Rivista Italiana di Paleontologia e Stratigrafia	volume 103	numero 1	tavole 1-2	pagine 39-52	Aprile 1997

CONODONT BIOSTRATIGRAPHY OF THE S.CASSIANO FORMATION SURROUNDING THE SELLA MASSIF (DOLOMITES, ITALY): IMPLICATIONS FOR SEQUENCE STRATIGRAPHIC MODELS OF THE TRIASSIC OF THE SOUTHERN ALPS

ADELAIDE MASTANDREA*, CLAUDIO NERI** & FRANCO RUSSO***

Key-words: Conodonts, Biostratigraphy, Sequence Stratigraphy, S. Cassiano Formation, Ladinian, Dolomites.

Riassunto. Lo scopo del presente lavoro è la definizione del contesto cronostratigrafico della Formazione di S. Cassiano interdigitata con i depositi clinostratificati di scarpata della piattaforma cassiana del Gruppo di Sella. Sono state studiate numerose sezioni, sia dal punto di vista sedimentologico che biostratigrafico; tre di queste, situate in prossimità dei passi Sella e Gardena, hanno fornito faune a Conodonti stratigraficamente significative, attribuibili alla Zona a *diebeli sensu* Krystyn (1983), indicativa della parte più alta del Ladinico superiore. Ne consegue che la piattaforma cassiana del Sella, che in base ai rapporti geometrico-stratigrafici è necessariamente coeva ai depositi bacinali della Formazione di S. Cassiano, è anch'essa di età ladinica terminale (in contrasto con la tradizionale attribuzione al Carnico). Dal momento che vari lavori hanno documentato l'esistenza, nell'area delle Dolomiti, di piattaforme carbonatiche post-vulcaniche *più vecchie* (es.: i Denti di Terra Rossa) e *più giovani* (es.: le piattaforme del Nuvolau e del Lagazuoi), si possono trarre le seguenti conclusioni: a) le successioni post-vulcaniche e cassiane delle Dolomiti sono decisamente più complesse e caratterizzate da più generazioni di piattaforme di quanto non si ritenesse; b) un modello stratigrafico-sequenziale del Ladinico superiore-Carnico delle Dolomiti, basato su due sole generazioni di piattaforme cassiane, non è ulteriormente sostenibile; c) la complessità stratigrafica delle Dolomiti occidentali nel Ladinico-Carnico è fortemente controllata dal segnale tettonico (che sovrasta quello eustatico), e quindi il modello sequenziale che si può costruire in quest'area non è proponibile come standard globale.

Abstract. The stratigraphy and age of the S. Cassiano Formation outcropping around the Sella Massif (Dolomites, Northern Italy) were investigated. The unit interfingers with slope deposits pertaining to the Cassian carbonate platform of the Sella Massif. Several stratigraphic sections were analyzed from a sedimentologic and biostratigraphic perspective. Three sections (Sella Pass Ia and Ib, Gardena Pass) yielded stratigraphically significant conodont faunas referable to the *diebeli* Assemblage Zone *sensu* Krystyn (1983) of latest Ladinian age. Therefore, the Sella Cassian Platform traditionally regarded as a typical Carnian buildup, is also latest Ladinian in age. The occurrence of post-volcanic carbonate platforms *older* (e.g. Denti di Terra Rossa) and *younger* (e.g., the Nuvolau and Lagazuoi platforms) than the Sella Platform, suggests that : a) the post-volcanic and Cassian succession of the Dolomites is far more complex than traditionally thought and b) a sequence stratigraphic model of the Middle-Upper Triassic of the Dolomites based on two generations of Cassian platforms is clearly inadequate to describe the actual succession.

Introduction.

The Sella Massif consists of an isolated, atoll-like, deeply dolomitized carbonate platform (Cassian Dolomite), overlain by the horizontal beds of the Raibl and Dolomia Principale Formations, respectively Late Carnian and Norian in age (Fig. 1 and 2). Due to its spectacular exposure and almost complete absence of tectonic deformation, the Sella Massif has been the object of several studies, and its depositional geometries and the stratigraphic relationships between basin and platform sediments have been well defined (Mojsisovics, 1879; Reithofer, 1928; Leonardi & Rossi, 1957; Bosellini et al., 1980; Bosellini, 1982; 1984; Kenter, 1990; Bosellini & Neri, 1991).

The studies cited above clearly demostrated that the Sella Platform is an isolated buildup, composed mainly of clinostratified slope deposits (breccias and megabreccias), radially prograding from a central nucleus represented by an undated, probably Early Ladinian, carbonate core (Bosellini & Neri, 1991). The clinoforms interfinger at the base with the S. Cassiano Fm., which consists of alternating marly pelites, platform-derived calciturbidites and olistolith swarms, and blackish sandstones derived from the erosion of volcanic areas.

The age of the Sella Platform and coeval S. Cassiano Formation has been regarded as Ladinian-Carnian by Leonardi (1967). The subsequent recognition of different generations of carbonate platforms (pre- and post-volcanics, Bosellini & Rossi, 1974) led to the idea that the "Cassian" platforms (post-volcanics) pertain to the Carnian. Some authors, however, (e.g., Assereto et al., 1977; Bizzarini & Braga, 1987; Fois & Gaetani, 1980) followed

* Dipartimento Scienze della Terra, Università di Modena, via Università, 4, I-41100 Modena.
** Dipartimento di Scienze Geologiche e Paleontologiche, Università di Ferrara, C.so Ercole I d'Este, 32, I-44100 Ferrara.
*** Dipartimento di Scienze della Terra, Università della Calabria, I-87030, Arcavacata di Rende (Cosenza).

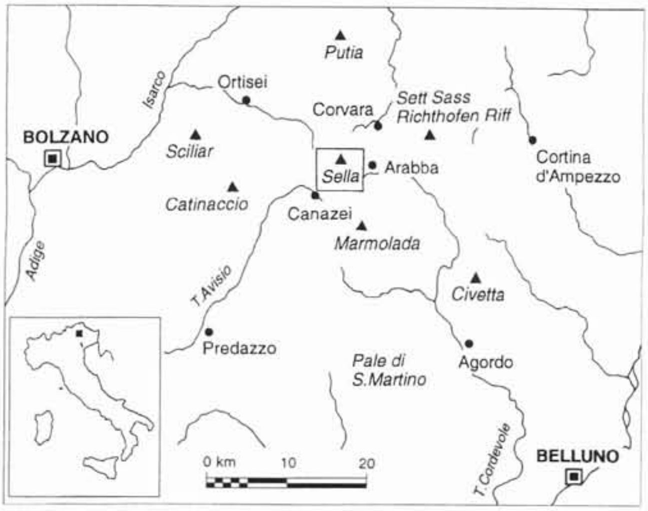


Fig. 1 - Index-map of the area studied with the toponyms quoted in the text.

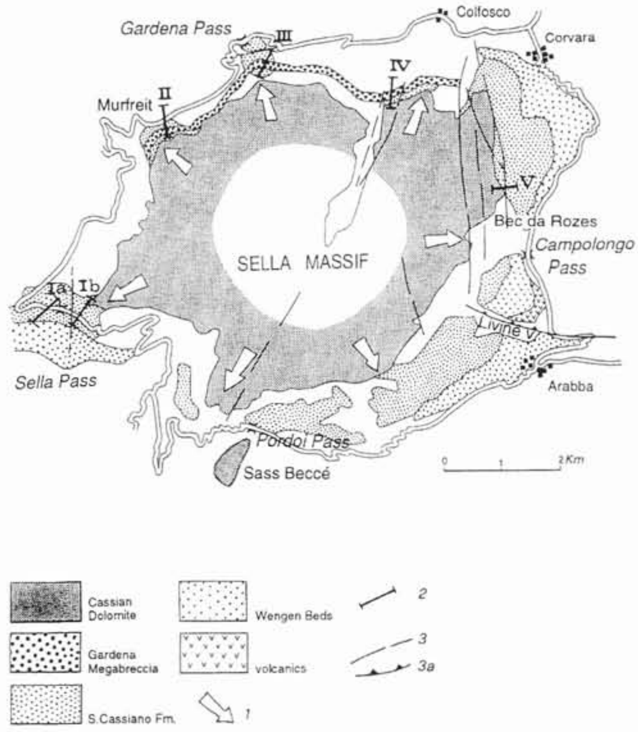


Fig. 2 - Simplified geologic map of the Sella Massif, showing the location of the stratigraphic sections. The post-Cassian formations have been omitted. Ia and Ib, Sella Pass sections; II, Murfreit section; III, Gardena Pass section; IV, Val Mesdì section; V, Campolongo Pass section. Key: 1, direction of progradation of the Sella Platform; 2, trace of the stratigraphic sections; 3, faults; 3a, overthrust.

the works of early German geologists (Mojsisovics, 1879; Ogilvie, 1893; Ogilvie Gordon, 1929) and distinguished a lower member of the S. Cassiano Fm. of Late Ladinian age and an upper member of Carnian age. As a consequence, a portion of the Cassian Dolomite is considered Upper Ladinian in age.

Recent interpretations of the sequence stratigraphic organization of the Cassian succession (Bosellini & Doglioni, 1988; Masetti et al., 1991; Bosellini, 1991; De Zanche et al., 1993) are based on two generations of Cassian platforms.

In the present paper, we supply age data for the Cassian successions of the Sella Massif based on conodonts and supported by the ammonoid findings reported by Neri et al. (1994), Mietto & Manfrin (1995a,b) and Baracca (1996).

The S. Cassiano Formation around the Sella Massif.

The San Cassiano Formation consists of pelites and marls alternating with micrites and gravity-displaced carbonates (calciturbidites and debrites) derived from the adjacent Cassian platforms. Variable amounts of volcaniclastic turbidites, fed by remnant, inactive volcanic highs, may be intercalated in the succession. The volcaniclastic content is quite low in the type area of the formation (S. Cassiano, Pralongià, Stuores Wiesen) or in the sorroundings of Cortina, while it is significant to the west (i.e., southern slope of Sasso Piatto Mt., western flank of Sella Massif), near the Buffaure-Monzoni Predazzo volcanic district.

On the basis of volcaniclastic content and overall stratigraphic organization, three kinds of successions, characterizing different areas, may be recognized within the S. Cassiano Formation surrounding the Sella Massif (Fig. 1).

1. The western sector (i.e., Sella Pass, Fig. 2) is characterized by a poorly exposed succession consisting of alternating marl, marly to pure micrite, bioclastic calcarenite and breccia, and olistolith swarms, locally organized in thickening- and coarsening-upward (CU) sequences (Masetti et al., 1991). This succession overlies a volcaniclastic sequence pertaining to the Wengen Formation, from which it is separated by an horizon about 25-30 m thick consisting of turbiditic coarse sandstones and conglomerates, with carbonate and volcanic clasts, alternating with lens-shaped ruditic debris flows and carbonate olistolith swarms (Fig. 3 and 4). The S. Cassiano Formation of this area contains a significant amount of volcaniclastic sandstones and microconglomerates. The volcaniclastic input increases southward, resulting in a Wengen-like succession that interfingers and partly replaces the S. Cassiano Formation, which is usually more rich in carbonate lithotypes.

2. The S. Cassiano Formation of the northern flank of the Sella Massif (from Murfreit to Colfosco, Fig. 2) contains a thick channeled megabreccia body (Gardena Megabreccia), described by Bosellini et al. (1980), Bosellini (1982; 1984) and Bosellini & Neri (1991). It consists of several megabeds formed by chaotically arranged carbonate olistoliths and ranges in thickness from a few tens of metres (Gardena Pass) to about 200 m (Murfreit). The Gardena Megabreccia subdivides the S. Cassiano deposits into two units, underlying and overlying the megabreccia respectively (Fig. 5).

The lower unit consists of an acyclical alternation of shales, marls, carbonate and volcanoclastic turbidites, ruditic debrites, lenses of carbonate megabreccia a few metres thick. The prominent characteristic of this succession is the frequent occurrence of: a) chaotic or poorly organized gravity-displaced deposits (slump deposit, mud-flow, debris-flow); b) unconformities related to slump and slide scars; c) small tensional synsedimentary faults with metre-size vertical displace-

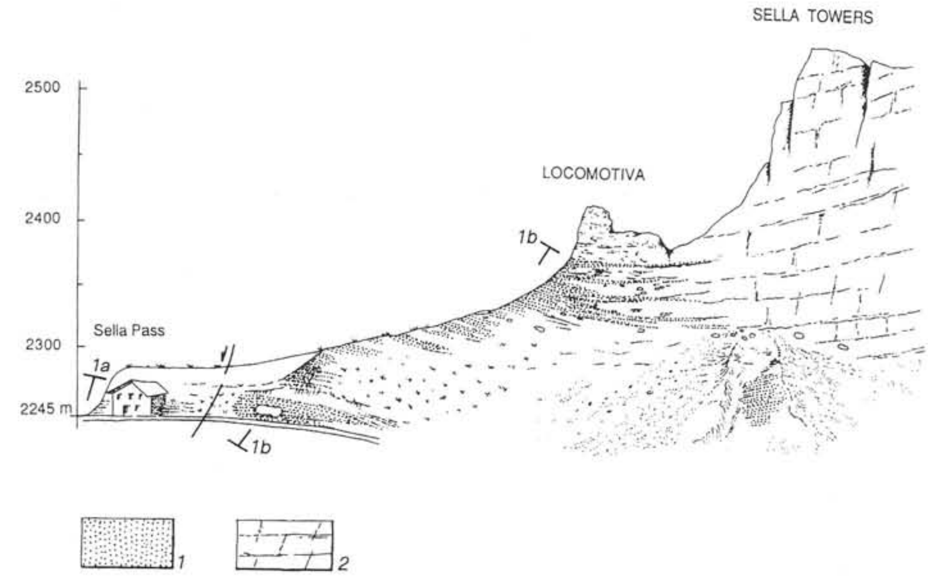


Fig. 3 - Field sketch of the geometrical relationships between the S. Cassiano Formation (section Ib) and the Sella Platform at the Sella Pass.
1) S. Cassiano Formation
2) Cassian Dolomite

ment, sutured by turbidites or pelite layers. All these features may be regarded as evidence of remarkable synsedimentary tectonics, probably related to the Triassic activity of the Gardena Pass Fault (Bosellini & Doglioni, 1988; Bosellini & Neri, 1991).

The upper unit of the S. Cassiano Formation, a few tens to about 100 m thick, consists of an organized succession of marls and carbonates, forming small CU sequences, in turn piled up according to an overall CU trend that reflects the progradation of the overlying carbonate platform. At the base, the sequences are represented by pelites evolving upward to micritic limestone (mudstone and wackestone) with minor turbidites. In the upper part of the unit, the CU sequences are capped by coarse amalgamated calciturbidites and finally by olistolith swarms. Volcaniclastic sandstones may occur but are quite rare.

3. The eastern and southeastern sectors of the Sella Massif, from Corvara to Arabba (Fig. 2), are characterized by stratigraphic successions very similar in facies pattern and vertical evolution to the S. Cassiano Formation of the type area. These successions consist of piles of thickening, coarsening-upward cycles, a few metres thick, composed in the lower part by pelites and marls that grade upward to micritic limestones (interpreted as periplatform mud, Masetti et al., 1991) and then to calciturbiditic units. The volcaniclastic input is negligible and, in general, the terrigenous component is almost exclusively represented by pelites. As a whole, the succession constitutes a major CU sequence, reflecting the progradation of the carbonate platform. The thickness of the succession varies greatly, from about 600 m (Arabba section, southwestern side of the Livinè valley) to a little more than 100 m (Bec da Rozes section, northeastern side of the Livinè valley, Fig. 2). According to Bosellini et al., (1982) this abrupt change in thickness is due to the synsedimentary activity of the Livinè Fault, that strongly controlled the thickness of the volcanic succession (mainly represented by volcanic-derived clastics) and Wengen-S. Cassiano (p.p.) formations, and was eventually sutured by the Sella buildup.

The data outlined above indicate that the sedimentary features of the Cassian succession in the investigated area are clearly influenced by synsedimentary tectonics as well as by the inherited paleogeography (i.e., the location of the relic volcanic highs undergoing erosion). As a result, the basin deposits show remarkable lateral facies changes over a very short distance. It is therefore very difficult to physically correlate the S. Cassiano successions around the Sella Massif and also to trace unambiguously the lithostratigraphic boundary between the volcaniclastic-dominated Wengen Formation and the carbonate-dominated S. Cassiano Formation. This boundary is diachronous and consequently prevents the establishment of a reliable subdivision of the S. Cassiano Fm. into members of regional extent.

The stratigraphic sections and the Conodont faunas.

Several stratigraphic sections, located in the northern and eastern sectors of the Sella Massif, from the Sella Pass to Arabba (Fig. 2) were investigated. Three of these sections (Sella Pass Ia and Ib; Gardena Pass; Fig. 4 and 5) yielded significant conodont faunas, evenly distributed from the the bottom to the top. A further section (Arabba) gave only scattered and poor conodont assemblages, substantially confirming the age data from the Sella and Gardena Pass sections. Other sections measured and sampled at Pordoi Pass, Corvara and Bec da Rozes (Fig. 2) were barren of conodonts. Bec da Rozes yielded ammonoid faunas indicative of the Regoledanus Zone (Neri et al., 1994; Baracca, 1996).

Sella Pass sections. Two partly overlapping sections from the Sella Pass area were measured (Fig. 2, 3 and 4). Both are composed at the base of coarse volcaniclastic sandstones with ruditic lenses, containing volcanic clasts and carbonate olistoliths. This unit is followed upward by cyclic alternations of marly pelites and marly to pure limestones (mudstone and wackestone). Following a rough coarsening-up trend, the top of the incomplete section Ia and the middle-upper part of section Ib are characterized by the occurence of coarse bioclastic calciturbidites. The upper part of section Ib also contains several carbonate olistolith swarms and eventually grades into the clinostratified slope deposits of the carbonate platform. Volcaniclastic sandstone and microconglomerates occur repeatedly in both sections.

The basinal deposits of section Ib are clearly interfingered with the clinostratified slope deposits of the Sella Platform (Fig. 3) that is here characterized by climbing progradation (Bosellini, 1984). From the geometric relationships it is apparent that the age of the Sella Platform is necessarily the same age of the S. Cassiano Formation.

Eleven samples collected from the two sections (Fig. 4) yielded stratigraphically significant conodonts. The fauna includes:

Budurovignathus mungoensis (Diebel)
Budurovignathus diebeli (Kozur & Mostler)
Budurovignathus mostleri (Kozur)
Budurovignathus cf. *longobardicus* (Kovacs)
Budurovignathus sp.A
Gladigondolella tethydis (Huckriede)
Gladigondolella malayensis malayensis Nogami
Gondolella foliata inclinata Kovacs
Pseudofurnishius murcianus praecursor Gullo & Kozur

Mietto & Manfrin (1995a) reported the occurrence in this section of ammonoids of the Regoledanus Subzone *sensu* Mietto and Manfrin.

Gardena Pass section. The S. Cassiano Fm. of the Gardena Pass section contains the Gardena Megabreccia, that subdivides the formation into the two units described above (Fig. 5). The lower unit is about 80 m thick but its base is not exposed. The upper unit is almost completely covered and, as for the lower unit, its thickness is not precisely determinable; its base , however, is represented by cyclic alternations of marly pelites and micritic limestones.

Six samples collected below and above the Gardena Megabreccia yielded the following conodont fauna (Fig. 5):

Budurovignathus mungoensis (Diebel)
Budurovignathus diebeli (Kozur & Mostler)
Budurovignathus mostleri (Kozur)
Gladigondolella tethydis (Huckriede)
Gladigondolella malayensis malayensis Nogami

Reithofer (1928, p. 542) reported a specimen of *Trachyceras regoledanum* (sic) from Col de Masores, corresponding to the upper part of the Gardena Pass section described here. Mietto & Manfrin (1995a) reported the occurrence of ammonoid faunas referable to the Regoledanus Subzone and *Daxatina* cf. *canadensis* Subzone *sensu* Mietto and Manfrin from the same section.These subzones correspond respectively to the lower and upper part of the Regoledanus Zone *sensu* Krystyn (in Zapfe, 1983).

Conodont biostratigraphy.

No significant biostratigraphic variation in the conodont fauna was observed in the investigated sections. This can be explained by a high sedimentation rate producing thick sequences deposited during the time span of a single conodont zone.

The conodont association of both Sella and Gardena Pass sections is characterized by Ladinian elements such as: *Budurovignathus mungoensis*, *B. mostleri* and *B. diebeli*. Specimens of *Pseudofurnishius murcianus praecursor* are present in sample PS 6 (Sella Pass section).

Gullo & Kozur (1991) recognized three zones in the Late Ladinian-Early Carnian, on the basis of the evolutionary trend observed within the genus *Pseudofurnishius*. The zones correlate well with the conodont standard zonation of Kozur (1980). In particular, according to these authors *P. murcianus praecursor* is the last representative of the bi-platform specimen type and it is indicative of the higher Longobardian.

According to the zonal scheme of Krystyn (1983) the fauna may be attribuited to the Late Ladinian and specifically to the upper part of the *diebeli* A.Z., which corresponds to the Regoledanus Zone (Late Longobardian) (Fig. 6). In the Epidaurus (Greece) sequence *B. mostleri* and *B. diebeli* are distinctive of the Late Longobardian and disappear at the base of the Carnian together with *B. mungoensis* (Krystyn, 1983). The presence of *B. diebeli* in the Late Longobardian has been reported also from the Himalayas (Chhabra & Kumar, 1992).

Kozur (1980, 1989) maintains, on the basis of data from the Apuseni Mts. (Romania), that *B. diebeli* is not present in the *mungoensis* A.Z., but it is restricted to the Cordevolian (= Sutherlandi - Aonoides Zones) (Fig. 6), where it occurs together with *Metapolygnathus polygnathiformis* (Budurov & Stefanov) and *M. tadpole* (Hayashi).

On the contrary, Krystyn (1983) considers the appearance of *B. diebeli*, and *M. polygnathiformis* diachronous events, starting from the Late Longobardian and the base of the Carnian, respectively. The appearance of *M. polygnatiformis* is considered isochronous with that of *Trachyceras aon*.

Data from the Dolomites seem to confirm Krystyn's (1983) conclusion. Since in the Dolomites *B. diebeli* is associated with *B. mostleri* and *B. mungoensis* and never with *M. polygnathiformis*, the latter occurring in beds containing *T. aon* (Neri et al., 1995).

Systematic Paleontology

Genus *Budurovignathus* Kozur, 1988

1973 *Carinella* Budurov, p. 799.
1988 *Sephardiella* March et al., p. 247.

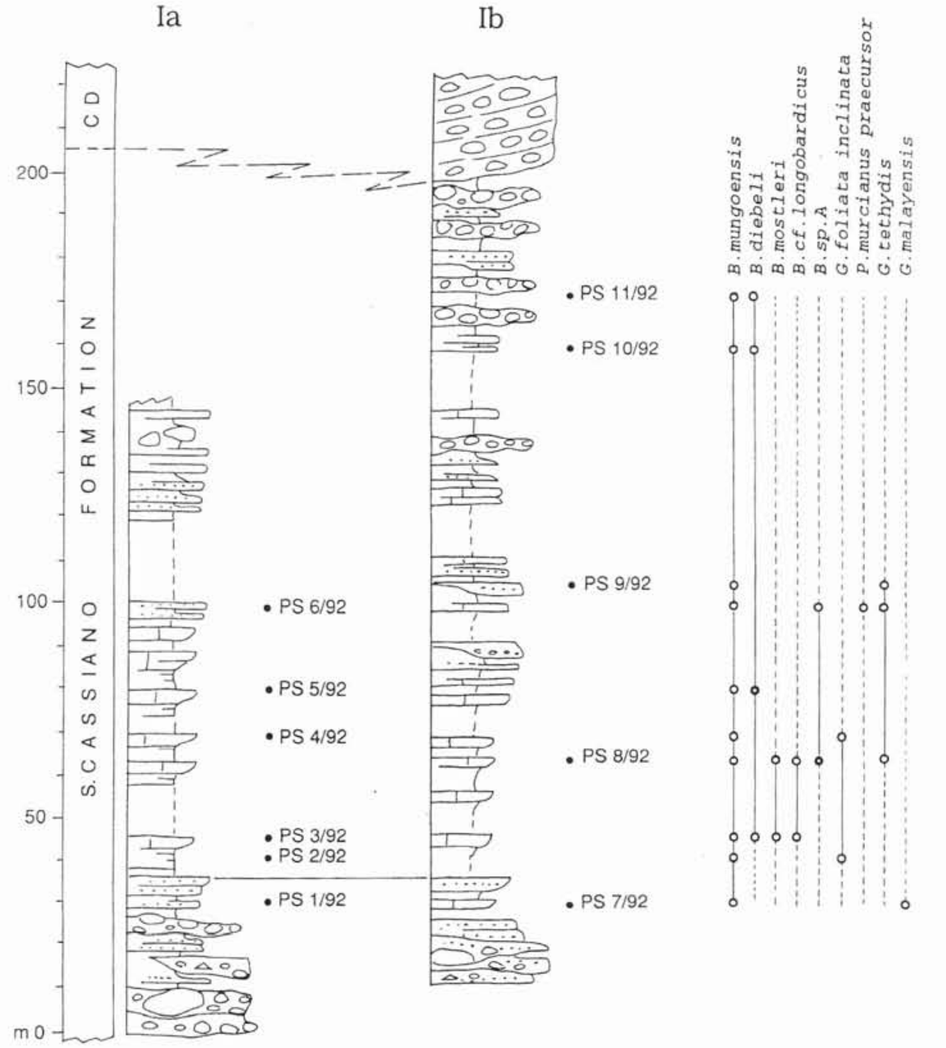
Type species: *Polygnathus mungoensis* Diebel, 1956

Budurovignathus diebeli (Kozur & Mostler, 1971)

Pl. 1, fig. 5-8

1971 *Tardogondolella diebeli* Kozur & Mostler, pp. 13-14, pl. 2, fig. 1, 2 (*non* fig. 3).
1975 *Epigondolella diebeli* - Krystyn in Kristan-Tollmann & Krystyn, p. 273, pl. 2, fig. 5-7, pl. 3, fig. 5 (*non* fig. 6).
1980 *Metapolygnathus diebeli* - Kovacs & Kozur, pl. 7, fig. 9; pl. 10, fig. 7-9.
1980 *Carinella diebeli* - Krystyn, pl. 11, fig. 6.
1983 "*Epigondolella*" *diebeli* - Krystyn, pl. 8, fig. 7-9.
1987 *Carinella diebeli* - Vrielynck, pp. 123-124, pl. 1, fig. 13-15.
1989 *Budurovignathus diebeli* - Kozur, pl. 12, fig. 3.
1990 *Carinella diebeli* - Budurov & Sudar, p. 214, pl. 3, fig. 1-8.
1994 *Budurovignathus diebeli* - Neri et al., pl. 1, fig. 5.
1995 *Budurovignathus diebeli* - Neri et al., pl. 2, fig. 2-4.

Remarks. The holotype of *B. diebeli* illustrated by Kozur & Mostler (1971, pl. 2, fig. 1) shows strong nodes developed on both margins of the platform and a broad and approximately rectangular posterior end. Some of our specimens (e.g., Pl. 1, fig. 5) have a more rounded



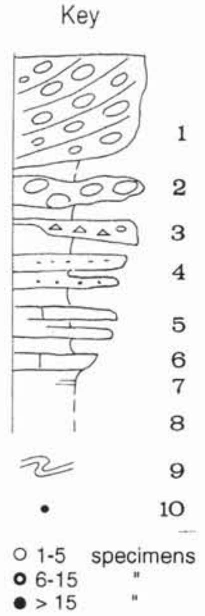


Fig. 4 - Sella Pass stratigraphic sections and distribution of conodont species. See Fig. 2 for location. CD, Cassian Dolomite. Symbols: see Fig. 4. Symbols: 1) clinostratified slope deposits of the Cassian Dolomite; 2) olistolith swarms; 3) carbonate breccia; 4) volcaniclastic turbidites; 5) carbonate, mainly bioclastic, turbidites; 6) micritic limestone; 7) pelites and marls; 8) covered interval; 9) slumps; 10) conodont sample.

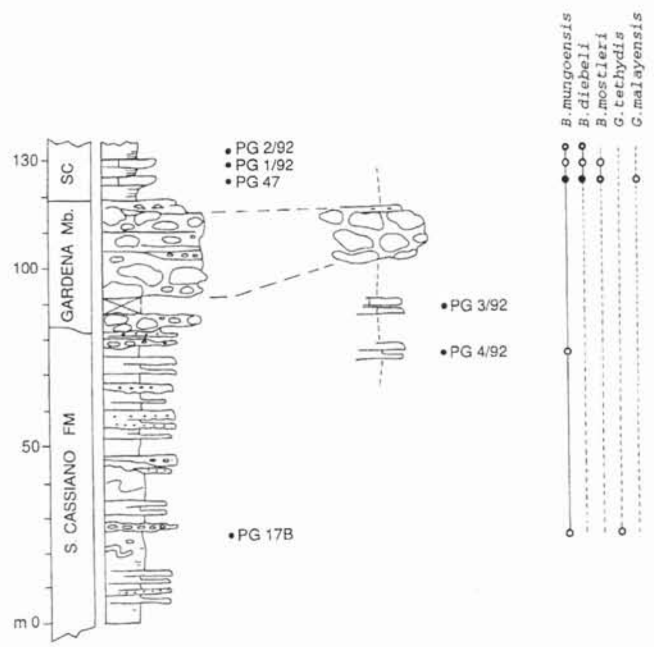


Fig. 5 - Gardena Pass stratigraphic section and distribution of conodont species. See Fig. 2 for location. Symbols: see Fig. 4.

platform posterior end similar to the specimens from Greece illustrated by Krystyn (1983, pl. 8, fig. 7, 8) and referred to *B. diebeli*.

The outline platform of these specimens resembles that of *B. longobardicus* (Kovacs) but they have more rounded and stronger marginal denticles than *B. longobardicus*. Both forms with a rounded or rectangular platform occur in the same samples. Microreticulation covers most of the platform, including nodes, and it is absent only in the adcarinal area. The keel is commonly bifurcated posterior to the pit.

Range. Upper Longobardian (Regoledanus Zone), *diebeli* A.Z. (Krystyn, 1983). Late Ladinian-Early Carnian (*mungoensis* A.Z. - *diebeli* A.Z.) (= the uppermost part Maclearni - Sutherlandi - Aonoides Zones Kozur & Mostler, 1971; Kozur, 1980; Kozur & Kovacs, 1980; Budurov & Sudar, 1990).

Budurovignathus cf. **longobardicus** (Kovacs, 1983)

Pl. 2, fig. 6

cf. 1983 *Metapolygnathus longobardicus* Kovacs, pp. 115-116, pl. 6, fig. 1.

Remarks. The specimens studied share some similarities with *B. longobardicus*, having parallel platform margins, the posterior part of the platform lacking marginal nodes and a broad platform end. They differ from *B. longobardicus* in having rounded anterior marginal nodes (two on each side) that do not continue in ridges toward the carina. Furthermore, in lower view, the basal cavity is relatively more broad and flat and has only slightly raised edges.

Range. At present this species is known only from Upper Longobardian in Northern Hungary.

Budurovignathus mostleri (Kozur, 1972)

Pl. 2, fig. 1-3

1972 *Epigondolella mostleri* Kozur in Kozur & Mock, pp. 9-10, pl. 1, fig. 8.
1980 *Metapolygnathus mostleri* - Kovacs & Kozur, pl. 8, fig. 4.
1983 *Metapolygnathus mostleri* - Kovacs, pl. 6, fig. 2.
1983 *"Epigondolella" mostleri* - Krystyn, pl. 8, fig. 4-6.
1992 *"Epigondolella" diebeli* - Chhabra & Kumar, pl. 4, fig. 10.
1994 *Budurovignathus mostleri* - Neri et al., pl. 1, fig. 3.
1995 *Budurovignathus mostleri* - Neri et al., pl. 2, fig. 11-12.

Remarks. A *Budurovignathus* with a symmetrically pointed platform to the posterior end; discrete, thin, sharp marginal denticles and a prominent continuous carina that extends to the posterior end of the unit. The symmetrical platform of *B. mostleri* differs from that of *B. mungoensis* which has one posterolateral lobe more strongly developed than the other and stronger, more rounded marginal nodes, absent on the posterior platform.

The platform outline of *B. mostleri* is similar to that of *B. japonica japonica* (Hayashi) from which *B. mostleri* would have developed according to Kozur (in Kozur & Mock, 1972, p. 10). *B. mostleri* can be distinguished from *B. japonica japonica* by the presence of denticles on the platform margins.

B. longobardicus has a broad, undenticulated platform end and marginal nodes developing into ridges.

Range. Upper part of the Longobardian (Regoledanus Zone *pars.*) upper part of *diebeli* A.Z. (Krystyn, 1983). Upper Longobardian - Cordevolian (Sutherlandi - Aonoides Zones) *mungoensis* A.Z. - *mostleri* A.Z.or *diebeli* A.Z. *sensu* Kozur 1980.

Budurovignathus mungoensis (Diebel, 1956)

Pl. 1, fig. 9-10

1956 *Polygnathus mungoensis* Diebel, pp. 431-432; pl. 1, fig. 1-20; pl. 2, fig. 1-4; pl. 3, fig. 1; pl. 4, fig. 1.
1970 *Epigondolella mungoensis* - Huddle, p. 127, fig. 2a-h.
1973 *Tardogondolella mungoensis mungoensis* - van den Boogaard & Simon, p. 17, pl. 1, fig. c; pl. 2, fig. a-b.
1980 *Metapolygnathus mungoensis* - Kovacs & Kozur, pl. 7, fig. 3.
1989 *Budurovignathus mungoensis* - Kozur, p. 417, pl. 11, fig. 5, pl. 13, fig. 1.
1990 *Budurovignathus mungoensis* - Sadeddin, p. 376, fig. 5.3 (*cum syn.*).
1990 *Sephardiella mungoensis* - March et al., p. 198, pl. 1, fig. a-p.
1994 *Budurovignathus mungoensis* - Neri et al., pl. 1, fig. 1.
1995 *Budurovignathus mungoensis* - Neri et al., pl. 2, fig. 7-9.

Remarks. The strong asymmetry of the posterior platform distinguishes this species from the other Upper Ladinian - Lower Carnian species.

The specimens studied show the typical features of *B. mungoensis*: a marked asymmetric platform with marginal nodes, and a distinct free blade and basal cavity shifted in the anterior third of the platform. The larger development of one of the posterolateral lobes distinguishes this species from *B. diebeli*, in which the platform margins are straight towards the posterior end. In transitional forms between these two species there is a tendency to develop a posteriorly continuous carina with an increase in size of the marginal nodes. The tendency of the marginal nodes to extend in ridges towards the carina and to form the second posterior lobe with the beginning of a bifurcated loop appears rather pronounced in some specimens.

Range. Late Ladinian worldwide (Mosher, 1968). Middle to Late Longobardian (upper Gredleri to the upper part of the Regoledanus Zones) *mungoensis* A.Z. (Krystyn, 1983). According to Kozur (1980), Kozur & Kovacs (1980) this species extends from the Upper Ladinian to the Cordevolian (Archelaus - Aon Zones).

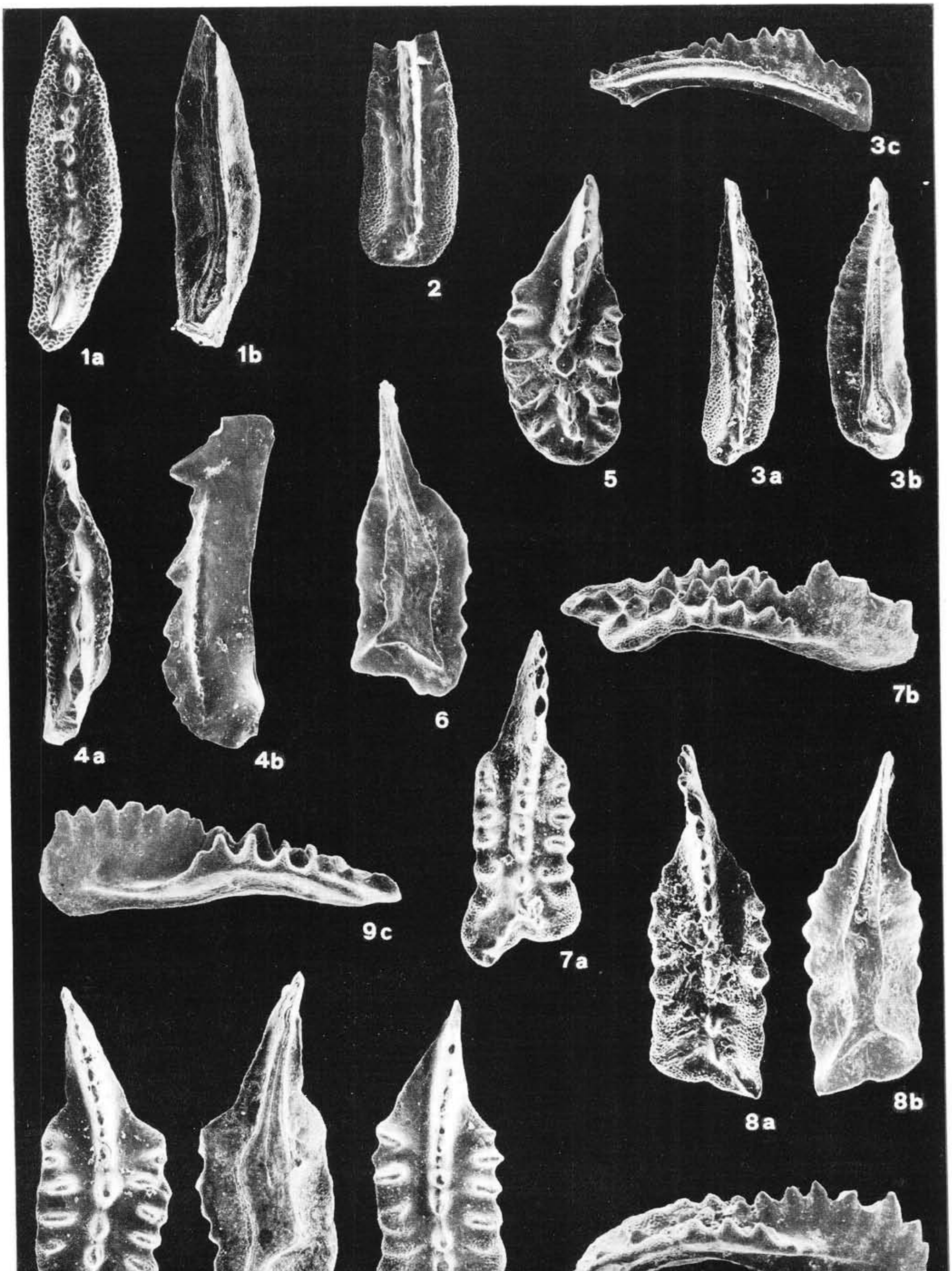
Budurovignathus sp.A

Pl. 2, fig. 7-9

PLATE 1

Upper Ladinian conodonts from Sella Pass (PS) and Gardena Pass (PG) sections.

Fig. 1a-b - *Gladigondolella malayensis malayensis* Nogami. 1a) Upper view; 1b) lower view; PG 47; x 100.
Fig. 2, 3a-c - *Gondolella foliata inclinata* Kovacs. 2) Upper view; PS 2; x 110. 3a) Upper view; 3b) lower view; 3c) lateral view; PS 4; x 110.
Fig. 4a-b - *Gladigondolella tethydis* (Huckriede). 4a) Upper view; 4b) lateral view; PS 9; x 130.
Fig. 5, 6, 7a-b, 8a-c - *Budurovignathus diebeli* (Kozur & Mostler). 5) Upper view; PS 10; x 100. 6) Lower view; PG 47; x 100. 7a) Upper view; 7b) upper-lateral view; PG 47; x 100. 8a) Upper view; 8b) lower view; 8c) lateral view; PS 3; x 120.
Fig. 9a-c, 10 - *Budurovignathus mungoensis* (Diebel). 9a) Upper view; 9b) lower view; 9c) lateral view; PS 10; x 100. 10) Upper view; PS 11; x 100.


1a
1b
2
3c
5
3a
3b
4a
4b
6
7b
7a
9c
8a
8b
9a
9b
10
8c

Diagnosis. A *Budurovignathus* characterized by prominent, rounded denticles present only on the anterior platform margins (two on each side), and a flat, broad, undenticulated posterior platform with a prominent, large denticle that dominates the centre of the posterior platform. This denticle is completely separated by a space from the last carinal denticle.

The carina, composed of large denticles, ends at about half of the platform length. A small pit is located beneath the anterior third of the platform; the keel is wide and flat with slightly raised edges.

Description. Slightly asymmetrical platform, with two denticles on the anterior margins. The posterior platform is flat, broad and undenticulated, with a prominent, large denticle in its centre. This denticle is completely separated by a large space from the last carinal denticle.

A microreticulation covers the margins of the platform, including the marginal denticles, but it is absent in the adcarinal area. The free blade shows its maximum height in the anterior part and is composed of four or five denticles that form a convex crest. The carina is composed of large denticles that end at about mid-length of the platform. In profile, the unit is arched and turned down anteriorly.

The lower surface has a small pit in the anterior third of the platform and the keel is wide, flat with slightly raised edges. Large elements (e.g. Pl. 2, fig. 9) show an increased platform with posterolateral expansion.

Remarks. *Budurovignathus* sp. A differs from *Budurovignathus longobardicus* in having a broad posterior platform with one prominent denticle at its centre, and rounded anterior marginal denticles. Furthermore, in profile the former is much more arched posteriorly. *B. mungoensis* and *B. diebeli* have a denticulated platform and a continuous carina that extends to the posterior end of the platform.

Range. Upper Longobardian (*diebeli* A.Z. *sensu* Krystyn, 1983). *Budurovignathus* sp. A occurs in association with *Budurovignathus mungoensis*, *B. mostleri*, *B.* cf. *longobardicus* and *Gladigondolella tethydis*.

Gondolella foliata inclinata Kovacs, 1983

Pl. 1, fig. 2-3

1983 *Gondolella foliata inclinata* Kovacs, pp. 110-112, pl. 1, fig. 1-4; pl. 3, fig. 2-4 (*cum syn.*).
1983 *Gondolella inclinata* - Krystyn, p. 239, pl. 4, fig. 1, 2; pl. 5, fig. 1, 2; ? pl. 3, fig. 5.
1987 *Gondolella inclinata* - Vrielynck, pp. 140-141, pl. 4, fig. 4-9.
1990 *Paragondolella inclinata* - Catalano et al., pl. 2, fig. 2.
1990 *Paragondolella foliata* - Budurov & Sudar, p. 210, pl. 1, fig. 3-6 (holotype of *G. foliata inclinata*).
1992 *Neogondolella inclinata* - Chhabra & Kumar, pl. 4, fig. 8-11, 13, 15.
1994 *Neogondolella foliata inclinata* - Neri et al., pl. 1, fig. 4.
1995 *Neogondolella foliata inclinata* - Neri et al., pl. 2, fig. 10, 14, 20.

Remarks. The specimens studied show the typical characteristics of *G. foliata inclinata*. They are slender, elongated with thickened upturned margins and a basal edge always arched before the pit.

According to Kovacs (1983, p. 111) *G. foliata inclinata* evolved from *Gondolella excelsa* (Mosher); the latter is distinguished by its high anterior carina, flat platform and never upturned margins. Krystyn (1983, p. 239) elevated this subspecies to species, whereas Budurov & Sudar (1990, p. 210) consider *G.foliata inclinata* as a synonym of *G.foliata* (Budurov).

Range. Base of Longobardian to Late Julian, *mungoensis* A.Z - *auriformis* Z. (upper Gredleri Zone to upper Austriacum Zone) (Kovacs & Kozur, 1980; Kovacs, 1983; Krystyn, 1983).

Genus *Pseudofurnishius* Van den Boogaard, 1966

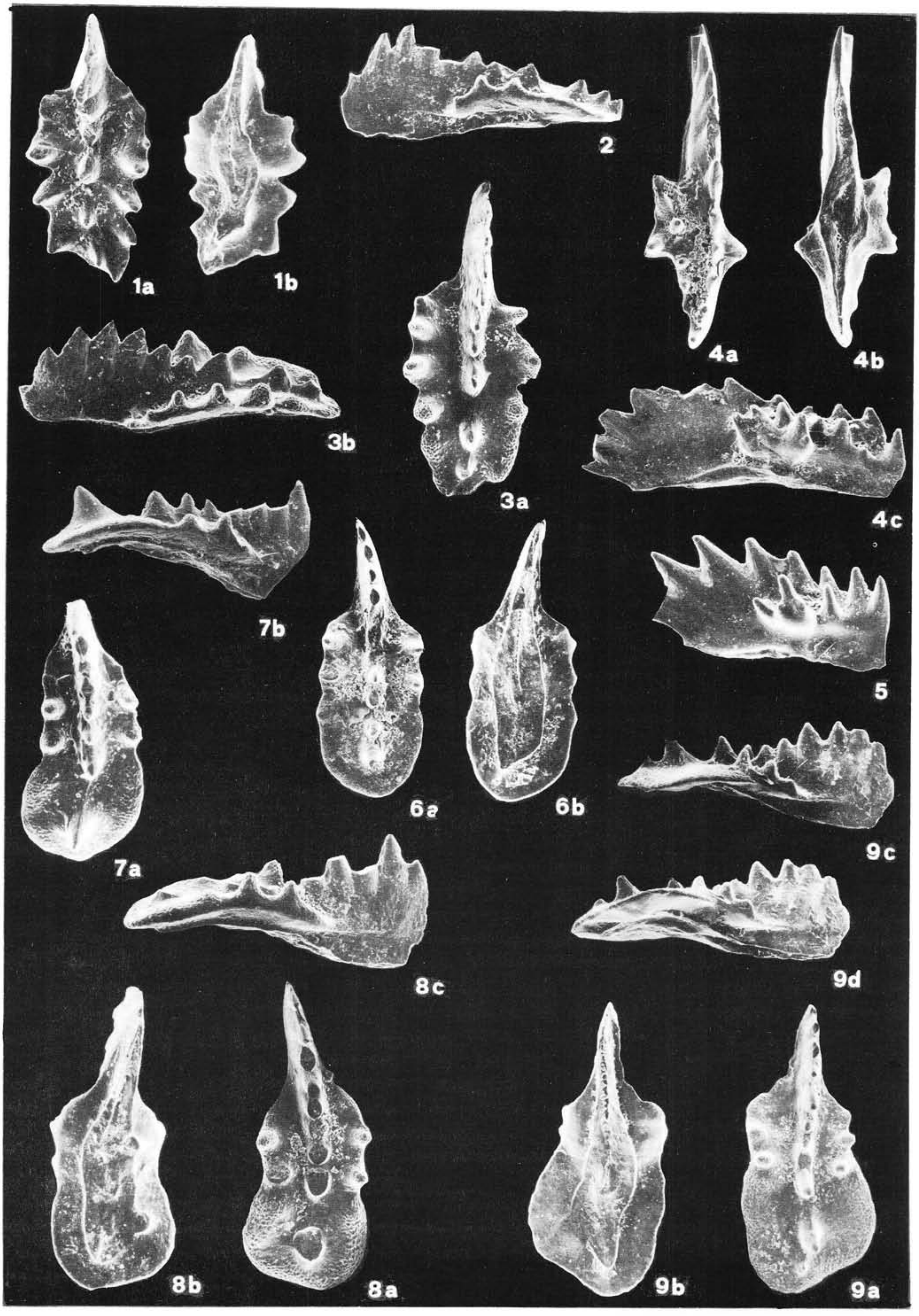
Type species: *Pseudofurnishius murcianus* Van den Boogaard, 1966

Remarks. Diebel (1956, p. 432) found some specimens from Cameroon that he assigned to *Spathognathodus* ? sp.inc. In the description he regarded as anterior the part with the platforms and opposite to the inclination of the denticles of the blade. Van den Boogaard (1966) established for these forms the genus *Pseudofurnishius*. He considered the platforms as posterior and suggested an orientation opposite to that proposed by Diebel. Some authors (Sadeddin, 1990; Gullo & Kozur, 1989; 1991, Sadeddin & Kozur, 1992; Eicher & Mosher, 1974) follow Diebel's orientation, others favor Van den Boogaard's (Huddle, 1970; Van den Boogaard & Simon, 1973; Ramovs, 1977).

PLATE 2

Upper Ladinian conodonts from Sella Pass (PS) and Gardena Pass (PG) sections.

Fig. 1a-b, 2, 3a-b - *Budurovignathus mostleri* (Kozur). 1a) Upper view; 1b) lower view; PS 8; x 150. 2) Lateral view; PS 3; x 140. 3a) Upper view; 3b) upper- lateral view; PS 3; x 140.
Fig. 4 a-c, 5 - *Pseudofurnishius murcianus praecursor* Gullo & Kozur. 4a) Upper view; 4b) lower view; 4c) lateral view. 5) Lateral view; PS 6; x 140.
Fig. 6a-b - *Budurovignathus* cf. *longobardicus* (Kovacs). 6a) Upper view; 6b) lower view; PS 8; x 110.
Fig. 7a-b, 8a-c, 9a-d - *Budurovignathus* sp.A. 7a) Upper view; 7b) lateral view; PS 8; x 130. 8a) Upper view; 8b) lower view; 8c) lateral view; PS 8; x 130. 9a) Upper view; 9b) lower wiew; 9c) lateral view; 9d) lateral-lower view; PS 8; x 100.


1a
1b
2
3a
3b
4a
4b
4c
5
6a
6b
7a
7b
8a
8b
8c
9a
9b
9c
9d

In our opinion the orientation proposed by Diebel prevents confusion and it is consistent with other platform elements.

Pseudofurnishius murcianus praecursor

Gullo & Kozur, 1991

Pl. 2, fig. 4-5

1980 *Pseudofurnishius murcianus* n.subsp. Kovacs & Kozur, pl. 7, fig. 6.

1991 *Pseudofurnishius murcianus praecursor* Gullo & Kozur, p. 77, pl. 4, fig. 9; ? pl. 5, fig. 1, 2.

1994 *Pseudofurnishius murcianus praecursor* - Neri et al., pl. 1, fig. 2.

Remarks. Subspecies of *Pseudofurnishius murcianus* with a reduced, narrow outer platform, often denticulated and sometimes longer than the inner ones. Gullo & Kozur (1991, p. 77) established this subspecies on material from the Sosio Valley (Sicily) and Spain. The authors chose as holotype the specimen illustrated by Kovacs & Kozur 1980, pl. 7, fig. 6 as *Pseudofurnishius murcianus* n.subsp. from Spain. The holotype of *Pseudofurnishius murcianus praecursor* is relatively stumpy and shows a well developed inner platform with 5-6 denticles on its surface. The outer platform is reduced to a row of denticles along the blade. Both platforms extend towards the anterior end. Our specimens, instead, are very narrow, slender, with a quite wide inner platform, characterized by six denticles, two of which are situated on the platform margin, whereas the outer platform is very reduced, rudimentary, with only one denticle. On the lower surface, the basal cavity beneath the inner platform is located anteriorly, a little before the midsection of the unit, and extends anteriorly and posteriorly but does not reach the posterior end. In the paratype illustrated by Gullo & Kozur (1991, pl. 4, fig. 9) and Catalano et al. (1990, pl. 3, fig. 1) the basal cavity is shifted completely into the posterior part.

Elements of *Pseudofurnishius murcianus praecursor* have been regarded previously as falling within the variability of *P. murcianus* (Eicher & Mosher, 1974; Ramovs, 1977; Bandel & Waksmundski, 1985). On the contrary, Gullo & Kozur (1991) regarded this subspecies as a primitive form from which *P. murcianus murcianus* is derived. In the latter no outer platform is present.

According to Kozur (1972; 1980; 1989), Van Den Boogaard & Simon (1973), Hirsch (1973), Hirsch & Gerry (1974), Catalano et al. (1990) and Gullo & Kozur (1989; 1991) the bi-platform are stratigraphically older than the mono-platform elements. This opinion was confirmed by the discovery of the stratigraphically oldest forms (*Pseudofurnishius sosioensis* Gullo & Kozur, *Pseudofurnishius priscus* Sadeddin and *Pseudofurnishius siyalaensis* Sadeddin & Kozur) that are exclusively of the bi-platform type.

In the Stuores-Wiesen section (Pralongià, Dolomites) mono-platform forms of *Pseudofurnishius murcianus* occur in beds containing *Trachyceras aon*.

Range. Middle-Late Longobardian (middle and upper part of *mungoensis* A.Z. *sensu* Kozur 1980).

Discussion on the stratigraphic setting of the Cassian platforms.

The data reported above indicate that the S.Cassiano Formation surrounding the Sella Massif is Late Ladinian in age.

This conclusion raises the question of the correlation between the various Cassian platforms of the Dolomites (Fig. 7).

According to the current stratigraphic interpretation, the "Cassian" (or post-volcanic) succession of the Dolomites is characterized by *two* generations of carbonate platforms, either referred to the Late Ladinian-Carnian p.p. interval (Assereto et al., 1977; De Zanche et al., 1993), or considered to be confined within the Carnian (Cordevolian-Julian) (Bosellini & Doglioni, 1988; Masetti et al., 1991).

The data presented in this paper, as well as a review of data from the literature, indicate that the stratigraphic succession between the Ladinian volcanics and the Raibl Formation is far more complex than previously thought. The post-volcanic succession of the Western Dolomites is characterized by several, though not necessarily isochronous, episodes of growth and retreat of carbonate platforms. The older post-volcanic platforms are documented in the Sciliar-Cime di Terrarossa area (Brandner, 1991; Brandner et al., 1991; Yose, 1991; Fig. 1 and 7). According to these authors, two su-

<table>
<tr><th rowspan="2">Stage</th><th rowspan="2">Substage</th><th>AMMONOID ZONES</th><th colspan="2">CONODONT ZONES</th><th>AMMONOID ZONES</th><th rowspan="2">Substage</th><th rowspan="2">Stage</th></tr>
<tr><th colspan="2">(Krystyn, 1983)</th><th colspan="2">(Kozur, 1980)</th></tr>
<tr><td rowspan="2">CARNIAN</td><td rowspan="2">JULIAN</td><td rowspan="2">Aonoides</td><td rowspan="2">tadpole</td><td rowspan="3">diebeli</td><td>Aonoides</td><td rowspan="3">CORDEVOLIAN</td><td rowspan="3">CARNIAN</td></tr>
<tr><td>Aon</td></tr>
<tr><td rowspan="4">LADINIAN</td><td rowspan="4">LONGOBARDIAN</td><td>Regoledanus</td><td>diebeli</td><td>Sutherlandi</td></tr>
<tr><td rowspan="2">Archelaus</td><td rowspan="2">mungoensis</td><td rowspan="2">mungoensis</td><td>Macleami</td><td rowspan="3">LONGOBARDIAN</td><td rowspan="3">LADINIAN</td></tr>
<tr><td>Megine</td></tr>
<tr><td>Gredleri</td><td>hungaricus</td><td>hungaricus</td><td>Poseidon</td></tr>
</table>

Fig. 6 - Zonation of the Longobardian-Julian (Upper Ladinian-Lower Carnian) based on ammonoids and conodonts according to Krystyn (1983) and Kozur (1980).

perimposed platforms occur in the post-volcanic succession of this area where they interfinger with volcaniclastic sediments (Marmolada Conglomerate, Wengen Formation). The lower platform progrades on a substrate represented by volcanic products (pillow-breccia and pillow-lavas). These platforms are assigned to the Archelaus Zone on the basis of the finding of a specimen of *Protrachyceras archelaus* near the top of the so-called "Schlernplateu beds", interpreted as the back-reef deposits of the second post-volcanic platform (Brandner, 1991, p. 9, fig. 4).

The younger Cassian platforms are represented by several dolomitic massifs located in the central-eastern Dolomites (Fig. 7): the Richthofen Riff-Sett Sass Mts., the Lagazuoi Mt. and its northern and eastern terminations, the Gusela del Nuvolau Mt., the upper carbonate bodies of the Dürrenstein Mt. (Picco di Vallandro) (Schlager et al., 1991). Chronostratigraphically, the best known platforms are probably represented by the Richthofen Riff and Sett Sass Mts. (Fig. 1 and 7), that correspond to the Lower and Upper Cassian Dolomite (Assereto et al., 1977) and to the Cassian Dolomite 1 and 2 respectively (De Zanche et al., 1993; De Zanche & Gianolla , 1995). Urlichs (1974; 1994) attributed the Richthofen Riff to the Aon Zone and the lower part of the Sett Sass platform to the Aonoides Zone. More recently, De Zanche et al. (1993), De Zanche & Gianolla (1995), Gianolla (1995) assigned the Cassian Dolomite 1 (Richthofen Riff) to the interval comprising the very top of Regoledanus Subzone, the *Daxatina* cf. *canadensis* Subzone and the lowermost part of the Aon Subzone (*sensu* Mietto & Manfrin, 1995a; 1995b). In the standard stratigraphic scale of the Triassic (Zapfe, 1983), accepted by the authors of the present paper, the *Daxatina* cf. *canadensis* Subzone of Mietto & Manfrin (1995a; 1995b) corresponds to the upper part of the Regoledanus Zone. Consequently, the Cassian Dolomite 1 is mostly Late Ladinian in age, although its uppermost part may be attributed to the Early Carnian. The so called "Cassian Dolomite 2" (e.g., Sett Sass Mt.) is considered Carnian in age. Chronostratigraphic data supporting this interpretation are based on:

a) the S. Cassiano Formation onlapping the Richthofen Riff (Urlichs, 1974; 1994);

b) the basin succession outcropping at Cian Zoppè-Milieres, near the eastern termination of the Lagazuoi platform (Bizzarini & Braga, 1987; Bizzarini et al., 1986; 1989);

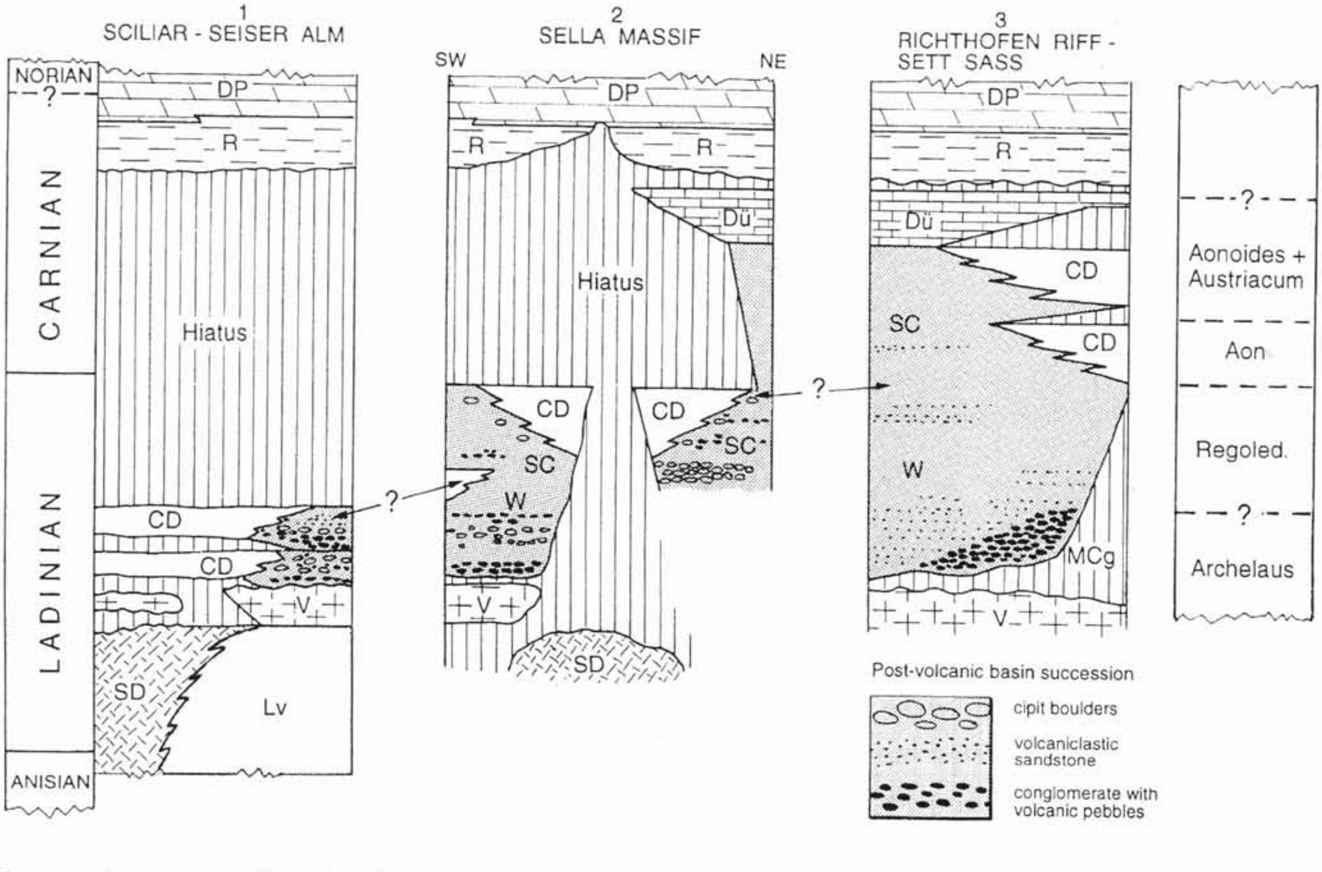


Fig. 7 - Chronostratigraphic setting of the Sella platform compared with the successions of Sciliar-Seiser Alm (from Brandner, 1991; Brandner et al., 1991) and of Sett Sass-Richthofen Riff (from Urlichs 1974; 1994; Neri et al., 1995). Abbreviations: SD, Sciliar Dolomite; Lv, Livinallongo Formation; V, volcanics; MCg, Marmolada Conglomerate; Cp, swarms and lenses of carbonate olistoliths (Cipit boulders); W, Wengen Formation; CD, Cassian Dolomite *sensu latu* (referred to all the post-volcanic platforms); SC, S. Cassiano Formation; Dü, Dürrenstein Dolomite; R, Raibl Formation; DP, Dolomia Principale.

c) the S. Cassiano Formation of the Cortina basin lateral to the upper Cassian platform (e.g., the Tamarin section, Mastandrea, 1994; Baracca, 1996).

On the basis of these sections, the uppermost generation of Cassian platforms may be referred to the Aonoides and Austriacum Zones of the Julian substage.

The Sella Platform, assigned to the latest Ladinian (Regoledanus Zone), occupies an intermediate position between the older and younger carbonate platforms. It is younger than the post-volcanic platforms of the Sciliar-Denti di Terrarossa area (Archelaus Zone) and older than the latest Cassian platforms such as Sett Sass, Nuvolau, Lagazuoi. It is conceivable that a considerable chronologic overlapping exists between the Sella Platform and the so called "Cassian Dolomite 1" of De Zanche et al. (1993). We have no age data on some carbonate bodies such as Sass Beccè, at the Pordoi Pass (Fig. 2), tentatively correlated to the second post-volcanic platform of the Denti di Terrarossa area (Fig. 7).

In conclusion, a conservative interpretation suggests at least four episodes of growth of carbonate platforms in the Dolomites (Fig. 7). It is thus clear that a sequence stratigraphic model based on two generations of carbonate platforms has to be rejected or significantly modified. A further aspect of the problem regards the type of control on the sequence stratigraphic organization: eustatic or tectonic? This question also addresses the meaning of the several wedges of carbonate olistoliths embedded in the post-volcanic basin succession. As pointed out by previous papers (e.g., Yose, 1991), the classic interpretation of the carbonate megabreccias as lowstand deposits cannot be dogmatically accepted, inferring that the eustatic control on the vertical stacking of different generations of carbonate platforms cannot be unequivocally proven.

The considerable number of post-volcanic carbonate platform episodes, the frequent occurrence of carbonate megabreccia wedges and the wide hiatuses separating the platforms both from their substrate and the overlying formations (Raibl, Dolomia Principale) suggest that the development of the "Cassian" carbonate bodies occurred in a complex paleogeographic setting. Platforms nucleated on paleohighs, at different times (Fig. 7). It is sometimes difficult to resolve with biostratigraphical tools the real succession of events, as the chronologic interval involved is relatively short (a few million years). Probably, the main control on growth, retreat and dismantling of platforms was of tectonic nature, especially in the late Ladinian, at the time of the huge megabreccia bodies embedded within Wengen-like deposits.

If this interpretation is correct, it is clear that the Cassian succession of the Dolomites cannot be a reliable standard for global sequence stratigraphic correlations.

Acknowledgements.

The authors are grateful to G. Leonardi for graphical support.

The manuscript was improved by a careful review by A. Nicora (Milano) and S. Kovacs (Budapest). English revision by E. Fois.

Financial support: MURST grant 40% (E. Serpagli, Modena; A. Bosellini, Ferrara) and CNR 96.00364 (F. Russo, Università della Calabria, CS).

REFERENCES

Assereto R., Brusca C., Gaetani M. & Jadoul F. (1977) - The Pb-Zn mineralization in the Triassic of the Dolomites. Geological history and genetic intepretation. *Ind. Miner.*, v. 28, pp. 267-302, Roma.

Bandel K. & Waksmundski B. (1985) - Trias conodonts from Jordan. *Acta Geol. Polonica*, v. 35, n. 3/4, pp. 288-304, Warzawa.

Baracca A. (1996) - Ammoniti e biostratigrafia del Ladinico sup.-Carnico delle Dolomiti (Triassico medio-sup., Alpi Meridionali). Tesi di dottorato inedita, Università di Modena.

Bizzarini F. & Braga G.P. (1987) - Considerazioni bio e litostratigrafiche sulla Formazione di S. Cassiano (Dolomiti Nord-Orientali, Italia). *Studi Trent. Sci. Nat., Acta Geol.*, v. 64, pp. 39-56, Trento.

Bizzarini F., Laghi G.F., Russo F. & Urlichs M. (1986) - Preliminary biostratigraphic correlation between Ampezzo basin sections and the Cordevolian stratotype (Late Triassic, Italian Dolomites). *Lavori Soc. Veneta Sc. Nat.*, v. 11, pp. 151-158, Venezia.

Bizzarini F., Laghi G.F., Nicosia U. & Russo F. (1989) - Distribuzione stratigrafica dei microcrinoidi (Echinodermata) nella Formazione di S. Cassiano (Triassico superiore, Dolomiti): studio preliminare. *Atti Soc. Nat. Mat. Modena*, v. 120, pp. 1-14, Modena.

Boogaard M.van den (1966) - Post-Carboniferous conodonts from south-eastern Spain. *Proc. Kon. Ned. Akad. Wet.*, v. 69, pp. 691-698, Amsterdam.

Boogaard M.van den & Simon O. (1973) - *Pseudofurnishius* (Conodonta) in the Triassic of Betic Cordilleras, SE Spain. *Scripta Geol.*, v. 16, pp. 1-18, Leiden.

Bosellini A. (1982) - Geologia dei Passi dolomitici circostanti il Gruppo del Sella. In Castellarin A. & Vai G.B. (Eds.) - Guida alla Geologia del Sudalpino Centro-orientale. *S.G.I. Guide Geologiche Regionali*, pp. 267-272, Bologna.

Bosellini A. (1984) - Progradation geometries of carbonate platform: examples from the Triassic of the Dolomites, northern Italy. *Sedimentology*, v. 31, pp. 1-24, Amsterdam.

Bosellini A. (1991) - Geology of the Dolomites. An Introduction. *Dolomieu Conference on Carbonate Platforms and Dolomitization*, pp. 1-43, Ortisei.

Bosellini A., Castellarin A., Doglioni C., Guy F., Peri M.C., Rossi P.M., Simboli G. & Sommavilla E. (1982) - Geologia della conca di Arabba e dei rilievi circostanti. In Castellarin A. & Vai G.B. (Eds.) - Guida alla Geologia del Sudalpino Centro-orientale. *S.G.I. Guide Geologiche Regionali*, pp. 243-254, Bologna.

Bosellini A. & Doglioni C. (1988) - Progradation geometries of Triassic carbonate platforms of the Dolomites and their large-scale physical stratigraphy. *AAPG mediterranean Basins Conference, Field Trip*, Guidebook 42 pp., Nice.

Bosellini A., Lobitzer H., Brandner R., Resch W. & Castellarin A. (1980)- The complex basins of the Calcareous Alps and paleomargins. 26 Int. Geol. Congress, Exc. 129 C, *Abh. Geol. B.-A.*,v. 34, pp. 287-325, Wien.

Bosellini A. & Neri C. (1991) - The Sella Platform (Upper Triassic, Dolomites, Italy). *Dolomieu Conference on Carbonate Platforms and Dolomitization, Guidebook Excursion B*, pp. 1-30, Ortisei.

Bosellini A. & Rossi R. (1974) - Triassic carbonate buildups of the Dolomites, northern Italy. In Laporte L.F. (Ed.) - Reefs in Time and Space. *SEPM Spec. Publ.*, v. 18, pp. 209-233, Tulsa.

Brandner R. (1991) - Geological setting and stratigraphy of the Schlern-Rosengarten buildup and Seiser Alm basin. In Brandner R., Flügel E., Koch R. & Yose L.A.- The northern margin of the Schlern/Sciliar-Rosengarten/Catinaccio platform. *Dolomieu Conference on Carbonate Platform and Dolomitization, Guidebook Excursion A*, pp. 4-16, Ortisei.

Brandner R., Flügel H. & Senowbari-Daryan B. (1991) - Microfacies of carbonate slope boulders: indicator of the source area (Middle Triassic: Mahlknecht Cliff, Western Dolomites). *Facies*, v. 25, pp. 279-296, Erlangen.

Budurov K.J. (1973) - *Carinella* n.gen. und revision der Gattung *Gladigondolella* (Conodonta). *C.R. Acad. Bulg. Sci.*, v. 26, n. 6, pp. 799-802, Sophia.

Budurov K.J. & Sudar M.N. (1990) - Late Triassic Conodont Stratigraphy. *Courier Forsch.-Inst. Senckenberg*, v. 118, pp. 203-239, Frankfurt a. M.

Catalano R., Di Stefano P., Gullo M. & Kozur H. (1990) - *Pseudofurnishius* (Conodonta) in pelagic Late Ladinian - Early Carnian sediments of western Sicily and its stratigraphic and paleogeographic significance. *Boll. Soc. Geol. It.*, v. 109, pp. 91-101, Roma.

Chhabra N.L. & Kumar S. (1992) - Late Scythian through Early Carnian conodont assemblages and their biostratigraphic importance from off shore carbonates of northern Kumaun, Tethys Himalaya, India. *Rev. Micropaléont.*, v. 35, n. 1, pp. 3-21, Paris.

Diebel K. (1956) - Conodonten in der Oberkreide von Kamerun. *Geologie*, v. 5, pp. 424-450, Berlin.

De Zanche V., Gianolla P., Mietto P., Siorpaes C. & Vail P.R. (1993) - Triassic sequence stratigraphy in the Dolomites (Italy). *Mem. Sc. Geol.*, v. 45, pp. 1-27, Padova.

De Zanche V. & Gianolla P. (1995) - Litostratigrafia al limite Ladinico-Carnico (Sudalpino orientale). *Annali Università di Ferrara*, 5 (Supplemento), pp. 41-48, Ferrara.

Eicher D.B. & Mosher L.C. (1974) - Triassic conodonts from Sinai and Palestine. *Journ. Paleont.*, v. 48, n. 4, pp. 727-739, Tulsa.

Fois E. & Gaetani M. (1980) - The northern margin of the Civetta buildup. Evolution during the Ladinian and the Carnian. *Riv. It. Paleont. Strat.*, v. 86, pp. 469-541, Milano.

Gianolla P. (1995) - Stratigrafia sequenziale al limite Ladinico-Carnico (Sudalpino orientale). *Annali Università di Ferrara*, 5 (Supplemento), pp. 49-57, Ferrara.

Gullo M. & Kozur H. (1989) - *Pseudofurnishius sosioensis* n.sp., a new conodont species from the Late Ladinian of Sosio valley, western Sicily (Italy). *Geol. Paläont. Mitt. Ibk.*, v. 16, pp. 207-211, Innsbruck.

Gullo M. & Kozur H. (1991) - Taxonomy, Stratigraphic and Paleogeographic significance of the Ladinian-Early Carnian conodont genus *Pseudofurnishius*. *Palaeontographica Abt. A*, v. 218, pp. 69-86, Stuttgart.

Hirsch F. (1973) - Middle Triassic conodonts from Israel, southern France and Spain. *Mitt. Ges. Geol. Berbaustud.*, v. 21, pp. 811-828, Innsbruck.

Hirsch F. & Gerry E. (1974) - Conodont- and Ostracode-biostratigraphy of the Triassic in Israel. In Zapfe H. (Ed.) - Die stratigraphie der alpin-mediterranen Trias. *Österr. Akad. Wiss. Schriftenr. Erdwiss. Komm.*, v. 2, pp. 107-114, Wien.

Huddle J.W. (1970) - Triassic conodonts from Israel. *U.S. Geol. Surv. Prof. Pap.*, n.700-B, pp. 124-130, Washington.

Kenter J.A.M. (1990) - Carbonate platform flanks: slope angle and sediment fabric. *Sedimentology*, v. 37, pp. 777-794, Amsterdam.

Kovacs S. (1983) - On the evolution of *excelsa*-stock in the Upper Ladinian - Carnian (Conodonta, Genus *Gondolella*, Triassic). *Österr. Akad. Wiss., Schriftenr. Erdwiss. Komm.*, v. 5, pp. 107-120, Wien.

Kovacs S. & Kozur H. (1980) - Stratigraphische Reichweite der wichtigsten Conodonten (ohne Zahnreihenconodonten) der Mittel - und Obertrias. *Geol. Paläont. Mitt. Ibk.*, v. 10, n. 2, pp. 47-78, Innsbruck.

Kozur H. (1972) - Die Conodontengattung *Metapolygnathus* Hayashi 1968 und ihr stratigraphischer Wert. *Geol. Paläont. Mitt. Ibk.*, v. 2, n. 11, pp. 1-37, Innsbruck.

Kozur H. (1980) - Revision der Conodontenzonierung der Mittel- und Obertrias des tethyalen Faunenreichs. *Geol. Paläont. Mitt. Ibk.*, v. 10, pp. 79-172, Innsbruck.

Kozur H. (1989) - The taxonomy of the gondolellid conodonts in the Permian and Triassic. *Courier Forsch. -Inst. Senckenberg*, v. 117, pp. 409-469, Frankfurt a. M.

Kozur H. & Mock R. (1972) - Neue Conodonten aus der Trias der Slowakei und ihre stratigraphische Bedeutung. *Geol. Paläont. Mitt. Ibk.*, v. 2, pp. 1-20, Innsbruck.

Kozur H. & Mostler H. (1971) - Probleme der Conodontenforschung in der Trias. *Geol. Paläont. Mitt. Ibk.*, v. 1, pp. 1-19, Innsbruck.

Kristan-Tollmann E. & Krystyn L. (1975) - Die Mikrofauna der ladinisch-karnischen Hallstatter kalke von Saklibeli

(Taurus-Gebirge, Turkei). *Sitzung. Österr. Akad. Wiss. math.-naturwiss. Kl., Abt.I*, v. 184, pp. 259-340, Wien.

Krystyn L. (1980) - Stratigraphy of the Hallstatt region. In Schönlaub H.P. (Ed.) - Second European Symposium. ECOS II. *Abh. Geol. B.-A.*, v. 35, pp. 61-98, Wien.

Krystyn L. (1983) - Das Epidaurus-Profil (Griechenland)-ein Beitrag zur Conodonten-Standardzonierung des tethyalen Ladin und Unterkarn. *Österr. Akad. Wiss. Schriftenr. Erdwiss. Komm.*, v. 5, pp. 231-258, Wien.

Leonardi P. (Ed.) (1967) - Le Dolomiti. Geologia dei monti tra Isarco e Piave. 2 V., 1019 pp., Edizioni Manfrini, Rovereto.

Leonardi P. & Rossi D. (1957) - La scogliera coralligena del Sella nelle Dolomiti occidentali. *Ann. Univ. Ferrara*, s. 9, v. 3, n. 1, pp. 1-36, Ferrara.

March M., Budurov K., Hirsch F. & Marquez-Aliaga A. (1988) - *Sephardiella* nov. gen. (Conodonta) emendation of *Carinella* (Budurov, 1973), Ladinian (Middle Triassic). In Ziegler W. (Ed.) - 1st International Senckenberg Conference and 5th European Conodont Symposium (ECOS V). Contributions I, part 2, *Courier Forsch. - Inst. Senckenberg*, v. 102, p. 247, Frankfurt a. M.

March M., Budurov K. & Hirsch F. (1990) - *Sephardiella* nov. gen. (Conodonta), emendation of *Carinella* (Budurov, 1973), from the Ladinian (Middle Triassic) type area in Catalonia (N.E. Spain), Sephardic Province. *Courier Forsch. -Inst. Senckenberg*, v. 118, pp. 197-201, Frankfurt a. M.

Masetti D., Neri C. & Bosellini A. (1991) - Deep-water asymmetric cycles and progradation of carbonate platforms governed by high-frequency eustatic oscillations (Triassic of the Dolomites, Italy). *Geology*, v. 19, pp. 336-339, Boulder.

Mastandrea A. (1994) - Carnian conodonts from Upper Triassic strata of Tamarin section (San Cassiano Fm., Dolomites, Italy). *Riv. It. Paleont. Strat.*, v. 100, pp. 493-510, Milano.

Mietto P. & Manfrin S. (1995a) - La successione delle faune ad ammonoidi al limite Ladinico-Carnico (Sudalpino, Italia). *Annali Università di Ferrara*, 5 (Supplemento), pp. 13-35, Ferrara.

Mietto P. & Manfrin S. (1995b) - A high resolution Middle Triassic ammonoid standard scale in the Tethys Realm. Preliminary report. *Bull. Soc. Géol. France*, v. 166, pp. 539-563, Paris.

Mojsisovics E. M. von (1879) - Die Dolomit-Riffe von Südtirol und Venetien. *Beiträge zur Bildungsgeschichte der Alpen*. 559 pp., Wien.

Mosher L.C. (1968) - Triassic conodonts from western North America and Europe and their correlation. *Journ. Paleont.*, v. 42, n. 4, pp. 895-946, Tulsa.

Neri C., Mastandrea A., Laghi G.F., Baracca A. & Russo F. (1994) - New biostratigraphic data on the S. Cassiano Formation around Sella Platform (Dolomites, Italy). *Paleopelagos*, v. 4, pp. 13-21, Roma.

Neri C., Russo F., Mastandrea A. & Baracca A. (1995) - Litostratigrafia, ammonoidi e conodonti della Formazione di S. Cassiano: la sezione dei Prati di Stuores (Stuores-Wiesen, Dolomiti). *Annali Università di Ferrara*, 5 (Supplemento), pp. 59-74, Ferrara.

Ogilvie M.M. (1893) - Contributions to the geology of the Wengen and St. Cassian Strata in Southern Tyrol. *Quart. Journ. Geol. Soc.*, v. 49, pp. 1-78, London.

Ogilvie Gordon M.M (1929) - Geologie des Gebietes von Pieve (Buchenstein), St. Cassian und Cortina d'Ampezzo. *Jahrb. Geol. B. Anst.*, v. 79, pp. 357-424, Wien.

Ramovs A. (1977) - Skellettapparat von *Pseudofurnishius murcianus* (Conodontophorida) im Mitteltrias Sloweniensis (NW Jugoslawien). *N. Jb. Geol. Pälaont. Abh.*, v. 3, pp. 361-399, Stuttgart.

Reithofer O. (1928) - Geologie der Sellagruppe (Südtiroler Dolomiten). *Jb. Geol. Bundensanst.*, v. 78, pp. 529-579, Wien.

Sadeddin W. (1990) - *Pseudofurnishius priscus* n.sp. (Conodonta) and its stratigraphical significance for the Ladinian (Middle Triassic) in Jordan. *N. Jb. Geol. Pälaont. Abh.*, v. 178, pp. 369-382, Stuttgart.

Sadeddin W. & Kozur H. (1992) - *Pseudofurnishius siyalaensis* n. sp. (Conodonta) from the Lower Ladinian of Wadi Siyala (Jordan). *N. Jb. Geol. Pälaont. Mh.*, pp. 359-368, Stuttgart.

Schlager W., Biddle K.T. & Stafleu J. (1991) - Picco di Vallandro (Dürrenstein) - A platform-basin transition in outcrop and seismic model. *Dolomieu Conference on Carbonate Platform and Dolomitization, Guidebook Excursion B*, pp. 1-22, Ortisei.

Urlichs M. (1974) - Zur Stratigraphie und Ammonitenfauna der Cassianer Schichten von St. Cassian (Dolomiten, Italien). *Österr. Akad. Wiss. Schriftenr. Erdwiss. Komm.*, v. 2, pp. 207-222, Wien.

Urlichs M. (1994) - *Trachyceras* Laube 1869 (Ammonoidea) aus dem Unterkarn (Obertrias) der Dolomiten (Italien). *Stuttgarter Beitr. Naturk., B*, n. 217, pp. 1-55, Stuttgart.

Vrielynck B. (1987) - Conodontes du Trias perimediterraneen. Systematique, stratigraphie. *Docum. Lab. Géol. Lyon*, v. 97 (1986), pp. 1-301, Lyon.

Yose L.A. (1991) - Sequence stratigraphy of mixed carbonate/volcaniclastic slope deposits flanking the Sciliar (Schlern)-Catinaccio buildup, Dolomites, Italy. In Brandner R., Flügel E., Koch R. & Yose L.A.- The northern margin of the Schlern/Sciliar-Rosengarten/Catinaccio platform. *Dolomieu Conference on Carbonate Platform and Dolomitization, Guidebook Excursion A*, pp. 17-39, Ortisei.

Zapfe H. (1983) - Das Forschungsprojekt "Triassic of the Tethys Realm" (IGCP Proj.4). Abschlussbericht. *Österr. Akad. Wiss. Schriftenr. Erdwiss. Komm.*, v. 5, pp. 7-16, Wien.

Received November 12, 1996; accepted January 31, 1997