortschaft Devín (S- und SW-Hang der K. Devínska Kobyla) vor, wo er von geringerer flächenmäßiger Ausdehnung ist.

Der Westhang der Hainburger Berge ist überwiegend von dunkelgrauen dolomitischen Kalken von brekzienartiger Struktur und Dolomiten aufgebaut. Dieselben Gesteine sind im Gebiete der Ortschaften Borinka und Devín, wo sie das Liegende des Borinka-Kalkes bilden.

Der Borinka-Kalk (ein detritischer und organodetritischer Kalk) kommt in den Hainburger Bergen (wahrscheinlich infolge der Erosion) in der Spaltenfüllung von mitteltriassischen dolomitischen Kalken brekzienartiger Struktur vor. Das liassische Alter is durch Vorkommen von Belemniten bestätigt. Im Aufschluß W der K. Braunsberg, in einer von organodetritischen Kalken gebildeten Spaltenfüllung, kommen Bruchstükke von Belemniten und Krinoidenstielglieder vor.

"TISOVEC LIMESTONE" — AN EXAMPLE OF THE PROBLEMS OF LITHOSTRATIGRAPHIC CORRELATION BETWEEN THE NORTHERN CALCAREOUS ALPS AND THE CENTRAL WEST CARPATHIANS

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1. Introduction

The unification of stratigraphic nomenclature is an important prerequisite for the coordination of geological events on an international scale. This is especially true for the Alps and the Carpathians. The similarities in facies and geodynamic development have been hidden by a mass of local names. Thus our joint goal must be to work out the similarities and differences in stratigraphy and lithofacies of this large area. This is only possible using an accepted and convenient stratigraphic nomenclature. One of the prerequisites for such a venture is the detailed review of the current lithostratigraphic terminology. The following new investigation of the Tisovec Limestone in its type locality is to be seen in this respect. This unit was set up in the central West Carpathians and used later in the Calcareous Alps. It seems, however, that this term has been used in a different sense in both regions. One part of the problem is the different use of the term „Dachstein Limestone" in both regions. In the West Carpathians this term has been used primarily for the Upper Norian — Rhaetian lagoonal facies of the Dachstein Formation.

2. Historical outline: the installation of the term "Tisovec Limestone" in the Central West Carpathians

The existence of unnamed light-grey massive limestones of Upper Triassic age in the southernmost zones of the Western Carpathians was known for a long period (STÜRZENBAUM 1879, UHLIG 1903, ZOUBEK 1932, and others; compare review in ANRUSOV 1959). It was supposed that parts of these limestones were Carnian in age, what was

confirmed (or ought to be confirmed) by fossils in numerous localities (Slovakian karst: BALOGH 1940, 1948, BALOGH & PANTO 1953, ANDRUSOV & KOVACIK 1955, BYSTRICKY 1955, 1957, 1960; Stratenská hornatina Mts.: MAHEL 1957; Murán Plateau: POUBA 1951, KOLLAROVA-ANDRUSOVOVA 1959). However, localities with occurrence of Norian fossils were even more abundant. BYSTRICKY and KOLLAROVA-ANDRUSOVOVA (in: KOLLAROVA-ANDRUSOVOVÁ 1960: p. 106) decided to name the Carnian part of the grey, massive, biogenic limestones with scattered corals, bivalves, and "Grossoolithes" of the Murán Plateau as the Tisovec Limestone; the Norian part was designated as the Furmanec Limestone. These limestones were described before by POUBA (1951) and BYSTRICKY (1959). POUBA attributed them Carnian and partly Norian age.

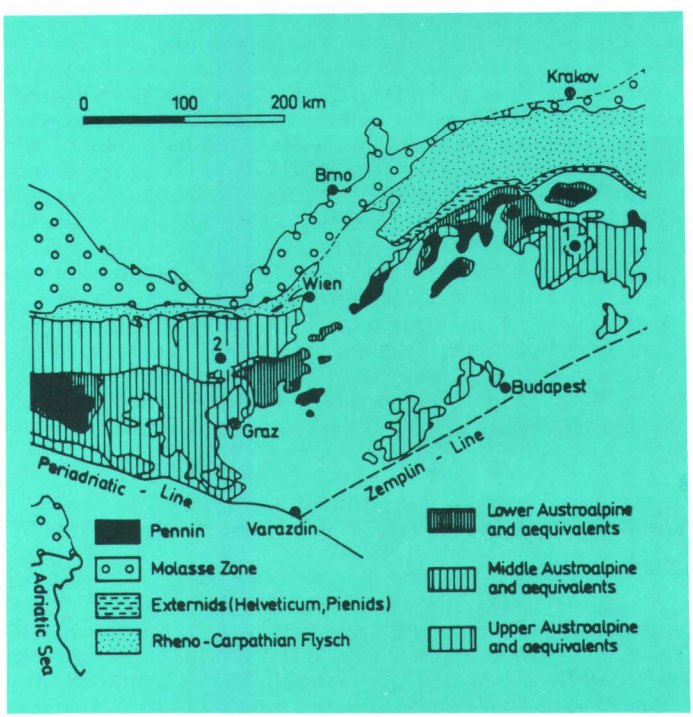
In spite of this delimitation and definition there was no reliable possibility to distinguish Tisovec Limestone from Furmanec Limestone during geological mapping. This was the reason for using the term Tisovec-Furmanec Limestone for light-grey massive limestones by mapping geologists on the Murán Plateau (mainly by BIELY 1960—1965 unpubl. rep., and later). Overlying bedded limestones were designated as Dachstein Limestone.

Later on BYSTRICKY (1965: p. 33, 1972, 1982), BYSTRICKY & BIELY (1966) and others used the term Tisovec Limestone for all bright limestones which resemble Wetterstein Limestone but Carnian in age (Slovakian karst, Stratenská hornatina Mts., Strázovské vrchy Mts., etc.; compare BYSTRICKY 1985: p. 270).

2.1. Problems of the "Tisovec Limestone": limits and dating in the past

The separation of a Carnian part of the bright massive limestones brought forth some troubles especially in the past. ROTH (1939), BALOGH (1940, 1948, 1950, 1953), and HOMOLA (1951) attributed those — not very precisely defined — parts of these bright limestones to Carnian age which are unfossiliferous and are overlain by presumed Norian limestones with *Gyroporella vesiculifera* GÜMBEL. HOMOLA (1951) even supposed a hidden disconformity between the Ladinian and the upper part of the Upper Triassic. This presumption was based on the occurrence of an endostratic breccia in Gombasek quarry which he interpreted as "regressive sediment". (Today we know that in Gombasek quarry only Wetterstein reef limestones are present).

Fig. 1: Tectonic sketch map (according to Tollmann 1969) with the position of the studied area of the "Tisovec Limestone": 1) Tisovec quarry (Muran plateau), 2) Kl. Waxeneck (Mürztal Region).



The problems of a lithostratigraphic subdivision of Upper Triassic massive limestones in the Stratenská hornatina Mts. and the separation of its Carnian part (Tisovec Limestone) are discussed in detail by BYSTRICKY et al. (1982).

The Carnian age of the Tisovec Limestone on the Murán Plateau, including the type locality in the Tisovec quarry, was established by means of ammonites from the Tisovec quarry (*Anatomites* cf. *fischeri* MOJS., *Megaphyllites jarbas* (MUENST.), *M. jarbas jarbasides* KUEHN, *Placites placodes* (MOJS.) and from Dedov vrch hill (*Placites placodes* MOJS., *Megaphyllites jarbas* (MUENST.), *Sirenites* cf. *senticosus* (DITTMAR)) (e.g., KOLLAROVA-ANDRUSOVOVA 1959: p. 92, 1960, 1961, 1962, 1967, BYSTRICKY & BIELY 1966, BYSTRICKY 1973, KOLLAROVA-ANDRUSOVOVA & BYSTRICKY 1974).

However, the ammonite community from these two localities — originally considered as being Julian in age — became "younger" step by step:

- Upper Julian: Ellipticus-zone (BYSTRICKY & BIELY 1966: p. 42).
- Tuvalian (BYSTRICKY 1973: p. 72).
- Middle Tuvalian: Subbulatus-zone (KOLLAROVA-ANDRUSOVOVÁ & BYSTRICKY 1974: p. 132).
- Uppermost Tuvalian (KRYSTYN 1983: p. 262, BYSTRICKY 1986: p. 313). KRYSTYN (1974: p. 50) expressed some doubts about the stratigraphic position of the ammonite fauna from the Tisovec quarry. He took the occurrence of *Placites* for the base of the Norian stage. Later (KRYSTYN 1983: p. 262) he reported *Placites placodes* from the "Uppermost Tuvalian". This view was accepted by BYSTRICKY (1986: p. 313). He additionally has taken this locality as upper boundary of the taxon range zone of *Andrusoporella duplicata* (op. cit.: p. 312). Nevertheless, *A. duplicata* occurs very frequently in the Tisovec as well as the Furmanec Limestone (Tuvalian — Alaunian, sensu BYSTRICKY loc. cit.) of the Murán Plateau. It also occurs in the Tisovec quarry (BYSTRICKY 1986: fig. 3).

  Among conodonts only Norian forms were reported from the Murán Plateau (MOCK 1971).

3. "Tisovec Limestone" in the Northern Calcareous Alps

LEIN (1972: p. 30—32) was the first to use the term "Tisovec Limestone" in the Northern Calcareous Alps for Carnian dasycladacean limestones followed by TOLLMANN (1972: p. 195). Before, these limestones had been included within the Dachstein Formation. The detailed description in the standard work "Analyse des klassischen Mesozoikums" (TOLLMANN 1976: p. 166—169) led to the factual establishment of the term Tisovec Limestone in the Northern Calcareous Alps.

The main occurrence of Upper Carnian dasycladacean limestones named Tisovec Limestone is concentrated to the southeastern part of the Northern Calcareous Alps within the Mürzalpen region (Styria, Fig. 1). Further occurrences have been reported from Carinthia in the area of the Krappfeld and the Mountains of St. Paul (GRUBER et al. 1980). The Triassic sequence of the Carinthian localities belongs to the tectonic unit of the Upper-Austroalpine Gurktal Nappe.

The North-Alpine Tisovec Limestone exhibits its characteristic development in the Mürzalpen Nappe where it is very well exposed in the Waxeneck Plateau (NE of Mürzsteg, Styria). Because these limestones represent shallow water facies, stratigraphically important fossils, such as ammonites and conodonts, which would be necessary for exact dating, are not present. Therefore, according to VEGH-NEUBRANDT et al. (1986) only a general Carnian age can be assigned to these beds by the occurrence of the

megalodontid bivalve *Cornucardia hornigii* (BITTNER) described by LEIN & ZAPFE (1971) and ZAPFE (1972). This is also true for the mass occurrence of the calcareous alga *Poikiloporella duplicata* (PIA)[1], which is mentioned as Carnian guide by OTT (1972) and BYSTRICKY (1986).

A stratigraphically clearly defined upper boundary of the "Tisovec Limestone" in the Mürztal Alps is given by the overlying Hallstatt Limestone containing Lower Norian conodonts. More difficult is the stratigraphic fixation of the lower boundary. In this case only lithologic comparisons in term of sequence stratigraphy can be made. The data collected up till now from the platform-basin transition zones of the south of the Northern Calcareous Alps suggest that the installation of the new carbonate platform above the terrigenic interval of the Raibl Beds s. l. occurs at the Julian/Tuvalian boundary.

The exact stratigraphic position of the "Tisovec Limestone" in Carinthia is not fully explained, due to considerable tectonic complications. Here time equivalent reef- and fore-reef limestones occur next to lagoonal dasycladacean limestones with *Poikiloporella duplicata* (PIA) (GRUBER et al. 1980, DULLO & LEIN 1982). Following the data, the conodont bearing fore-reef sediments of Lower Carnian age can, at least partially, be assigned to the Wetterstein Limestone. Another till now not well dated part of these limestones may be Upper Carnian in age. In conclusion it must be stated that those rocks of the Northern Calcareous Alps designated as "Tisovec Limestone" are clearly of **Carnian** age. This is in contrast to the now proven Lower to Middle Norian age range of the type locality in Tisovec (see chapter 4.2.). It is thus necessary to establish a new formation name for the Upper Carnian dasycladacean limestones of the Upper-Austroalpine, which obviously differ from the type locality of the Tisovec Limestone in age as well as in facies. The name **Waxeneck Limestone** is proposed for the above mentioned lightly colored Carnian shallow water carbonates with calcareous algae and frame-building organisms in the area of the Waxeneck-Schönhaltereck-Plateau (Schwarzkogel, Jausenstein, Donnerswand, Kl. Waxeneck; LEIN & ZAPFE 1971: Fig. 2). The profile in the region of the Kl. Waxeneck (Fig. 2) is designated as type locality because of its completeness and good exposure. The Waxeneck Limestone at the type locality is lithostratigraphically clearly separated from the underlying terrigenous influenced limestones/marls of the Leckkogel Beds, as well as from the micritic Hallstatt Limestones above.

A lithostratigraphic separation may be difficult in the case of a "continuous" shallow water carbonate development from the Ladinian up to the Norian. However, when the lithostratigraphic marker ("Lunz event") is missing the boundary to the underlying Wetterstein Limestone is often marked by an emersion horizon (e.g., profile Bärenlochgraben, E Schönhaltereck; LEIN 1972: Fig. 6). The boundary to the overlying Dachstein Limestone exhibits commonly a facial change.

At the type locality, the light coloured, thick bedded Waxeneck Limestone consists mainly of well washed dasycladacean grainstones. The bio- and intraclasts often show oncolithic incrustation. Interbedded are scattered layers of ooliths and beds with megalodontid bivalves. Very rare are coral fragments. The lithological affinities of this facies to some parts of the Wetterstein Limestone are evident.

In the upper part of the type locality sedimentation was more quiet, because instead of the coarse biosparites of the lower part biopelsparites and -micrites containing coquinas of thinly shelled bivalves (filaments) dominate.

The following microfacies types could be identified in the type locality of the Waxeneck Limestone:
a) Algal-foraminiferal Detritus Facies (partly with clasts of frame-building organisms),
b) Oncoid Facies (with up to 5 cm large *Girvanella*-oncoids),
c) Grapestone Facies

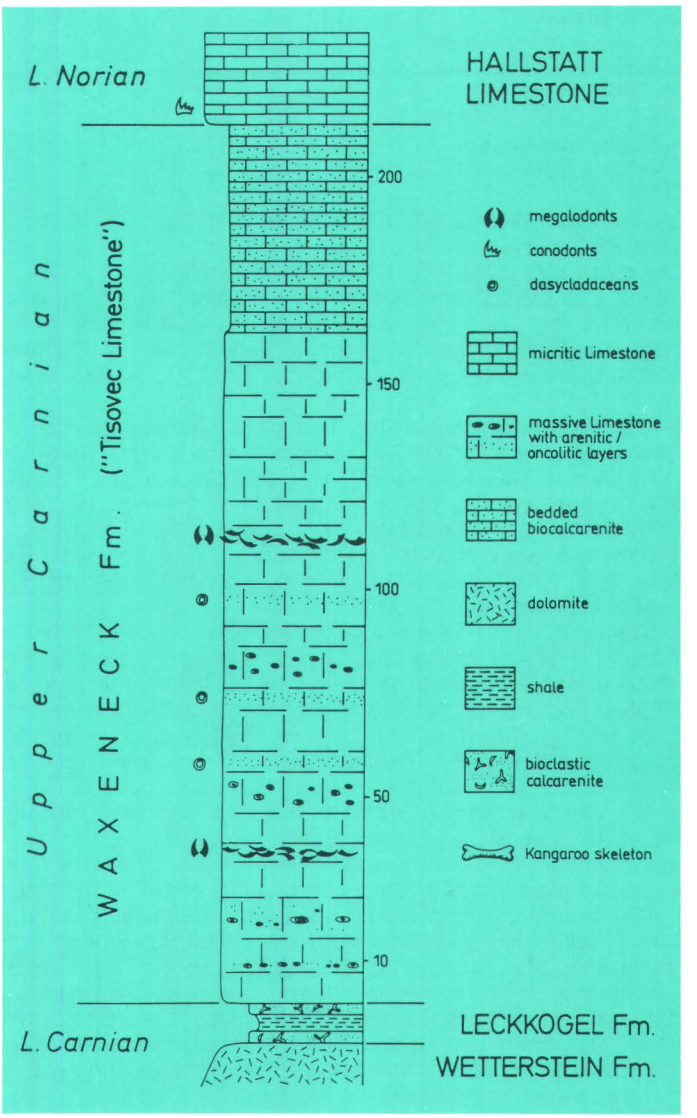


Fig. 2: Type section of the Waxeneck Limestone. The range of lithology of the limestone in its type locality is clearly seen. The rocks occurring below and above show clear differences in their facies.

d) Grapestone Facies with fixed sediment (representing a bindstone, probably built by subtidal microbial mats).

Following this microfacial spectrum the depositional environment of the Waxeneck Limestone can be reconstructed as open platform with a bathymetric range from dominating shallow subtidal to depths of a maximum of a few tens of metres.

The macrofauna of the Waxeneck Limestone consists on the one hand of frame-building organisms dominated by calcisponges (not yet investigated), on the other hand of megalodontid bivalves *(Cornucardia hornigii* (BITTNER), *Megalodus* cf. *triqueter* (WULF.)) and gastropods *(Omphaloptychia* cf. *rosthorni* (HOERNES), *Purpuroidea* aff. *excelsior* (KOKEN)).
The dasycladacean flora contains *Poikiloporella duplicata* (PIA), *Teutloporella herculea* (STOPP.), and *Clypeina besici* (PANTIC).
In the type section (Fig. 2) the following foraminifera were identified:
Glomospirella sp.
"Pilaminella" falsofriedli SALAJ, BORZA & SAMUEL
Agathammina austroalpina TOLLMANN & KRISTAN-TOLLMANN
Agathammina cf. *iranica* ZANINETTI, BRÖNNIMANN, BOZORGNIA & HUBER

Reophax sp.
Spiroplectammina sp.
Trochammina sp.
Endothyra sp.
various Duostominidae gen. et spec. indet.
Ophthalmidium sp.
Quinqueloculina sp.
"Sigmoilina" sp.
Aulotortus friedli (KRISTAN-TOLLMANN)
Aulotortus sinuosus (WEYNSCHENK)
Aulotortus tumidus (KRISTAN-TOLLMANN)
various Lagenina *(Nodosaria, Frondicularia, Lenticulina)*

4. New investigation of the type locality of the Tisovec Limestone and its surroundings

The summary concerning stratigraphy and tectonics of the surroundings of Tisovec is given by the map of the Murán plateau of KLINEC (1976). The data base of the Triassic part of this map largely originated from the work of BYSTRICKY. In this map the Tisovec and the Furmanec Limestones are combined in one signature. This is due to the fact that up till now a differentiation of these formations was not possible.

Compiling data from the surroundings (BYSTRICKY 1959, KLINEC 1976), it seems that a thinly developed terrigenous Carnian sequence is present in the Murán region (e.g., in Tisovec, at the northeastern flanks of Hradova; in the region of Ciganka; south of Cervena Skala), but mostly tectonically suppressed. The presence of such a terrigenous Lower Carnian horizon can also be assumed by facial analogies with the Northern Calcareous Alps (northern Juvavicum: Dachstein region; southern rim of Tirolicum: Tennengebirge). In these regions the thickness of the terrigenous Carnian interval ranges between 20 and 150 metres.

The tectonically disturbed position of the base of the Upper Triassic carbonate rocks at the type locality is also suggested by the map of KLINEC (1976). Here the Tisovec Limestone is in anomalous contact with the Wetterstein Limestone in a northwestern as well as southeastern direction. The character of the tectonics responsible for this complication is not sufficiently shown in the existing maps. Further detailed stratigraphic investigations are thus necessary within the area.

4.1. Indications for the tectonic situation in the quarry

The tectonic complications of the quarry, as well as the short time studying and sampling the outcrop, determine the preliminary character of the following contribution. A continuation of these investigations is clearly necessary. Additionally, these studies have to be expanded in order to refine our knowledge of the composition and structure of the Murán Plateau. Only by using this knowledge can the considerable but until now underestimated tectonic deformation of this region be elucidated. Within the framework of our limited studies, only age and facies of selected parts of the quarry were investigated:

1) the southwest corner of the quarry on the lowermost platform (samples A 1350 — A 1353 and 14A 100—101),
2) the middle part of the quarry on the main platform (samples A 943 — A 945; 14A 1—7),
3) the eastern part of the quarry between the main platform and the two overlying floors (samples A 1355, A 1362; 14A 102—103).

In spite of the wide-spaced sampling the quarry could be subdivided into three parts of different age and/or into four different facies units (Fig. 4), which are separated from one another through faults or large exploratory gaps.

In 1960, when the term "Tisovec Limestone" was established, the outcrop situation in the quarry was quite different from today. Recently, at the western outermost margin we found a thin (5 m), indistinctly bedded — up to now undescribed — sequence of crinoidal limestones. By its conodont fauna (sample A 1353) with *Gondolella polygnathiformis* BUD. & STEF. and *G. nodosa* (HAYASHI) this sequence has to be placed into the Upper Carnian (Tuval 3). In 1960 this limestone was not exposed in the quarry (see Fig. 4).

This sequence is separated by a fault from the massive carbonate rocks — Lower to Middle Norian in age — of the main part of the quarry. Outside the quarry bright algal limestones are connected to this fault, which should be classified with the Wetterstein formation following the map of KLINEC (1976). The exact direction of this fault, which separates the marginal Wetterstein Limestone from the Carnian crinoidal limestone, is not fully understood up till now. On the other side of this fault, in the central area of the quarry, red colored carbonate rocks are exposed, which seem massive but are strongly fractured. The red color partly originates from the faults.

An additional very steep large fault crosses the quarry. This fault recognizable for the main part of the quarry causes the immediate contact of the rocks differing in facies and age (Fig. 4).

The Norian carbonate rocks in the quarry can be roughly subdivided into three clearly separated facies units:

1) On the lowermost platform, grainstones with abundant frame-building organisms are present. These are irregularly intercalated with strongly bioturbated, skeletal rich, partly colored wackestones, which represent slope deposits (samples A 1350 — A 1352). Basing on their conodont fauna they are Middle Norian in age.
2) Above, in the western part of the main platform of the quarry, follow bioclastic grainstones to rudstones with associations of frame-building organisms of typical Norian character (samples A 943 — A 945; 14A 1—7). The rocks of the slope facies grade into grainstones, and breccias of the fore-reef facies (sample 14A 100—101).
3) The rocks east of the main fault of the quarry are made up by peloidal grainstones. Inserted are isolated small patches of a Norian reef-fauna showing somewhat of a Carnian character (14A 103). In spite of some foraminifers, which seem to reflect a lagoonal environment, the occurrence of a — Lower Norian — conodont fauna point to a slope position.

Interpreting the different facies units in terms of a stratigraphic sequence is very difficult, because the bedding relationships are widely unclear. A clarification is needed, for example, whether the mega-bedding in the eastern part of the quarry at the uppermost platform and the similarly dipping parallel "fractures" at the main platform, dipping in a SE direction (150/30—45), represent a sedimentary bedding. Our first attempts to explain the bedding relationships with the help of geopetal structures were not successful. To answer these questions work will be continued on oriented samples.

4.2. Age and fauna of the Tisovec quarry

At present accurate dating of marine Triassic rocks is possible by using either ammonoids or conodonts. Both groups, though normally rare in shallow water deposits, are represented in Tisovec. Ammonites are well-known since the early sixties (KOLLAROVA-ANDRUSOVOVA 1959, 1960, 1962); conodonts, previously undescribed from the quarry, have recently been found by us. The fitting of the ammonoid and conodont ages should guarantee a well-established and precise dating of the rocks under study.

Ammonites

KOLLAROVA-ANDRUSOVOVA (1962) described ammonites from two localities at Tisovec. In the quarry itself she found *Anatomites* cf. *fischeri* MOJSISOVICS and *Megaphyllites jarbas jarbasides* KUEHN. Several specimens of *Placites placodes* MOJSISOVICS originate from above the quarry (op. cit.: p. 78). Concerning the last locality, however, there is some incertainty about its exact position, as

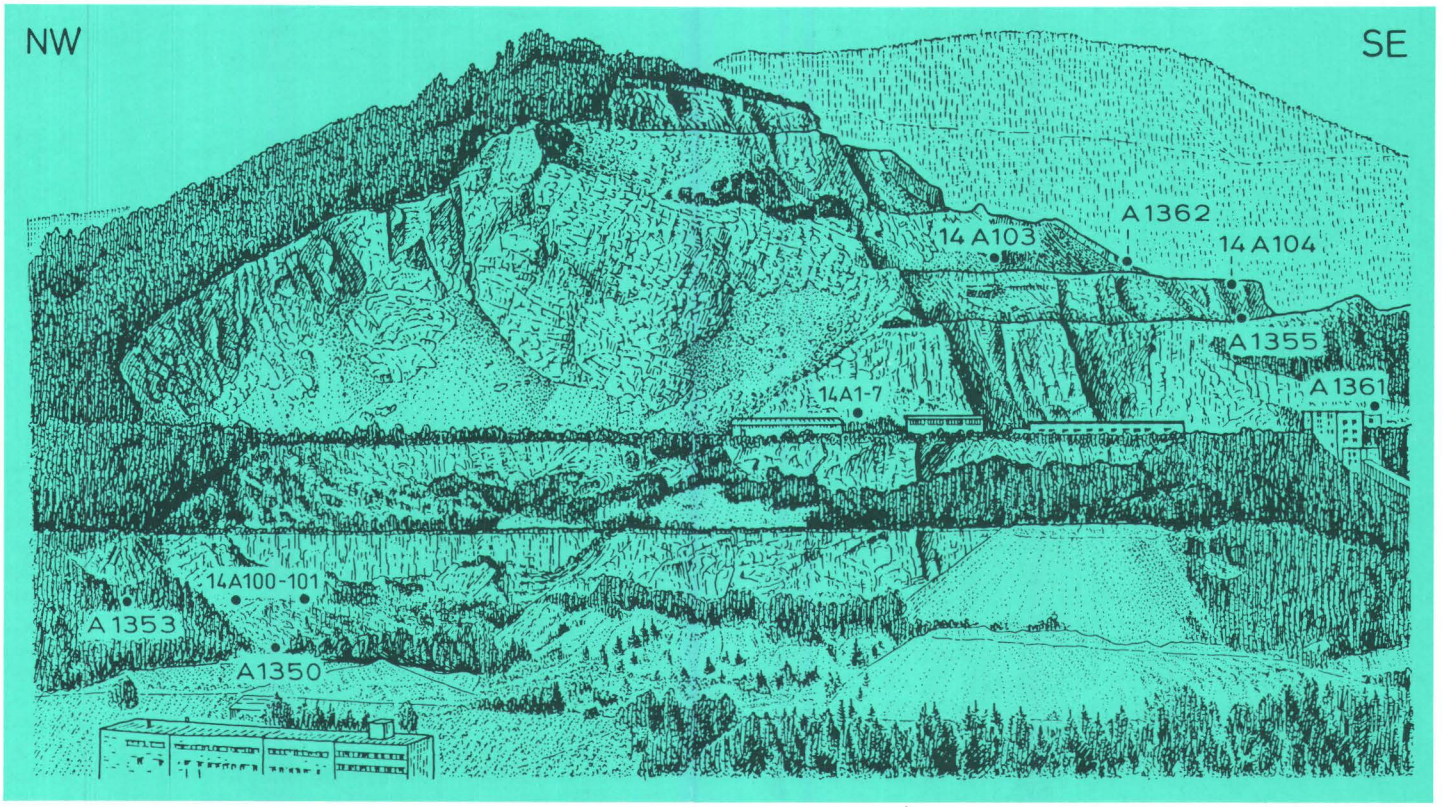
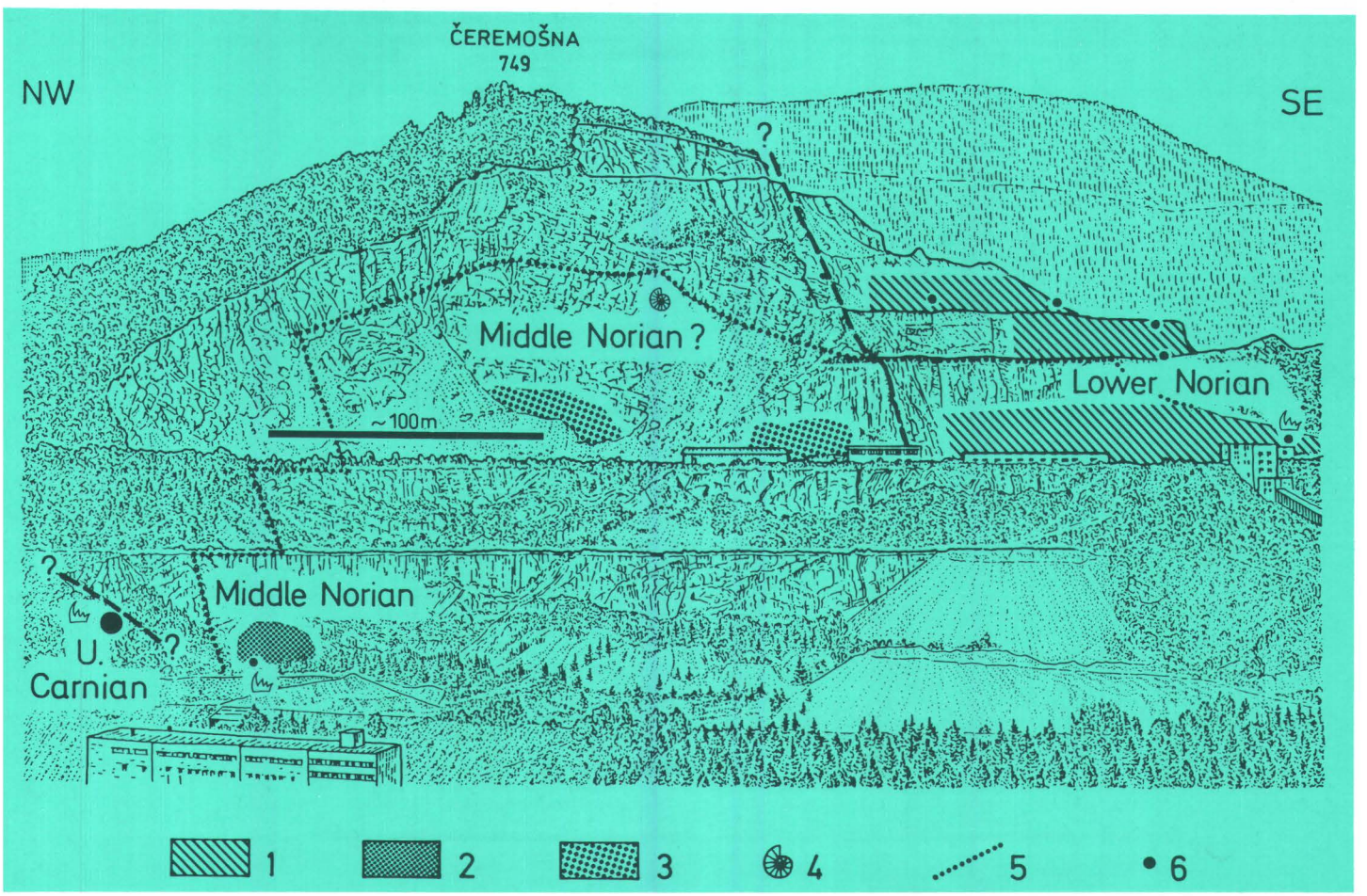


Fig. 3: View of the Tisovec quarry seen from the northeastern slope of Hradova hill with indication of the sample sites.

Fig. 4: Stratigraphy and preliminary facies distribution of the Tisovec quarry. 1) peloidal grainstones with isolated patches, 2) bioclastic grainstones with intercalated wackestones, 3) bioclastic grain- and rudstones, 4) ammonite site, 5) border of the quarry around 1960, 6) Crinoidal limestone (Tuval).



on p. 80 the same *Placites* specimens are labelled with "Tisovec quarry". According to Mrs. ANDRUSOVOVA (pers. comm.) the fossils have been collected by BYSTRICKY in 1959 and unfortunately no information is available on the original sampling sites. Since Triassic cephalopods are normally not common in fore-reef environments, we suggest a single rather than two localities for all the Tisovec ammonites and locate them with some uncertainty to the top of the quarry in its 1960 outline (see Fig. 4). Nevertheless, the opposite may also be possible in that the ammonites have been found in the lower part of the quarry near our samples A 1350 and A 1351 containing Middle Norian conodonts.

Because of the partly unsatisfying reproduction quality of the figures in KOLLAROVA-ANDRUSOVOVA (1962), a direct examination of the topotypes stored in the Slovakian Academy at Bratislava was inavoidable. This study led to serious changes in nomenclature which may be seen from different aspects. Taxonomic revision of Tethyan Upper Triassic ammonites is still at its beginning with only few new investigations (TATZREITER 1981, KRYSTYN 1982). Modern stratigraphic classification of the Upper Triassic started with TOZER (1965, 1967) for North America and was followed later in Europe (KRYSTYN 1973, 1980). KOLLAROVA-ANDRUSOVOVA published her paper long before basing her conclusions on the 80 years old monograph of MOJSISOVICS. This, however, includes a stratigraphic standard with extraordinary long or often missing ranges of most of the ammonite species. Thus relying on MOJSISOVICS (1873—1902), KOLLAROVA-ANDRUSOVOVA had no chance of avoiding the incorrect (Lower) Carnian age assignment to her Tisovec fauna. Another serious problem has to be seen in the relatively bad state of preservation of the material as well as in the small amount of specimens both making specific determinations rather difficult.

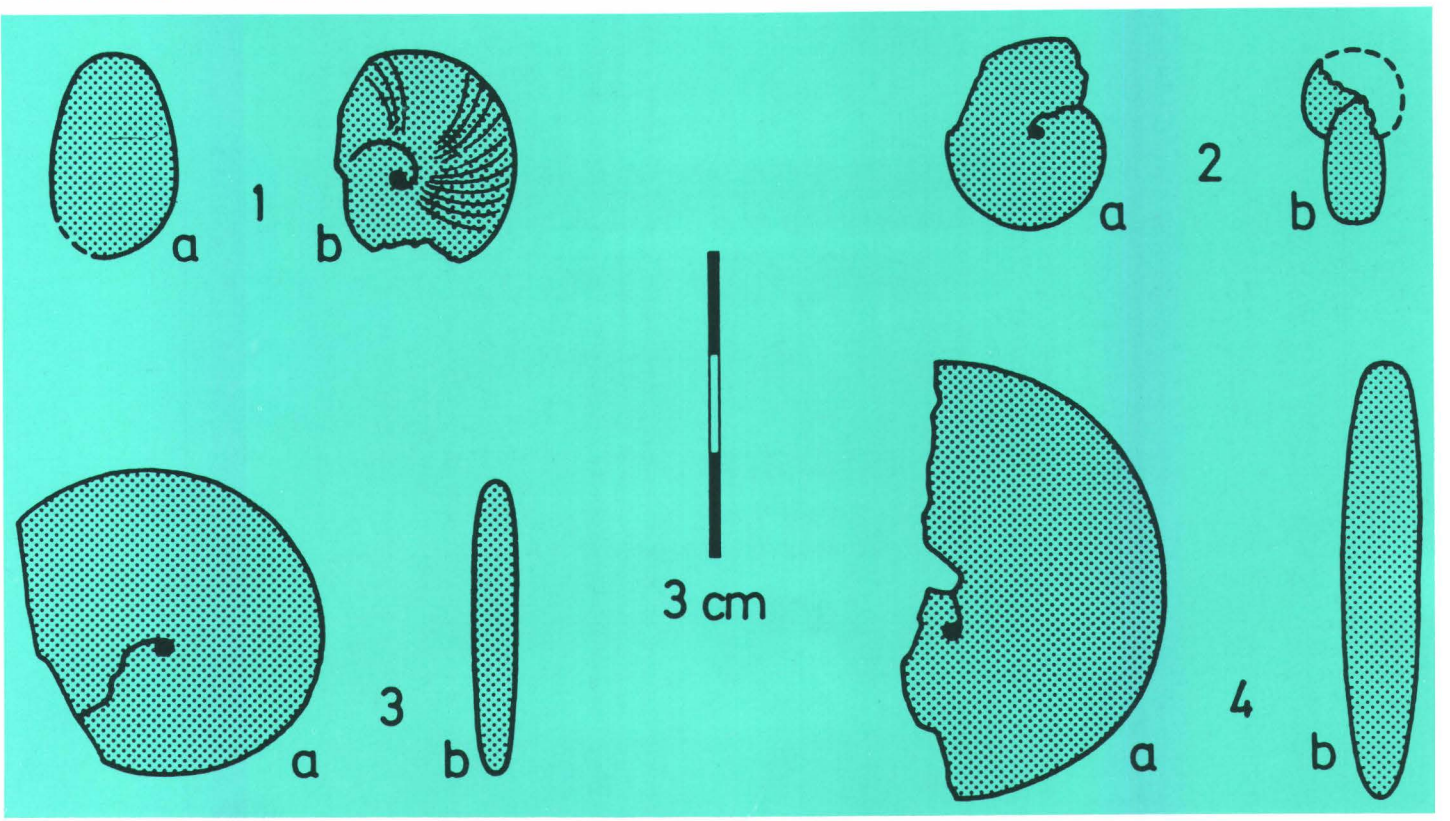
The lateral as well as the frontal or ventral outline drawings on Fig. 5 are based on the photographic figures of Pl. 4 and 5 in KOLLAROVA-ANDRUSOVOVA (1962). They are refigured here for demonstrating features which are interpreted as species-diagnostic. Those are, for example, the umbilical egression with the *Halorites* or the umbilicus size and the cross-section with the *Megaphyllites* and the *Placites* species.

KOLLAROVA-ANDRUSOVOVA 1962	this paper
Anatomites cf. *fischeri* (MOJS.)	*Halorites* sp. indet.
Megaphyllites jarbas jarbasides KUEHN	*Megaphyllites insectus* (MOJS).
Placites placodes MOJS.	*Placites myophorus* (MOJS.)
Placites sp.	*Placites myophorus* (MOJS.)

Halorites sp. indet. (Fig. 5—1) is identical with the specimen figured by KOLLAROVA-ANDRUSOVOVA (1962: Pl. 4, Fig. 9). The specimen is relatively badly preserved. It shows the sculpture sporadically and on one side only the umbilicus. The latter is closed till the beginning of the last half whorl but suddenly egresses afterwards (Fig. 5—1b). This adult feature is most diagnostic for haloritins and some tropidids but has never been found with juvavitins s. str. Tropidids can be ruled out by the lack of a ventral keel as may be seen from Fig. 5—1. In cross-section the last whorl is compressed oval with gently curved flanks and a broadly rounded venter, the greatest whorl width close to the umbilicus. As far as the sculpture is preserved it consists of numerous relatively delicate multiple branching ribs which cross the venter without interruption. A constriction was mentioned and also figured on Pl. 5, Fig. 9 by KOLLAROVA-ANDRUSOVOVA (1962). Since it is weekly developed and moreover restricted to a very small area at one flank only, it may well be the result of diagenetic overprint.

With respect to the adult umbilical egression in combination with the missing keel, the specimen can be closely compared with the Middle Norian genera *Halorites* MOJSI-

Fig. 5: Lateral and frontal outline drawings of 1) *Halorites* sp. ind., 2) *Megaphyllites insectus*, 3 + 4) *Placites myophorus*; all from Tisovec.



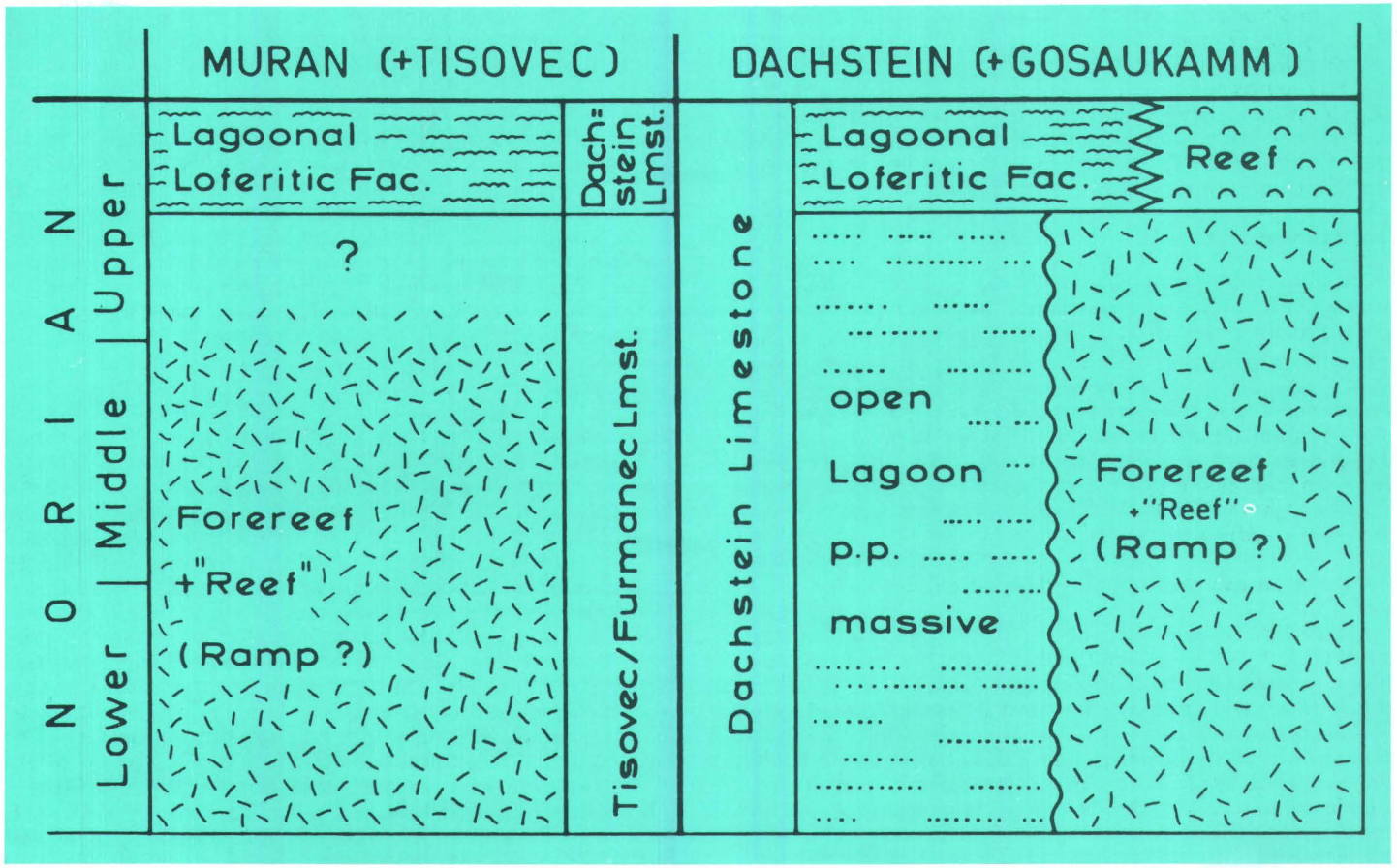


Fig. 6: Comparison of the lithostratigraphic nomenclature between the Dachstein region and the Muran plateau. Note the different extent of the use of the term Dachstein Formation within these two areas. The terminological range of the Dachstein Formation is restricted to the lagoonal facies in the type region of the Tisovec/Furmanec Limestone.

SOVICS, 1892, and *Episculites* SPATH, 1951. The last genus has a clearly different final whorl section of rectangular shape through subparallel and less convex flanks and a relatively flat venter. *Halorites* according to TATZREITER (1981) is stratigraphically restricted to the Upper Middle Norian *Halorites macer* zone and is very common in this time interval.

Megaphyllites insectus (MOJS.) (Fig. 5—2): Described originally as *Megaphyllites jarbas jarbasides* KUEHN by KOLLAROVA-ANDRUSOVOVA (1962: Pl. 5, Fig. 4) the specimen in question can be clearly attributed to the above cited species by its subcircular whorl section with well-rounded flanks (Fig. 5—2b). *Megaphyllites insectus* starts in the Upper Middle Norian and ranges well to the top of the Triassic. A Rhaetian representative of the species has been described by POMPECKY (1892) as *"Megaphyllites Joannis Böhmi* n. sp.".

Placites myophorus (MOJS.) (Fig. 5—3, 4): The specimen in Fig. 5—3 is identical with KOLLAROVA-ANDRUSOVOVA's *Placites placodes* MOJS. of Pl. 4, Fig. 8, specimen Fig. 5—4 with her *Placites* sp. of Pl. 5, Fig. 2. Both are marked by a closed umbilicus and by thin whorls. There are two species with a similarly slender whorl section in question: *Placites myophorus* to which the specimens belong in our view and *Placites placodes* which differs by having an open umbilicus (see MOJSISOVICS 1873).

According to unpublished data from the Hallstatt facies of Timor and the Alps *Placites myophorus* ranges from Middle Norian to Lower Rhaetian.

Conodonts

Altogether six samples have been collected in the quarry. Four close to the western corner (A 1350 to A 1353) and two (A 1361, A 1362) above the main platform in the eastern part of the quarry (Fig. 3). Between two and three kilograms have been dissolved per sample, resulting in, if productive, rich and time-diagnostic faunas (see below).

Samples A 1352, a peloidal mudstone and A 1362, a bioclastic grainstone, were barren. Sample A 1353 taken at the quarry's western border represents a crinoidal limestone of Carnian age. This differs in lithology as well as microfacies from the Tisovec Limestone and is therefore treated in chapter 4.1. The remaining three samples indicate a stratigraphic two-fold division of the rocks of the Tisovec quarry as discussed below.

A 1350: wackestone with echinoderms, filaments (halobiids?) and foraminifers

Gondolella steinbergensis (MOSHER)	52×
Epigondolella postera (KOZUR & MOSTLER)	42×
ramiform elements	15×

A 1351: wackestone with echinoderms

Gondolella steinbergensis (MOSHER)	5×
Epigondolella postera (KOZUR & MOSTLER)	32×
ramiform elements	8×

The *Epigondolella* specimens are identical within the two samples and are morphologically close to the *"Epigondolella postera* population" of ORCHARD (1983: p. 186, Fig. 11). Typologically they also include *"Gladigondolella abneptis"* sensu HUCKRIEDE (1958) and *Metapolygnathus zapfei* sensu KOZUR (1973).

Compared with *Epigondolella* populations from Timor they are restricted to the Middle and basal Upper Middle Norian (Alaun 2 to Alaun 3/1).

A 1361: wackestone to packstone

Gondolella navicula (HUCKRIEDE)	4×
Epigondolella "triangularis" (BUDUROV)	2×
ramiform elements	15×

Epigondolella "triangularis" is used here in a very informal way for *Epigondolella* populations with an asymmetrically expanding posterior platform similar to the *"Epigondolella abneptis* subsp. B population" of ORCHARD (1983: p. 182). A Middle Lower Norian age (Lac 2) is estimated by comparison with ammonoid bearing sequences in the Alps (Feuerkogel) and Timor. The Lower Norian age of the sample is further supported by *Gondolella navicula.*

Conodont biofacies

Gondolella and *Epigondolella* dominated Triassic samples clearly reflect basinal facies influence (CARR et al. 1984, CAREY 1984). If they are not reworked (and there are no signs of reworking within the studied samples) they provide a valuable tool for characterizing the sedimentary environment. The conodont bearing rocks of Tisovec are of typical basinal character including lower slope deposits or the deeper part of a carbonate ramp (sensu READ 1982). The rich representation of platform conodonts excludes high-energetic shallow water environments like the platform rim (reef) or the upper slope.

Remarks on the reef-building and dwelling fauna

Most of the macrofauna of the Tisovec quarry is not determinable. The organisms, most probably inozoans and spongiomorphids, have been dissolved. In a following stage the molds have been coated by several generations of yellow palisade cements. Remaining cavities have been closed in a later stage by white sparry calcite. Due to this kind of preservation of most reef builders it is difficult to decide which have been the important members of the constructor guild.

Compared with the Dachstein Limestone of the Northern Calcareous Alps (FLÜGEL 1981) the fauna and flora of the limestones of the Tisovec quarry shows a lower diversity. Common elements of the reef facies of the Dachstein Limestone like corals, tabulozoans, hydrozoans, red algae, and many of the secondary reef builders (e.g., *Follicatena irregularis* SENOWBARI-DARYAN & SCHÄFER) were not observed.

The typical Dachstein reef foraminifers, like *Galeanella,* are present. Spiriamphorellids, comparable to those described from the Norian Hohe Wand near Vienna (SADATI 1981) and the Norian reefs of Sicily (SENOWBARI-DARYAN 1982), occur in the Tisovec quarry as well. These taxa are not identical with those of the Carnian!

4.3. Facies of the Tisovec quarry

Depending on the small number of thin sections the limestones in the quarry can be classified into two main facies types, a slope facies and a reef facies s. l.

Slope facies

The slope facies is reflected by mudstones and wackestones, containing very fine grained shell debris and mud intraclasts. Only a few filaments and tiny clasts of echinoderms occur. Besides that crinoidal grain- to packstones were observed. The sediment of the latter consists of peloids, echinoderm clasts, lithoclasts, fine grained shell debris, and thin shells of bivalves. Sometimes fecal pellets (∅ 1 mm) occur. Nodosariid and textulariid foraminifers, ostracods, and gastropod shells are rare. The echinoderm clasts (∅ 0.5 mm) have micritic envelopes and many of the bivalve shells show thin algal crusts. Sometimes graded bedding can be observed within this normally massive limestones.

Reef facies s. l.

By far most of the samples have to be placed into this group which consists of various microfacies types. Most common are peloidal grainstones and rudstones, but also bafflestones are frequently found. Reef building organisms in situ are very seldom, only in some places small patches (∅ 0.5 m) of reef organisms in growth position were observed. Sometimes large clasts of reef builders (up to several cm) occur. Peloidal sediment and fine grained shell debris are found in between the reef building organisms. In some places clasts of dasycladaceans are common co-occurring with broken reef builders and unbroken encrusters.

Main reef building organisms are inozoans and probably spongiomorphids whereas corals, hydrozoans, and sphinctozoans are very rare. The reef builders are encrusted by spongiostromata. Only in some cases tabulozoans and foraminifers *(?Alpinophragmium perforatum* FLÜGEL) encrust other organisms. An important and frequent secondary reef builder is *Radiomura cautica* SENOWBARI-DARYAN & SCHÄFER.

Characteristic elements of the dweller guild are foraminifers, especially miliolids (*Ophthalmidium* sp., *Spiriamphorella* sp., *Galeanella* sp.) and textulariids (*Kaeveria fluegeli* (ZANINETTI, ALTINER, DAGER & DUCRET) and *Palaeolituonella majzoni* BERCI—MAKK), ostracods, and microproblematica *(Microtubus communis* FLÜGEL, *Baccanella floriformis* PANTIC, *Muranella sphaerica* BORZA). Echinoderm clasts, sea-urchin spines, and mollusk shells are rare.

Some peloidal grainstones and packstones contain a foraminiferal fauna with *Glomospira* sp., *Duostomina* sp., and *Aulotortus* sp.; other components are fine grained shell debris, mollusks shells, and rare echinoderm fragments. Micritic coatings are infrequently found.

These microfacial data suggest an interpretation of the depositional environment of the limestones of the Tisovec quarry as follows: In the upper part of a slope or carbonate ramp in shallow, agitated water patches of reef building organisms formed small buildups. The inter-reef or — perhaps — back-reef deposits are created by destructive processes causing coarse to fine clastic sediments with reworked reef builders. In a more downslope position the sediments are dominantly fine grained, poor in fossils, and partly show an influence by shallow water material, transported down by gravity transport mechanisms.

5. Tisovec Limestone as part of Dachstein Formation

From the very beginning (SIMONY 1847) the term "Dachstein Limestone" has always been understood in its complete facial differentiation in the literature concerning the Eastern Alps (ZAPFE 1959, FLÜGEL 1963, SCHLAGER 1967, ZANKL 1969, TOLLMANN 1976). In the surroundings of the type locality of the Dachstein Formation at the Gosaukamm reef complex, these facies units are arranged in more or less distinct zones representing, roughly speaking, fore-reef, reef, back reef, and lagoonal deposits (Fig. 7). Neither in lateral nor in vertical direction do these zones remain constant during the Norian-Rhaetian. The development of these facies also changes through time.

The facies migrations are best observable at the platform margins because of the narrower zones (fore-reef, reef, backreef). Intercalated into these marginal types of Dachstein Limestone are beds of colored wackestones to mudstones (SCHAUER 1983). The occurrence of these fine grained limestones also expresses the facies migration. They are well dated by pelagic faunal elements (conodonts, halobiid bivalves) reflecting the adjacent basinal sedimentation. Changes not only in the position but also in the development of the facies units are recognizable, for example, in the western part of the Dachstein plateau. Here the reef facies of the lower part of the sequence is overlain by bedded Dachstein Limestone in "Lofer facies". Additionally differences occur in the reef types itself as well as in the back reef sediments (Fig. 6).

This use of the term Dachstein Limestone in the Eastern Alps has been totally ignored during the last three decades

in the Western Carpathians. In this area only the bedded limestones, expressing lagoonal depositions by the occurrence of "Lofer cycles", were named "Dachstein Limestone". This followed an overinterpretation of UHLIG's (1903) remarks. For other facial variations new terms like Tisovec and Furmanec Limestone were introduced (KOLLAROVA-ANDRUSOVOVA 1960, 1961). The introduction of these new terms was encouraged by the supposed Carnian age of the Tisovec Limestone being in contrast to the Norian-Rhaetian age of the Dachstein Formation. Following the new stratigraphic range (chapter 4.2) and the facial data (chapter 4.3) it has to be stated that the Tisovec Limestone in its type locality fully corresponds with the Dachstein Limestone of the Eastern Alps. Thus the Tisovec Limestone has to be renamed into Dachstein Limestone. However, future discussions will show the necessity to divide the Dachstein Formation into individual members based on the different facial variations.

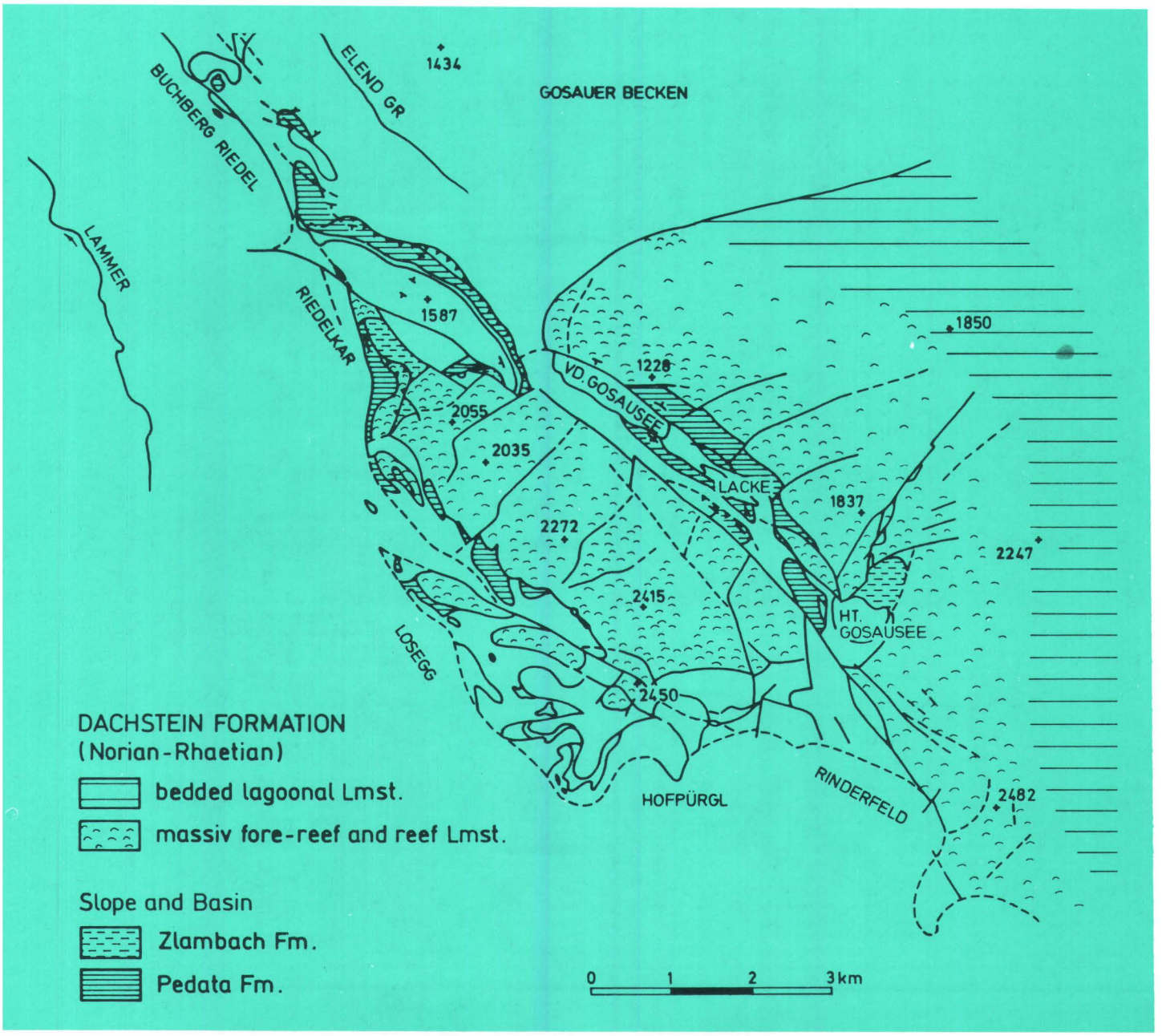
Acknowledgements

The research was supported by grants of the Deutsche Forschungsgemeinschaft (Projekt "Evolution von Riffen" FL 42/49—2 under the direction of Prof. E. Flügel) and by grants of the IGCP, Project 198. We wish to thank for the preparation of the drawings (N. Frotzler, L. Leitner) and the thin sections (Hammermüller, Karisch). The examination of the English text was done by J. Nebelsick.

The thin section and samples on which this work is based are stored on following sites:

1) Ammonites (coll. BYSTRICKY, det. KOLLAROVA-ANDRUSOVOVA): Geologicky ústav Slov. akad. vied
2) Thin sections and conodont samples of the sample set A . . .: Geological Institute of the University, Vienna
3) Thin sections of the sample set 14A . . .: Paleontological Institute of the University, Erlangen.

Fig. 7: Upper Triassic facies distribution in the western Dachstein region (according to MANDL 1984: fig. 2). Note, that the original use of the term "Dachstein Formation" in its type region includes the forereef, reef and back reef development.

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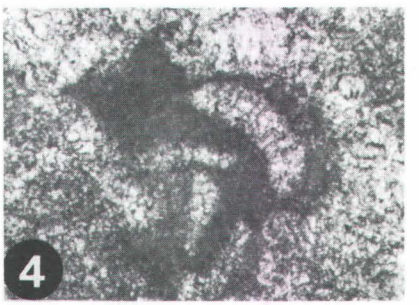
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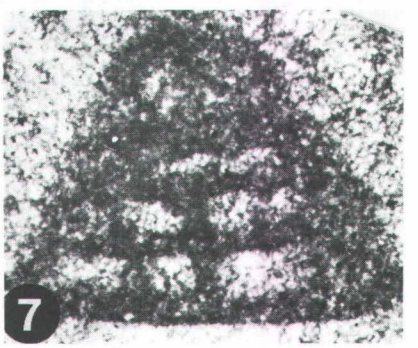
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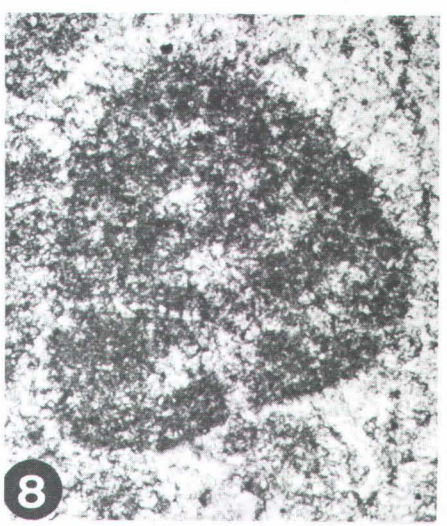
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◄ Fig. 1: Thick algal-bacterial layers surround this bioclast. Thin tubes within this crust proof the fixing activity of algae.
Tisovec Quarry, Norian, thin section 14A4/3, scale 6.5×.

Fig. 2: Diverging tubes and irregularly arranged tabulae within the tubes are characteristic of red algae.
Tisovec Quarry, Norian, thin section 14A7, scale 14×.

Fig. 3: ? *Paradeningeria* sp. The younger chambers of this sphinctozoan sponge are encrusted by thick algal crusts.
Tisovec Quarry, Norian, thin section 14A4/1, scale 3.5×.

Fig. 4: *Spiriamphorella* districta? BORZA & SAMUEL is a common dweller of the reef facies of the Tisovec quarry.
Tisovec Quarry, Norian, thin section 14A1/2, scale 70×.

Fig. 5: *Radiomura cautica* SENOWBARI-DARYAN & SCHÄFER is an important secondary reef builder. The shape of this microproblematic resembles of sphinctozoan sponges.
Tisovec Quarry, Norian, thin section 14A7, scale 6.5×.

Fig. 6: *Vesicocaulis* cf. *alpinus* OTT is a rare member of the constructor guild in the reef facies. This sphinctozoan sponge is a characteristic Ladinian/Carnian faunal element which normally does not occur in Norian reefs.
Tisovec Quarry, Norian, thin section 14A3, scale 4×.

Fig. 7: *Palaeolituonella majzoni* BERCI-MAKK is a common member of the foraminiferal association of Norian reef limestones.
Tisovec Quarry, Norian, thin section 14A7, scale 100×.

Fig. 8: ? *Palaeolituonella majzoni* BERCI-MAKK is an abundant element of the foraminiferal assemblage of Norian reefs.
Tisovec Quarry, Norian, thin section 14A1/2, scale 110×.

Fig. 9: *Spiriamphorella districta?* BORZA & SAMUEL is also known from the Norian limestones of the Hohe Wand near Vienna (Austria).
Tisovec Quarry, Norian, thin section 14A1/2, scale 210×.

Fig. 10: *Spiriamphorella* sp. Spiriamphorellids are characteristic foraminifera of the reef facies.
Tisovec Quarry, Norian, thin section 14A1/2, scale 150×.

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[1] **There are some new indications that this taxon has a longer range and may well reach the (?Middle) Norian.**

Abstrakt

Nové výskumy v tisovskom lome, teda na typovej lokalite rovnomenných tisovských vápencov, považovaných za karnské, priniesli prekvapujúci poznatok o ich spodno- a strednonorickom veku. Dostatočne to preukazuje fauna konodontov a amonitov.

Z litologického hľadiska je možné v lome odkryté vápence zaradiť do dvoch hlavných faciálnych zón: k svahovej fácii a k rífovému vývoju v širšom zmysle.

Z litologického ako aj stratigrafického hľadiska v tisovskom lome odkryté masívne norické vápence zodpovedajú východoalpskému dachsteinskému vápencu a v dôsledku toho by sa tak mali aj nazývať (obr. 6). Označenie „tisovský" vápenec by sa teda na označovanie takýchto vápencov nemalo používať.

Z toho dôvodu je na označenie skutočných vrchnokarnských riasových vápencov, ktoré boli dosiaľ v literatúre týkajúcej sa vápencových Álp označované ako „tisovské", potrebné zaviesť nové pomenovanie. Navrhuje sa pre ne pomenovanie waxenecké vápence (Waxeneck-Kalk) (typový profil Kleines Waxeneck, mürzalpský prikrov, obr. 2).

Zusammenfassung

Die Bearbeitung des Steinbruches in Tisovec, der Typuslokalität des gleichnamigen, für karnisch gehaltenen Kalkes, erbrachte das überraschende Ergebnis eines norischen Alters. Dieses ist durch Conodonten und Ammoniten hinreichend abgesichert.

In lithologischer Hinsicht können die im Steinbruch aufgeschlossenen Gesteine zwei Hauptfaziesbereichen zugeordnet werden: einer Slope-Fazies und einer Riffentwicklung im weitesten Sinne.

In lithologischer wie auch in stratigraphischer Hinsicht entsprechen die im Steinbruch Tisovec aufgeschlossenen massigen norischen Kalke vollkommen dem ostalpinen Dachsteinkalk und sind folglich auch so zu benennen (Abb. 6). Die Bezeichnung „Tisovec-Kalk" ist dagegen einzuziehen.

Aus diesem Grund war eine Neubenennung jener echten oberkarnischen Algenkalke nötig, die bisher in der Literatur über die Kalkalpen unter der Bezeichnung „Tisovec-Kalk" geführt wurden. Für sie wird die Bezeichnung Waxeneck-Kalk (Typusprofil Kleines Waxeneck, Mürzalpendecke, Abb.2) vorgeschlagen.

COMPARATIVE STUDY OF WETTERSTEIN CARBONATE PLATFORMS OF THE EASTERNMOST NORTHERN CALCAREOUS ALPS AND WEST CARPATHIAN MOUNTAINS: PRELIMINARY RESULTS

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Introduction

Most of the fieldwork on which this paper is based was carried out in the frame of the respective Austrian and Slovak regional mapping programmes. Field mapping is still in progress and detailed paleontological work will be a future task. The calcisponges collected so far in the Austrian working area (leg. LOBITZER) at present are under study by colleagues from Erlangen University. The comparatively scarce and often poorly preserved coral fauna will be evaluated by Mrs. Doc. E. Roniewicz, Warsaw. Therefore, in order not to confuse the literature by inadequate fossil determinations, we do not refer to our preliminary determinations in the frame of this paper.

We also have to state that all the poor English in this paper is in the responsibility of the Austrian/Slovak authors, Sal Mazzullo did not forget his mother language!

For the sake of brevity, in the remainder of this paper we often refer to the Anisian to Cordevolian sequence as "Middle Triassic". In the study area, Middle Triassic rocks include diverse lithologic types, each with a distinct faunal assemblage.

Wetterstein carbonate platforms of the easternmost Northern Calcareous Alps

Published data on the facies distribution in the Wetterstein Limestone of the easternmost Northern Calcareous Alps are scarce and the only documentation so far is the unpublished map in the PhD-Thesis by LOBITZER (1971), followed by several short accounts by LOBITZER (1972—1988) and MANDL (1985—1987). In the following paragraphs we shortly summarize the results of our field in-