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SELECTED AMMONOID FAUNA FROM PRATI DI STUORES/STUORES WIESEN AND RELATED SECTIONS ACROSS THE LADINIAN-CARNIAN BOUNDARY (SOUTHERN ALPS, ITALY)

PAOLO MIETTO[1], STEFANO MANFRIN[1], NEREO PRETO[1,2] & PIERO GIANOLLA[3]

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Abstract. The ammonoid fauna of the Prati di Stuores/Stuores Wiesen section (Dolomites, northeastern Italy) was studied in detail. This section was proposed and later adopted as stratotype for the Carnian GSSP, with the first appearance of *Daxatina* cf. *canadensis* as primary marker, based on preliminary data. The validity of this proposal is confirmed by the present study, which integrates collections from the Prati di Stuores/Stuores Wiesen section and from others, particularly Bec de Roces (Passo Campolongo) and Antersass (Badia Valley). Ammonoids collected in these localities belong to three biostratigraphic units: *regoledanus, canadensis* and *aon* subzones. These subzones constitute, in the Southern Alps, the Ladinian/Carnian boundary interval. *Regoledanus* Subzone: the north American species *Zestoceras enode* is most probably documented in this biostratigraphic interval here associated with *Frankites apertus*. Most probably the top of the subzone is characterized by the disappearance of the genus *Protrachyceras*. *Canadensis* Subzone: the base is marked by the first appearance of *Daxatina canadensis*, and at least, another north American species, *Daxatina laubei*, seems to be present. Two species of *Zestoceras* are found: *Z. barwicki* e *Z. lorigae* sp. n. Two species of *Trachyceras*, distinct from *T. aon*, are represented in the *canadensis* Subzone: *T. muensteri* and *T. bipunctatum*. These species predate the first appearance of *Trachyceras*, justifying the *canadensis* Subzone to be included in the Carnian also on the basis of nomenclatural stability. Other significant taxa of this subzone are *Rossiceras*? *armatum* and *Sirenotrachyceras thusneldae*. *Aon* Subzone: the ammonoid fauna of this subzone is extensively treated in existing literature and thus not further discussed. Taxonomical notes and stratigraphic consequences: the new subfamily Anolcitinae (family Trachyceratidae) is erected. At present, *Frankites regoledanus*, *F. apertus* and *F.* sp. A are recognized in the Southern Alps. The lectotype of *Ammonites (Trachyceras?) Regoledanus* is defined. The latter species is exclusive of the *regoledanus* Subzone, whereas the distribution of the two other species encompasses the defined GSSP. The shell morphology of *F. apertus* and the north American species *F. sutherlandi* is identical. The suture line is also comparable, hence these two species are considered synonyms. This synonymy is relevant for long-distance correlations. The lectotypes of *Trachyceras rutoranum* and *T. laricum* are also defined.

Riassunto. È stata studiata in dettaglio la fauna ad ammonoidi raccolta nella sezione di Prati di Stuores/Stuores Wiesen (Dolomiti, Italia nordorientale). Sulla base dei dati preliminari, tale sezione era stata proposta quale GSSP per la base del Carnico, utilizzando come criterio la prima comparsa di *Daxatina* cf. *canadensis* (Whiteaves, 1889). Nel giugno 2008 questa proposta è stata formalmente accettata. La revisione della fauna, integrata con lo studio del materiale raccolto in altre sezioni dolomitiche e, in particolare, in quelle di Bec de Roces (Passo Campolongo) e di Antersass (Val Badia), conferma in larga misura la validità della proposta. La fauna in questione va riferita a tre unità biostratigrafiche: sottozone a *regoledanus, canadensis*, *aon*, che costituiscono nel Sudalpino l'intervallo limite Ladinico-Carnico. La Sottozona a *regoledanus* è qui caratterizzata dalla presenza di *Zestoceras* cf. *enode* (Tozer, 1972), in associazione con *Frankites apertus*. La parte alta della sottozona sembra documentare la scomparsa del genere *Protrachyceras*. La successiva Sottozona a *canadensis*, che ha il suo stratotipo nella sezione dei Prati di Stuores/Stuores Wiesen, è marcata alla base dalla comparsa di *Daxatina*, genere pressoché cosmopolita e, in particolare, da *Daxatina canadensis* (Whiteaves, 1889). Nello stesso intervallo è documentata la presenza di almeno un'altra specie riferibile a questo genere, confrontabile con *Daxatina laubei* Tozer, 1994, nota finora solo in Nord America. Il genere *Zestoceras* è rappresentato da due specie: *Z. barwicki* (Johnston, 1941) e *Z. lorigae* sp. n. L'istituzione di quest'ultima nuova specie ha reso necessario definire i lectotipi di *Trachyceras rutoranum* Mojsisovics, 1882 e di *Trachyceras laricum* Mojsisovics, 1882, conservati nella collezione storica di Mojsisovics presso il Geologische Bundesanstalt di Vienna. Il genere *Frankites* risulta attualmente documentato nelle Alpi Meridionali da *Frankites regoledanus* (Mojsisovics, 1869), *F. apertus* (Mojsisovics, 1893), *F.* sp. A. Pur non essendo documentato nelle sezioni esaminate, è stato designato il lectotipo di *Ammonites (Trachyceras?) Regoledanus* Mojsisovics, 1869. Questa specie risulta esclusiva della omonima sottozona, mentre le altre due sono distribuite in un intervallo che comprende il limite Ladinico-Carnico. Non sono state

1 Università degli studi di Padova, Dipartimento di Geoscienze, via Giotto 1, I-35137 Padova. E-mail: paolo.mietto@unipd.it
2 C.N.R., Istituto di Geoscienze e Georisorse, C.so Garibaldi 37, I-35137 Padova
3 Università degli studi di Ferrara, Dipartimento di Scienze della Terra, via Saragat 1, Blocco B, I-44100, Ferrara

notate differenze morfologiche fra *Frankites apertus* (Mojsisovics, 1893) e la specie nord Americana *Frankites sutherlandi* (McLearn, 1947); anche la linea suturale risulta compatibile. La sinonimia così proposta risulta rilevante ai fini delle correlazioni a lunga distanza. Sono descritte inoltre due specie riferibili al genere *Trachyceras* diverse da *T. aon* (Münster, 1834), documentate nella Sottozona a *canadensis*: *T. muensteri* (Wissmann in Wissmann & Münster, 1841) e *T. bipunctatum* (Münster, 1834). Tali specie predatano la comparsa del genere *Trachyceras* e giustificano l'appartenenza della Sottozona a *canadensis* al Carnico. Altre specie significative documentate in questa sottozona e qui descritte, sono *Rossiceras*? *armatum* (Münster in Wissmann & Münster, 1841) e *Sirenotrachyceras thusneldae* (Mojsisovics, 1893). La fauna della Sottozona ad *aon*, ampiamente descritta in recenti lavori, non viene ridiscussa. La nuova sottofamiglia Anolcitinae, riferibile alla famiglia Trachyceratidae, è qui istituita.

Introduction

The definition of Global Stratotype Sections and Points (GSSPs) of Triassic stages experienced an acceleration in the last few years (e.g. Hongfu et al. 2001; Brack et al. 2005; Guaiumi et al. 2007; Krystyn et al. 2007). Among the Triassic stages with a GSSP, the Carnian was the last to be defined by the I.C.S. and ratified by the I.U.G.S. in June of 2008. The original proposal was published (Broglio Loriga et al. 1998b, 1999) to establish the GSSP of the Carnian Stage in the Prati di Stuores/Stuores Wiesen section in northern Italy, using the first appearance of *Daxatina* cf. *canadensis* (Whiteaves) as the principal marker for the boundary definition. Subsequently, Mietto et al. (2007a) reviewed this previous proposal. The result was that, on the one hand, the goodness of the proposal in Broglio Loriga et al. (1999) was confirmed, but on the other hand it was clear that a revision of the ammonoid taxonomy was required.

The aim of this paper is to revise the most relevant ammonoid taxa from the Prati di Stuores/Stuores Wiesen and related sections, used for the Ladinian-Carnian boundary definition, and thus to corroborate the approved proposal for the GSSP of the base of the Carnian (Mietto et al. 2007a). All taxa come from the quoted sections except for *Frankites regoledanus* (Mojsisovics), which revision was necessary for comparison with other species of *Frankites*.

The palaeontological section of this contribution has been prepared by S. Manfrin and P. Mietto.

Geological settings

The late Ladinian to early Carnian paleogeography of the Dolomites was characterized by a complex distribution of isolated and attached carbonate platforms (Fig. 1), with an elevation of several hundred meters above a basinal area with prevailing siliciclastic sedimentation (Assereto et al. 1977; Bosellini et al. 2003; Stefani et al. 2004).

Lower Carnian carbonate platforms, known as Cassian Dolomite 1 and 2 (e.g. De Zanche et al. 1993) were probably mud-mounds (Keim & Schlager 2001). Their top were reaching the sea level and their geometries were thus similar to those of rimmed tropical platforms (Bosellini 1984).

Siliciclastics of the Badia Valley basinal areas derived from the progressive dismantling of upper Ladinian volcanic edifices (e.g., the volcanoes of Predazzo to the southwest). In the northeastern Dolomites, the supply of siliciclastics is remarkably continuous and expanded in the upper Ladinian – lower Carnian basinal successions. Volcanic conglomerates, arenites and clays constitute the upper Ladinian Wengen Formation (formerly La Valle Fm.: Viel 1979); the conglomeratic unit at its base is sometimes separated (Marmolada Conglomerate). When the first Cassian platform started to grow, the basins were fed by platform-shed carbonates, which added to clays of volcaniclastic origin. The hemipelagic sedimentation thus included a significant carbonate component. The mixed, carbonate-siliciclastic basinal succession deposited during the growth of Cassian platforms is called San Cassiano Formation. In the Badia Valley area, the base of the San Cassiano Formation is close to the Ladinian-Carnian boundary (e.g., Mietto & Manfrin 1995b; Broglio Loriga et al. 1998b, 1999; Mietto et al. 2007a, 2007b). The upper Ladinian – lower Carnian stratigraphy of the Badia Valley area is summarized in Fig. 2.

The Prati di Stuores/Stuores Wiesen section, adopted as the GSSP of the Carnian Stage, exposes a ca. 220 m siliciclastic and mixed hemipelagic succession of the Wengen and San Cassiano formations (Fig. 3). It is located at the head of Cordevole Valley, near the village of San Cassiano. In the surrounding area, and expecially in the Badia Valley, the Ladinian-Carnian boundary interval is exposed in several sections and localities; ammonoids are common, conodonts are usually present but are seldom abundant (Broglio Loriga et al. 1998b, 1999; Manco et al. 2004; Mietto et al. 2007a, 2007b).

Stratigraphic sections

The stratigraphic sections of Prati di Stuores/StuoresWiesen, Bec de Roces and Antersass (Fig. 1) are the most important for the aim of the present work, because of their vertical extension, continuity, richness in ammonoids and their biostratigraphic significance. These are located around the Sella Massif and in the middle Badia Valley. Numerous additional sections and localities of the Southern Alps were also considered and are briefly described here. Sample positions of the stratigraphic sections cited in the text are available on request to the corresponding author.

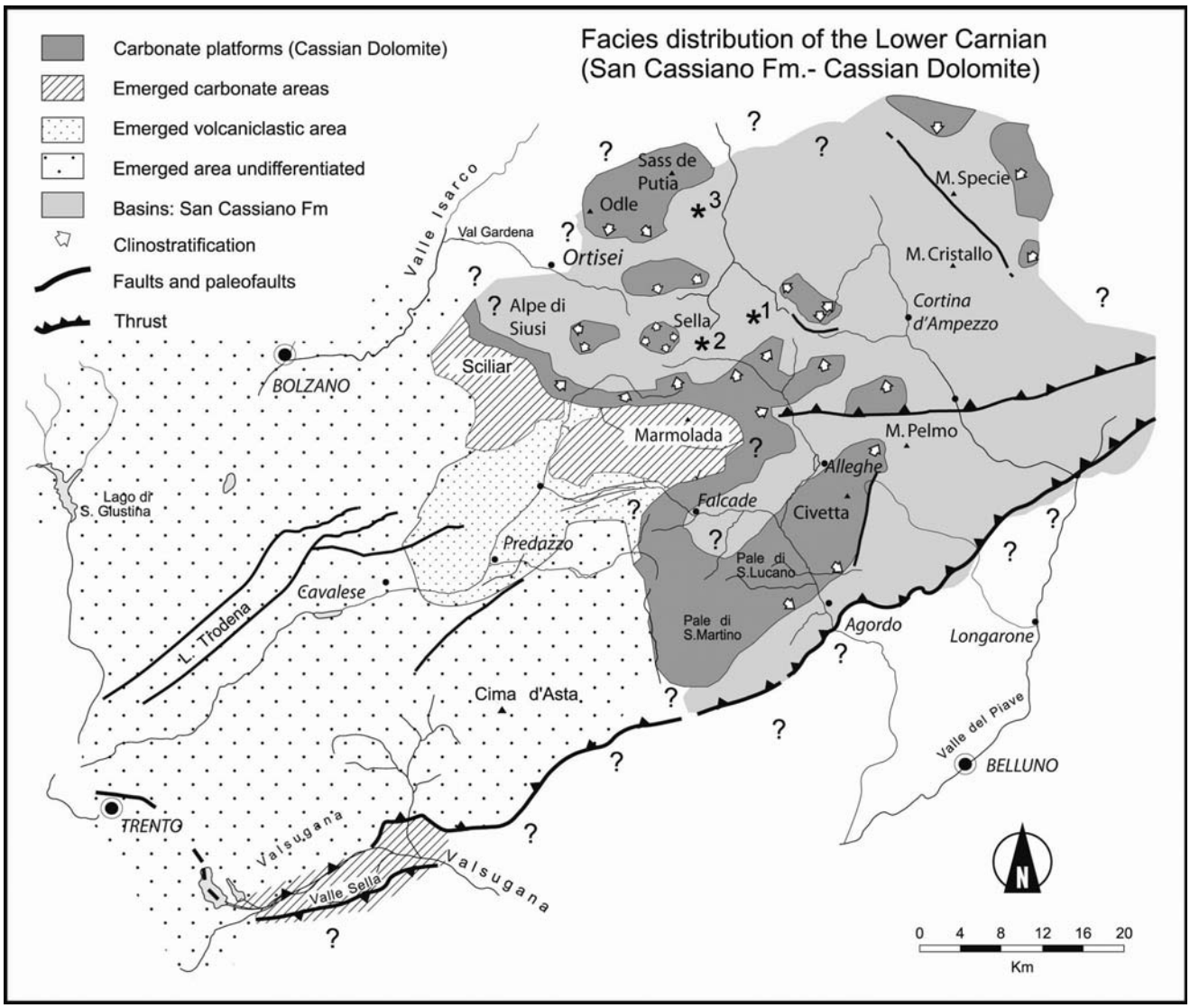


Fig. 1 - Paleogeographic map of the Dolomites during the Ladinian-Carnian boundary interval and location of selected stratigraphic sections: Prati di Stuores/Stuores Wiesen (asterisk 1), Bec de Roces (asterisk 2) and Antersass sections (asterisk 3).

Geographic coordinates as in the official Italian cartography, scale 1:25000, published by Istituto Geografico Militare (I.G.M.), Florence, Italy. Coordinates were omitted for those localities where material was not found in situ.

1. Prati di Stuores/Stuores Wiesen section (Prà de Störes)

Location: crest between Cordevole and San Cassiano valleys, municipality of Livinallongo del Col di Lana, Belluno province.

Geographical coordinates: Ref. I.G.M. 11 I SE Corvara in Badia (5th ed., 1963); long. W 0° 31' 26"; lat. 46° 31' 24"; 1980 m a.s.l. (base of measured section).

Description: the Prati di Stuores/Stuores Wiesen section is located on the crest separating the Cordevole and Parola-San Cassiano valleys, in the central-western Dolomites. The section occupies a wide gully incision with the base at 1980 m a.s.l., and reaching the crest at 2150 m a.s.l. (Fig. 4). The section can be reached from the Hotel Pralongià walking the CAI trail n. 23 towards Settsass, a few hundred meters beyond Piz Stuores (2181 m). The Hotel Pralongià can be reached by chair lift or through a dirt road either from Corvara in Badia/Kurfar (Bz) or from Arabba – Cherz – Incisa Hut (Bl).

This section is well known in literature since the nineteenth Century (Münster 1834; Wissmann & Münster 1841; Klipstein 1843-1845; Laube 1869; Mojsisovics 1882; Ogilvie 1893). More recently, further contribution are provided by Urlichs (1974, 1994), Bizzarini et al. (1986), Bizzarini & Braga (1987), De Zanche & Gianolla (1995), Mietto & Manfrin (1995a, 1995b), and Neri et al. (1995). This section is within the type area of the historical Cordevolian Substage sensu Mojsisovics et al. (1895). In order to define the stratotype of the Cordevolian Substage, Urlichs (1974, 1994) illustrates the

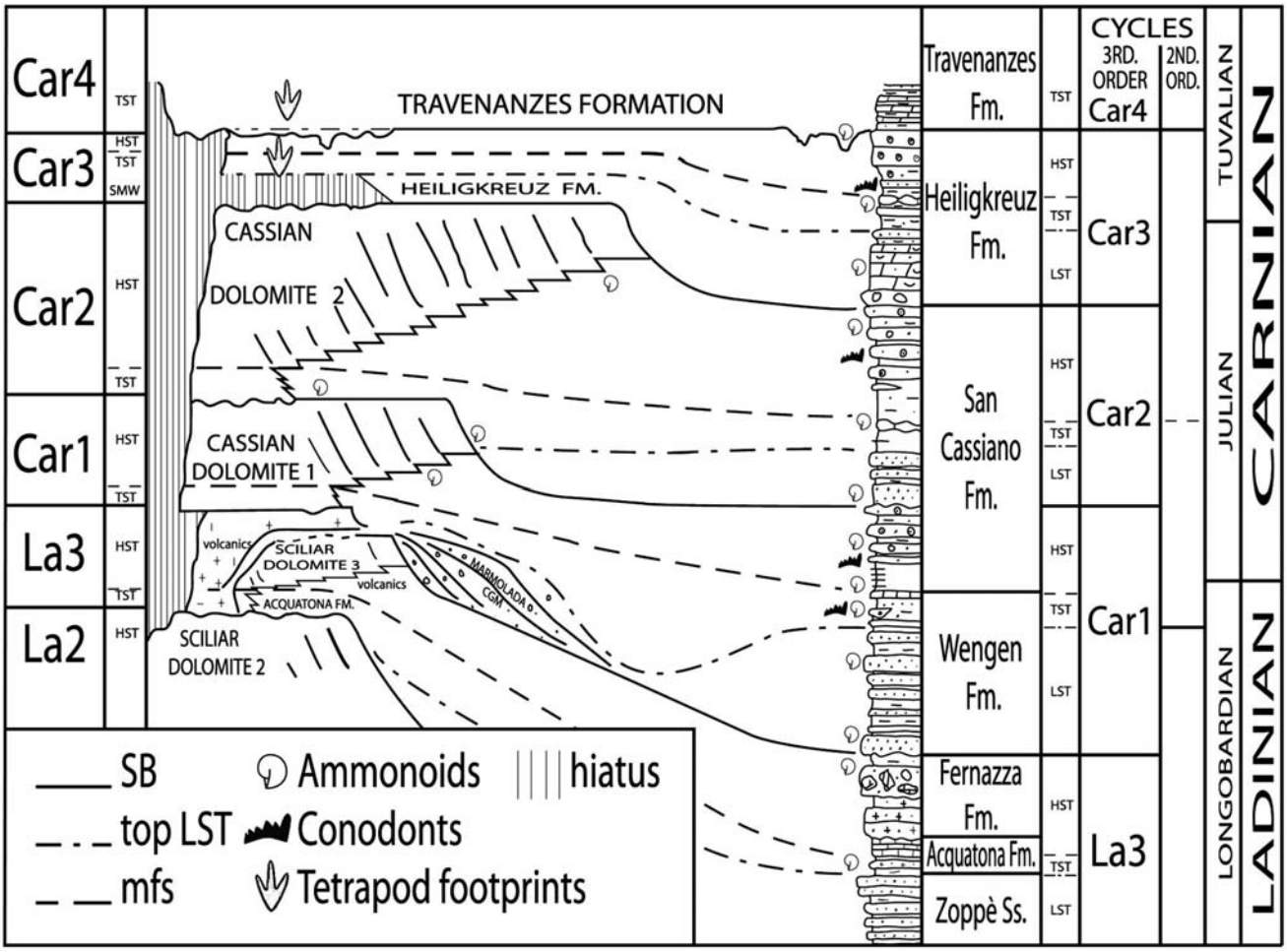


Fig. 2 - Upper Ladinian – Lower Carnian stratigraphy of Val Badia and surrounding areas (modified from De Zanche et al. 1993).

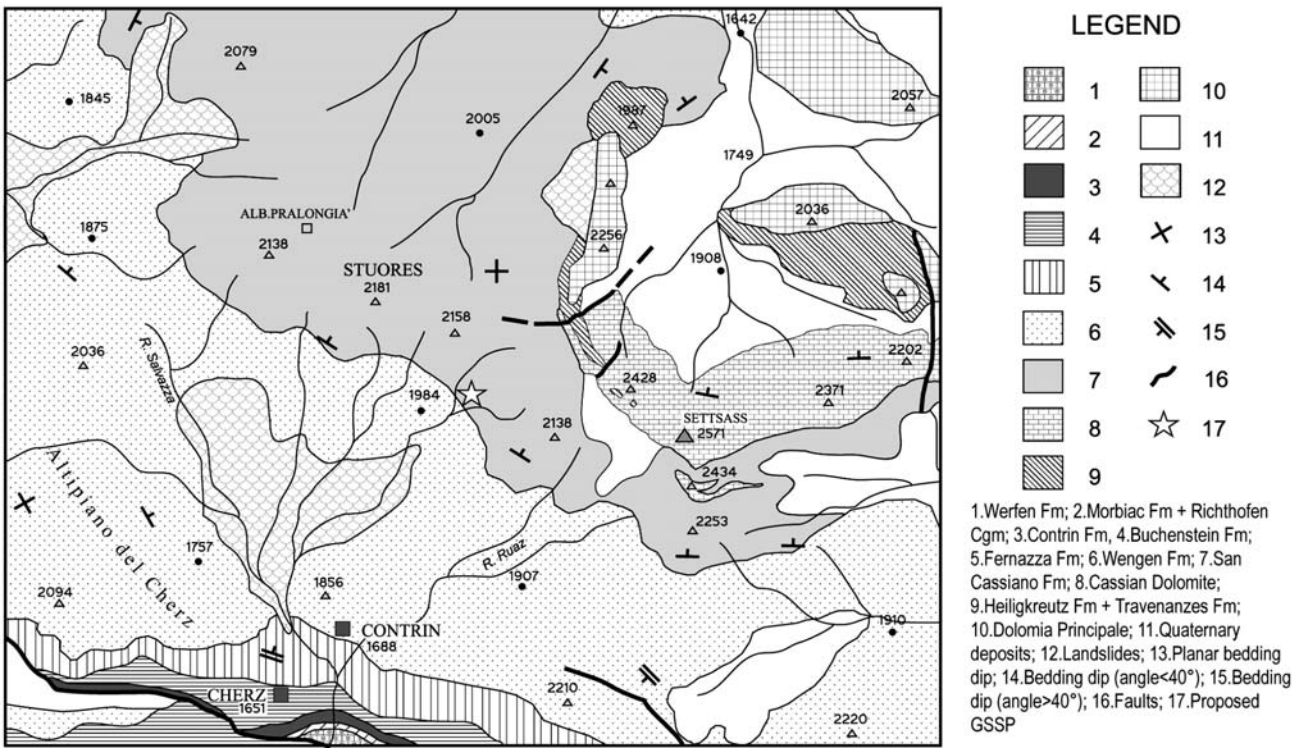


Fig. 3 - Geologic map of the type area of the proposed GSSP for the base of the Carnian (from Mietto et al. 2007b).

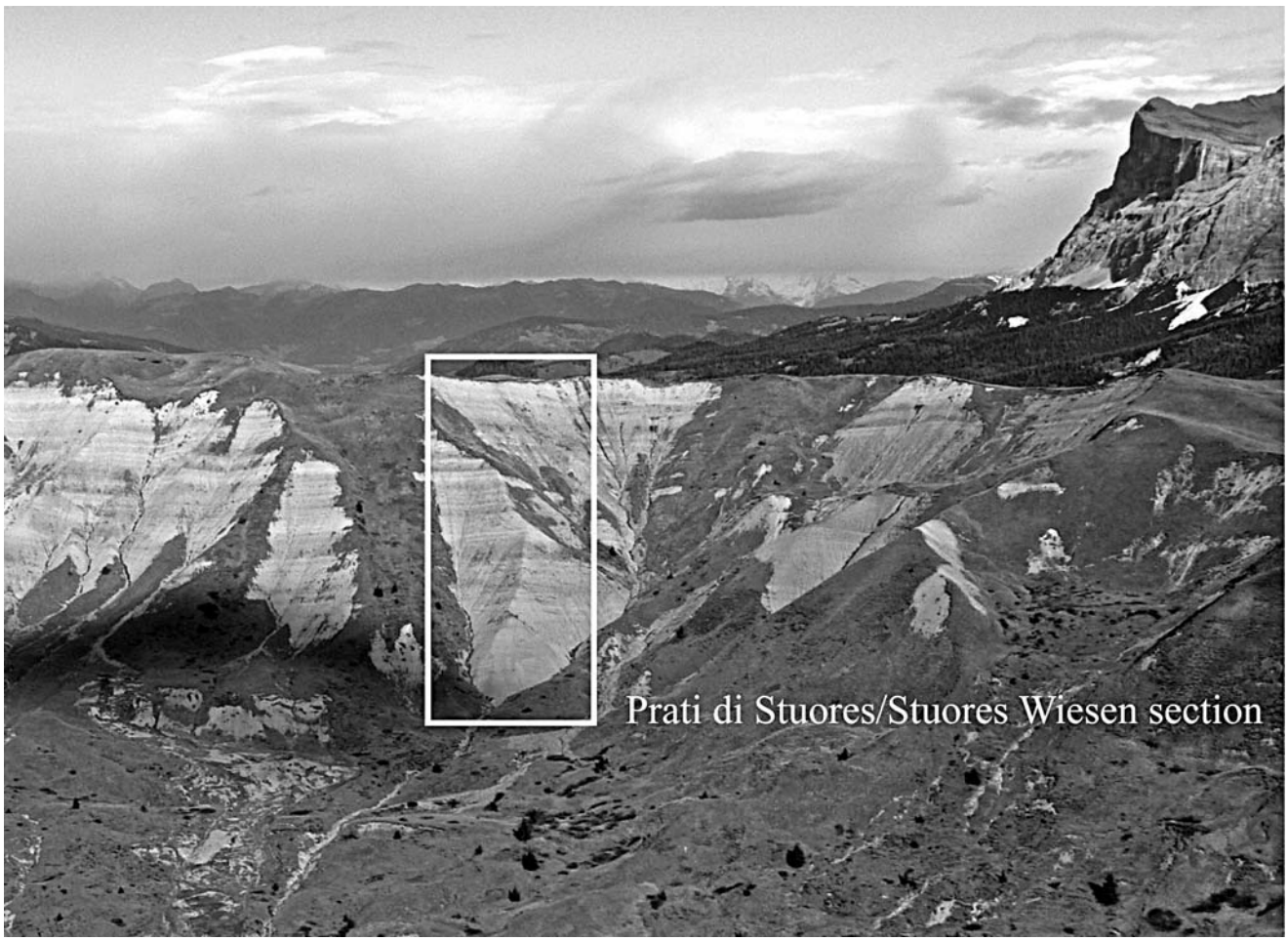


Fig. 4 - Picture view of the Prati di Stuores/Stuores Wiesen section.

higher part of the Prati di Stuores/Stuores Wiesen section, included in the Oberen Cassianer Schichten (i.e., Upper Cassian beds, OCS hereafter) sensu Ogilvie Gordon (1900) but not further investigated in this work. The OCS overlie the Unteren Cassianer Schichten (UCS hereafter) and are distinct for the absence of volcanoclastic intercalations. On the base of the occurrence of *Trachyceras* cf. *aon*, Urlichs (1974) and *Trachyceras aon*, Urlichs (1994), the base of the Cordevolian, and thus of the Carnian, were placed at the base of the OCS. Moreover, Urlichs (1974) finds, 55 m below the UCS/OCS boundary, the ammonoid association *Frankites regoledanus* (= *F. apertus* in Urlichs 1977), *Klipsteinia* sp., *Lobites* cf. *ellipticus*, which he considered equivalent to the upper Longobardian *sutherlandi* Zone. The Ladinian/Carnian boundary should thus roughly coincide with the lithological boundary between UCS and OCS. It must be clear that in the Prati di Stuores/Stuores Wiesen section, as described here and in Mietto & Manfrin (1995b), the first occurrence of Carnian ammonoid fauna lies quite below the Urlichs' statement (1974, 1994), i.e. mostly within the UCS (cf. Broglio Loriga et al. 1998b, 1999; Mietto et al. 2007a, 2007b).

The Prati di Stuores/Stuores Wiesen section is characterized by a thick interval of marine hemipelagic sediments, deposited below storm wave-base. The depositional suite consists of hemipelagites and thin turbidite beds (both siliciclastic and from nearby carbonate platforms) documenting high but variable sedimentation rates. In detail, a slight decrease in sedimentation rate is noticed towards the upper part of the section accordingly to the general regressive trend. Along the whole section, terrigenous sedimentation decreases upwards in favor of the carbonate supply coming from surrounding carbonate platforms (Cassian Dolomite).

The quoted Prati di Stuores/Stuores Wiesen section encompasses 200 meters of hemipelagic beds of the Wengen and San Cassiano formations, which become more than 220 once the physically correlated section 1bis is taken into account (Fig. 5). Below the defined GSSP at level SW4 (Broglio Loriga et al. 1998b, 1999; Mietto et al. 2007a, 2007b), 45 m of marls and arenites referred to the San Cassiano Fm. and ca. 20 m of prevailing shales of the Wengen Formation are exposed at Prati di Stuores/Stuores Wiesen section, which represent the top of the upper Ladinian *regoledanus* Subzone (see Tab. 1)

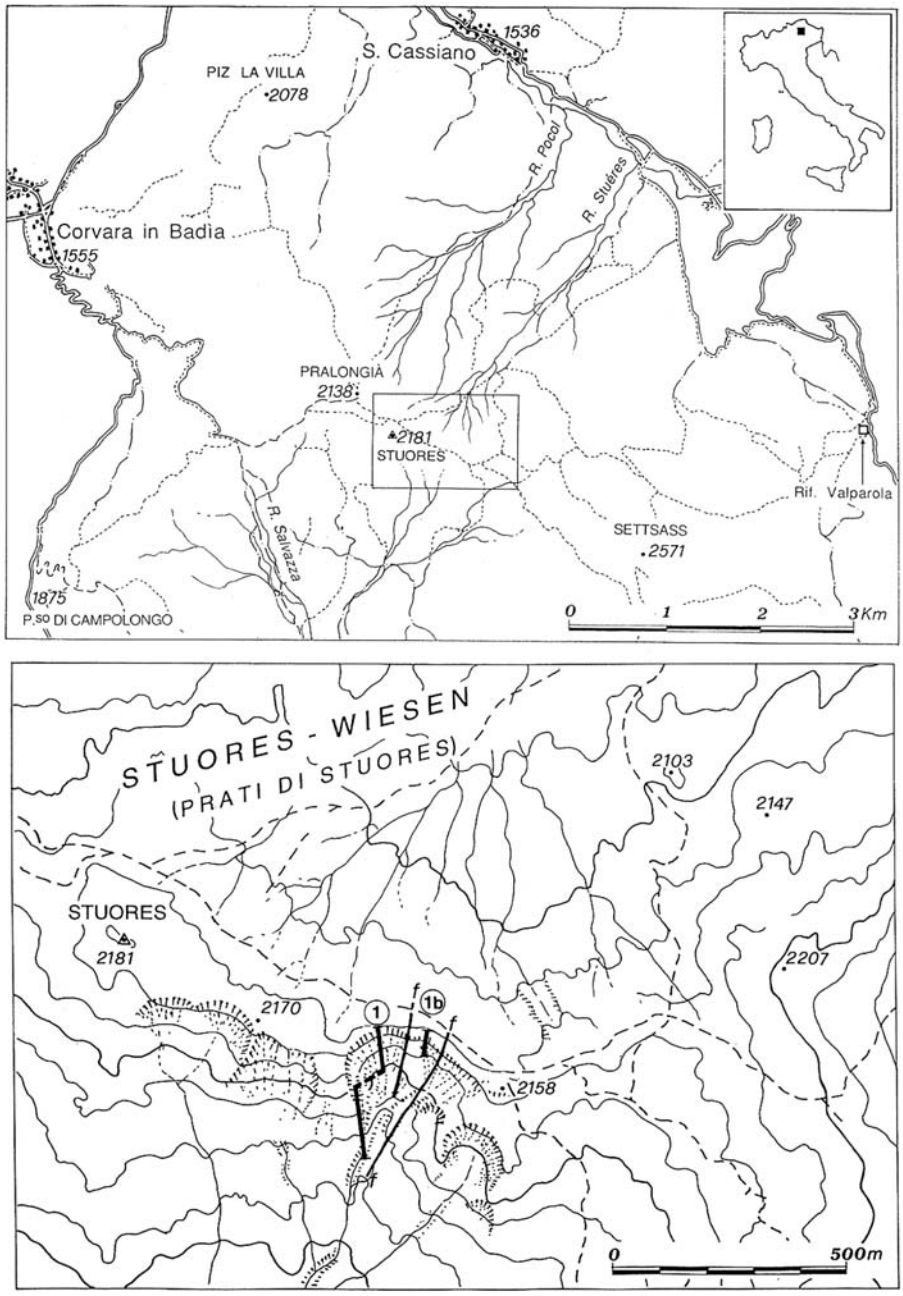


Fig. 5 - Location map of the section 1 and 1bis of Prati di Stuores/ Stuores Wiesen (from Mietto et al. 2007b).

The first biozone of the Carnian, the *canadensis* Subzone, is well represented in the section up to m 194.3, where the boundary with the overlying *aon* Subzone is documented in section 1bis (Fig. 6).

2. Bec de Roces section

Location: southeastern flank of the Sella Massif, municipality of Livinallongo del Col di Lana, Belluno.

Geographical coordinates: Ref. I.G.M. 11 I SE Corvara in Badia (5th ed., 1963); long. W 0° 35' 08"; lat. 46° 30' 47"; 2040 m a.s.l. (base of measured section).

Description: the Bec de Roces section occupies the headwall of a landslide which is visible on the south-eastern flank of the Sella Massif from Passo Campolongo, roughly in front of Hotel Cherz. It can be reached by a gravel road, closed to traffic, corresponding to CAI trail n. 636. Afterwards, leaving the trail slightly above altitude 2000 m and walking on the right through the meadows to reach the scarp, a 20 m section of channelled calciturbidites, marls and siltites of the San Cassiano Formation is exposed (Fig. 7). The complete ammonoid association, including specimens from debris (marked PCL.dt), are listed in Tab. 2.

Some ammonoids were collected in situ also from a short section (Bec de Roces section B) exposed below the measured tract in the main scarp of the landslide, featuring the same facies (samples PCL.27, PCL.0). Above the measured tract, a few meters of hybrid arenites and oolitic-bioclastic calcarenites, intercalated

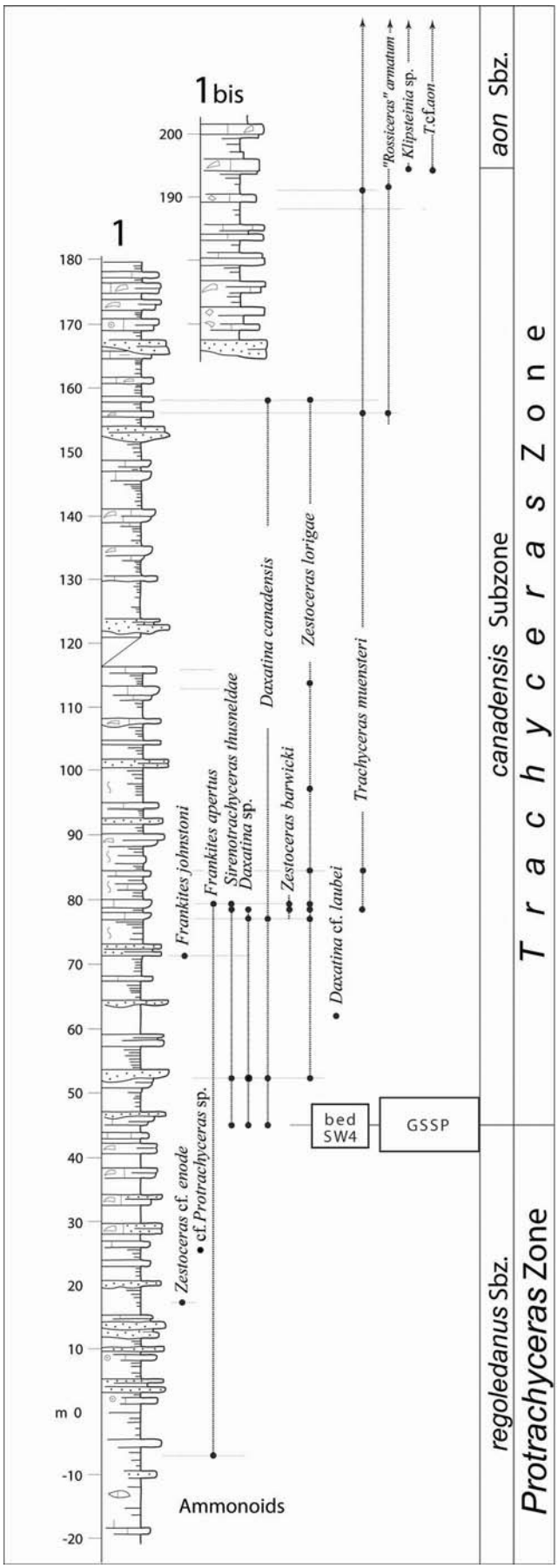


Fig. 6 - The Prati di Stuores/Stuores Wiesen section with distribution of ammonoids.

within siltites and siltitic shales, were also sampled (samples PCL.3, PCL.15 and PCL.26).

Fauna (Bec de Roces section B): *Trachyceras* sp., cf. *Zestoceras* sp., cf. *Frankites* sp., *Sirenotrachyceras* sp., *Sirenotrachyceras thusneldae* (Mojsisovics), *Lecanites glaucus* (Münster), cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

3. Antersass section

Location: northeastern flank of Gardenaccia Massif, middle Badia Valley, municipality of San Martino in Badia/St. Martin in Thurn, Bolzano/Bozen.

Geographical coordinates: Ref. I.G.M. 11 I NE Badia (4th ed., 1963); long. W 0° 36' 30"; lat. 46° 37' 08"; 1800 m a.s.l. (base of the section).

Description: this section, already noted by Ogilvie (1893), is located west of Col da Oi, under the Antersass/Zwischenkofel (2384 m a.s.l.), one of the peaks edging the Gardenaccia Massif. It can be reached from the Badia Valley through Longiarù/Campill. The section outcrop is clearly visible from the valley bottom, and can be reached from the village of Peres (near Longiarù) through a trail to the hillside called "Taiada", and then continuing along the crest. The outcrop is the main scarp of a large rotational landslide, is more than 100 m wide and ca. 60 m thick. The measured section encompasses the lower part of the outcrop, starts into volcanic arenites, hybrid arenites and dark shales and passes into marls, marly limestones and calcarenites typical of the upper San Cassiano Formation (Fig. 8; Tab. 3).

4. Other sections and sites

Other stratigraphic sections and/or fossiliferous localities were sampled and studied, located in the area around the Sella Massif and scattered in the Southern Alps from Tarvisio (Italian/Slovenian boundary) to eastern Lombardy. These sections and/or localities are described here, from east to west:

a. Santa Caterina

Area: Tarvisio; location: right side of Val Canale, municipality of Malborghetto Valbruna, Udine.

Description: material collected in debris from blocks of siltstones and greenish fine sandstones (San Cassiano Formation) along the riverbed Vallone di Rio Bianco, upstream of the confluence with torrent Fella at Santa Caterina locality, next to Malborghetto. The fauna, not homogeneous, is attributed to the Longobardian/Julian boundary interval. A preliminary survey of the area revealed that the specimens belong from the head of a deeply incised hollow on the hydrographic left of Rio Bianco, on the western flank of Alpe Piccola, ca. 500 m north of the Santa Caterina rail station. Unfortunately, the outcrops cannot be reached. This ammonoid association is stored in the MFST and partly in the MGPD.

Fauna: *Celtites epolensis* Mojsisovics, aff. *Anolcites* sp., *Zestoceras* sp. *Trachyceras* sp., cf. *Trachyceras* sp., *Trachyceras aon* (Münster).

Age: Longobardian/Julian interval (*regoledanus* to *aon* subzones).

b. Casera Chiansaveit

Area: Carnia; location: northwestern flank of Mount Clapsavon, municipality of Sauris, Udine; geographical coordinates: ref.

Beds	metres	*Lobites ellipticus* (Hauer)	*Frankites apertus* (Mojsisovics)	*Lecanites glaucus* (Münster)	*Sirenotrachyceras* sp.	cf. *Anolcites* sp.	*Zestoceras* sp.	*Asklepioceras sp.*	*Frankites* sp. A	cf. *Joannites* sp.	*Zestoceras* cf. *enode* (Tozer)	*Pseudocarnites* sp.	cf. *Protrachyceras* sp.	*Lobites* sp.	*Frankites* sp.	*Daxatina* sp.	*Daxatina canadensis* (Whiteaves)	*Sirenotrachyceras thusneldae* (Mojsisovics)	cf. *Muensterites* sp.	cf. *Daxatina* sp.	*Zestoceras lorigae* sp.n.	*Daxatina* cf. *laubei* Tozer	*Zestoceras barwicki* (Johnston)	*Trachyceras muensteri* (Wissmann)	*Zestoceras* cf. *barwicki* (Johnston)	cf. *Romanites* sp.	*Lecanites* sp.	cf. *Zestoceras* sp.	cf. *Sirenotrachyceras* sp.	*Trachyceras* sp.	*Muensterites* sp.	*"Rossiceras" armatum* (Münster)	cf. *Klipsteinia* sp.	*Klipsteinia* cf. *achelous* (Münster)	*Trachyceras* cf. *muensteri* (Wissmann)	*Trachyceras* cf. *aon* (Münster)	TOTAL	SUBZONES
SW 24	194.30			2																												2			1	5	*aon*
SW 22	188.20			1				1																								1	1			5	
SW 21	188.00			1						2																						4				8	
SW 20	183.80																															1				1	
SW 10b	165.20			1																																1	
SW 10	157.80							3							1		3				1			1							1					10	
SW 9	156.20			1				1							1		2															1				6	
SW 8	153.00			1										1																						2	
SW 7D	141.00			2																																2	
SW 7C	131.50							1																												1	
SW 7B	122.40								1																											2	
SW 7A	113.00	1																																		1	
SW 31	112.50						1																													1	
SW 30	111.40																				2															2	
PSR 12	96.40						1																													1	
PSR 11	84.60			2						1											3															6	
PSR 10	84.50						2			1											15			1						1						20	
PSR 9	79.40																	1																		1	
PSR 8	79.30		2	3			1			3											3		1													13	
PSR 7	79.20	1								2													2						1							6	*canadensis*
PSR 6	79.15	2																			7		1		2			1	1						14	
PSR 5	79.10			1			1														1		1	1				1								6	
PSR 4	79.00			2			2									1				2	2		2													11	
PSR 3	78.90			4			6			4				1	1		1	2			33		11	2	2	1	1									69	
PSR 2	78.80	2					2			1					1						12		2	1												21	
PRS 1	78.50									1											3															4	
PSR 1b	77.30															1																				1	
SW 7	71.00								1																											1	
SW 6b	69.40			1																																1	
SW 6	61.50																					1														1	
SW 5d	52.90			1																																1	
SW 5c	52.70	3								4																										7	
SW 5b	52.40	11								2							1	4			1															19	
SW 5a	52.20						1							1		1	2			1																	6	
SW 4b	45.50	1																																		1	
SW 4a	45.20																		1																	1	
SW 4	45.00													1	1	1	1	1																		5	
SW 3d	37.50	1																																		1	
SW 3c	29.00												1																							1	
SW 3b	28.70	1								1			1																							3	
SW 3a	28.50	2																																		2	
SW 2	17.00							1			1	1																								3	*regoledanus*
SW 1	2.20	10					1	1	1	4																										17	
SW 0b	4.90 -	1																																		1	
SW 0a	7.00 -		1	2	1	1																														5	
SW 0	12.00 -	2																																		2	
debris			1	1			1										1				3		1				1									10	
TOTAL		38	4	26	1		19	8	3	26	1	1	2	4	5	4	11	8	1	3	86	1	21	6	4	2	1	3	1	2	2	2	8	1	1	1	308	

Lobites ellipticus (Hauer)
Frankites apertus (Mojsisovics)
Lecanites glaucus (Münster)
Sirenotrachyceras sp.
cf. *Anolcites* sp.
Zestoceras sp.
Asklepioceras sp.
Frankites sp. A
cf. *Joannites* sp.
Zestoceras cf. *enode* (Tozer)
Pseudocarnites sp.
cf. *Protrachyceras* sp.
Lobites sp.
Frankites sp.
Daxatina sp.
Daxatina canadensis (Whiteaves)
Sirenotrachyceras thusneldae (Mojsisovics)
cf. *Muensterites* sp.
cf. *Daxatina* sp.
Zestoceras lorigae sp.n.
Daxatina cf. *laubei* Tozer
Zestoceras barwicki (Johnston)
Trachyceras muensteri (Wissmann)
Zestoceras cf. *barwicki* (Johnston)
cf. *Romanites* sp.
Lecanites sp.
cf. *Zestoceras* sp.
cf. *Sirenotrachyceras* sp.
Trachyceras sp.
Muensterites sp.
"Rossiceras" armatum (Münster)
cf. *Klipsteinia* sp.
Klipsteinia cf. *achelous* (Münster)
Trachyceras cf. *muensteri* (Wissmann)
Trachyceras cf. *aon* (Münster)
TOTAL

Tab. 1 - Distribution of the ammonoid fauna in the Prati di Stuores/Stuores Wiesen section.

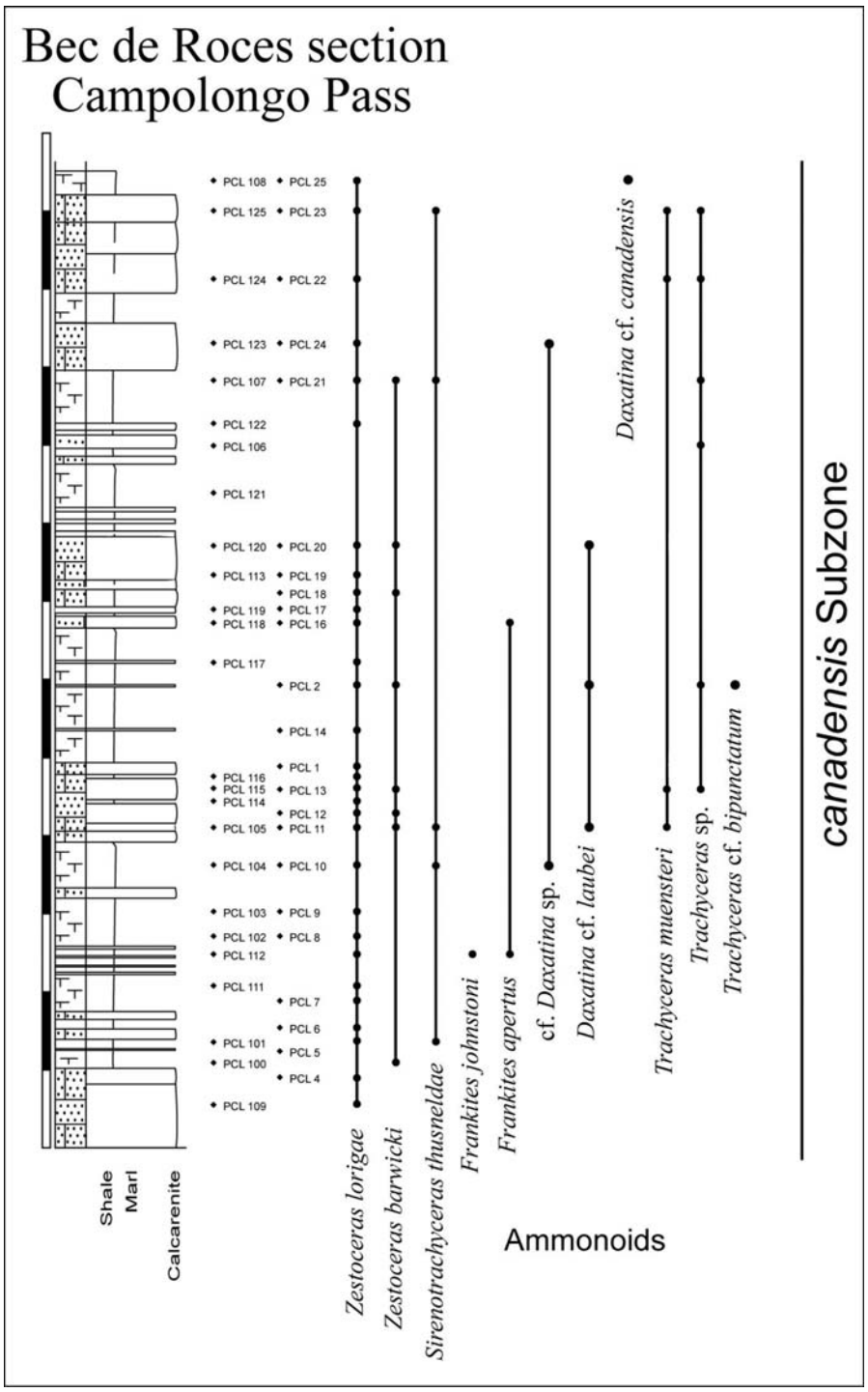


Fig. 7 - The Bec de Roces section with distribution of ammonoids.

I.G.M. 13 III NE Monte Bìvera (ed. 3A, 1984); long. E 0° 11' 22,3"; lat. 46° 27' 02,4"; 1765 m a.s.l. (basal beds).

Description: from Casera Razzo a track leads to Casera Mediana, from where path n. 210 leads first to Casera Chiansaveit and then climbs up to Forcella Chiana (2052 m). A little beyond the latter Casera, along the path, between 1765 and 1805 m a.s.l., vulcanodetritic sandstones attributable to Wengen Formation crop out irregularly.

Fauna: *Protrachyceras* sp., *Protrachyceras* cf. *ladinum* (Mojsisovics), cf. *Anolcites* sp., *Frankites* sp.

Age: Longobardian (*regoledanus* Subzone).

c. Casera Montemaggiore

Area: Carnia; location: Southeastern side of Mount Lagna, municipality of Forni di sopra, Udine; geographical coordinates: ref. I.G.M. 13 III NE Monte Bìvera (ed. 3A, 1984); long. E 0° 09' 36,5"; lat. 46° 26' 24"; 1705 m a.s.l.

Description: from Forni di Sopra, path n. 210 leads to Forcella Chiana (2052 m). At 1729 m a.s.l., in a wide valley immediately SE of the peak of Mount Lagna, there it lies Casera Montemaggiore. From there, path n. 211 goes on the left along the south slopes of Mount Lagna. At the crossing of the path with the first valley, some meters of fine grey-pink siltstones attributed to the Wengen Formation outcrop. The sample PMG1 was collected at the base of this outcrop. This locality is also quoted in Mietto & Manfrin (1995b) as Monte Lagna.

Fauna: *Maclearnoceras* sp., *Protrachyceras* sp., *Frankites* sp., *Frankites regoledanus* (Mojsisovics), *Frankites* sp. A, cf. *Asklepioceras* sp., *Lecanites glaucus* (Münster), *Celtites epolensis* Mojsisovics, *Mono-*

Beds	*Zestoceras lorigae* sp.n.	cf. *Zestoceras* sp.	*Zestoceras barwicki* (Johnston)	*Lecanites glaucus* (Münster)	*Sirenotrachyceras thusneldae* (Mojsisovics)	*Zestoceras* sp.	cf. *Joannites* sp.	*Lobites ellipticus* (Hauer)	*Frankites* sp. A	*Frankites apertus* (Mojsisovics)	cf. *Daxatina* sp.	*Daxatina* cf. *laubei* Tozer	*Trachyceras muensteri* (Wissmann)	*Zestoceras* cf. *barwicki* (Johnston)	*Trachyceras* sp.	*Trachyceras* cf. *muensteri* (Wissmann)	*Sirenotrachyceras* cf. *thusneldae* (Mojsisovics)	*Frankites* sp.	cf. *Romanites* sp.	*Trachyceras* cf. *bipunctatum* (Münster)	*Romanites* sp.	*Daxatina* sp.	cf. *Trachyceras* sp.	*Daxatina* cf. *canadensis* (Whiteaves)	*Zestoceras* cf. *lorigae* sp.n.	*Muensterites* sp.	TOTAL	SUBZONES
pcl 25	2						1																				3	
pcl 108	1							1																			2	
pcl 23	4																										4	
pcl 125	30	1		2	1		2	1					1	1										1			40	
pcl 22	1						1								1												3	
pcl 124	45			3			6	1					1		1	1											58	
pcl 24	8			1																							9	
pcl 123	7			1							1																9	
pcl 21	7	1	1	1	1		1	1			1				1												15	
pcl 107	4						1																				5	
pcl 122	2						2	2					1			1								1			9	
pcl 106													1		1												2	
pcl 121								1																			1	
pcl 20	11		1			2	1									1						1	1				18	
pcl 120	6											1															7	
pcl 19	5			1			1	1																			8	
pcl 113	24						1	3																			28	
pcl 18	9		1			1		1					1														13	
pcl 17	2																										2	
pcl 119	9						1																				10	
pcl 16	2									1								1									4	
pcl 118	7							1																			8	
pcl 117	11	2		1		1	1	1														1					18	
pcl 2	17		1				2	2				3	3		2	1				1							32	
pcl 14	4																		1								5	*canadensis*
pcl 1	1	2														1											4	
pcl 116	5			2																							7	
pcl 13	2		1	1		3									1	2	1	1									12	
pcl 115	1														1												2	
pcl 114	6													1													7	
pcl 12	11		1																								12	
pcl 11	14		1				1	1				1	1	1													20	
pcl 105	1	1		1	2	1	1	2				1															10	
pcl 10	1																										1	
pcl 104				2	1						1																4	
pcl 9		1																									1	
pcl 103	2																										2	
pcl 8	1			1		1																					3	
pcl 102	1																										1	
pcl 112	3			1						1																	5	
pcl 111	11						2	2	1																		16	
pcl 7	1					2	1																				4	
pcl 6	2			1																							3	
pcl 101	1				1																						2	
pcl 5				1																							1	
pcl 100	1	1	1																								3	
pcl 4	1	1																									2	
pcl 109	2																										2	
debris	45	1	1	4		2	2	5				3	1		3			1							1	1	70	
TOTAL	331	11	9	24	6	13	28	26	1	2	3	9	10	3	11	7	1	3	1	1	2	1	1	1	1	1	507	

	Zestoceras lorigae sp.n.	cf. *Zestoceras* sp.	*Zestoceras barwicki* (Johnston)	*Lecanites glaucus* (Münster)	*Sirenotrachyceras thusneldae* (Mojsisovics)	*Zestoceras* sp.	cf. *Joannites* sp.	*Lobites ellipticus* (Hauer)	*Frankites* sp. A	*Frankites apertus* (Mojsisovics)	cf. *Daxatina* sp.	*Daxatina* cf. *laubei* Tozer	*Trachyceras muensteri* (Wissmann)	*Zestoceras* cf. *barwicki* (Johnston)	*Trachyceras* sp.	*Trachyceras* cf. *muensteri* (Wissmann)	*Sirenotrachyceras* cf. *thusneldae* (Mojsisovics)	*Frankites* sp.	cf. *Romanites* sp.	*Trachyceras* cf. *bipunctatum* (Münster)	*Romanites* sp.	*Daxatina* sp.	cf. *Trachyceras* sp.	*Daxatina* cf. *canadensis* (Whiteaves)	*Zestoceras* cf. *lorigae* sp.n.	*Muensterites* sp.	TOTAL

Tab. 2 - Distribution of the ammonoid fauna in the Bec de Roces section.

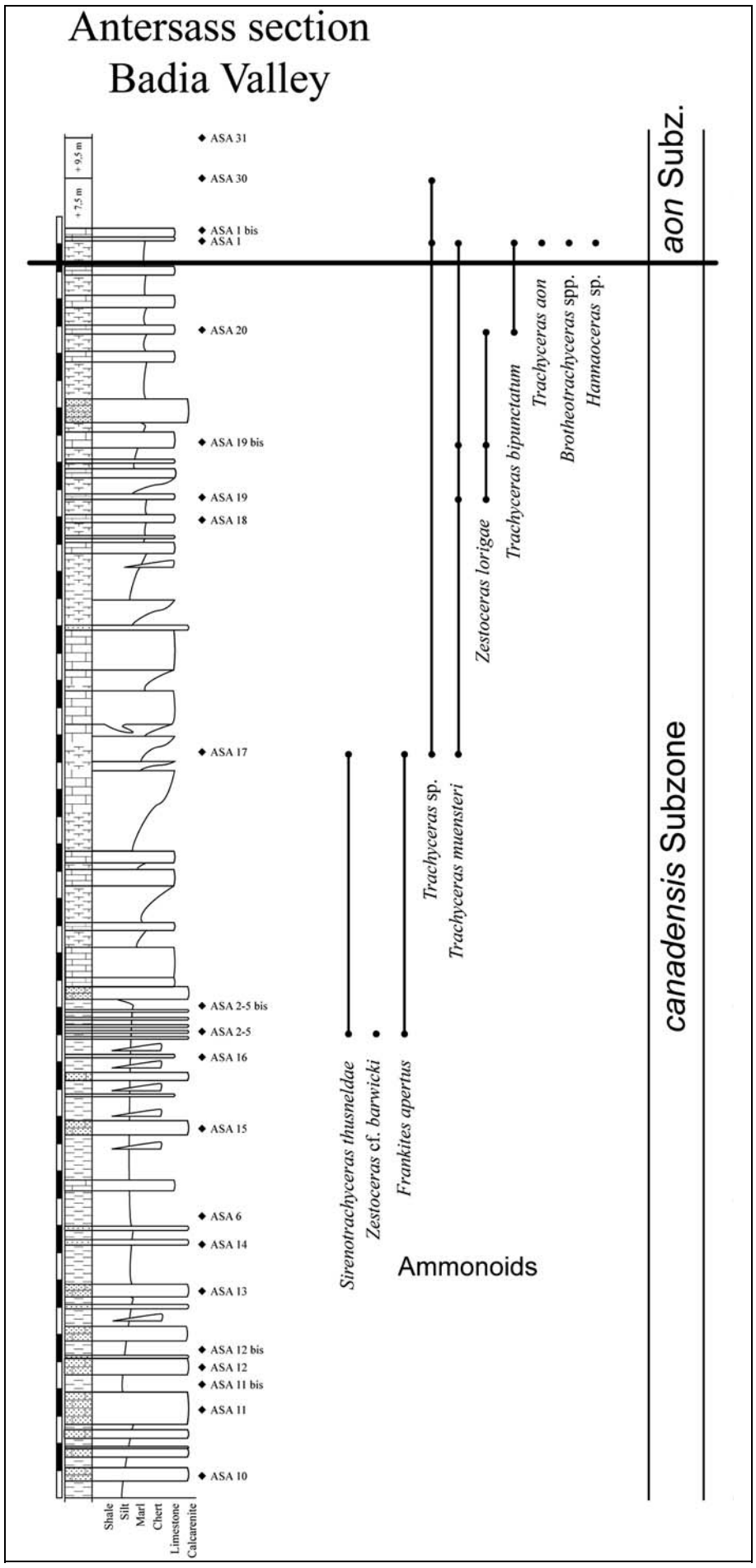


Fig. 8 - The Antersass section with distribution of ammonoids.

Beds	cf. *Zestoceras* sp.	*Lecanites glaucus* (Münster)	*Sirenotrachyceras thusneldae* (Mojsisovics)	*Sirenotrachyceras* sp.	*Frankites apertus* (Mojsisovics)	*Frankites* cf. *apertus* (Mojsisovics)	*Lobites ellipticus* (Hauer)	*Frankites* sp.	cf. *Frankites* sp.	*Lobites* sp.	*Lecanites* sp.	*Trachyceras* sp.	*Trachyceras muensteri* (Wissmann)	cf. *Joannites* sp.	*Zestoceras lorigae* sp.n.	*Trachyceras bipunctatum* (Münster)	cf. *Lobites* sp.	cf. *Asklepioceras* sp.	cf. *Sirenotrachyceras* sp.	*Trachyceras aon* (Münster)	*Trachyceras* cf. *aon* (Münster)	*Brotheotrachyceras* sp.	*Brotheotrachyceras brotheus* (Münster)	*Brotheotrachyceras* cf. *brotheus* (Münster)	*Brotheotrachyceras difforme* (Münster)	*Badiotites* sp.	*Badiotites eryx* (Münster)	*Hannaoceras* sp.	cf. *Muensterites* sp.	*Asklepioceras* sp.	cf. *Trachyceras* sp.	*Frankites* sp. A	*Zestoceras* cf. *barwicki* (Johnston)	*Daxatina* sp.	*Daxatina canadensis* (Whiteaves)	*Daxatina* cf. *laubei* Tozer	*Trachyceras* cf. *dichotomum* (Münster)	TOTAL	SUBZONES
ASA 31							2							1																1								5	
ASA 30												1																			1							2	***aon***
ASA 1		1		1								14	2	1		2		2	1	3	1	2	1	1	3	1	1	1	1								39	
ASA 20							1							1	4	1	1																					8	
ASA 19A							1								3																							4	
ASA 19bis		1											1		4																							6	
ASA 19													1		4																							5	
ASA 17C													1																									1	
ASA 17B		1	2		1								1	2																								7	***canadensis***
ASA 17A												2																										2	
ASA 15									1																													1	
ASA 2		1			1			2		1	1																											6	
ASA 3		4		2	2	1	2	2	1																													14	
ASA 4		6	1																																			7	
ASA 5	1																																					1	
debris	1		1	1	6			1						3	7			1															1	1	1	2	2	1	1	31	
TOTAL	2	14	4	4	10	1	6	5	2	1	1	17	6	8	22	3	1	3	1	3	2	2	1	1	3	1	1	1	2	2	1	1	1	2	2	1	1	139	

cf. *Zestoceras* sp. | *Lecanites glaucus* (Münster) | *Sirenotrachyceras thusneldae* (Mojsisovics) | *Sirenotrachyceras* sp. | *Frankites apertus* (Mojsisovics) | *Frankites* cf. *apertus* (Mojsisovics) | *Lobites ellipticus* (Hauer) | *Frankites* sp. | cf. *Frankites* sp. | *Lobites* sp. | *Lecanites* sp. | *Trachyceras* sp. | *Trachyceras muensteri* (Wissmann) | cf. *Joannites* sp. | *Zestoceras lorigae* sp.n. | *Trachyceras bipunctatum* (Münster) | cf. *Lobites* sp. | cf. *Asklepioceras* sp. | cf. *Sirenotrachyceras* sp. | *Trachyceras aon* (Münster) | *Trachyceras* cf. *aon* (Münster) | *Brotheotrachyceras* sp. | *Brotheotrachyceras brotheus* (Münster) | *Brotheotrachyceras* cf. *brotheus* (Münster) | *Brotheotrachyceras difforme* (Münster) | *Badiotites* sp. | *Badiotites eryx* (Münster) | *Hannaoceras* sp. | cf. *Muensterites* sp. | *Asklepioceras* sp. | cf. *Trachyceras* sp. | *Frankites* sp. A | *Zestoceras* cf. *barwicki* (Johnston) | *Daxatina* sp. | *Daxatina canadensis* (Whiteaves) | *Daxatina* cf. *laubei* Tozer | *Trachyceras* cf. *dichotomum* (Münster) | TOTAL

Tab. 3 - Distribution of the ammonoid fauna in the Antersass section.

phyllites wengensis (Klipstein), *Megaphyllites jarbas* (Münster), *Proarcestes* sp.

Age: Longobardian (*regoledanus* Subzone).

d. Mount Lagna

Area: Carnia; location: eastern ridge of Mount Lagna, municipality of Forni di sopra, Udine; geographical coordinates: ref. I.G.M. 13 III NE Monte Bìvera (ed. 3A, 1984); long. E 0° 10' 09"; lat. 46° 26' 40"; 2042 m a.s.l.

Description: first lava and jaloclastites (Fernazza Formation) and then volcanoarenites alternated with marls and siltstones attributable to the Wengen Formation lie in a not-exposed tectonic contact on the Red Ammonitic Limestones of Forcella Chiana, followed by the San Cassiano Formation and Cassian Dolomite. The succession outcrops not continuously along the ridge from Forcella Chiana to Mount Lagna (2134 m), between 2051 m and 2068 m a.s.l. Ammonoids was collected in the lower part of the Wengen Formation.

Fauna: "*Anolcites*" cf. *laricus* (Mojsisovics), *Frankites* sp., *Asklepioceras* sp., *Lobites ellipticus* (Hauer).

Age: Longobardian (*regoledanus* Subzone)

e. Puiche

Area: Sappada Valley; location: northern side of Mount Siera, municipality of Sappada, Belluno; geographical coordinates: ref. I.G.M. 13 I SO Prato Carnico (4thA ed., 1986); long. E 0° 15' 33"; lat. 46° 34' 07"; 1240 m a.s.l.

Description: the outcrops are found on the left of Piave river, near the village of Puiche (1 km from Cima Sappada). Tectonics complicates the stratigraphic reconstruction at this site, so that the second terrigenous unit of the Acquatona Fm. was found here (Viel 1979b),

besides the Wengen Fm. through a tectonic contact. Specimens were collected in situ from the Wengen Fm.

Fauna: *Protrachyceras* sp., *Protrachyceras ladinum* (Mojsisovics), *Maclearnoceras* sp., *Frankites regoledanus* (Mojsisovics), *Indoceltites aberrans* (Mojsisovics), *Lecanites glaucus* (Münster), cf. *Joannites* sp., *Megaphyllites jarbas*.

Age: Longobardian (*regoledanus* Subzone).

f. "Vecchio Mulino" in front of Ecche section

Area: Sappada Valley; location: northern flank of Mount Siera, municipality of Sappada, Belluno; geographical coordinates: ref. I.G.M. 13 I SO Prato Carnico (4thA ed., 1986); long. E 0° 15' 23"; lat. 46° 34' 03"; 1225 m a.s.l.

Description: this is the locality described by Leonardi (1964) and Mietto & Manfrin (1995b) as "Molino di Ecche". Here volcanic arenites of the Wengen Formation form a large outcrop on the left bank of Piave river. The outcrop is now a single bed, and the ammonoid fauna marked FZ 1 occurs from its upper surface. Due to a recent landslide, the outcrop is now hardly reachable, but a short stratigraphic section is now exposed downstream. Another ammonoid association, marked VMP and stratigraphically younger, was also collected. Both associations belong to the *regoledanus* Subzone.

This locality is reached leaving the road Sappada-Cima Sappada just after the junction to Puiche. A trail on the right leads to the Piave river crossing over a wooden bridge, then a trail dips down to the riverbed on the left. The outcrop is in front of the old mill ("vecchio mulino") of Ecche, visible on the opposite riverside.

Fauna: *Protrachyceras* sp., *Protrachyceras archelaus* (Laube), *Protrachyceras ladinum* (Mojsisovics), *Anolcites* sp., *Frankites* sp., *Frankites regoledanus* (Mojsisovics), cf. *Frankites* sp., *Maclearnoceras* sp., cf. *Maclearnoceras* sp., *Sirenotrachyceras* sp., *Lecanites glaucus* (Münster), *Indoceltites* sp., cf. *Lobites* sp.

Age: Longobardian (*regoledanus* Subzone).

g. Pista Nera section

Area: Sappada Valley; location: northern flank of Mount Siera, municipality of Sappada, Belluno; geographical coordinates: ref. I.G.M. 13 IV SE Sappada (ed. 4thA ed., 1984); long. E 0° 14' 18",8"; lat. 46° 33' 36,5"; 1193 m a.s.l.

Description: the outcrop is reached from Sappada by taking the trail towards the Piave river along the Rio dei Molini/Mühlbach. Some 400 m downstream of the confluence with Rio Siera di Sappada, a wooden bridge crosses the Piave river. Here, on the left riverside, a short and tectonically affected stratigraphic section exposes dark marls and silty limestones of the San Cassiano Formation. Samples PN 19, 20, 21 and 22 are located 2.9 m from the base of the section, and sample PN 4 at m 5.7.

Fauna: *Daxatina* cf. *canadensis* (Whiteaves), *Trachyceras* sp., *Trachyceras* cf. *muensteri* (Wissmann), *Sirenotrachyceras* sp.

Age: Julian (*canadensis* Subzone).

h. Val Giaule 2 section

Area: eastern Dolomites; location: left side of Talagona valley, municipality of Domegge di Cadore, Belluno; geographical coordinates: ref. I.G.M. 12 II N.E. Pieve di Cadore (ed. 4thA ed., 1984); long. W 0° 01' 05"; lat. 46° 26' 15,5"; 900 m a.s.l. (base of the section).

Description: starting from Vallesella (between Pieve di Cadore and Calalzo), a bridge crosses the lake of Calalzo. Then, follow trail n. 343 to Fienili Muz (ca. 900 m a.s.l.). Here starts a trace which follows the left side of Talagona Valley through Fienili Larieto and Fienile Laial. A small valley is reached (Val Giaule). Going upstream, a bifurcation is reached where the Val Giaule 1 section occupies the right branch, while Val Giaule 2 section is in the left branch. Here is considered only the Val Giaule 2 section. The Val Giaule 2 section exposes a long stratigraphic succession comprising the Anisian Dont, Bivera and Ambata formations and the Anisian-Ladinian Livinallongo Formation (Buchenstein Fm). A terrigenous succession with a basal conglomerate lies unconformably above the Buchenstein Formation. This unit is extremely rich in fossils, and yielded ammonoids of the *neumayri* and *regoledanus* subzones.

This section was also mentioned by Riedel (1949, as Val Talagona), Semenza (1965), Leonardi (1968), Mietto & Manfrin (1995a, 1995b).

Fauna: *"Anolcites" neumayri* (Mojsisovics), *Protrachyceras archelaus* (Laube), *Protrachyceras ladinum* (Mojsisovics), *Protrachyceras* cf. *ladinum* (Mojsisovics), *Maclearnoceras* sp., cf. *Maclearnoceras* sp., *Celtites epolensis* Mojsisovics, cf. *Joannites* sp., *Megaphyllites jarbas* (Münster), *Monophyllites wengensis* (Klipstein), *Monophyllites* cf. *wengensis* (Klipstein).

Age: Longobardian (*neumayri* Subzone).

Fauna: *"Anolcites"*cf. *neumayri* (Mojsisovics), *Protrachyceras archelaus* (Laube), *Protrachyceras* cf. *archelaus* (Laube), *Protrachyceras ladinum* (Mojsisovics), *Protrachyceras* cf. *ladinum* (Mojsisovics), *Protrachyceras* sp., cf. *Protrachyceras* sp., *"Anolcites"* cf. *laricus* (Mojsisovics), *Asklepioceras* sp., cf. *Asklepioceras* sp., *Zestoceras* cf. *enode* (Tozer), *Frankites* sp., *Frankites regoledanus* (Mojsisovics), *Frankites apertus* (Mojsisovics), *Frankites* sp. A, *Rimkinites* sp., *Celtites* sp., *Celtites epolensis* Mojsisovics, *Lobites ellipticus* (Hauer), *Lobites* cf. *ellipticus* (Hauer), cf. *Joannites* sp., *Monophyllites wengensis* (Klipstein).

Age: Longobardian (*regoledanus* Subzone).

i. Pecol

Area: eastern Dolomites; location: right side of Maé creek, municipality of Zoldo Alto, Belluno.

Description: during the building of a cable lift to the top of Crep di Pecol (1811 m a.s.l.), above Camping Civetta at Pecol vecchio (Zoldo Valley), abundant volcanic arenites and siltites of the Fernazza and Wengen formations were excavated. They yielded a longobardian ammonoid fauna, recently quoted in Mietto & Manfrin (1995b).

Fauna:*"Anolcites" neumayri* (Mojsisovics), *Frankites regoledanus* (Mojsisovics), *Protrachyceras archelaus* (Laube), *Protrachyceras ladinum* (Mojsisovics).

Age: Longobardian (*neumayri* and *regoledanus* subzones).

j. Varisele

Area: eastern Dolomites; location: left side of Maé creek, Fusine, municipality of Zoldo Alto, Belluno; Geographical coordinates: Ref. Tav. I.G.M. 12 III SE Forno di Zoldo (ed. 1963); long. W 0° 18' 35"; lat. 46° 22' 05"; 1120 m a.s.l

Description: this locality was indicated already by Mietto & Manfrin (1995b). From Dont towards Forcella Staulanza, a trail starts slightly before the deviation to Iral. The trail heads South and crosses several small streams. Bedded volcanic arenites of the lower Wengen Fm. crop out at the intersection with the second stream.

Fauna: *Protrachyceras archelaus* (Mojsisovics), *Protrachyceras ladinum* (Mojsisovics), *Sirenotrachyceras* sp., cf. *Pseudocarnites* sp., *Lobites* sp., *Monophyllites wengensis* (Klipstein).

Age: Longobardian (*Protrachyceras* Zone).

Fauna: *"Anolcites" neumayri* (Mojsisovics), *Liardites* sp., *"Anolcites" richthofeni* (sensu Mojsisovics, 1882: tav. XXXVII, fig. 5).

Age: Longobardian (*neumayri* Subzone).

Fauna: *Lobites* sp., *Frankites* sp., *Frankites* cf. *regoledanus* (Mojsisovics).

Age: Longobardian (*regoledanus* Subzone).

k. Rio Cuzze section

Area: eastern Dolomites; location: eastern flank of Mount Penna, municipality of Borca di Cadore, Belluno; geographical coordinates: Ref. I.G.M. 12 II N.O. Monte Antelao (5thA ed., 1984); long. W 0° 13' 45,5"; lat. 46° 25' 32,5"; 915 m a.s.l. (base of the section).

Description: this stratigraphic section was already mentioned by Leonardi (1932) and illustrated in Mietto & Manfrin (1995b) and De Zanche & Gianolla (1995). It is located on the hydrographic right of

Boite river, south of Borca di Cadore. From the latter locality, take the bridge (Ponte di Cancia) towards Vodo di Cadore. Once reached the Lake of Vodo, the second small valley after Molino (Mill) Varettoni is Rio Cuzze (or Rio Val di Cuze). The stratigraphic section is measured within the San Cassiano Formation and yielded ammonoids of the *regoledanus* and *canadensis* subzones.

Fauna: *Protrachyceras* cf. *ladinum* (Mojsisovics), *Lecanites glaucus* (Münster), *Lobites ellipticus* (Hauer), cf. *Lobites* sp.

Age: Longobardian (*regoledanus* Subzone).

Fauna: *Daxatina canadensis* (Whiteaves), cf. *Trachyceras* sp., *Zestoceras lorigae* sp.n., *Frankites* sp., *Lecanites glaucus* (Münster), *Lobites* sp., *Lobites ellipticus* (Hauer).

Age: Julian (*canadensis* Subzone).

l. Le Rocchette

Area: eastern Dolomites; location: south-eastern flank of Rocchetta di Campolungo, municipality of San Vito di Cadore, Belluno; geographical coordinates: ref. I.G.M. 12 III NE Monte Pelmo (5thA ed., 1984); long. W 0° 18' 59"; lat. 46° 27' 36",5; 2090 m a.s.l. (base of the section).

Description: this locality was identified by Leonardi (1932). The Leonardi's Collection is stored at MGPD, and new collections are also deposited here. The exposure consists of marls and marly limestones of the San Cassiano Formation, cropping out into gullies excavated on the SE flank of the Rocchetta di Campolungo (2287 m a.s.l.). The outcrops are reached from San Floreano near San Vito di Cadore (Boite Valley). Here, the Boite river is crossed by a bridge to the north (Ponte Geralba) leading to a dirt road to Tabià Salvaniera. Then, the road changes into the trail n. 459 on the left side of Val de Cortaredo (Ru de la Frates) to a small pass at 1719 m a.s.l. Take now the trail n. 436 until ca. 1500 m before Malga Prendera. Here the outcrops occur, and samples ROC 1, ROC 2 and ROC 3 represent new collections. The original specimens of Leonardi (1932) are marked ROC.PL and revised.

Fauna: *Trachyceras* sp., *Trachyceras muensteri* (Wissmann), *Trachyceras bipunctatum* (Münster), cf. *Zestoceras* sp., *Badiotites* sp., *Badiotites eryx* (Münster), cf. *Klipsteinia* sp., *Lecanites glaucus* (Münster), cf. *Lobites* sp., *Lobites ellipticus* (Hauer).

Age: Julian (*canadensis* Subzone).

m. Lavarella/Piz d'La Varella

Area: western Dolomites; location: San Cassiano Valley, municipality of Badia/Abtei, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SE Corvara in Badia (5th ed., 1963); long. W 0° 30' 06"; lat. 46° 34' 52",5; 2040 m a.s.l. (base of the section).

Description: this locality was described in detail by Masetti et al. (1991) and Keim et al. (2001). Below the section illustrated by these authors, at the altitude of ca. 2040 m, marls and marly limestones of the San Cassiano Formation were sampled. This locality yielded an ammonoid fauna of the *canadensis* Subzone.

Fauna: *Trachyceras* sp., *Trchyceras muensteri* (Wissmann), *Zestoceras lorigae* sp.n., cf. *Zestoceras* sp., *Badiotites* sp., *Lecanites glaucus* (Münster), *Lobites ellipticus* (Hauer), cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

n. Contrada D'lira/Glira

Area: western Dolomites; location: San Cassiano Valley, municipality of Badia/Abtei, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I NE Badia (4th ed., 1963); long. W 0° 30' 12"; lat. 46° 34' 05"; 1700 m a.s.l.

Description: from San Cassiano, take the road towards Passo Valparola and, after 800 m, turn left to contrada D'lira/Glira (1649 m a.s.l.). Here, follow the trail n. 15 towards the Ospizio di Santa Croce/Heiligkreutz Hospiz. At the altitude of 1700 m ca., a large outcrop on the flanks of the trail exposes marls and oolitic-bioclastic calcarenites of the San Cassiano Formation, in which the *canadensis* Subzone is documented.

Fauna: *Trachyceras* sp., *Zestoceras* sp., *Zestoceras lorigae* sp.n., cf. *Zestoceras* sp., cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

o. Pralongià/Prelungé

Area: western Dolomites; location: crest between Cordevole and San Cassiano valleys, municipality of Badia/Abtei, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SE Corvara in Badia (ed. 5, 1963); long. W 0° 32' 10",5; lat. 46° 31' 56"; 2138 m a.s.l. (Little church of Pralongià).

Description: some specimens were collected in situ, though not positioned within a measured stratigraphic section, between Pralongià church and Settsass (trail C.A.I. n° 23). Bed SW 11 is a small outcrop right East of the church. Bed SW p.4 comes from the top of Piz Stuores (2181 m a.s.l.). Bed URL12 is 500 m North of Piz Stuores, within an erosional gully. Bed URL4b lies ca. 800 m South-East of Piz Stuores, above the Prati di Stuores/Stuores Wiesen section, in small erosional patches within the meadows. The last two beds coincide with those with the same name in Urlichs (1994).

Fauna (bed SW 11): *Daxatina* sp., cf. *Daxatina* sp., *Frankites* sp., cf. *Frankites* sp., *Trachyceras* sp., cf. *Trachyceras* sp., *Sirenotrachyceras* sp., *Paratrachyceras* sp., *Badiotites* sp., *Badiotites eryx* (Münster), cf. *Badiotites* sp., *Clionitites*? *basileus* (Münster), *Lecanites glaucus* (Münster), *Monophyllites* sp.

Age: Julian (*canadensis*/*aon* mixed subzones).

Fauna (beds SW p.4, URL 4b,URL 12): *Trachyceras bipunctatum* (Münster), *Trachyceras muensteri* (Wissmann), *Brotheotrachyceras* cf. *brotheus* (Münster), *Brotheotrachyceras larva* (Klipstein), *Sirenotrachyceras furcatum* (Mojsisovics), *Clionitites*? *basileus* (Münster), *Clionitites acutecostatus* (Klipstein), cf. *Clionitites* sp., *Klipsteinia* sp., cf. *Klipsteinia* sp., *Badiotites* sp., *Badiotites eryx* (Münster), *Lecanites glaucus* (Münster), *Proarcestes bicarinatus* (Münster), *Megaphyllites jarbas* (Münster).

Age: Julian (*aon* Subzone).

p. Rü de Stores

Area: western Dolomites; location: left side of the San Cassiano Valley, municipality of Badia/Abtei, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I NE Badia (4th ed., 1963); long. W 0° 30' 51,9"; lat. 46° 32' 17"; 2000 m a.s.l.

Description: from Piz di Stuores (see Prati di Stuores/Stuores Wiesen section), take the trail towards San Cassiano Valley and Albergo Valparola. This trail follows the narrow valley of Rü de Stores. At the altitude of ca. 2000 m, along the creek, marls of the San Cassiano Formation yielded ammonoids of the *canadensis* Subzone. Along the same creek, but in debris, a specimen of *Frankites apertus* was also found.

Fauna: *Zestoceras lorigae* sp. n., cf. *Frankites* sp., *Sirenotrachyceras* sp., *Lecanites glaucus* (Münster).

Age: Julian (*canadensis* Subzone).

q. Settsass

Area: western Dolomites; location: crest between Cordevole and San Cassiano valleys, municipality of Livinallongo del Col di Lana, Belluno.

Description: some 900 m south-west of Piz Stuores, trail CAI n° 24 departs from trail n° 23. Following trail n° 23 for another 1.2 km, bed SS p.1 is reached, at the base of Montagna della Corte (2225 m a.s.l.). Bed SS p.2 lies along the same trail, 800 m further ahead, at an height of 2230 m, within a wide gully South-West of Settsass.

Fauna: *Trachyceras aon* (Münster), *Trachyceras* cf. *aon* (Münster), *Trachyceras bipunctatum* (Münster), *Trachyceras* cf. *muensteri* (Wissmann), cf. *Trachyceras* sp., *Brotheotrachyceras brotheus* (Münster), cf. *Diplosirenites* sp., *Clionitites*? *basileus* (Münster), *Clionitites* ? *busiris* (Münster), *Badiotites* sp., *Badiotites eryx* (Münster), cf. *Badio-*

tites sp., *Klipsteinia achelous* (Münster), *Klipsteinia karreri* Mojsisovics, cf. *Carnites* sp., *Lecanites glaucus* (Münster), *Orthoceltites buchi* (Klipstein), *Lobites* sp., *Proarcestes bicarinatus* (Münster).

Age: Julian (*aon* Subzone).

r. Crep de Mont section

Area: western Dolomites; location: eastern flank of the Sella Massif, municipality of Corvara in Badia/Kurfar, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SE Corvara in Badia (5th ed., 1963); long. W 0° 34' 49"; lat. 46° 31' 37"; 2000 m a.s.l. (base of the section).

Description: this section is located at the altitude of 2000 m a.s.l. along the crest from Crep de Mont to Rifugio Crep de Mont. It can be reached from Albergo Boè taking the trail n. 638 and, once at Crep de Mont, trail n. 639. This section was identified also in Neri et al. (1994) and is characterized by shales prevailing with respect of arenites, carbonate, paraconglomerates and isolated carbonate olistoliths, belonging to the San Cassiano Formation. The section yielded ammonoids of the *canadensis* Subzone. The presence of the *regoledanus* Subzone in the lower part of the section needs to be confirmed.

Fauna: *Asklepioceras* sp., *Lecanites glaucus* (Münster).

Age: Longobardian (*regoledanus* Subzone).

Fauna: *Trachyceras muensteri* (Wissmann), *Zestoceras barwicki* (Johnston), *Zestoceras* cf. *barwicki* (Johnston), *Zestoceras lorigae* sp. n., cf. *Muensterites* sp., *Frankites apertus* (Mojsisovics), *Lobites ellipticus* (Hauer), cf. *Romanites* sp., cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

s. Passo Campolongo section

Area: western Dolomites; location: eastern flank of the Sella Massif, municipality of Corvara in Badia/Kurfar, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SE Corvara in Badia (5th ed., 1963); long. W 0° 34' 58,5"; lat. 46° 31' 11,5";1915 m a.s.l.(base of the section).

Description: this section is located at Passo Campolongo, near the spring NW of Albergo Boè, at the administrative boundary between Veneto and Trentino-Alto Adige/Südtirol regions. It is reached by the dirt road n. 638 from Albergo Boè. Facies similar to those of the Crep de Mont section crop out and yielded an ammonoid fauna of the *canadensis* Subzone.

Fauna: cf. *Daxatina* sp., *Zestoceras barwicki* (Johnston), *Zestoceras lorigae* sp. n., cf. *Muensterites* sp., *Lecanites glaucus* (Münster), cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

t. Pallua section

Area: western Dolomites; location: south-eastern flank of the Sella Massif, high Cordevole Valley, municipality of Livinallongo del Col di Lana, Belluno; geographical coordinates: ref. I.G.M. 11 II NE Monte Marmolada (3th ed., 1963); long. W 0° 35' 36,5"; lat. 46° 29' 34,5"; 1740 m a.s.l. (base of the section).

Description: from Arabba, take the road to Passo Pordoi. After ca. 1 km, cross the village of Pallua/Palua: a gully or small valley cuts the flank of Col Burz in the Sella Group. A continuous, more than 100 m long section is exposed, which includes the Wengen and San Cassiano formations. Only the lower part of the section was sampled, and yielded ammonoids of the *regoledanus* Subzone. According to Bizzarini & Braga (1987) this interval is attributable to the San Cassiano Formation.

Fauna: *Protrachyceras* sp., cf. *Protrachyceras* sp., *Zestoceras* sp., *Frankites* sp., *Frankites apertus* (Mojsisovics), *Celtites epolensis* Mojsisovics, *Lecanites glaucus* (Münster), cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

u. Prati del Pordoi

Area: western Dolomites; location: southern flank of the Sella Massif, high Cordevole Valley, municipality of Livinallongo del Col di Lana, Belluno; geographical coordinates: ref. I.G.M. 11 II NO Canazei (3th ed., 1959); long. W 0° 37' 37"; lat. 46° 29' 25,5"; 2220 m a.s.l.

Description: take the dirt road from Passo Pordoi to the Pordoi ossuary. The underlying slope (Prati del Pordoi, i.e. Pordoi meadows) is cut by several erosional gullies exposing the San Cassiano Formation. Ammonoids of the *canadensis* Subzone come in situ from two localities of separated gullies, but it was impossible to measure a stratigraphic section.

Fauna: *Zestoceras lorigae* sp. n., cf. *Zestoceras* sp., *Lecanites glaucus* (Münster), *Lobites* sp., *Lobites ellipticus* (Hauer), cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

v. "La Locomotiva" section

Area: western Dolomites; location: western flank of the Sella Massif, municipality of Canazei, Trento; geographical coordinates: Ref. I.G.M. 11 I SO S. Cristina Valgardena (5th ed., 1963); long. W 0° 40' 32"; lat. 46° 30' 25"; 2350 m a.s.l. (base of the section).

Description: this section crops out near Passo Sella and was described by Bosellini & Neri (1991), Neri et al. (1994), who reported a conodont fauna, and Mietto & Manfrin (1995b) with reference to ammonoids. The section occurs in a hollow on the southern flank of the Torri del Sella (Sella towers), almost under the so-called "Locomotiva" (a rock pinnacle with the shape of a locomotive). It can be reached from Passo Sella by a trace leaving the main road near the Maria Flora Hotel. The section is constituted by shales, calcarenites, calcirudites, carbonate conglomerates and isolated calcareous olistoliths.

Fauna: *Frankites apertus* (Mojsisovics), *Sirenotrachyceras thusneldae* (Mojsisovics), *Lecanites glaucus* (Münster), *Lecanites* cf. *glaucus* (Münster), *Lobites ellipticus* (Hauer), cf. *Romanites* sp., cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

w. Sasso di Levante/Grohmann Spitze section

Area: western Dolomites; location: southern flank of Sassolungo/Langkofel, municipality of Campitello di Fassa, Trento; geographical coordinates: Ref. I.G.M. 11 I SO S. Cristina Valgardena (5th ed., 1963); long. W 0° 42' 33"; lat. 46° 30' 05"; 2250 m a.s.l. (base of the section).

Description: the Punta Grohmann section was described by Leonardi (1968), Scudeler Baccelle (1974), Wendt & Fürsich (1980), and Russo et al. (1997), who referred most of the succession to the San Cassiano Formation. De Zanche et al. (1993) and Gianolla et al. (1998) gave a different lithostratigraphic and sequence stratigraphic interpretation, recently updated (Mietto et al. 2007b). The section occupies a wide valley cutting the southern slope of Sasso di Levante. It can be reached from Passo Sella/Sellajoch by trails n. 4 and n. 594. The section crops out into the first valley after Rifugio F. August (2298 m a.s.l.). Alternatively, from Campitello di Fassa, take the chair-lift to Col Rodella and then trail n. 594 as from Passo Sella.

The section is well exposed, and starts with the Marmolada Conglomerate, lying uncomformably upon Ladinian volcanics. A thick succession of alternating volcanic arenites, siltites and shales with channelized horizons of carbonate conglomerates and olistoliths, i.e., "Cipit" boulders (cf. Russo et al. 1997) characterizes the lower part of the section. Upwards the section shows an increase in carbonates debris related to the progradation of a carbonate platform and ends with the inter-fingering of a coarse grain toe of slope of the Cassian carbonate platform. The succession is referred to the Wengen and S. Cassiano formations, and yielded few, but very significant ammonoids (Mietto & Manfrin 1995b).

Fauna: *Frankites* sp., *Frankites apertus* (Mojsisovics), *Frankites* cf. *apertus* (Mojsisovics), *Maclearnoceras* sp., *Asklepioceras* sp., *Celtites* sp., *Celtites epolensis* Mojsisovics, *Lecanites glaucus* (Münster), *Lobites ellipticus* Hauer, cf. *Orestites* sp., cf. *Joannites* sp.

Age: Longobardian-Julian boundary interval (*regoledanus-canadensis* Subzones).

x. Col de Frea section

Area: western Dolomites; location: northern flank of the Sella Massif, municipality of Corvara in Badia/Kurfar, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SO S. Cristina Valgardena (5th ed., 1963); long. W 0° 38' 26"; lat. 46° 32' 42"; 2180 m a.s.l. (base of the section).

Description: two stratigraphic sections were measured in the area of Passo Gardena/Grödner Joch (Mietto & Manfrin 1995b). The first crops out along the crest from Passo Gardena to Col de Frea (i.e. Col de Masores in Reithofer 1928b). The section is well exposed only for short intervals, due to detrital cover. The lower part is comprised in the Wengen Formation, while the uppermost part (under a clearly visible antenna) is given by calcareous-silty facies of the San Cassiano Formation. This upper portion lies above the so-called "megabreccia" (i.e., olistostrome) and is practically coincident with the upper part (beds G*306/206) of the Passo Gardena section (see below).

Sample GJ.1b was collected in laminated siltites 2.3 m from the base of the section; GJ.1a from an underlying calcarenitic bed. These beds belong from few meters of laminated shales with volcanoclastic intercalations, cropping out almost at Passo Gardena. Sample GJ.1 was collected in debris, from the same interval.

Fauna: *Maclearnoceras* sp., *Asklepioceras* sp., *Frankites* sp., *Frankites apertus* (Mojsisovics), *Celtites epolensis* Mojsisovics, *Celtites* cf. *epolensis* Mojsisovics, *Lecanites glaucus* (Münster), *Lobites* sp., *Lobites ellipticus* (Hauer), cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

Fauna: *Sirenotrachyceras* sp., *Sirenotrachyceras furcatum* (Mojsisovics), *Sirenotrachyceras* cf. *furcatum* (Mojsisovics), *Sirenotrachyceras thusneldae* (Mojsisovics), cf. *Sirenotrachyceras* sp., *Lecanites glaucus* (Münster), *Lobites ellipticus* (Hauer), cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

y. Passo Gardena/Grödner Joch section

Area: western Dolomites; location: northern flank of the Sella Massif, municipality of Corvara in Badia/Kurfar, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SO S. Cristina Valgardena (5th ed., 1963); long. W 0° 38' 19"; lat. 46° 32' 51"; 2050 m a.s.l. (base of the section).

Description: the second section measured at Passo Gardena is located at the head of Badia valley, within an erosional gully excavated from the base of the Passo Gardena "megabreccia" (Bosellini & Neri 1991). It can be reached from the second sharp bend of the road from Passo Gardena to Corvara/Kurfar. It is mostly characterized by dark shales and arenites, with rare channelized proximal calciturbidites of the Wengen Formation. Above the "megabreccia", marls and marly limestones of the San Cassiano Formation are identical to those of the Col de Frea section (see above). Eighteen beds within the Wengen Formation yielded ammonoids, and further three in the San Cassiano Formation above the "megabreccia" were also studied. Samples G301/201 and G*306/206 are from dm-scale bed sets of arenaceous siltites.

Fauna: cf. *Protrachyceras* sp., cf. *Zestoceras* sp., cf. *Maclearnoceras* sp., *Asklepioceras* sp. cf. *Asklepioceras* sp., *Frankites* sp., *Frankites apertus* (Mojsisovics), *Sirenotrachyceras* sp. cf. *Sirenotrachyceras* sp., *Celtites epolensis* Mojsisovics, *Lecanites glaucus* (Münster), *Lobites* sp., *Lobites ellipticus* (Hauer), *Lobites* cf. *ellipticus* (Hauer), cf. *Lobites* sp., cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

Fauna: *Zestoceras sp.*, cf. *Zestoceras* sp., *Frankites apertus* (Mojsisovics), *Frankites* cf. *apertus* (Mojsisovics), *Sirenotrachyceras furcatum* (Mojsisovics), *Sirenotrachyceras thusneldae* (Mojsisovics), *Lecanites glaucus* (Münster), *Lobites ellipticus* (Hauer), cf. *Joannites* sp.

Age: Julian (*canadensis* Subzone).

z. Kerpatscha

Area: western Dolomites; location: southern flank of the Pizzes da Cir, Passo Gardena/Grödner Joch, municipality of Corvara in Badia/Kurfar, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SO S. Cristina Valgardena (5th ed., 1963); long. W 0° 37' 45,6"; lat. 46° 33' 09,7"; 2110 m a.s.l.

Description: this locality was already identified by Reithofer (1928a) for sparce ammonoid findings. A group of isolated outcrops encompasses here the Wengen Formation, the lower San Cassiano Formation and the base-of-slope facies of the Cassian Dolomite. The outcrops are located in a relatively vast area between Passo Gardena and Passo Cir, called Kerpatscha/Pra de Frara (see also Mietto & Manfrin 1995b). Samples CIR A-B come from volcanic arenites of the Wengen Formation, cropping out at 2110 m a.s.l. These outcrops are reached from Passo Gardena, taking the trails to Rifugio Forcelles and then Rifugio Clark.

Fauna: *Protrachyceras* cf. *archelaus* (Laube), cf. *Protrachyceras* sp., cf. *Anolcites* sp., *Celtites epolensis* Mojsisovics, *Lecanites glaucus* (Münster), cf. *Lobites* sp., cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

za. Pizzes da Cir section

Area: western Dolomites; location: southern flank of the Pizzes da Cir, Passo Gardena/Grödner Joch, municipality of Corvara in Badia/Kurfar, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SO S. Cristina Valgardena (5th ed., 1963); long. W 0° 38' 26"; lat. 46° 32' 46"; 2150 m a.s.l. (base of the section).

Description: in a gully located above Kerpatscha, a short stratigraphic section was measured within shales, arenaceous shales, volcanic and hybrid arenites, calcilutites and carbonate breccias of the upper Wengen Formation. Sample CFR 3 is from the base of the section, in a correlated spot along the trail but out of the gully; sample CIR C comes from instead from an isolated outcrop of the overlying San Cassiano Formation, constituted by marls and calcarenites.

Fauna: cf. *Maclearnoceras* sp., *Asklepioceras* sp., *Asklepioceras* cf. *segmentatum* (Mojsisovics), cf. *Asklepioceras* sp., *Frankites* sp., *Frankites apertus* (Mojsisovics), cf. *Frankites* sp., *Sirenotrachyceras* sp., cf. *Sirenotrachyceras* sp., *Celtites epolensis* Mojsisovics, *Lobites ellipticus* (Hauer), cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

Fauna: cf. *Daxatina* sp., *Zestoceras* sp., *Frankites* sp., *Sirenotrachyceras thusneldae* (Mojsisovics), *Badiotites eryx* (Münster).

Age: Julian (*canadensis* Subzone).

zb. Sass Ciampac

Area: western Dolomites; location: southern flank of the Pizzes da Cir, Passo Gardena/Grödner Joch, municipality of Corvara in Badia/Kurfar, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I SE Corvara in Badia (5th ed., 1963); long. W 0° 36' 43"; lat. 46° 33' 35"; 2150 m a.s.l. (base of the section).

Description: a thick stratigraphic succession including the upper Wengen Formation, the San Cassiano Formation and the Cassian Dolomite is exposed at the base of the eastern wall of Sass Ciampac. This section can be reached from Colfosco/Kolfuschg, by a trail to Rifugio Forcelles. Once at the base of Sass Ciampac, turn west. The steepness of the section discouraged a bed-by-bed study, but a very well preserved fauna of the *regoledanus* Subzone was collected in a shale of the Wengen Formation, at the base of the section.

Fauna: *Frankites apertus* (Mojsisovics), *Zestoceras* cf. *enode* (Tozer), cf. *Zestoceras* sp., cf. *Romanites* sp., *Celtites epolensis* Mojsisovics, cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

zc. Col da Oi

Area: western Dolomites; location: left side of the Badia valley, municipality of Badia/Abtei, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 I NE Badia (4th ed., 1963); long. W 0° 34' 47"; lat. 46° 37' 18"; 1600 m a.s.l. (eastern margin of the outcrop).

Description: this locality was already identified by Mojsisovics (1882) and Ogilvie (1893) and called Pescol from the name of the nearby village. It can be reached from Pedraces/Pedratsches by the local road to Pescol-Longiarù/Campill. The outcrop is the main scarp of a large landslide, later incised by gullies, straddling between 1600 and 1700 m a.s.l. The exposures are dissected and separated by faults, however, a succession of the Wengen Formation and lower San Cassiano Formation can be identified. Each gully was identified with a capital letter, from A to E (Mietto & Manfrin 1995b). The outcropping intervals become younger from A to E, with rather large superpositions between the first four incisions. Calcarenites and calcilutites appear in gully OI-D and are then progressively more abundant, and mark the base of the San Cassiano Formation. Abundant ammonoids were collected in the debris within and at the base of each gully, and marked accordingly. OI-B' and OI-D' refer instead to faunal assemblages collected in situ.

Locality OI-K is on the western slopes of Col da Oi, at the altitude of 1770 m a.s.l.; OI-L comes from the western face of the hilltop, at an altitude of ca. 1800 m; both are in the San Cassiano Formation. Taken as a whole, Col da Oi yields ammonoid associations of the *regoledanus*, *canadensis* and *aon* subzones.

Fauna: *Protrachyceras* sp., *Protrachyceras archelaus* (Laube), *Anolcites* sp., cf. *Anolcites* sp., *Maclearnoceras* sp., cf. *Maclearnoceras* sp., *Asklepioceras* sp., cf. *Muensterites* sp., *Frankites* sp., *Frankites apertus* (Mojsisovics), *Lecanites glaucus* (Münster), *Celtites epolensis* Mojsisovics, *Celtites* cf. *epolensis* Mojsisovics, cf. *Romanites* sp., *Lobites ellipticus* (Hauer), *Lobites* cf. *ellipticoides* (Laube), cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

Fauna: *Frankites apertus* (Mojsisovics), cf. *Muensterites* sp., cf. *Zestoceras* sp., *Lecanites glaucus* (Münster), *Lobites ellipticus* (Hauer), cf. *Joannites* sp.

Age: Longobardian-Julian boundary interval (*regoledanus* vel *canadensis* subzones).

Fauna: *Daxatina* cf. *laubei* Tozer, cf. *Daxatina* sp., *Trachyceras* sp., cf. *Trachyceras* sp., *Zestoceras barwicki* (Johnston), *Zestoceras lorigae* sp.n., *Asklepioceras* sp., *Frankites* sp., *Frankites apertus* (Mojsisovics), *Frankites* sp. A, *Frankites* cf. sp. A, *Sirenotrachyceras* sp., *Sirenotrachyceras thusneldae* (Mojsisovics), *Lecanites glaucus* (Münster), *Lobites* sp.

Age: Julian (*canadensis* Subzone).

Fauna: *Trachyceras* cf. *dichotomum* (Münster).

Age: Julian (*aon* Subzone).

zd. Rio Frommer/Frommerbach 1 section

Area: western Dolomites; location: Alpe di Siusi/Seiser Alm, municipality of Castelrotto/Kastelruth, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 IV SE Ortisei (4th ed., 1963); long. W 0° 50' 53"; lat. 46° 32' 13"; 1700 m a.s.l. (base of the section).

Description: this section was already described in Brandner et al. (1982) and Mietto & Manfrin (1995b: Frombach-Frötschbach). It is a composite section cropping out along Rio Frommer/Frommerbach, starting from a car park on the road from Siusi/Seis to Alpe di Siusi/Seiser Alm, slightly above Hotel Frommer. A first tract of the section, given by volcanic fine arenites and siltites, lies above Upper Ladinian volcanics and under the Marmolada Conglomerate. The so-called "Pachycardientuffe", fossiliferous horizon known in the literature from the nineteenth century, are comprised in the Marmolada Conglomerate along Rio Frommer. Beds RF 1 to 6 were sampled within the first 2 meters above the Ladinian volcanics, while samples PCT 1 to 3 come from immediately below or within the "Pachycardientuffe" of Rio Freddo/Frötschbach (Urlichs 1977). The faunal associations encompass the *neumayri* and *regoledanus* subzones.

Fauna: *Protrachyceras* sp., *Protrachyceras ladinum* (Mojsisovics), *Protrachyceras* ex gr. *ladinum* (Mojsisovics), *Maclearnoceras* sp., cf. *Maclearnoceras* sp., *Celtites epolensis* Mojsisovics, *Lecanites glaucus* (Münster), *Proarcestes* sp., *Joannites* sp., cf. *Joannites* sp., *Monophyllites* sp., *Monophyllites wengensis* (Klipstein).

Age: Longobardian (*neumayri - regoledanus* subzones)

ze. Rio Frommer/Frommerbach 2 section

Area: western Dolomites; location: Alpe di Siusi/Seiser Alm, municipality of Castelrotto/Kastelruth, Bolzano/Bozen; Geographical coordinates: Ref. I.G.M. 11 IV SE Ortisei (4th ed., 1963); long. W 0° 50' 52"; lat. 46° 32' 12"; 1720 m a.s.l. (base of the section).

Description: this section is near to the lower part of Rio Frommer 1 (see above). From the car park, cross the Rio Frommer, and reach a second small incision with direction N-S. In this gully, an exposure of fine volcanic arenites and siltites of the Fernazza Formation, and the base of the Marmolada Conglomerate occurs.

Fauna: *Protrachyceras* sp., *Protrachyceras archelaus* (Laube), *Protrachyceras* ex gr. *ladinum* (Mojsisovics), *"Anolcites"* cf. *neumayri* (Mojsisovics), *Zestoceras* cf. *nitidum* Tozer, *Maclearnoceras* sp., cf. *Maclearnoceras* sp., cf. *Rossiceras* sp., *Lecanites* sp., *Proarcestes* sp., cf. *Joannites* sp., *Monophyllites wengensis* (Klipstein).

Age: Longobardian (*neumayri* Subzone).

Fauna: *Protrachyceras* sp., *Protrachyceras ladinum* (Mojsisovics), *Protrachyceras* ex gr. *ladinum* (Mojsisovics), *"Anolcites"* cf. *neumayri* (Mojsisovics), *Maclearnoceras* sp., *Asklepioceras* sp., cf. *Asklepioceras* sp., *Muensterites* sp., *Zestoceras* sp., *Frankites* sp., *Frankites regoledanus* (Mojsisovics), cf. *Frankites* sp., *Meginoceras* sp., *Lecanites glaucus* (Münster), *Indoceltites aberrans* (Mojsisovics), cf. *Joannites* sp., *Monophyllites* sp., *Monophyllites wengensis* (Klipstein).

Age: Longobardian (*regoledanus* Subzone).

zf. Rio Saltria/Jëndertal section

Area: western Dolomites; location: Alpe di Siusi/Seiser Alm, municipality of Castelrotto/Kastelruth, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 IV SE Ortisei (4th ed., 1963); long. W 0° 47' 20",6; lat. 46° 31' 38",5; 1770 m a.s.l. (base of the section).

Description: from Compaccio/Compatsch, take the road to Val Saltria/Jëndertal. At the crossing neah Hotel Saltria, follow the indications to Albergo Floralpina and then take trail n° 12 to Punta d'Oro/Golfdknopf, keeping the right side of the valley. At the height of 1770 m, extensive outcrops of volcanic arenites of the Wengen Formation are found.

Fauna: cf. *Protrachyceras* sp., *Frankites apertus* (Mojsisovics), *Asklepioceras* sp., *Lecanites glaucus* (Münster), *Celtites epolensis* Mojsisovics, *Joannites* sp., *Monophyllites wengensis* (Klipstein).

Age: Julian (*regoledanus* Subzone).

zg. Brunelle section

Area: western Dolomites; location: Alpe di Siusi/Seiser Alm, municipality of Castelrotto/Kastelruth, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 11 IV SE Ortisei (4th ed., 1963); long. W 0° 46' 40",8; lat. 46° 32' 05",3; 1690 m a.s.l. (base of the section).

Description: beyond the crossing near Hotel Saltria (see above), reach Hotel Brunelle and then follow trail n° 9, until a small stream is reached. Here, a few metres of volcanic arenites of the Wengen Formation crop out.

Fauna: *Asklepioceras sp., Frankites* sp., *Zestoceras* sp., *Monophyllites wengensis* (Klipstein).

Age: Julian (*regoledanus* Subzone).

zf. Rio Cipit/Cipitbach section

Area: western Dolomites; location: Alpe di Siusi/Seiser Alm, municipality of Castelrotto/Kastelruth, Bolzano/Bozen; geographical coordinates: Ref. Table I.G.M. 11 IV SE Ortisei (ed. 4, 1963); long. W 0° 50' 58"; lat. 46° 31' 01"; 1725 m a.s.l. (base section).

Description: from Siusi/Seis, reach Bagni di Razzes/Bad Ratzes, and take trail n° 1 (Prossliner Steig). After the path becomes steeper, take the deviation to Rio Freddo/Frötschbach (trail n° 1a) and reach

Malga Brusamolin/Prossliner Schwaige (1740 m). Some 300 m after Malga Brusamolin, the path crosses a deeply incised valley (Rio Cipit/Cipitbach). A succession of reworked volcanics, referred to the Fernazza Formation/Marmolada Conglomerate, crops out upstream.

Fauna: *Frankites regoledanus* (Mojsisovics).

Age: Longobardian (*regoledanus* Subzone).

zg. Monte Lungo/Lungkofel

Area: Braies/Prags Dolomites; location: western flank of the Monte Serla/Sarlkofl, municipality of Villabassa/Niederdorf, Bolzano/Bozen; geographical coordinates: Ref. I.G.M. 4B III SE Villabassa (ed. 1959); long. W 0° 15' 58"; lat. 46° 41' 42",5; 2130 m a.s.l. (basal sample).

Description: Monte Lungo/Lungkofel (2282 m a.s.l.) is the western minor peak of Monte Serla/Sarlkofel (2378 m a.s.l.), on the right side of Valle di Braies Vecchia/Altprags. A crest goes from Monte Lungo northwards to Picco di Vallandro/Dürrenstein (2839 m a.s.l.) through Punta del Monego/Messnerköpfe (2199 m a.s.l.), Passo Serla/Sarlriedl (2099 m a.s.l.) and Punta di Serla/Sarlkopf (2314 m a.s.l.). A high trail (Alta Via delle Dolomiti/Dolomitenhöhenweg) runs along the crest. Facies of the Fernazza and Wengen formations crop out after Monte Lungo, and yielded ammonoid faunas of late Longobardian age.

Fauna: *Protrachyceras* sp., *Frankites apertus* (Mojsisovics), *Celtites epolensis* (Mojsisovics), *Monophyllites wengensis* (Klipstein).

Age: Longobardian (*regoledanus* Subzone).

zh. Regola di Brenta/Brenteriegel

Area: Braies/Prags Dolomites; location: Valdaora/Olanger Dolomites, municipal district of Braies/Prags, Bolzano/Bozen; Geographical coordinates: I.G.M. 4B III SE Villabassa (ed. 1959); long. W 0° 20' 13"; lat. 46° 42' 31"; 1826 m a.s.l.

Description: take a street from Corte/Säge towards Braies Lake and reach Oberhaus where on the left there is a road to Seminario and thus to Monte di Riva/Astspitz. From Seminario, a white road cuts the slope eastwardly and goes up to the Rio Schade/Schadebach creek. Here the white road turns abruptly on the right cutting the Bosco del Lago/Seewald slope to the little valley side. Follow the valley upstream until height 1826 m. Here, specimens were collected in situ within the San Cassiano Formation.

Fauna: *Trachyceras* sp., *T. muensteri* (Wissmann) *T.* cf. *muensteri* (Wissmann).

Age: Julian (*Trachyceras* Zone)

zi. Monte Riva/Astspitz

Area: Braies/Prags Dolomites; location: Valdaora/Olanger Dolomites, municipal district of Braies/Prags, Bolzano/Bozen.

Description: take the white road (trail n° 37) that starts at the confluence of Rio di Stolla/Stollabach with Rio di Braies/Pragser Bach, near Corte/Säge, and that follows the left flank of the valley towards Braies Vecchia/Altprags. At Bagni di Braies Vecchia/Bad Altprags, turn left into another white road on the eastern flank of Monte Riva/Astspitz (1803 m a.s.l.). Reach the pass between Monte Riva/Astspitz and Monte Daumo/Daumkofel (2216 m) at height 1738 m. Sample BRA.dt was collected in debris of the San Cassiano Formation, at an height of 1780 m south of the pass.

Fauna: *Trachyceras muensteri* (Wissmann).

Age: Julian (*Trachyceras* Zone)

zj. Bagolino section

Area: eastern Lombardy; location: middle part of the Chiese River basin, municipality of Bagolino, Brescia; geographical coordinates: Ref. I.G.M. 35 II NO Bagolino (ed. 6th 1972); long. W 1° 58' 45,5"; lat. 45° 49' 05"; 735 m a.s.l. (part C: Mietto et al. 2003b).

Description: ammonoid faunas from the "Wengen beds" of Bagolino (*neumayri* and *regoledanus* subzones) are here recorded. This section is well known in literature, including the GSSP of the base of the Ladinian (Brack & Rieber 1986, 1993, 2003; Brack & Nicora 1998; Mietto et al. 2003a, 2003b; Brack et al. 2005).

Fauna: cf. *Maclearnoceras* sp.

Age: Longobardian (*neumayri* Subzone).

Fauna: *Protrachyceras* sp., cf. *Protrachyceras* sp., *Protrachyceras ladinum* (Mojsisovics), *Protrachyceras* ex gr. *ladinum* (Mojsisovics), *"Anolcites"* cf. *neumayri* (Mojsisovics), *Anolcites* ex gr. *judicaricus* (Mojsisovics), *Frankites regoledanus* (Mojsisovics), *Rimkinites* sp., *Lecanites glaucus* (Münster), cf. *Joannites* sp.

Age: Longobardian (*regoledanus* Subzone).

Systematic descriptions

The taxonomical source is mostly taken from Tozer (1981, 1994), but some emendations, new definitions and new attributions are introduced. The terminology of Venturi & Ferri (2001) was used for ribs morphology.

Figurations: except for specimens stored in the Geologische Bundesanstalt of Wien, all specimens figured in the photographic plates have been whitened with Magnesium Oxide.

Acronyms: MGPD = Museo Geopaleontologico dell'Università di Padova; MFST = Museo Friulano di Storia Naturale, Udine; GBA = Geologische Bundesanstalt, Wien.

Numbering of specimens: all mentioned specimens are identified by collecting and by repository numbers. The collecting number reports the acronym of the bed collection and the individual number of the specimen (i.e, ASA 19.4 = means 4th specimen from the bed 19 of the Antersass section; PSR3.dt1 = means the 1st specimen from debris derived from bed PSR 3; SW.dt3 = means 3rd specimen in debris in the section SW). The repository number is in brackets; all the collected samples are housed in the MGPD.

Along with the collected material, specimens from other collections were examined and compared: the Laube's and Mojsisovics' collections stored in the Geologische Bundesanstalt of Wien, Austria (courtesy of I. Zorn), casts of the holotype and paratypes of *Daxatina canadensis* from British Columbia (courtesy of M. Balini), unpublished specimens stored in the Museo Friulano di Storia Naturale, Udine, Italy (courtesy of G. Muscio and L. Simonetto), photos and casts from the Simionescu's Collection, stored in Romania (courtesy of E. Gradinaru).

Morphological parameters: D = diameter (mm) = H+h+U; H = max. whorl height in D (mm); h = min. whorl height in D (mm); U = umbilicus in D (mm); W = whorl width in H (mm); SGR(%) = [(H-h)/h]x100.

Order **Ceratitida** Hyatt, 1884
Superfamily Ceratitaceae Mojsisovics, 1879
Family Ceratitidae Mojsisovics, 1879
Subfamily Paraceratitinae Silberling, 1962

Rossiceras? armatum (Münster in Wissmann & Münster, 1841)

Pl. 1, fig 1; Pl. 2, figs 1, 2

* 1841 *Goniatites armatus* Münster. Münster in Wissmann & Münster, pp. 127-128, pl. 14, fig. 8.

1847 *Aganides armatus* d'Orb. - d'Orbigny (non vidimus, fide d'Orbigny, 1850).

1852 *A. hoplophorus.* Giebel, p. 486.

v cf. 1869 *Ammonites hoplophorus* Giebel - Laube, p. 83, pl. 37, fig. 8.

v pars 1882 *Trachyceras armatum* (Graf Münster) E. v. M.-Mojsisovics, pp. 100-101, pl. 24, figs. 35, 36, non pl. 34, fig. 2 = *Zestoceras barwicki* (Johnston).

Material. (2 specimens) *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW 9.4 (MGPD 30243), 21.1 (MGPD 29449).

Description. A compacted specimen (SW 21.1) is described and compared with those of Mojsisovics (1882, pl. 24, figs. 35-36). The shell is moderately involute with the whorl slowly increasing in height. The venter is crushed but we notice that is crossed by weak ribs. Umbilical rim fairly rounded. The ornamentation consists of ribs and nodes; the former are proverse at first but slightly sigmoid in most part of the last whorl. The ribs are generally wider than the interspaces and of variable width. They start at the umbilical rim and become larger towards the external area. Bifurcated, intercalatory and primary ribs randomly alternate on the flank, even if the latter are rare. The branching point commonly occurs at the umbilical rim, but bifurcations at the lateral row of nodes are also present. Intercalatory ribs generally start from the inner third of the flank. Three rows of nodes occur: umbilical, lateral and external. The umbilical are well pointed, more elevated where the branching point occurs. The lateral nodes are located at one third of the flank. The external are stronger, well pointed, sometimes elongated in the coiling direction.

A second specimen (SW 9.4), a not well preserved external mould, smaller in shape, is more involute and shows an intermediate morphology between Mojsisovics' specimens (see above) and sample SW 21.1. Spaced, radial coarse ribs, are strongly marked in the inner part of the flank but expanded and barely visible in its outer third. The ventral area is not preserved but in correspondence of the ventrolateral shoulder blunt external nodes, where the ribs end, occur.

Suture line not visible.

Comparison and Discussion. Among the specimens stored in the GBA and referred to *Trachyceras armatum*, those depicted by Mojsisovics (1882) at pl. 24, figs. 35-36 are deemed as innermost whorls of *Rossiceras*? *armatum*, for the presence of strong radial and distant ribs bearing blunt nodes on the ventrolateral shoulders. Lateral nodes are absent whereas umbilical swellings are present only in the last ribs of the shell. The specimen of fig. 35 is not crushed and shows a rounded venter crossed by broad and weak ribs.

This species has a complex taxonomic history. Besides the synonyms indicated above, it was listed as "*Ammonites armatus* Münst." by Quenstedt (1849: p. 329), as "*Aganides armatus* d'Orb." by d'Orbigny (1850: p. 180), as "*Goniatites armatus* Mü." by Bronn (1848: p. 540), as "*Ammonites hoplophorus* Giebel" by Laube (1864: p. 412), as "*Trachyceras (Anolcites) armatum* Gf. Münster" by Diener (1915: p. 287) and Kutassy (1933: p. 763), and finally as "*Eremites armatus* (Münster)" by Urlichs (1974: p. 216, fig. 5). Giebel (1852) identified the omonymy of this taxon, as instituted by Münster, with the liassic species *Ammonites armatus*, instituted by Sowerby in 1815 (p. 215), and renominated the Triassic species as *Ammonites hoplophorus*. This point of view was embraced by Laube (1864, 1869); later on, Mojsisovics (1882) assigned this species to genus *Trachyceras*. However, the species of Munster is still valid, because the secondary omonymy, due to a genus change, predates year 1961 (International Code of Zoological Nomenclature – ICZN, art. 59.3).

Mietto et al. (2007a, 2007b), indicating the quoted species with open nomenclature as *"Ceratites" armatus*, also produced a case of secondary omonymy with *Ceratites armatus* Philippi, 1901. An adequate generic attribution of this taxon is far to be defined. At present, the closest genus in morphology and the nearest in age seems to be *Rossiceras* Fantini Sestini, 1994, but the species of Münster differs for the strength of ornamentation in all ontogenetic stages. A specimen (FBP6B.1, MGPD n. 30773), possibly belonging to genus *Rossiceras*, was collected in the Frommbach 2 section, within beds of the Wengen Formation dated to the *neumayri* Subzone.

The attribution of this taxon to genus *Eremites* by Urlichs (1974) is incorrect. The type species of *Eremites*, *Trachyceras orientale* (Mojsisovics, 1882, p. 102, pl. 31, fig. 5), and related species are morphologically not comparable with *Rossiceras*? *armatum* in particular because of the serpenticone coiling, the ovoidal whorl section and the fading of the ornamentation during ontogeny.

Occurrence and Age. This species is known only in the Prati di Stuores/Stuores Wiesen area. Its occurrence range from the uppermost part of the *canadensis* to the lower part of the *aonoides* subzones (cf. Urlichs 1974).

Superfamily Clydonitaceae Hyatt in Meek, 1877

Remarks. The writers agree with Tozer (1994) in considering Trachyceratacеae a junior synonym of Clydonitaceae. In disagreement with Shevyrev (1995), Hyatt (in Meek 1877) has the priority on Mojsisovics (1879) in the definition of this taxonomic unit. In a similar way, Hyatt (in Meek 1877) has the priority on Haug (1894) in the definition of Trachyceratidae. As previously stated (Mietto & Manfrin 1995a: p. 541) the Superfamily framework is far from satisfactory, with

particular reference to the taxonomical setting of Ladinian forms.

Family Trachyceratidae Hyatt in Meek, 1877, emended

Subfamily Anolcitinae Mietto & Manfrin, subfam. n.

Remarks. Some genera, previously comprised in the Subfamily Trachyceratinae (i.e. Tozer 1994), but showing a ceratitic suture line, are attributed to this new Subfamily. In particular, some of them are characterized by a phragmocone with a thick preseptal layer. Except for *Daxatina*, all the Anolcitinae show ribs, otherwise constrictions, wrinkles or broad flares that cross the venter and, when present, the external nodes are in opposite position. The latter morphological feature is generally present also in *Daxatina*.

In the *maclearni* Zone of the British Columbia (Tozer 1994) a close phyletic relationship among *Anolcites*, *Zestoceras* and *Asklepioceras* can be inferred basing on morphological features. In particular, we deem that some representatives of *Zestoceras*, as *Z. barwicki* (Johnston) and *Z. lorigae* sp. n., are the direct descendants of *Anolcites*; indeed, both genera are characterized by a relatively thin preseptal layer, compressed whorl section and sigmoid ribs more or less projected in the outer part of the flank. Instead, two of species referred by Tozer to *Anolcites* (i.e. *A. gemmatus* and *A. papillatus*) exhibit a phragmocone characterized by a thick preseptal layer, rounded whorl section, and radial or rursiradiate ribs, particularly where they cross the venter. We suspect the latter two species could be an offshoot of *Anolcites* from which *Asklepioceras* had its origin.

Type genus. *Anolcites* Mojsisovics, 1893.

Composition of the subfamily. *Falsanolcites* Rieber & Brack, 2004; *Anolcites* Mojsisovics, 1893; *Maclearnoceras* Tozer, 1963; *Zestoceras* Tozer, 1994; *Asklepioceras* Renz, 1911; *Frankites* Tozer, 1971; *Muensterites* Mojsisovics, 1893; *Daxatina* Strand, 1929 (pro *Dawsonites* Böhm, 1903 non Scudder, 1895).

Genus *Zestoceras* Tozer, 1994

Type species: *Zestoceras cerastes* Tozer, 1994, p.160, fig. 65d, pl. 82, fig. 4 (= *Clionites barwicki* Johnston, 1941)

Zestoceras barwicki (Johnston, 1941)

Fig. 9a; Pl. 1, fig. 12; Pl. 2, figs 3-9

v pars 1882 *Trachyceras armatum* (Graf Münster) E. v. M. - Mojsisovics, pp. 100-101, pl. 34, fig. 2; non pl. 24, figs. 35, 36.

* 1941 *Clionites barwicki* Johnston n. sp. Johnston, pp. 450-451, pl. 58, figs. 9-18.

1994 *Zestoceras cerastes* n.sp. Tozer, p. 160, pl. 82, fig. 4.

v 1995b *Clionitites* sp. - Mietto & Manfrin, pl. 2, figs. 2, 11.

1995 *Clionitites* sp. - Neri et al., pl. 1, fig. 18.

v 1998a *Clionitites* sp. - Broglio Loriga et al., pl. 2, figs. 2, 11.

v 1999 *Clionitites* sp. - Broglio Loriga et al., pl. 1, figs. 8-10.

2007 *Clionites barwicki* - Jenks et al., pl. 25, fig. C.

Material. (34 specimens) *Bec de Roces section* (Livinallongo del Col di Lana): PCL 2. 28 (MGPD 30270), 11.12a (MGPD 30288a), 12.10 (MGPD 30298), 13.1 (MGPD 30300), 18.7a (MGPD 30312a), 20.2 (MGPD 30318), 21.2 (MGPD 30323), 100.4 (MGPD 30338), dt.60a (MGPD 30681a); *Passo Campolongo section* (Corvara in Badia/Kurfar): PCN 3.1b (MGPD 30512b); *Crep de Mont section* (Corvara in Badia/Kurfar): PCM 5.3 (MGPD 30611) -.7 (MGPD 30612); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): PSR 2.5a,b (MGPD 30162a,b) -.9 (MGPD 30166), 3.4 (MGPD 29550) -5 (MGPD 29551) -.6b (MGPD 29461b) -.18b (MGPD 29552b) -.21 (MGPD 30186) -.30 (MGPD 30192) -.32a (MGPD 29462a) -.36 (MGPD 29464) -.38 (MGPD 29465) -.40 (MGPD 29553) -.45 (MGPD 30196), 4.3 (MGPD 30205) -.4 (MGPD 30206), 5.2 (MGPD 30210), 6.10b (MGPD 30215b), 7.1c (MGPD 30218c) -.3 (MGPD 30219), 8.4 (MGPD 30221), dt.2b (MGPD 30247b); *Col da Oi* (Badia/Abtei): OI-E.2 (MGPD 30628).

Description. The material at our disposal consists of compacted but fairly preserved fragments of shells. The examination of this material suggests a nearly evolute shell, most probably subelliptical in section basing on the roundness of flanks. In specimen PSR 3.5 an angular ventrolateral rim is present. In early growth stages, the ornamentation consists of sigmoid, often rursiradiate, moderately spaced ribs, scarcely projected in the outer third of the flank. They are rounded in section and scarcely elevated, homogeneous in shape, as wide as the interspaces or narrower. In the inner whorls short intercalatory ribs are regularly alternated with the primary. During ontogeny, ribs become less sigmoid, sometimes nearly rectilinear in shape, and frequently replaced by bifurcated ribs. The branching point is at the midflank or just above. Only an external row of very small tubercles is present.

The suture line is visible only in the specimen PSR 3.21 from Prati di Stuores/Stuores Wiesen section, well comparable with Mojsisovics' specimen from Pozoritta in its general outline. It shows a simple ceratitic outline with a brachyphyllic first lateral saddle followed by further two, gradually subdued towards the umbilical rim. Only the first lateral lobe appreciably denticulated, as in the specimen from British Columbia (Tozer 1994). The first lobe is strongly deeper respect the second one (Fig. 9a).

Comparison and Discussion. *Zestoceras barwicki* differs from other representatives of the genus by the presence of relatively spaced, slightly sigmoid ribs. Moreover, the branching point is markedly higher on the flank and short intercalatory ribs occur. We fully agree with Johnston (1941) who argued the impressive resemblance of his new species *Clionites barwicki* with the specimen from Pozoritta (now Pojorita) in Bukowi-

na (Romania) labelled by Mojsisovics (1882, pl. 34, fig. 2) as *Trachyceras armatum* (Münster).

Afterwards, Tozer (1994: p.160) noticed the strong similarity between *Zestoceras cerastes* and *Trachyceras armatum* from Bukowina. Unfortunately, Tozer was not be able to examine this specimen stored in the GBA. It was examined by the writers and referred to *Zestoceras cerastes*. The whorl section and the ventral morphology are not recognizable in the Prati di Stuores/Stuores Wiesen material. However, the ribs framework, the coiling degree and the suture line perfectly fit with those of Johnston's and Tozer's specimens. Hence, Tozer's taxon must be held as junior synonym of Johnston's species.

The material from Prati di Stuores/Stuores Wiesen was previously referred to *Clionitites* sp. on the comparison with the representatives of *Ceratites busiris* Münster and *Ceratites basileus* Münster for the general morphological features (e.g. Broglio Loriga et al. 1999). Recently, also Tozer (1994) ascribed to *Clionitites* the north American species *Clionites reesidei* Johnston, which shows some morphological features comparable with those of *Ceratites busiris*. The ventral area of the former species shows at first the presence of tiny tubercles in opposite position but connected by ribs during growth. Nevertheless, this ventral morphology evolution is hard or impossible to check in the small specimens of the hystorical fauna from Prati di Stuores/Stuores Wiesen stored in the GBA. We want to emphasize that the peculiar character of the ventral area, above described, is not comparable with the real representatives of the genus *Clionitites* (type species *Clionites angulosus* Mojsisovics) but, on the contrary, closely related with *Zestoceras*. *Clionitites* shows a persistent ventral furrow or depression during all ontogenetic stages. Another difference between the two genera is the presence, in early growth stages, of a row of marginal nodes, never present in *Zestoceras*. Moreover, *Clionitites* generally exhibits primary ribs, persistent and homogeneous in shape along the flank during ontogeny.

Surprisingly, among specimens referred to *Zestoceras barwicki*, a small portion of a single juvenile exemplar from Prati di Stuores/Stuores Wiesen section (PSR 3.21) shows a barely visible marginal row of tiny nodes (Pl. 2: Fig. 7). This morphological character, otherwise absent in *Zestoceras*, could be of evolutionary meaning.

Occurrence and Age. *Zestoceras barwicki* is documented in the Southern Alps (Dolomites), in Romania (cf. Mojsisovic 1882: Pozoritta in Bukowina), in the U.S.A. (Johnston 1941: New Pass Range in Nevada) and in Canada (Tozer 1994: British Columbia).

The species characterizes the *canadensis* Subzone in the Southern Alps and the coeval *sutherlandi* Subzone 2 of Canada; it is also present in the not well defined "Trachyceras Zone" of Nevada (Silberling 1956), subsequently renamed *Desatoyense* Zone by Silberling & Tozer (1968).

Zestoceras cf. **enode** (Tozer, 1972)

Pl. 2, figs 10, 11; Pl. 4, fig. 7

Material. (4 specimens) *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW 2.1 (MGPD 29529); *Sass Ciampac* (Corvara in Badia/Kurfar): SCI.1 (MGPD 30599) -.12 (MGPD 30642); *Val Giaule 2 section* (Domegge di Cadore): VGL 40.3 (MGPD 30591).

Description. Among the material at our disposal, three specimens are described: SW2.1 is a fragment of an intermediate sized specimen while SCI.1 is a compacted specimen where the main morphological characters are well visible. Moreover, specimen VGL 40.1 is a fragment that shows also the ventral area. The shell is moderately evolute and characterized by serried, sigmoid, scarcely elevated ribs. In sample SW2.1, ribs are as wide as the interspaces, due to the preservation as internal mould. On the contrary, in sample SCI.1, the test is preserved and the ribs appear broader. Primary, very long intercalatory and bifurcated ribs randomly alternate. The branching point occurs in the periumbilical area. Nevertheless, rare bifurcations or short intercalatory ribs seems to be present in the outer part of the flank. In sample SW 2.1 from Prati di Stuores/Stuores Wiesen section, where the external area is partly visible, the ribs cross the venter. This ventral outline is also partly preserved in specimen VGL 40.1 in which a faint furrow seems to be present. Nodes apparently absent.

The suture line not visible.

Comparison and Discussion. The general morphological features of the above described material strongly resemble those of the holotype of *Zestoceras enode* (Tozer) from British Columbia, that differs by the presence of rectilinear, slightly proverse, instead of sigmoid, ribs. This is probably due to the imperfect preservation and deformation from Southern Alps material, as for the apparent absence of nodes.

Occurrence and Age. The holotype of *Zestoceras enode* (Tozer) is documented in British Columbia, probably in the *sutherlandi* Subzone 2 (Tozer 1994). The other specimens referred by Tozer (1994) to this taxon, are most probably not conspecific (see below). The specimens of the Southern Alps occur in the *regoledanus* Subzone.

Zestoceras lorigae Mietto & Manfrin, sp. n.

Figs. 9b, 9c, 10a; Pl. 1, figs 5, 7; Pl. 3, figs 5, 12-19; Pl. 4, figs 1-4, 8, 9

Derivatio nominis. In memory to the untimely late Carmen Loriga Broglio.

Stratum typicum and locus typicus. Bed PCL 18 of the San Cassiano Formation in the Bec de Roces Section. The locus typicus is Passo Campolongo, Cordevole Valley, Belluno (NE Italy).

v pars 1882 *Trachyceras rutoranum* E.v. Mojsisovics. Mojsisovics, p. 98, pl. 24, fig. 2, non fig. 1.

v pars 1882 *Trachyceras laricum* E. v. Mojsisovics. Mojsisovics, p. 96, pl. 24, fig. 3, non figs. 4, 5, non pl. 23, fig. 13.

1977 *Trachyceras laricum* (Mojsisovics) - Urlichs, pl. 1, fig. 2.

pars 1994 *Zestoceras enode* (Tozer) - Tozer, pp. 160-161, pl. 82, fig. 5 non figs. 2, 3.

1994 *"Trachyceras"* cfr. *rutoranum* Mojsisovics - Neri et al., pl. 1, fig. 9.

1994 *"Trachyceras" laricum* Mojsisovics - Neri et al., pl. 1, fig. 10.

v pars 1995b *"Anolcites"* ex gr. *laricum* (Mojsisovics, 1882) - Mietto & Manfrin, pl. 2, figs. 4-6, non fig. 3 (= *Sirenotrachyceras thusneldae*)

1995 *"Trachyceras" rutoranum* Mojsisovics - Neri et al., pl. 1, fig. 1.

1995 *Anolcites* sp. - Neri et al., pl. 1, fig. 11.

v 1998a *Zestoceras* sp. A - Broglio Loriga et al., pl. 2, figs. 4-6.

v pars 1999 *"Anolcites"* ex gr. *laricus* (Mojsisovics) - Broglio Loriga et al., pl. 1, fig. 11, non fig. 12 (= *Sirenotrachyceras thusneldae*).

v 1999 *Zestoceras* n. sp. A - Broglio Loriga et al., pl. 1, figs. 2-7.

2000 *Clionitites* aff. *busiris* (Münster, 1834) - Balini et al., pp. 41-42, pl. 1, figs. 7-9.

Type series. Holotype MGPD 30068 (PCL 18.1). See Pl. 3, fig. 13. Paratypes: MGPD 30069 (PCL 1.1), MGPD 30070 (PCL 113.7), MGPD 30071 (PCL dt.2), MGPD 30072 (PCL dt.8), MGPD 30073 (PSR 2.3), MGPD 30707a (PCL 15.1a).

Material. (486 specimens) *Rio Cuzze section* (Borca di Cadore): CUZ 15.1 (MGPD 39759), 16.1 (MGPD 30760), 17.1 (MGPD 30593) -.2 (MGPD 30594) -.3 (MGPD 30595) -.5 (MGPD 30596) -.6 (MGPD 30597); *Prati del Pordoi* (Livinallongo del Col di Lana): PPO.A.3 (MGPD 30666); *Bec de Roces section* (Livinallongo del Col di Lana): PCL 1.1 (MGPD 30069), 2.3 (MGPD 30250) -.4a (MGPD 30251a) -.5 (MGPD 30252) -.14 (MGPD 30259) -.17a (MGPD 30261a) -.19 (MGPD 30262) -.20 (MGPD 30263) -.21 (MGPD 30264) -.22 (MGPD 30265) -.23 (MGPD 30266) -.24 (MGPD 30267) -.25 (MGPD 30268) -.26 (MGPD 30269) -.29a (MGPD 30271a) -.30 (MGPD 30698) -.31 (MGPD 30699) -.32 (MGPD 30700), 4.1 (MGPD 30272), 6.3 (MGPD 30273) -.4 (MGPD 30274), 7.1 (MGPD 30275), 8.1 (MGPD 30276), 10.1 (MGPD 30277), 11.1 (MGPD 30278) -.2 (MGPD 30279) -.3 (MGPD 30280) -.4 (MGPD 30281) -.5 (MGPD 30282) -.8 (MGPD 30284) -.9 (MGPD 30285) -.10 (MGPD 30286) -.11 (MGPD 30287) -.14 (MGPD 30701) -.15 (MGPD 30702) -.17a (MGPD 30703a) -.17b (MGPD 30703b), 12.1 (MGPD 30290) -.2 (MGPD 30291) -.3 (MGPD 30292) -.4 (MGPD 30293) -.5 (MGPD 30294) -.6 (MGPD 30257) -.7 (MGPD 30295) -.8 (MGPD 30296) -.9 (MGPD 30297) -.11 (MGPD 30299) -.12 (MGPD 30704), 13.3 (MGPD 30301) -.10 (MGPD 30705), 14.1 (MGPD 30302) -.2 (MGPD 30303) -.3 (MGPD 30304) -.4 (MGPD 30706), 15.1a (MGPD 30707a), 16.1 (MGPD 30305) -.5 (MGPD 30708), 17.1 (MGPD 30307) -.2 (MGPD 30735), 18.1 (MGPD 30068) -.2 (MGPD 30308) -.3 (MGPD 30309) -.4 (MGPD 30310) -.5 (MGPD 30311) -.8 (MGPD 30313) -.9 (MGPD 30709) -.11 (MGPD 30711) -.12 (MGPD 30712), 19.1 (MGPD 30314) -.2 (MGPD 30315) -.3 (MGPD 30316) -.6 (MGPD 30317) -.8 (MGPD 30713), 20.3 (MGPD 30319) -.5 (MGPD 30320) -.6 (MGPD 30321) -.7 (MGPD 30322) -.10a (MGPD 30714a) -.10b (MGPD 30714b) -.11 (MGPD 30715) -.13 (MGPD 30716) -.14 (MGPD 30717) -.15b (MGPD 30718b) -.15c (MGPD 30718c), 21.3a (MGPD 30324a) -.3b(MGPD 30324b) -.4 (MGPD 30325) -.5 (MGPD 30326) -.8 (MGPD 30328) -.9 (MGPD 30329) -.10 (MGPD 30719) -.11a (MGPD 30720a) -.11b (MGPD 30720b), 22.1 (MGPD 30330), 23.1 (MGPD 30332) -.2 (MGPD 30333) -.3 (MGPD 30721) -.4 (MGPD 30722), 24.1 (MGPD 30334) -.3 (MGPD 30723) -.4 (MGPD 30724) -.5 (MGPD 30725) -.6 (MGPD 30726) -.7

PLATE 1

Specimens of Mojsisovics' Collection, housed in the Geologische Bundesanstalt of Wien.

Fig. 1 - *Rossiceras*? *armatum* (Münster) [= *Trachyceras armatum* (Graf Münster), original specimen]. Mojsisovics 1882, pl. 24, fig. 36. Stuores Wiesen (Dolomites, NE Italy). GBA 1882/003/0122/3, 1,5x, 1a, 1b lateral views.

Fig. 2 - *Sirenotrachyceras thusneldae* (Mojsisovics) [= *Anolcites (Trachyceras) Lenaui* E.v. Mojsisovics; monotypic holotype]. Mojsisovics, 1893, pl. 162, fig. 19. Feuerkogel (Steiermark, Austria). GBA 1893/001/0628, 2a, 2b lateral views, 2c ventral view, x 1,25.

Fig. 3 - *Trachyceras bipunctatum* (Graf Münster). Original of Mojsisovics 1882, pl. 23, fig. 11. Stuores Wiesen (Dolomites, NE Italy). GBA 1882/003/0174/1, 3a lateral view, 3b ventral view.

Fig. 4 - *Sirenotrachyceras* cf. *thusneldae* (Mojsisovics) [= *Anolcites (Trachyceras) Carnerii* E.v. Mojsisovics; monotypic holotype]. Mojsisovics, 1893, pl. 162, fig. 17. Feuerkogel (Steiermark, Austria). GBA 1893/001/0629, 4a, 4b lateral views, x 1,25.

Fig. 5 - *Zestoceras lorigae* sp. n. [= *Trachyceras rutoranum* E.v. Mojsisovics; original specimen]. Mojsisovics 1882, pl. 24, fig. 2. Rutor Graben bei Corvara (Dolomites, NE Italy). GBA 1882/003/0118/2, lateral view.

Fig. 6 - *Sirenotrachyceras thusneldae* (Mojsisovics) [= *Anolcites (Trachyceras) Thusneldae* E.v. Mojsisovics; monotypic holotype]. Mojsisovics, 1893, pl. 162, fig. 20. Raschberg (Oberösterreich, Austria). GBA 1893/001/0627, 6a, 6b lateral views, 6c ventral view.

Fig. 7 - *Zestoceras lorigae* sp. n. [= *Trachyceras laricum* E.v. Mojsisovics; original specimen]. Mojsisovics 1882, pl. 24, fig. 3. Rutor Graben bei Corvara (Dolomites, NE Italy). GBA 1882/003/0114/2, lateral view.

Fig. 8 - *Frankites apertus* (Mojsisovics) [= *Juvavites (Dimorphites) apertus* E.v. Mojsisovics; monotypic holotype]. Mojsisovics 1893, pl. 126, fig. 28. Feuerkogel (Steiermark, Austria). GBA 1893/001/0132, 8a lateral view, 8b, 8c ventral views, 8d lateral view with traces of suture line.

Fig. 9 - *Trachyceras rutoranum* E.v. Mojsisovics [Lectotypus, here designated]. Original of Mojsisovics 1882, pl. 24, fig. 1. Corvara (Dolomites, NE Italy). GBA 1882/003/0118/1, lateral view.

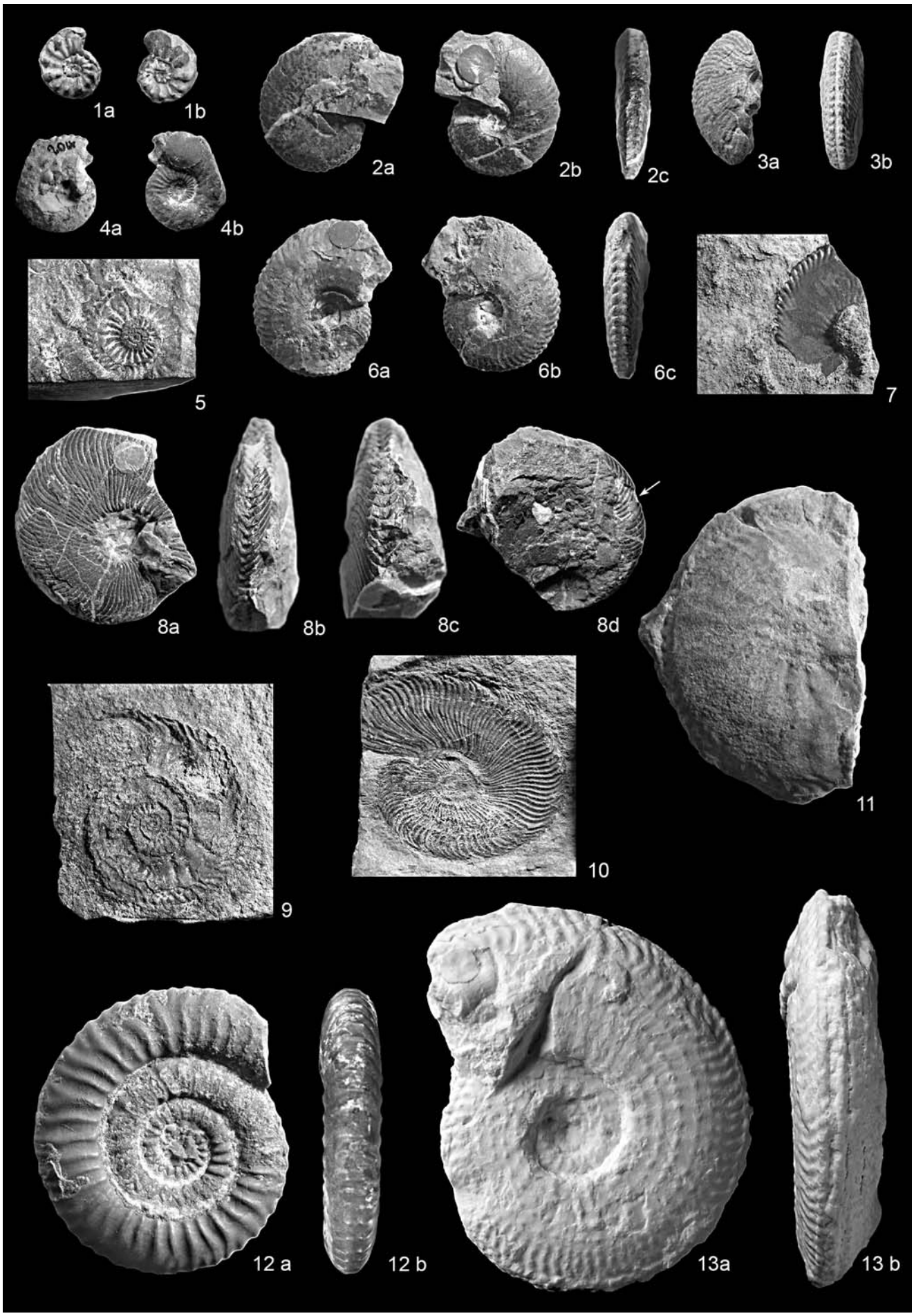
Fig. 10 - *Frankites regoledanus* (Mojsisovics) [= *Ammonites (Trachyceras?) Regoledanus* Mojs. n. sp.; lectotypus, here designated]. Prezzo (Giudicarie area, NE Italy). GBA 1869/004/0005/1, lateral view.

Fig. 11 - *Trachyceras laricum* E.v. Mojsisovics [Lectotypus, here designated]. Mojsisovics 1882, pl. 24, fig. 5. Val del Monte bei Esino (Lombardy, Italy). GBA 1882/003/0114/4, lateral view.

Fig. 12 - *Zestoceras barwicki* (Johnston) [= *Trachyceras armatum* (Graf Münster); original specimen]. Mojsisovics 1882, pl. 34, fig. 2. Pozoritta (now Pojorita) in Bukowina (Romania). GBA 1882/003/0122/1, lateral view.

Fig. 13 - *Sirenotrachyceras thusneldae* (Mojsisovics) [= *Protrachyceras (Trachyceras) Rudolphi* E.v. Mojsisovics (var. *Aldegondae* in the text); original specimen]. Mojsisovics 1893, pl. 166, fig. 3. Raschberg (Oberösterreich, Austria). GBA 1893/001/0555/2; figure from the gypsum cast, 13a lateral view, 13b ventral view.

If not specified, all figures are illustrated in natural size.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(MGPD 30727) -.8 (MGPD 30728) -.9 (MGPD 30729), 25.1a (MGPD 30335a) -.2 (MGPD 30336), 100.9 (MGPD 30339), 101.2 (MGPD 30340), 102.1 (MGPD 30342), 103.6 (MGPD 30343) -.8 (MGPD 30344), 105.14 (MGPD 30349), 107.1 (MGPD 30351) -.2 (MGPD 30352) -.3 (MGPD 30353) -.6 (MGPD 30354), 108.2 (MGPD 30355), 109.2 (MGPD 30356) -.5 (MGPD 30357), 111.1 (MGPD 30358) -.3 (MGPD 30359) -.6 (MGPD 30360) -.8 (MGPD 30361) -.24 (MGPD 30362) -.25 (MGPD 30363) -.26 (MGPD 30364) -.27 (MGPD 30365) -.28 (MGPD 30366) -.29 (MGPD 30367) -.30 (MGPD 30368), 112.3 (MGPD 30370)-.5 (MGPD 30371) -.8 (MGPD 30372), 113.1a (MGPD 30373a) -.1b (MGPD 30373b) -.1c (MGPD 30373c) -.2 (MGPD 30374) -.3 (MGPD 30375) -.4 (MGPD 30376) -.6 (MGPD 30377) -.7 (MGPD 30070) -.8 (MGPD 30379) -.10a (MGPD 30380a) -.11 (MGPD 30381) -.12 (MGPD 30382) -.13 (MGPD 30383) -.14a (MGPD 30384a) -.15 (MGPD 30385) -.16 (MGPD 30386) -.17 (MGPD 30387) -.18 (MGPD 30388) -.20 (MGPD 30389) -.21 (MGPD 30390) -.22 (MGPD 30391) -.24 (MGPD 30392) -.25 (MGPD 30393) -.26 (MGPD 30394), 114.2 (MGPD 30295) -.3 (MGPD 30296) -.4 (MGPD 30297) -.5 (MGPD 30298) -.6 (MGPD 30299) -.8 (MGPD 30400), 115.1 (MGPD 30401), 116.2 (MGPD 30402) -.3 (MGPD 30403) -.4a (MGPD 30404a) -.4b (MGPD 30404b) -.6 (MGPD 30406), 117.1 (MGPD 30407) -.2 (MGPD 30408) -.3 (MGPD 30409) -.8 (MGPD 30410) -.10 (MGPD 30411) -.12a (MGPD 30412a) -.12b (MGPD 30412b) -.13 (MGPD 30413) -.15 (MGPD 30414) -.16 (MGPD 30415) -.18 (MGPD 30416), 118.1 (MGPD 30417) -.3 (MGPD 30418) -.4 (MGPD 30419) -.6 (MGPD 30420) -.7 (MGPD 30421) -.8 (MGPD 30422) -.9 (MGPD 30423), 119.1 (MGPD 30424) -.2 (MGPD 30425) -.3 (MGPD 30426) -.4 (MGPD 30427) -5 (MGPD 30428) -.6 (MGPD 30429) -.8 (MGPD 30430) -.9 (MGPD 30431) -.10 (MGPD 30432), 120.2 (MGPD 30433) -.3 (MGPD 30434) -.4 (MGPD 30435) -.5 (MGPD 30436) -.6 (MGPD 30437) -.7 (MGPD 30438), 122.6a (MGPD 30441a) -.7 (MGPD 30442), 123.1 (MGPD 30443) -.2 (MGPD 30444) -.5 (MGPD 30445) -.6 (MGPD 30446) -.7a,b (MGPD 30447a,b) -.8 (MGPD 30448) -.9 (MGPD 30449), 124.2 (MGPD 30450) -.3 (MGPD 30451) -.4 (MGPD 30452) -.6 (MGPD 30454) -.7a,b (MGPD 30455a,b) -.8c,m (MGPD 30456c,m) -.8d (MGPD 30456d) -.8f (MGPD 30456f) -.8g,h (MGPD 30456g,h) -.8n (MGPD 30456n) -.9a (MGPD 30457a) -.9b (MGPD 30457b) -.11a (MGPD 30458a) -.11c (MGPD 30458c) -.11d (MGPD 30458d) -.12 (MGPD 30459) -.13 (MGPD 30460) -.14 (MGPD 30461) -.15a (MGPD 30462a) -.16 (MGPD 30463) -.17 (MGPD 30464) -.18 (MGPD 30465) -.19 (MGPD 30466) -.20 (MGPD 30467) -.21 (MGPD 30468) -.22 (MGPD 30469).-23a (MGPD 30470a) -.25 (MGPD 30471) -.26 (MGPD 30472) -.27 (MGPD 30473) -.28 (MGPD 30474) -.30 (MGPD 30688) -.31 (MGPD 30689) -.32 (MGPD 30690) -.34 (MGPD 30691) -.35 (MGPD 30475) -.36 (MGPD 30476) -.38 (MGPD 30477) -.39 (MGPD 30478) -.40 (MGPD 30479) -.41 (MGPD 30480) -.42 (MGPD 30481) -.45 (MGPD 30482) -.46 (MGPD 30483), 125.1a (MGPD 30484a) -.6 (MGPD 30485) -.9 (MGPD 30487) -.10 (MGPD 30488) -.11 (MGPD 30489) -.12 (MGPD 30490) -.13 (MGPD 30491) -.14 (MGPD 30492) -.16 (MGPD 30494) -.17 (MGPD 30495) -.20 (MGPD 30497) -.21 (MGPD 30498) -.22 (MGPD 30499) -.23 (MGPD 30500).-24 (MGPD 30501).-27 (MGPD 30502) -.28 (MGPD 30503) -.29 (MGPD 30504) -.30 (MGPD 30505) -.31 (MGPD 30506) -.32 (MGPD 30507) -.33 (MGPD 30508) -.35 (MGPD 30509) -.37 (MGPD 30560) -.38 (MGPD 30561) -.40 (MGPD 30562) -.42 (MGPD 30563) -.44 (MGPD 30564) -.46 (MGPD 30565) -.47 (MGPD 30566), dt.2 (MGPD 30071) -.3 (MGPD 30568) -.4 (MGPD 30569) -.5 (MGPD 30570) -.8 (MGPD 30072) -.11a (MGPD 30573a) -.12 (MGPD 30574) -.13 (MGPD 30575) -.14 (MGPD 30576) -.15 (MGPD 30577) -.16 (MGPD 30578) -.17 (MGPD 30579) -.18a (MGPD 30580a) -.19 (MGPD 30581) -.20 (MGPD 30582) -.21 (MGPD 30583) -.22 (MGPD 30584) -.23 (MGPD 30585) -.26 (MGPD 30586) -.28 (MGPD 30588) -.29 (MGPD 30589) -.30 (MGPD 30590) -.32 (MGPD 30601) -.33 (MGPD 30602) -.36 (MGPD 30603) -.37 (MGPD 30604) -.39 (MGPD 30605) -.40 (MGPD 30606) -.42 (MGPD 30607) -.43 (MGPD 30608) -.44 (MGPD 30609) -.46 (MGPD 30670) -.47 (MGPD 30671) -.49 (MGPD 30672) -.51 (MGPD 30673) -.52 (MGPD 30674).-53 (MGPD 30675) -.54 (MGPD 30676) -.55a (MGPD 30677a) -.56 (MGPD 30678) -.57 (MGPD 30679) -.58 (MGPD 30680) -.63a (MGPD 30683a) -.64 (MGPD 30684) -.66 (MGPD 30686) -.67a (MGPD 30687a) -.69 (MGPD 30730) -.70 (MGPD 30731) -.72 (MGPD 30732) -.74 (MGPD 30734); *Passo Campolongo section* (Corvara in Badia/Kurfar): PCN 1.1 (MGPD 305210) -.2 (MGPD 30655) -.3 (MGPD 30511), 2.1 (MGPD 30656), 3.1a (MGPD 30512a), 4.1 (MGPD 30513) -.2 (MGPD 30514) -.3 (MGPD 30515), dt.1 (MGPD 30516) -.2a (MGPD 30517a); *Crep de Mont section* (Corvara in Badia/Kurfar): PCM 5.2 (MGPD 30613) -.4 (MGPD 30614) -.5 (MGPD 30615), dt.2 (MGPD 30616) -.5 (MGPD 30617) -.6 (MGPD 30618) -.8 (MGPD 30619) -.9 (MGPD 30620) -.10 (MGPD 30736); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW5B.15 (MGPD 30151), 10.7 (MGPD 30245), 30.1 (MGPD 29450) -.2 (MGPD 29451), dt.4 (MGPD 30737) -.5 (MGPD 30738) -.6 (MGPD 30739), PSR 1.1 (MGPD 30156) -.3 (MGPD 30157) -.4 (MGPD 30158), 2.1 (MGPD 30159) -.3 (MGPD 30073) -.4 (MGPD 30161) -.6 (MGPD 30163) -.7a (MGPD 30164a) -.8 (MGPD 30165) -.10 (MGPD 30167) -.11 (MGPD 30168) -.12 (MGPD 30169) -.15 (MGPD 30170) -.16a (MGPD 30171a) -.17a,b (MGPD 30172a,b), **3**.1 (MGPD 29548) -.2 (MGPD 29454) -.3 (MGPD 29549) -.6a (MGPD 29461a) -.7 (MGPD 30174) -.9 (MGPD 30175) -.11a (MGPD 30177) -.11b (MGPD 30178) -.13 (MGPD 30179) -.15 (MGPD 30180) -.16b (MGPD 30181b) -.17a (MGPD 30183a) -.17b (MGPD 30183b) -.18a (MGPD 29552a) -.19 (MGPD 30185) -.24 (MGPD 30187) -.25 (MGPD 30188) -.26 (MGPD 30189) -.27 (MGPD 30190) -.29 (MGPD 30191) -.32b (MGPD 29462b) -.34 (MGPD 30193) -.42 (MGPD 29554) -.43 (MGPD 30195) -.49 (MGPD 30197) -.51 (MGPD 30198) -.52 (MGPD 30199) -.53 (MGPD 30200) -.54 (MGPD 30201) -.55b (MGPD 30202b) -.55c (MGPD 30202c) -.56 (MGPD 30203) -.58 (MGPD 30204) -.dt4 (MGPD 29458), 4.6a (MGPD 30207a) -.8a (MGPD 30208a), 5.6 (MGPD 30211), 6.1 (MGPD 29556) -.4 (MGPD 30212) -.8 (MGPD 30213) -.9 (MGPD 30214) -.10a (MGPD 30215a) -.11 (MGPD 30216) -.12 (MGPD 30217), 8.2 (MGPD 29557) -.3a (MGPD 30220a) -.dt1b (MGPD 30223b), 10.1 (MGPD 30225) -.4 (MGPD 30226) -.5 (MGPD 30227) -.6 (MGPD 30228) -.8 (MGPD 30229) -.9 (MGPD 29558) -.10 (MGPD 30230) -.11 (MGPD 30231) -.12 (MGPD 30232) -.13 (MGPD 30233) -.14 (MGPD 30234) -.16 (MGPD 30236) -.17 (MGPD 30237) -.18 (MGPD 30238) -.20 (MGPD 30239), 11.1a (MGPD 29471a) -.1b (MGPD 29472b) -.2 (MGPD 30240); *Rü de Stores* (Badia/Abtei): RST 1.1 (MGPD 30661); *Contrada D'Lira section* (Badia/Abtei): SKA.1 (MGPD 29506) -.3 (MGPD 29508) -.4 (MGPD 29509) -.5 (MGPD 30662) -.6 (MGPD 29510) -.7 (MGPD 30664); *Piz d'la Varella section* (Badia/Abtei): SKB 1.1 (MGPD 30518) -.2 (MGPD 30519) -.5 (MGPD 29514); *Col da Oi* (Badia/Abtei): OI-D'.1 (MGPD 30659), OI-E.3 (MGPD 30629) -.5b (MGPD 30635b); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASA 19.1 (MGPD 30113) -.2a (MGPD 30114a) -.3 (MGPD 30115) -.4 (MGPD 30116), 19A.1 (MGPD 30118) -.2 (MGPD 30119) -3 (MGPD 30120), 19bis.1b (MGPD 30121b) -.3 (MGPD 30123) -.4 (MGPD 30124) -.5 (MGPD 30125), 20.4 (MGPD 30127) -.5 (MGPD 30128) -.6 (MGPD 30129) -.7 (MGPD 30130), dt.base.3 (MGPD 30133) -.4 (MGPD 30134) -.5 (MGPD 30135) -.10 (MGPD 30137) -.12 (MGPD 30139) -.15 (MGPD 30141), >17B dt.3 (MGPD 30131).

Diagnosis. *Zestoceras* characterized by a highly compressed whorl section. The flanks bear numerous serried ribs, as a rule abruptly projected in the upper part of the flank. The ribs appear sigmoid later on, generally where the body chamber occurs. The ornamentation might fade during ontogenesis.

Description. Very compressed, scarcely involute shell characterized by a slender, high trigonal whorl section. The venter is narrow, tabulate, rounded in the body chamber of mature specimens, and early crossed by ribs. The latter morphological character is more evi-

dent if the test is preserved, particularly in juvenile stages. Otherwise the whorl height, the whorl increases very slowly in width so that the umbilicus is shallow. A rounded periumbilical area is gently connected with the previous whorl.

From early growth stages the flanks are characterized by frequent ribs, serried, homogeneous in strength and less broad than intercostal spaces. The ribs are sigmoid, otherwise radial or slightly convex in the inner part of the flank, then strongly projected in its upper part. Later on, the ribs could be various in strength, sometimes broader, barely visible or attenuated along the flank, then sigmoid in correspondence of the body chamber or just before where they could fade. On the phragmocone, primary, intercalatory and bifurcated ribs freely alternate, even if the latter are prevalent. Generally the branching point occurs in the upper part of the flank but bifurcations in the periumbilical area are present, particularly on the body chamber. The intercalatory ribs more frequently occur in the upper part of the flank. Only an external row of small, blunt rounded tubercles occurs, in corresponding position with those of the other side, early connected by ribs during growth. The nodes tending to fade in mature specimens. In the periumbilical area only weak swellings are present at most.

The suture line is simple ceratitic characterized by a slender first lateral saddle followed by further two, gradually subdued towards the umbilical rim. Only the first lateral lobe is finely denticulated, deep twice or more the second lateral (Figs. 9b, 9c).

Dimensions (mm)

	D	H	h	U	W	H/W	U/D	SGR
Holotype (Pl. 3, fig. 13)	28,2	10,4	7,8	10	-	-	0,35	33,3
Paratype 1 (PCL1.1)	-	-	-	-		-	-	-
Paratype 2 (PCL113.7)	22,1	9.0	7,0	6,1	-	-	0,28	28,6
Paratype 3 (PCL.dt2)	17,4	7,3	5,3	4,8	-	-	0,27	37,7
Paratype 4 (PCL.dt8)	28,2	10.2	8,2	9,8	-	-	0,34	24,4
Paratype 5 (PSR2.3)	32,4	10,7	8,6	13,1	-	-	0,40	24,4
Paratype 6 (PCL15.1)	-	-	-	-	-	-	-	-

Comparison and Discussion. Among the stock of ammonoids referred to *Zestoceras lorigae* sp. n. we selected the following specimens: the holotype (PCL 18.1) is a well preserved external composite mould with the imprint of the suture line of a medium sized exemplar, showing the standard morphology; paratypes 1 and 6 (PCL 1.1, PCL 15.1) show only the venter morphology, a feature very infrequent to notice (see also the specimen illustrated by Neri et al. 1995, pl. 1, fig. 11); paratype 2 (PCL 113.7) is not so compacted specimen as usually occurs, suggesting the outline of the flank and consequently its whorl section; paratype 3 (PCL.dt2) is a juvenile form that nevertheless shows the suture line as for paratype 4 (PCL.dt 8) which exhibits a faint ornamentation; paratype 5 (PSR 2.3) is bigger in size but rather compacted.

The examination of more than 400 specimens referred to the new species, permits to recognize a large intraspecific variability, documented within single layers. The intraspecific analysis has been carried out bed by bed in the Bec de Roces section where most of the studied material comes. Bec de Roces section is characterized by several beds very rich in ammonoids.

The intraspecific variability concerns both the degree of evolution and the ornamentation features, according to the Buckman's law of covariation. Besides the standard morphology of the holotype, two extreme morphological variants could be recognized. The first one, represented by specimen PCL. dt 49 (Pl.4: Fig. 3), shows marked ribs also in the body chamber of large specimens and more evolute. On the contrary, the other one, represented by paratype 4 (Pl.3: Fig. 18), shows a faint sculpture except for the innermost whorls.

In order to better illustrate the intraspecific variability, the authors have considered the best preserved specimens, even if collected from different layers.

Specimens of *Zestoceras lorigae* sp. n. were ascribed to *Trachyceras rutoranum* Mojsisovics, 1882 or *Trachyceras laricum* Mojsisovics, 1882 by previous Authors (Mojsisovics 1882; Urlichs 1977; Mietto & Manfrin 1995b; Neri et al. 1994, 1995). Hence, the original material of the Mojsisovics' Collection, stored in the GBA (courtesy of dr. Irene Zorn), was examined by the writers. Lectotypes of *Trachyceras rutoranum* and *Trachyceras laricum* illustrated and described by Mojsisovics [1882, pl. 24, fig. 1 (GBA 1882/003/0118/1) and pl. 24, fig. 5 (GBA 1882/03/0114.4) respectively], are here designated. The direct examination of the other specimen of *T. laricum* coming from Esino Limestone as the lectotype, reveals that is not well preserved as depicted by Mojsisovics (1882: pl. 24, fig. 4). The lectotype is better preserved and exhibits a small portion of the ventral area.

Trachyceras rutoranum differs from *Zestoceras lorigae* because it is more evolute, and having more spaced ribs that abrupt adoradly also at larger diameters. Moreover, short intercalatory are much more numerous than primary. In the lectotype the venter is not visible but a similar specimen of De Toni's Collection from Valdepena (Mietto & Manfrin 1995b, pl. 1, fig. 7), shows a sulcate venter. As a consequence, we deem reasonable to attribute this taxon to genus *Liardites*. As for *Trachyceras laricum*, the presence of a marginal row of nodes, associated to a scarcely ornamented and highly involute shell, prevents any attribution to *Zestoceras*. For the general morphological features any reference to other known genera is, at present, premature.

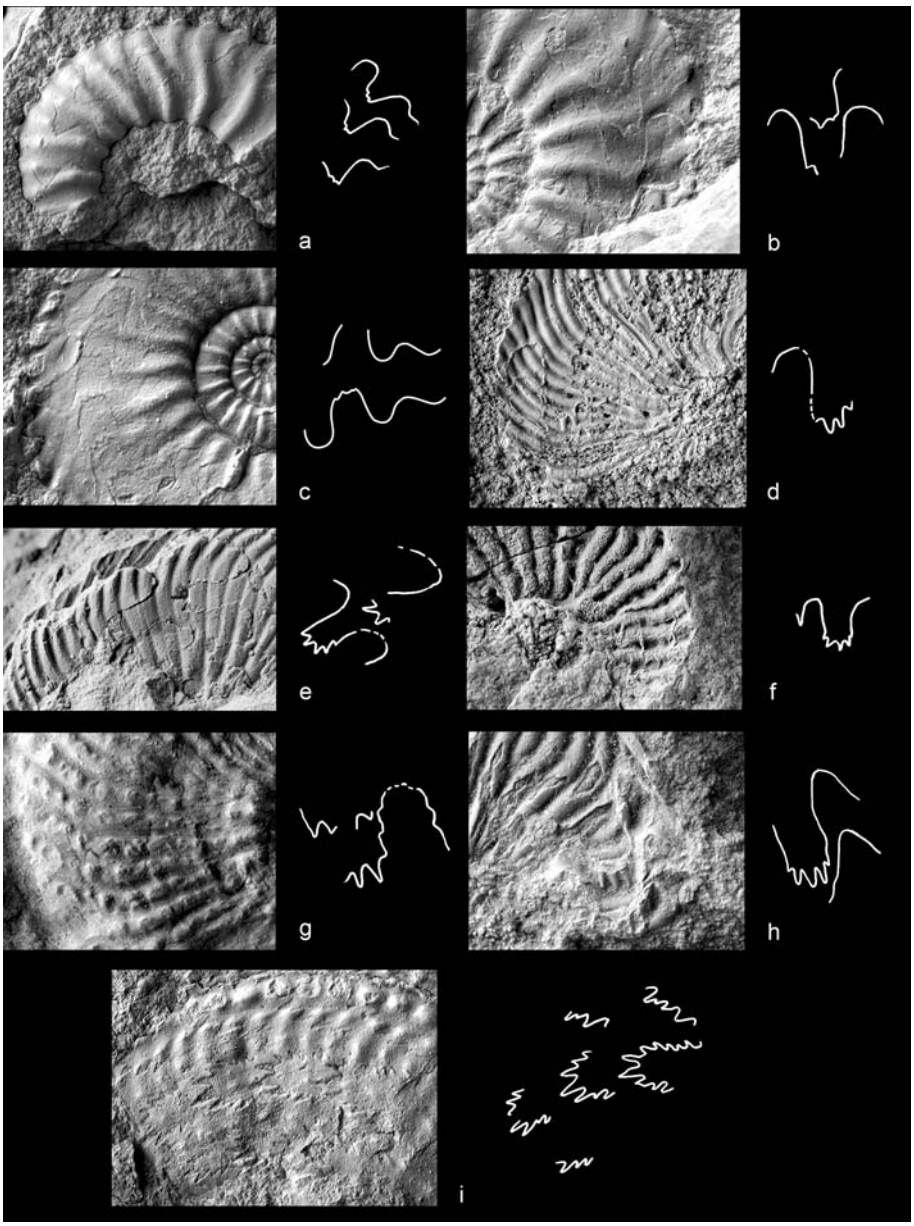


Fig. 9 - Suture line of: a) *Zestoceras barwicki* (specimen PSR 3.21), 4x; b) *Zestoceras lorigae* (specimen PCL 18.1), 4x; c) *Zestoceras lorigae* (specimen PCL dt.8), 4x; d) *Frankites apertus* (specimen SW.dt3), 3x; e) *Frankites* sp. A (specimen SW 7.1), 3x; f) *Daxatina canadensis* (specimen SW 10.2), 2x; g) *Trachyceras muensteri* (specimen PSR 3.dt1), 5x; h) *Daxatina canadensis* (specimen SW 10.11), 2x; i) *Sirenotrachyceras thusneldae* (specimen ASA 17B.3), 2x.

Among the specimens referred to *Zestoceras enode* by Tozer (1994: pl. 82), that of fig. 5 fall into the intraspecific variability of *Zestoceras lorigae* and is well comparable with the specimen depicted at Pl. 4 (figs. 2, 4). On the contrary, the holotype of *Zestoceras enode* exhibits serried, proverse, homogeneous in shape, non abruptly projected ribs. As referred by Tozer (1994) the fig. 2a of the holotype shows a flank as a probable result of injury, and therefore is not to be considered for a correct diagnosis.

With reference to the diagnosis of *Zestoceras* (see Tozer 1994), the writers notice that the external tubercles are present not only in the phragmocone but at least in the adapical part of the body chamber.

Balini et al. (2000) find, at level DG5-MB124 of the Corna San Fermo composite section (Schilpario), some ammonoids, mostly referred to *Clionitites* aff. *busiris* (Münster) because of their general morphological features, also comparable with those of *Ceratites Basileus* Münster. *Ceratites Busiris* Münster shows a thin ventral furrow, not present in the Schilpario's specimens. On the contrary, the latter are characterized by a tabulate venter bordered by tiny rounded external nodes. Despite the apparently different ventral morphology, the flank ornamentation perfectly fits with that of *Zestoceras lorigae* sp. n. As showed in specimens PCL 15.1 and PCL 19.8 (Pl. 4: figs. 8, 9) this different ventral outline is due to a preservation as internal mould.

Moreover, *Ceratites busiris* differs from *Z. lorigae* sp. n. by the presence of concave, strongly projected ribs and the persistence of the ventral furrow at larger diameters. Moreover, the former species also lacks of bifurcated, chevron-like ribs. We emphasize the close

resemblance between *Ceratites busiris* and *Clionites reesidei* Johnston. The latter species are most probably phyletically related to the more ancient *Zestoceras lorigae*.

Occurrence and Age. At present, *Zestoceras lorigae* is documented in the uppermost Wengen Formation of the Schilpario area (Lombardy: see Balini et al. 2000), in the lower part of the San Cassiano Formation of the Southern Alps: Rutor-graben near Corvara in Badia/Kurfar (Mojsisovics 1882), in the Prati di Stuores/Stuores Wiesen section (Mietto & Manfrin 1995b; Neri et al. 1994, 1995; Broglio Loriga et al. 1999) and in several sections and localities (see above). The quoted species is also present in northeastern British Columbia (Canada: Tozer 1994). The alpine specimens are confined within the *canadensis* Subzone (= *Daxatina* cf. *canadensis* Subzone, *sensu* Mietto & Manfrin 1995a); the canadian specimen is documented only in the *sutherlandi* Subzone 2, in which *Daxatina canadensis* occurs (see Tozer 1994).

Genus *Frankites* Tozer, 1971

Type species: *Paratrachyceras sutherlandi* McLearn, 1947: p. 22, pl. 8, figs. 9-12 [= *Juvavites (Dimorphites) apertus* Mojsisovics, 1893].

Frankites apertus (Mojsisovics, 1893)

Fig. 9d; Pl. 1, fig. 8; Pl. 4, figs 5, 6; Pl. 5, figs 7-17

v pars 1882 *Trachyceras regoledanum* E. v. Mojsisovics - Mojsisovics, p. 132, pl. 29, fig. 6 (non vidimus), non figs. 7, 8.

v *1893 *Juvavites (Dimorphites) apertus* E. v. Mojsisovics. Mojsisovics, p. 147, pl. 126, fig. 28.

? 1901 *Protrachyceras regoledanum* Mojs. - Tommasi, p. 58.

1903 *Trachyceras (Anolcites) Richthofeni* Mojs. - Frech, p. 29, pl. 6, fig. 5.

? 1908 *Protrachyceras* cf. *regoledanum* Mojs. - Kittl, p. 495.

? 1911 *Juvavites (Dimorphites) apertus* Mojsisovics - Renz, p. 82.

v 1913 *Trachyceras dichotomum* Münst. - Simionescu, p. 298, pl. 3, fig. 7.

non 1913 *Trachyceras Regoledanum* Mojs. - Simionescu, p. 298, pl. 3, fig. 8 (= *Frankites* sp. A).

1915 *Paratrachyceras regoledanum* Mojs. sp. - Arthaber, p. 137, pl. 14(6), fig. 1.

? 1931 *Paratrachyceras regoledanum* (v. Mojs.) - Voelcker, p. 455.

1947 *Paratrachyceras sutherlandi* n. sp. McLearn, p. 22, pl. 5, fig. 9.

1960 *Trachyceras (Paratrachyceras)* cf. *T. (P.) regoledanum* (Mojsisovics) - Kummel, pl. 83, figs. 1, 2; pl. 84, fig. 10.

pars 1964 *Trachyceras (Paratrachyceras)* sp. cf. *T. (P.) regoledanum* Mojsisovics - Sato, pp. 95-96, pl. 4, figs. 2, 3, 5-7,? fig. 12.

pars 1967 *Paratrachyceras sutherlandi* McLearn - Tozer, pl. 8, figs. 9, 11, 12,? fig. 10.

non 1970 *Paratrachyceras sutherlandi* McLearn - Tozer, pl. 17, fig. 22 (= *Frankites* sp.).

pars 1972 *Frankites sutherlandi* (McLearn) - Tozer, pl. 128, figs. 5, 6,? figs. 7-9.

1976 *Paratrachyceras* sp. - Wang & He, p. 323, pl. 14, figs. 16, 17.

1977 *Frankites apertus* (Mojsisovics) - Urlichs, pl. 1, fig. 3.

1994 *Trachyceras regoledanum* Mojsisovics, 1869 - Balini, pl. 4, fig. 3.

pars 1994 *Frankites sutherlandi* (McLearn) - Tozer, p. 165, pl. 82, fig. 10; pl. 83, figs. 10-12,? fig. 8, non fig. 9 (= *Frankites* sp. A).

v pars 1995a *Frankites regoledanus* (Mojsisovics, 1869), Mietto & Manfrin, pl. 5, fig. 3, non fig. 4.

v pars 1995b *Frankites regoledanus* (Mojsisovics, 1869), Mietto & Manfrin, pl. 1, fig. 9, non fig. 6, non fig. 15 (= *Frankites* sp. A).

v 1995b *Frankites apertus* (Mojsisovics, 1893) - Mietto & Manfrin, pl. 1, fig. 16; pl. 2, fig. 18, non fig. 10 (= *Frankites* sp. A).

1995 *Frankites apertus* (Mojsisovics) - Neri et al., pl. 1, fig. 16.

v pars 1998a *Frankites regoledanus* (Mojsisovics, 1869), Broglio Loriga et al., pl. 1, fig. 9, non fig. 6, non fig. 15 (= *Frankites* sp. A).

v pars 1998a *Frankites apertus* (Mojsisovics, 1893) - Broglio Loriga et al., pl. 1, fig. 16; pl. 2, fig. 18, non fig. 10 (= *Frankites* sp. A).

v 1999 *Frankites apertus* (Mojsisovics). Broglio Loriga et al., pl. 1, fig. 17.

2004 *Frankites regoledanus*. Krystyn et al., fig. MV19.

2005 *Frankites sutherlandi* (McLearn, 1947) - Waller & Stanley, figs. 3: 1, 2.

non 2008 *Frankites sutherlandi*. Balini, fig. 5: 5-8 (= *Frankites* sp. A)

Material. (56 specimens) *Casera Chiansaveit* (Sauris): *Val Giaule 2 section* (Domegge di Cadore): VGL 43.1 (MGPD 30592), 47.1 (MGPD 30753) -.2 (MGPD 30754), 48.1 (MGPD 30755) -.2 (MGPD 30756) -.3 (MGPD 30757); *Rü de Stores* (Badia/Abtei): EA 31 (MGPD 30637); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW0A.5 (MGPD 30248), dt3 (MGPD 30160), PSR 8.1 (MGPD 29468) -.8 (MGPD 30222); *Bec de Roces section* (Livinallongo del Col di Lana): PCL 16.3 (MGPD 30306), 112.2 (MGPD 30369); *Crep de Mont section* (Corvara in Badia/Kurfar): PCM 5.1 (MGPD 30621), dt.3 (MGPD 30622); *Pallua section* (Livinallongo del Col di Lana): ARA 5.1 (MGPD 30522), 6.5 (MGPD 30523), 7.13 (MGPD 30524); *La Locomotiva section* (Canazei): SJ 19.20b (MGPD 30525b); *Col de Frea section* (Corvara in Badia/Kurfar): GJ 1.5 (MGPD 30529), 1b.1 (MGPD 30657), 4.9 (MGPD 30530); *Passo Gardena section* (Corvara in Badia/Kurfar): GJ 6.52 (MGPD 29672),111.1 (MGPD 30547) -.2 (MGPD 30548), 306*.6 (MGPD 29698) -.13 (MGPD 30549); *Pizzes da Cir* (Corvara in Badia/Kurfar): CFR 2.1 (MGPD 30551) -.13 (MGPD 30552) -.14 (MGPD 30652) -.16 (MGPD 30553) -.17 (MGPD 30653) -.22 (MGPD 30654), 4.2 (MGPD 30554); *Col da Oi* (Badia/Abtei): OI-C.14 (MGPD 30630), -D.25 (MGPD 30631) -.29 (MGPD 30668), -K.4 (MGPD 29475); *Sass Ciampac* (Corvara in Badia/Kurfar): SCI.3a (MGPD 30643a) -.4 (MGPD 30644) -.5b (MGPD 30645b) -.14 (MGPD 30646); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASA 2.1 (MGPD 30103), 3.5 (MGPD 30104) -.10 (MGPD 30105), 17B.5 (MGPD 30111), dtbase.11 (MGPD 30138) -.14 (MGPD 30140), dtmedio.2 (MGPD 30142), dt.1 (MGPD 30143) -.3 (MGPD 30144) -.4 (MGPD 30145); *Punta Grohmann section* (Campitello di Fassa): GRH 2a.3 (MGPD 30556), 3.1 (MGPD 30557); *Monte Lungo/Lungkofel* (Villabassa/Niederdorf): MLU.L 1b (MGPD 30558b); *Rio Saltria section* (Castelrotto/Kastelruth): AS 13.3 (MGPD 39743).

Description of the monotypic holotype. The type is largely provided with test. The shell is very compressed, involute, with a high subtrigonal whorl section, quickly increasing in height. The venter is narrow, clearly sulcated and crossed by ribs. Interestingly, the ribs imbricate in the ventral area (Pl. 1, figs. 8b-c). The umbilical rim is clearly angular.

The ornamentation is characterized by numerous, dense, scarcely elevated, flattened ribs. At a diameter of 3,9 cm, the ribs are ca. 42 per half a whorl. These are

more or less proverse or slightly sigmoid in shape, but markedly projected in the outer part of the flank. Primary and bifurcated ribs are present, but the latter are prevalent. The branching point occurs along the inner third of the flank. Since the test is preserved, alongside the ventral furrow or depression, ribs become more ridged, forming a structure similar to a row of blunt swellings.

In disagreement with Mojsisovics (1893), a ceratitic suture line is partly visible (Pl. 1: Fig. 8d) and comparable with that of *Frankites*, as also checked by Tozer (1971, 1994).

Description of the material. Except the specimens EA31 from Rü de Stores in Badia Valley and AS 13.3 from Rio Saltria/Jëndertal section in the Alpe di Siusi/Seiser Alm, all the examined material is represented by compacted ammonoids in which the venter morphology and whorl section are not appreciable. Nevertheless, the flank ornamentation is strikingly comparable with that of the monotypic holotype.

Involute shell quickly increasing in height. The ornamentation is characterized by numerous, dense, scarcely elevated ribs. In early stages they are concave, then more or less proverse, slightly or markedly sigmoid in shape, in every case strongly projected in the outer part of the flank. On the shell surface the ribs are increasingly flattened and much more wider than the interspaces during growth but rounded in section and thinner in the internal mould. Primary and bifurcated ribs are present, but the latter are generally prevalent already in early growth stages. Later on, the bifurcated are the rule so that the primary are very infrequent. Long intercalatory ribs could sporadically be present in mature ontogenetic stages. The branching point occurs firstly at the umbilical rim, but quickly along the inner third of the flank.

Unfortunately, the few collected specimens does not permit to analyze the intraspecific variability bed by bed. However, basing on the studied ammonoids, *Frankites apertus* shows constant morphology.

The suture line is partly visible in specimen SW.dt 3 (Prati di Stuores/Stuores Wiesen section) and comparable with that of *Frankites*. This specimen shows an entire and elevated first lateral saddle followed by a broad and deeply denticulated first lateral lobe. Traces of preseptal layer are noticed.

Comparison and Discussion. *Frankites apertus* is here compared to *Frankites regoledanus* and *Frankites* sp. A (see below). In *Frankites apertus*, the bifurcated ribs are the rule. In early stages, the branching point is in correspondence of the umbilical rim but, during ontogeny, migrates to the inner third of the flank. In early ontogenetic stages (up to 2,5 cm in diameter) the ribs are 30-33 in number per half whorl; at intermediate diameters (3,4 to 4,5 cm) the ribs are 40-48; in large specimens (6,5 to 8 cm) they increase to 50 to 60 per half whorl.

Frankites regoledanus shows bifurcated ribs only at the umbilical rim and the ribs outline is clearly falcoid. In small specimens bifurcations are nearly absent. No substantial differences in the number of ribs with respect to the previous species.

In *Frankites* sp. A ribs are chiefly bifurcated; the branching point is in correspondence of the umbilical rim or above, in the inner third of the flank, as for *Frankites apertus*. The ribs outline is similar, also if the occurrence of proverse ribs seems more frequent. Di-

PLATE 2

Figs. 1-2 - *Rossiceras*? *armatum* (Münster in Wissmann & Münster, 1841), *canadensis* Subzone, Prati di Stuores/Stuores Wiesen section: 1) sample SW21.1, preserved test, lateral view; 2) sample SW9.4, internal side of preserved shell, lateral view.

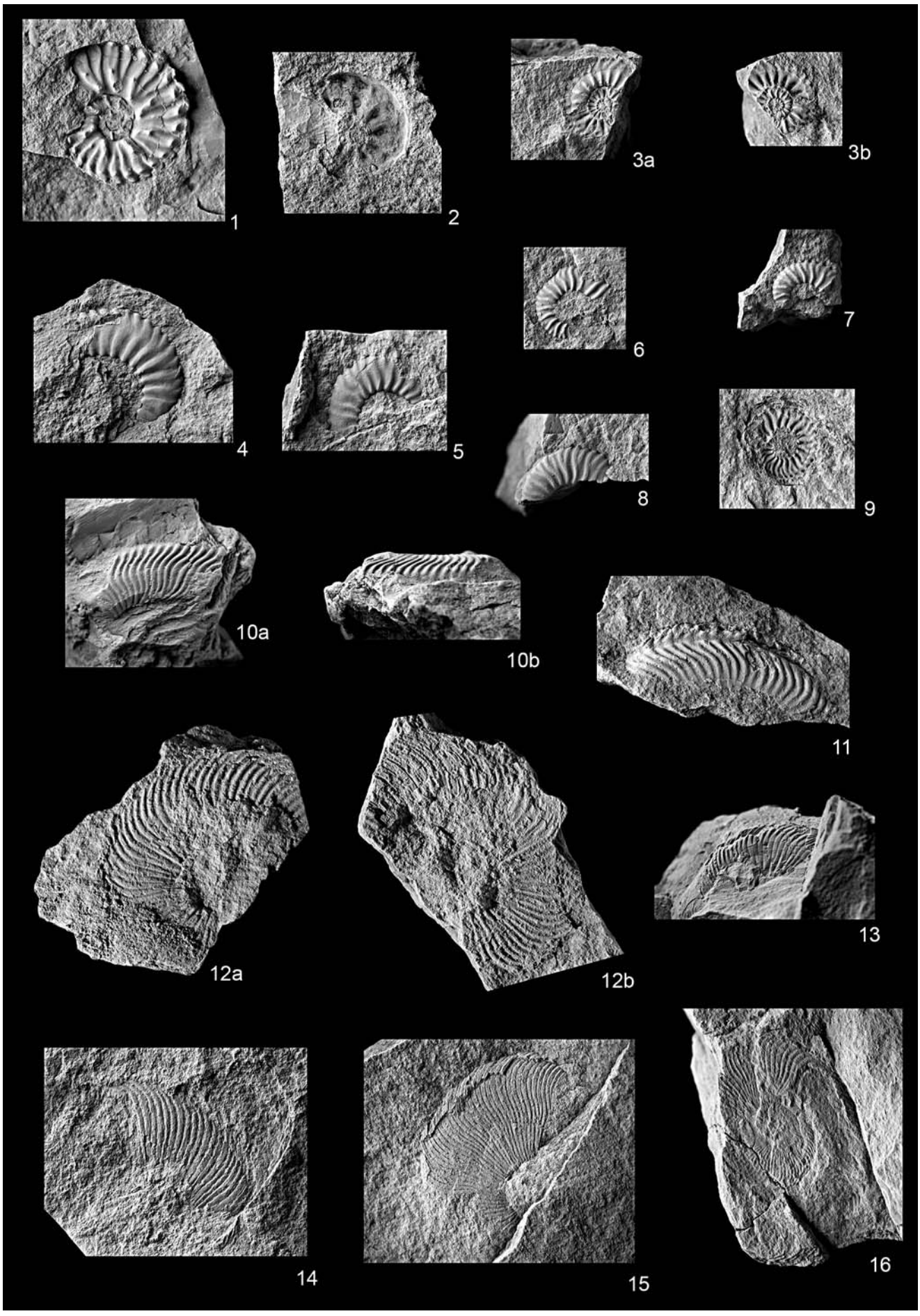
Figs. 3-9 - *Zestoceras barwicki* (Johnston, 1941), *canadensis* Subzone: 3) sample PCL 21.2(a-b), Bec de Roces section: 3a. (a), composite mould, lateral view, 3b. (b), composite mould, lateral view; 4) sample PSR 3.5a, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view; 5) sample PSR 3.32, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view; 6) sample PSR 3.4, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view; 7) sample PSR 3.21, Prati di Stuores/Stuores Wiesen section, internal composite mould with suture line, lateral view; 8) sample PSR 3.40, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view; 9) sample PCLdt.60b, Bec de Roces section, external composite mould, lateral view.

Figs. 10-11 - *Zestoceras* cf. *enode* (Tozer, 1972), *regoledanus* Subzone: 10) sample SW2.1, Prati di Stuores/Stuores Wiesen section, internal composite mould, 10a. lateral view, 10b, ventral view; 11) sample VGL 40.1, preserved test, ventrolateral view.

Figs. 12-16 - *Frankites* sp. A: 12) sample ASAdt.med.4(a-b), *canadensis* Subzone, Antersass section, 12a. (a) internal composite mould, lateral view, 12b. (b), external composite mould, lateral view; 13) sample SW 7.1, *canadensis* Subzone, Prati di Stuores/Stuores Wiesen section, internal composite mould with suture line, lateral view; 14) sample VGL 31.1b, *regoledanus* Subzone, Val Giaule 2 section, internal composite mould; 15) sample PMG 1.3, *regoledanus* Subzone, Casera Montemaggiore, internal composite mould; 16) sample VGL 27dt.1, *regoledanus* Subzone, Val Giaule 2 section, composite mould, lateral view*.

All specimens are illustrated in natural size.

* This specimen was erroneously reported as natural size in Mietto & Manfrin (1995b) and Broglio Loriga et al. (1998a).


1
2
3a
3b
4
5
6
7
8
9
10a
10b
11
12a
12b
13
14
15
16

agnostic seems to be the number of ribs, which are 20% less in average with respect to the latter species.

Recent photos and a cast of the specimen depicted by Simionescu (1913) as *Trachyceras dichotomum* (courtesy of Eugen Gradinaru) allow the writers to identify it as *Frankites apertus*, for the ribs outline, its number and, in particular, the venter morphology. The latter is clearly crossed by ribs, but not shown in the Simionescu's work. Moreover, the lack of spiral rows of nodes on the flank confirms this attribution. This statement is partly in agreement with the Arthaber's remarks (1915: p. 137).

Neither morphological nor dimensional parameters are different between *Juvavites (Dimorphites) apertus* Mojsisovics and *Paratrachyceras sutherlandi* MacLearn, as strongly suspected by Tozer (1971: p. 1018; 1994: p. 165). This holds true also for the suture line. Moreover, also the iconographic comparison is impressive. Hence, we retain these taxa conspecific. A specimen illustrated by Tozer (1967: pl. 8, fig. 10), by the presence of infrequent bifurcations in the upper part of the flank, often due to a rebifurcation of the same, probably do not belong to *F. apertus.*

Occurrence and Age. With the reference to the synonymic list, *Frankites apertus* occurs at Feuerkogel (Steiermark, Austria: Mojsisovics 1893) and in Hungary (Balaton Highlands: Frech 1903). In the Southern Alps, this species certainly occurs in the Brescian Prealps (Schilpario: Mojsisovics 1882) and in the Dolomites (Stuores Wiesen section: Urlichs 1977). In the eastern Mediterranean area *F. apertus* occurs in Romania (Dobrogea: Simionescu 1913) and in Bithynia (Arthaber 1915). In the Eastern Panthalassa the species surely occurs in the Himalayas (Everest: Wang & He 1976; Spiti: Krystyn et al. 2004), in Thailand (Kummel 1960) and in Japan (Sato 1964). As *Frankites sutherlandi* (McLearn) it is known also in British Columbia (Canada: McLearn 1947; Tozer 1967, 1972, 1994) and in Nevada (South Canyon: Waller & Stanley 2005).

The writers found the species in many localities and sections of the Southern Alps (cf. Mietto & Manfrin 1995b; Broglio Loriga et al. 1998a, 1998b, 1999).

The species probably occurs, as *Frankites sutherlandi*, also in Turkey (fide Assereto & Monod 1974). Nevertheless, the absence of adequate description and illustrations hampers any sure attribution.

The quoted species is characteristic of the Ladinian-Carnian boundary interval and occurs from the upper *regoledanus* Subzone to the lower *canadensis* Subzone at least. In Canada the species is documented in the comparable interval *sutherlandi* Subzone 2.

Frankites regoledanus (Mojsisovics, 1869)

Pl. 1, fig. 10; Pl. 3, figs 1-4, 6-11

v *1869 *Ammonites (Trachyceras?) Regoledanus* Mojs. n. sp. Mojsisovics, p. 134, pl. 3, figs. 7-8.

v 1882 *Trachyceras regoledanum* E. v. Mojsisovics - Mojsisovics, p. 132, pl. 29, figs. 7, 8, non fig. 6 (*non vidimus*) [= *Frankites apertus* (Mojsisovics)].

v 1882 *Trachyceras Mundevillae* E. v. Mojsisovics. Mojsisovics, p. 134, pl. 29, fig. 9.

v non 1882 *Trachyceras* nov. f. indet. ex aff. *Trach. Mundevillae*. Mojsisovics, p. 134, pl. 24, fig. 38 (= indet.).

? 1901 *Protrachyceras regoledanum* Mojs. - Tommasi, p. 58.

1901 *Protrachyceras Mundevillae* Mojs. - Tommasi, pp. 58-59, pl. 5(1), fig. 12.

? 1908 *Protrachyceras* cf. *regoledanum* Mojs. - Kittl, p. 495.

? 1908 *Protrachyceras* sp. ind. cf. *regoledanum* Mojs. - Diener, p. 25, pl. 1, fig. 7.

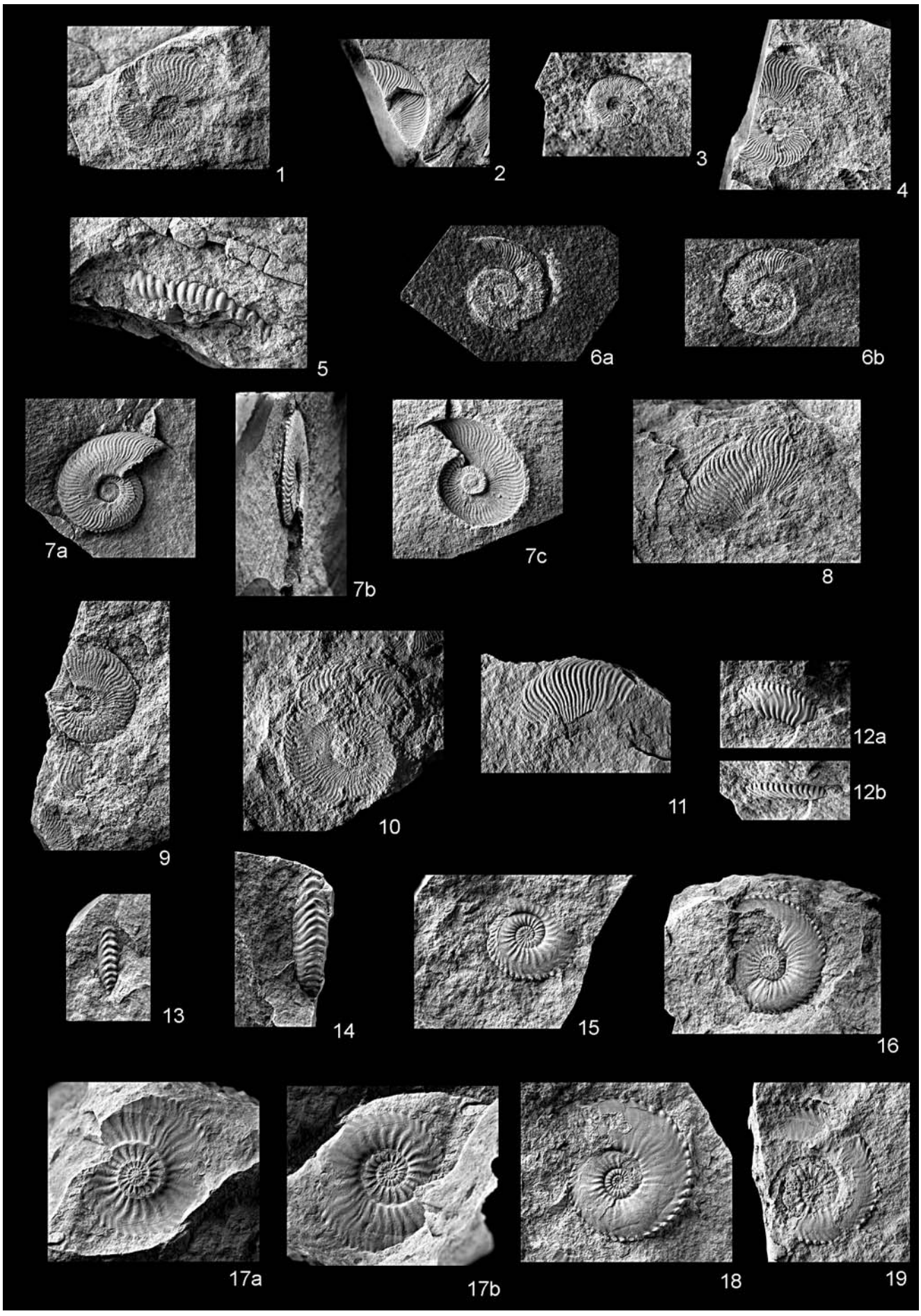
PLATE 3

Figs. 1-4, 6-11 - *Frankites regoledanus* (Mojsisovics, 1869), *regoledanus* Subzone: 1) sample BA 50.1, Bagolino section, composite mould, lateral view; 2) sample VMP s3.18a, "Vecchio Mulino" section, composite mould, lateral view; 3) sample VMP s8.1, "Vecchio Mulino" section, preserved test, lateral view; 4) sample VMP s3.30, "Vecchio Mulino" section, external mould, lateral view; 6) sample VMP s13.7(a-b), "Vecchio Mulino" section, 6a. (a), preserved test, lateral view, 6b. (b), external mould, lateral view; 7) sample IM 2, Pecol, 7a. external mould, lateral view*, 7b. ventral view of the cast of the sample IM 2, x 1,5, 7c. cast of the sample IM 2; 8) sample RFB 200.2, Rio Frommerbach 2 section, internal composite mould; 9) sample RC 30.3a, Rio Saltria/Jëndertal section, internal composite mound; 10) sample RC 30.2a, Rio Saltria/Jëndertal section, internal composite mound; 11) sample PCM 1.6, Casera Montemaggiore, internal composite mould.

Figs. 5, 12-19 - *Zestoceras lorigae* sp. n., *canadensis* Subzone: 5) sample PSR 3.58, Prati di Stuores/Stuores Wiesen section, internal composite mould, ventral view; 12) sample PSR 3.9, Prati di Stuores/Stuores Wiesen section, internal composite mould, a. lateral view, b. ventral view; 13) sample PCL 1.1, paratype 1, Bec de Roces section, internal composite mould, ventral view; 14) sample PSR 3.19, Prati di Stuores/Stuores Wiesen section, internal composite mould, ventral view; 15) sample PCL dt.2, paratype 3, Bec de Roces section, internal composite mould with suture line, lateral view; 16) sample PCL 113.7, paratype 2, Bec de Roces section, internal composite mould, lateral view; 17) sample PCL 18.1, holotype, Bec de Roces section, lateral view, 17a. external composite mould with suture line, 17b. 180° turned print of 17a; 18) sample PCL dt.8, Bec de Roces section, paratype 4, internal composite mould, lateral view with suture line; 19) sample ASA 19bis.3, Antersass section, composite mould, lateral view.

If not specified, all specimens are illustrated in natural size.

* This specimen was erroneously reported as natural size in Mietto & Manfrin (1995b) and Broglio Loriga et al. (1998a).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non 1913 *Trachyceras Regoledanum* Mojs. - Simionescu, p. 298, pl. 3, fig. 8 (= *Frankites* sp. A).

non 1915 *Paratrachyceras regoledanum* Mojs. sp. - Arthaber, p. 137, pl. 14(6), fig. 1 [= *Frankites apertus* (Mojsisovics)].

non 1927 *Protrachyceras Mundevillae* Mojsisovics - Ogilvie Gordon, pp. 60-61, pl. 7, fig. 8 (= *Lecanites* sp.).

1927 *Monophyllites* cf. *wengensis* Klipstein sp. - Ogilvie Gordon, p. 61, pl. 7, fig. 9.

? 1927 *Arpadites sakawanus* Mojs. - Yehara, pp. 36-37, pl. 3, fig. 2.

? 1931 *Paratrachyceras regoledanum* (v. Mojs.) - Voelcker, p. 455.

non 1932 *Paratrachyceras regoledanum* Mojsisovics - Arabu, fig. 14/18 (=? *Paratrachyceras* sp.).

non 1960 *Trachyceras (Paratrachyceras)* cf. *T. (P.) regoledanum* (Mojsisovics) - Kummel, pl. 83, figs. 1, 2; pl. 84, fig. 10 [= *Frankites apertus* (Mojsisovics)].

non 1964 *Trachyceras (Paratrachyceras)* sp. cf. *T. (P.) regoledanum* Mojsisovics - Sato, pp. 95-96, non pl. 4, figs. 2, 3, 5-7 (= *Frankites apertus*), non fig. 12 (= *Frankites* cf. *apertus*).

? 1964 *Trachyceras regoledanum mundevillae* Mojs. - Leonardi G., p. 202, pl. 6, figs. 2, 3.

? 1968 *Trachyceras regoledanum = mondevillae* (sic) Mojs. - Leonardi P., pl. 26, fig. 7.

1972 *Trachyceras (Protrachyceras) mundevillae* Mojs. - Pisa, p. 602, pl. 77(10), fig. 5.

1986 *Trachyceras* sp. - Calligaris, p. 59, fig. B 14ab.

cf. 1990 *Frankites regoledanus* - Neri & Russo, fig. 8.

non 1994 *Trachyceras regoledanum* Mojsisovics, 1869 - Balini, pl. 4, fig. 3 [= *Frankites apertus* (Mojsisovics)].

? 1994 *Otoarpadites auritus* n. sp. Tozer, pp. 152-153, pl. 79, fig. 6, non figs. 7-13.

v pars 1995a *Frankites regoledanus* (Mojsisovics, 1869) - Mietto & Manfrin, pl. 5, fig. 4, non fig. 3 [= *Frankites apertus* (Mojsisovics)].

v pars 1995b *Frankites regoledanus* (Mojsisovics, 1869) - Mietto & Manfrin, pl. 1, fig. 6, non fig. 9 [= *Frankites apertus* (Mojsisovics)], non fig. 15 (= *Frankites* sp. A).

? 1997 *Paratrachyceras richthofeni* (Mojs.) - He & Wang, pp. 339-340. pl. 2, fig. 3 non fig. 4.

v pars 1998a *Frankites regoledanus* (Mojsisovics, 1869) - Mietto & Manfrin, pl. 1, fig. 6, non fig. 9 [= *Frankites apertus* (Mojsisovics)], non fig. 15 (= *Frankites* sp. A).

non 2000 *Frankites regoledanus* (Mojsisovics, 1869) - Balini et al., p. 40, pl. 1, fig. 3 (= *Maclearnoceras* sp. vel *Frankites* sp.), fig. 4 (= *Frankites* sp. A).

non 2004 *Frankites regoledanus* - Krystyn et al., fig. MV19. [= *Frankites apertus* (Mojsisovics)].

v 2004 *Frankites regoledanus* - Gervasi, fig. p. 18.

Material. (31 specimens) *Casera Montemaggiore* (Forni di Sopra): PMG 1.6 (MGPD 36907); *Puiche* (Sappada): PS 0.1 (MGPD 30749a), 1.2 (MGPD 30750) -.3 (MGPD 30751); *Vecchio Mulino section* (Sappada): VMP s3.18a (MGPD 30647a),-.30 (MGPD 30648), s8.1 (MGPD 30649), s13.7 (MGPD 30559) -.11a (MGPD 30650a), FZ 1.2 (MGPD 30743) -.3 (MGPD 30744) -.4 (MGPD 30745) -.5 (MGPD 30746) -.6 (MGPD 30747) -.7 (MGPD 30748); *Val Giaule 2 section* (Domegge di Cadore): VGL 27dt.2 (MGPD 30752); *Pecol* (Zoldo Alto): IM 2 (MGPD 29417-29418); *Frommerbach 2 section* (Castelrotto/Kastelruth): RFB I.1a (MGPD 30610a), II.2 (MGPD 30665) -.3 (MGPD 30669) -.5 (MGPD 30692) -.9 (MGPD 30693), 200.2 (MGPD 30776), FBP 9A.8 (MGPD 30774) -10 (MGPD 30775); *Rio Cipit section* (Castelrotto/Kastelruth) RC 30.1 (MGPD 30778), -.2a (MGPD 30779a) -.2b (MGPD 30779b) -.3a (MGPD 30780a) -.3b (MGPD 30780b); *Bagolino section* (Bagolino): BA 50.1 (MGPD 20572).

Designation of the lectotype. We designate as lectotype the specimen depicted by Mojsisovics (1869) and illustrated at Pl. 3, fig. 7, from Prezzo in the Giudicarie area (NE Italy). Unfortunately the specimen from Regoledo, quoted in the original description, is missing. A very damaged syntype from Prezzo, corresponding to the pl. 3, fig. 8 of Mojsisovics (1869), is stored in the GBA with the repository number GBA 1869/004/0005/1.

Description of the lectotype. The type specimen exposes the internal side of the test. Faint traces of last suture lines are visible. The body chamber occupies at least half of the last whorl, the former displaying also the umbilical wall. The shell is involute, with the last whorl clearly increasing in height. The ornamentation is characterized by dense, flattened ribs, wider than the interspaces. The ribs are falcoid in shape and strongly projected in the outer part of the flank. At a diameter of 3.8 cm, ca. 43 ribs per half a whorl are counted. Except for infrequent bifurcation at the umbilical rim, primary ribs are the rule. A row of tiny nodes is sometimes visible in the ventral area.

Description of the material. Based on the specimens at our disposal, the species shows a very compressed, involute shell, with a high trigonal whorl section, rapidly increasing in height. The venter is narrow and sulcated, as shown in the specimen IM 2 from Pecol (Zoldo Valley in Dolomites). This specimen is a external mould of a undeformed specimen; from a cast, the venter morphology and the whorl section is easily checked (Pl. 3, fig. 7b).

In all the examined material, the ornamentation is characterized by primary, serried, falcoid ribs, strongly projected in the outer part of the flank, in all ontogenetic stages. Bifurcated ribs are rare or absent, but become less infrequent at larger diameter (see lectotype). The branching point is at the umbilical shoulder. The ribs are dense, scarcely elevated, wider than the interspaces and nearly flattened, particularly if the test is preserved. The two latter characters become more pronounced during growth. The falcoid outline of the ribs is retained diagnostic. With reference to the number of the ribs no differences are noted with respect to *Frankites apertus*. In the specimen IM2 a row of flattened, small, pointed nodes is present alongside the ventral furrow (Pl. 3, fig. 7b). Umbilical nodes are absent, only weak swellings could be present when the ribs bifurcate.

The suture line is not known.

Except for the whorl section and the venter shape, all the morphological characters are comparable with those of lectotype.

Comparison and Discussion. Since the works of Urlichs (1974) and Krystyn (1983), *Ammonites (Trachyceras?) regoledanus* was referred to the genus *Frankites* evidently for its general morphological features and

generally accepted. Nevertheless, the venter morphology is unknown, except for the specimen IM2 from Pecol, here described, and the closely related specimen from the Himalayas (Diener 1908). Moreover, the ribs don't cross the venter, a feature well visible in the type species of *Frankites* (*Frankites sutherlandi* = *F. apertus*) already in early ontogenetic stages (e.g. Tozer 1967, 1994). As a consequence, the attribution of *Ammonites (Trachyceras?) Regoledanus* to the genus *Frankites* is far to be definitive. The morphological framework resembles that of *Meginoceras*.

A direct comparison of Mojsisovics's types, kept in the Geologische Bundesanstalt of Wien, did not allow the writers to notice any difference between the quoted species and *Trachyceras Mundevillae*.

The specimen illustrated by Diener (1908) as *Protrachyceras* sp. ind. cf. *regoledanum* Mojs. from Spiti in the Himalayas, shows bifurcated ribs in a much higher position with respect to *F. regoledanus*, even if the falcoid outline of the ribs is similar. Partly in disagreement with Balini et al. (2000) we dubitatively include it in the synonymic list. This specimen may be a pathological form.

The paratype GSC 28672 of *Otoarpadites auritus*, depicted by Tozer (1994, pl. 79, fig. 6) is very similar to the specimen from Pecol (Zoldo Valley), with particular reference to the venter morphology. Only some long intercalatory ribs and the probable occurrence of rare bifurcations just a little over the umbilical rim prevent a sure identification with *F. regoledanus*.

In agreement with Balini et al. (2000), the specimens referred to *Frankites regoledanus* show different morphological features. In particular the specimen of Pl. 1, fig. 3 shows branching point and sigmoid ribs not comparable, in our opinion, with *F. regoledanus*. Moreover, the frequent bifurcations at the umbilical rim and a rebifurcation of one of the ribs, as well as an apparent rounded section of the same, suggest a comparison with representatives of *Maclearnoceras*. This bifurcation style is very infrequent in *Frankites*, which also shows flattened ribs on the shell surface.

Occurrence and Age. *Frankites regoledanus* is the subzonal marker of the last biozone of the Longobardian. On the basis of the synonymic list, the species surely occurs in the Southern Alps, from Lombardy (Dezzo Valley: Tommasi 1901), in the Giudicarie area (Prezzo: Mojsisovics 1869, 1882), in the Dolomites (Braies: Calligaris 1986; Badia Valley: Mojsisovics 1882; Salei creek in the Fassa Valley: Ogilvie-Gordon 1927; Pecol in Zoldo Valley: Mietto & Manfrin 1995a, 1995b, 1998, Gervasi 2004). Pisa (1972) reports the species, named as *Trachyceras (Protrachyceras) mundevillae*, at the top of his "Pseudobuchenstein" outcropping at Clap di Val in Carnia. The writers find *F. regoledanus* also in the Bagolino section (Brescian Prealps). The species is dubitatively present also outside the Southern Alps, in the Himalayas (Spiti: Diener 1908), in China (He & Wang 1997), in Japan (Yehara 1927) and in British Columbia (Tozer 1994).

F. regoledanus seems to be confined in the lower part of the *regoledanus* Subzone. In particular, the datum from British Columbia, if confirmed, appears of particular interest for global correlations.

The species probably occurs in the Balkan area (fide Kittl 1908), at Epidaurus in Greece (fide Krystyn & Mariolakos 1975; Krystyn 1983). Nevertheless, the absence of adequate descriptions and illustrations hampers any sure attribution.

Frankites sp. A

Fig. 9e; Pl. 2, figs 12-16

1913 *Trachyceras Regoledanum* Mojs. - Simionescu, p. 298, pl. 3, fig. 8.

? 1927 *Anolcites Richthofeni* Mojsisovics - Ogilvie Gordon, pp. 61-62, pl. 7, fig. 11.

? 1931 *Paratrachyceras regoledanum* (v. Mojs.) - Voelcker, p. 455.

pars 1994 *Frankites sutherlandi* (McLearn) - Tozer, p. 165, pl. 83, fig. 9, non figs. 10-12 [= *Frankites apertus* (Mojsisovics)], non fig. 8 (= *Frankites* cf. *apertus*).

v pars 1995b *Frankites regoledanus* (Mojsisovics, 1869) - Mietto & Manfrin, pl. 1, fig. 15, non fig. 6, non fig. 9 [= *Frankites apertus* (Mojsisovics)].

v pars 1995b *Frankites apertus* (Mojsisovics, 1893) - Mietto & Manfrin, pl. 2, fig. 10, non fig. 18.

v pars 1998a *Frankites regoledanus* (Mojsisovics, 1869) - Broglio Loriga et al., pl. 1, fig. 15, non fig. 6, non fig. 9 [= *Frankites apertus* (Mojsisovics)].

v pars 1998a *Frankites apertus* (Mojsisovics, 1893) - Broglio Loriga et al., pl. 2, fig. 10, non fig. 18.

pars 2000 *Frankites regoledanus* (Mojsisovics, 1869) - Balini et al., p. 40, pl. 1, fig. 4, non fig. 3 (*Maclearnoceras* sp. vel *Frankites* sp.).

2008 *Frankites sutherlandi.* Balini, fig. 5: 5-8.

Material. (9 specimens) *Casera Montemaggiore* section (Forni di Sopra): PMG 1.3 (MGPD 30694) -.5 (MGPD 30695); *Val Giaule 2 section* (Domegge di Cadore): VGL 27dt.1 (MGPD 30075), 31b.1 (MGPD 30758); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW 1.1 (MGPD 30249), 7.1 (MGPD 30076); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASA.dt.med.4 (MGPD 30074); *Col da Oi* (Badia/Abtei): OI-L.5 (MGPD 29480),-.7 (MGPD 29481).

Description. Few sections of the Southern Alps provides some fragments of shells surely referred to *Frankites*, but slightly different from *F. apertus*. The shell is involute with the whorl rapidly increasing in height. The venter is not visible. The flank ornamentation is characterized by serried, scarcely elevated ribs. The latter are flattened on the test surface, but slightly rounded in the internal mould. The ribs are mainly proverse or, less frequently, slightly sigmoid in shape, in every case strongly projected in the outer third of the flank. They are generally bifurcated, at first at the um-

bilical rim but successively in the inner third of the flank. At a diameter of 2.6 – 4.5 cm, there are 28-36 ribs per half a whorl. Ribs are ca. 20% less in average at a comparable diameter respect *Frankites apertus* and *F. regoledanus.* This is possibly a diagnostic character.

The suture line, visible in specimen SW 7.1 from the Prati di Stuores/Stuores Wiesen section, even if not complete, is comparable with that of *Frankites*. Traces of preseptal layer are noticed (Fig. 9e).

Dimensions (mm)

	D	H	h	U	W	H/W	U/D	SGR
ASA.dt.med.4	49,2	-	13.7	-	-	-	-	-
VGL 27.dt1	45,1	20,8	13,5	10,8	-	-	0,24	54,1

Comparison and Discussion. From literature, the appraisal of specimens attributed to *Frankites*, allow the writers to discriminate a stock of specimens similar to *Frankites apertus* but with a less number of ribs per whorl. This morphological feature could fall in the intraspecific variability of the latter species. As a consequence, although the ribs number could be potentially a diagnostic character, at present we deem the erection of a new species of *Frankites* premature. Moreover, the material at our disposal is scarce and mainly found in debris. The informal taxon of *Frankites* with lower ribs number corresponds to *Frankites johnstoni* in Mietto et al. (2007a).

The specimen labelled VGL 27.dt.1 from Val Giaule 2 section (Pieve di Cadore) shows falcoid ribs in the adoral part of the last preserved whorl. This is due to a deformation during diagenesis, as demonstrated also by comparison with the specimen VGL 31b.1.

The specimen from Dobrogea illustrated by Simionescu (1913) as *Trachyceras Regoledanum* fits well with *Frankites* sp. A.

From the stock of *Frankites sutherlandi* as depicted by Tozer (1994), a hypotype from the GSC loc. 49998 (British Columbia) is comparable, because of the number of ribs at the considered diameter, to *Frankites* sp. A. For the same reason also the specimen quoted by Balini et al. (2000, pl. 1, fig. 4) from the Corna San Fermo section in northeastern Lombardy, and that from New Pass Range in Nevada (Balini 2008, fig. 5: 5-8), is referred to the quoted taxon.

Occurrence and Age. On the basis of synonymic list, *Frankites* sp. A occurs in the Southern Alps, in Romania (Dobrogea: cf. Simionescu 1913), in Nevada (cf. Balini 2008) and in northeastern British Columbia (cf. Tozer 1994). In the Southern Alps the species occurs in the Wengen and basal San Cassiano formations in northeastern Lombardy (Corna San Fermo section: cf. Balini et al. 2000), in western Dolomites (Antersass and Prati di Stuores/Stuores Wiesen sections) and in eastern Dolomites (Casera Montemaggiore and Val Giaule 2 sections).

At present this taxon is documented from the lower part of the *regoledanus* to the lower part of the *canadensis* subzones. In North America it occurs in the *sutherlandi* Subzone 2 of British Columbia (cf. Tozer 1994) and in the *desatoyense* Zone of Nevada (Balini, 2008).

Genus *Daxatina* Strand, 1929

(= *Dawsonites* Böhm, 1903 not Scudder, 1895)

Type species: *Trachyceras Canadense* Whiteaves, 1889, pp. 142-144, pl. 18, fig. 4.

Daxatina canadensis (Whiteaves, 1889)

Figs. 9f, 9h; Pl. 5, fig. 2; Pl. 6, figs. 7-18

v *1889 *Trachyceras Canadense* (N. Sp.). Whiteaves, pp. 142-144, pl. 18, fig. 4.

1903 *Dawsonites* nov. gen. *canadensis* Whiteaves sp. - Böhm, pp. 56-57, pl. 6, figs. 25-30.

1903 *Dawsonites canadensis* Whiteaves var. nov. *elimata.* Böhm, pp. 57-58, pl. 6, figs. 31, 32, 34, 35.

1927 *Clionites (Dawsonites) canadensis* (Whiteaves) - Smith, pp. 92-93, pl. 107, figs. 8-10.

1947 *Dawsonites canadensis* Whiteaves - McLearn, p. 25, pl. 8, fig. 6

1957 *Dawsonites canadensis* (Whiteaves) - Arkell et al., p. L160, fig. 190.

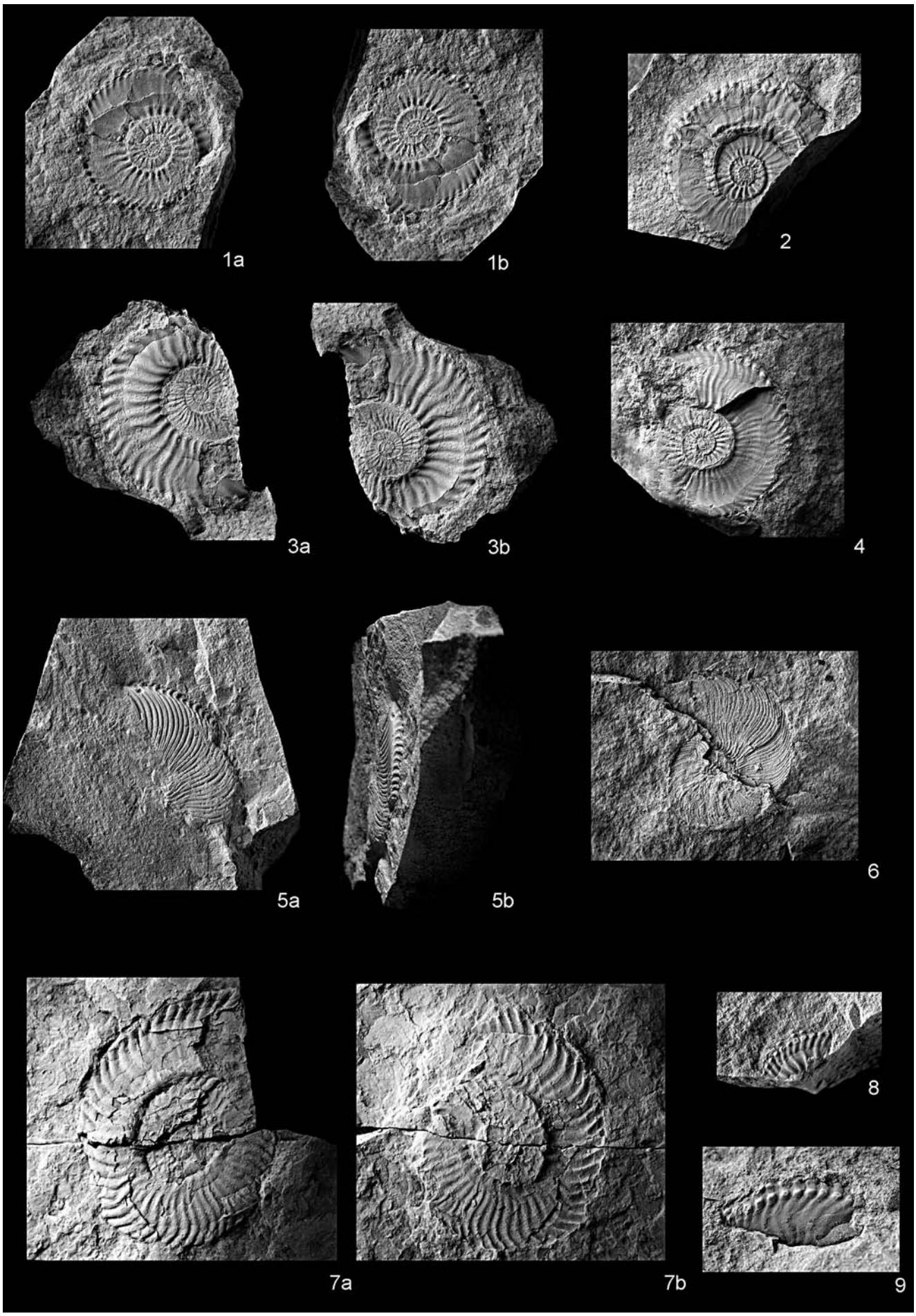
PLATE 4

Figs. 1-4, 8, 9 - *Zestoceras lorigae* sp. n., *canadensis* Subzone: 1) sample PCL 24.4, Bec de Roces section, 1a. external composite mould, lateral view, 1b. 180° turned print of 1a; 2) sample PSR 2.3, paratype 5, Prati di Stuores/Stuores Wiesen section, 2a. internal composite mould, lateral view, 2b. 180° turned print of 2a; 3) sample PCL dt.49, Bec de Roces section, 3a. external composite mould, lateral view, 3b. 180° turned print of 3a; 4) sample PCL 124.38, Bec de Roces section, composite mould, lateral view; 8) sample PCL 15.1, Bec de Roces section, Paratype 6, internal composite mould, lateral and ventral view, x 2; 9) sample PCL 19.8, internal composite mould, lateral and ventral view, x 1,5.

Fig. 5, 6 - *Frankites apertus* (Mojsisovics, 1893): 5) sample AS 13.3a, Rio Saltria/Jëndertal section, internal composite mould, x 1,5, 5a. lateral view, 5b. ventral view; 6) sample VGL 48.1, Val Giaule 2 section, composite mould.

Fig. 7 - *Zestoceras* cf. *enode* (Tozer, 1972), *regoledanus* Subzone: sample SCI.1(a-b), Sass Ciampac, 7a. (a), preserved test, lateral view, 7b. (b), external mould, lateral view.

If not specified, all specimens are illustrated in natural size.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1b
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9

non 1962 *Daxatina (= Dawsonites) canadensis* (Whiteaves) - Tozer, pl. 6, fig. 12 (= *Daxatina* sp.).

1970 *Daxatina canadensis* (Whiteaves) - Tozer, pl. 17, fig. 21.

1984 *Daxatina canadensis* (Whiteaves) - Tozer, p. 154, fig. 38 at p. 24.

1993 *Daxatina canadensis* (Whiteaves) - Dagys et al., pl. 3, fig. 1.

v 1994 *Daxatina canadensis* (Whiteaves) - Tozer, pp. 165-166, cover-illustration, fig. 68b-e, pl. 85, figs. 2-4, 7-9, non figs. 5, 6 (= *Daxatina* sp.) (vidimus pl. 85, figs. 3, 7, 8).

v 1995a *Daxatina* cf. *canadensis* (Whiteaves, 1889) - Mietto & Manfrin, pl. 5, fig. 7.

v 1995b *Daxatina* cf. *canadensis* (Whiteaves, 1889) - Mietto & Manfrin, fig. 6; pl. 2, figs. 8, 13, 14.

v 1998 *Daxatina* cf. *canadensis* (Whiteaves) - Gianolla et al., fig. 11c.

v pars 1998a *Daxatina* cf. *canadensis* (Whiteaves) - Broglio Loriga et al., pl. 2, figs. 8, 13, 14, non fig. 16 [= *Trachyceras muensteri* (Wissmann), typing error].

v 1999 *Daxatina* cf. *canadensis* (Whiteaves) - Broglio Loriga et al., pl. 2, figs. 10, 11.

v pars 1999 *Daxatina* sp. - Broglio Loriga et al., pl. 2, figs. 7, 9, non figs. 6, 8.

2004 *Daxatina* sp. - Krystyn et al., fig. MV23 (2 pictures).

v 2004 *Daxatina* cf. *canadensis* - Gervasi, fig. at p. 18.

? 2007 *Daxatina* sp. - Balini et al., p. 133, fig. 8 L-M, non A-C, I-K.

? 2007 *Daxatina* - Balini & Jenks, p. 19, fig. 7 C-D non A-B, E.

Material. (15 specimens) *Rio Cuzze section* (Borca di Cadore): CUZ dt.1 (MGPD 30598); *Bec de Roces section* (Livinallongo del Col di Lana): PCL 125.18 (MGPD 30496); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW 4.1 (MGPD 29531), 5A.2 (MGPD 29444) -.3 (MGPD 30148), 5B.7 (MGPD 29536), 9.2 (MGPD 30241) -.3 (MGPD 30242), 10.1 (MGPD 29446) -.2 (MGPD 29447) -.11 (MGPD 29539), dt.1 (MGPD 30246), PSR3dt.2a,b (MGPD 29455/ 29456); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASAdt.7 (MGPD 30147), dtbase.2 (MGPD 30132).

Description. The material consists of compacted shells, steinkerns, or internal sides of preserved tests, from which rubber casts were obtained.

The shell is involute, with whorl height appreciably increasing during ontogenesis. Broad external area, characterized by a sharp and deep ventral furrow. The umbilical wall seems overhanging, as far as it is possible to check it. The ribs are generally strong, well elevated and coarsely rounded in section, more or less as wide as the interspaces, but broader when the test is preserved. In early growth stages, ribs are roughly arranged, rectilinear or proverse in shape then sigmoid, sometimes slightly biconcave, in every case markedly projected on the outer part of the shell. Primary and bifurcated ribs are mostly abundant along the flank, even if the latter are more frequent on the phragmocone. Intercalatory are rare. The branching point generally occurs at the umbilical rim or in the upper part of the flank, often due to a rebifurcation of the ribs. At least, nine rows of well pointed tubercles occur, more or less in equidistant position. Only the umbilical tubercles appear as swellings. In the shell fragments where the external area could be checked, we notice the lack, alongside the ventral furrow, of the close ridged double rows of nodes typical of *Trachyceras*. On the contrary, of the two non-ridged rows of tubercles, the nearer to the furrow is slightly bigger and more elevated. This character is often present in many representatives of the genus *Daxatina*.

The suture line is visible in samples SW10.2 and SW10.11 from Prati di Stuores/Stuores Wiesen section (Figs. 9f, 9h). At a whorl height of 1 cm and 1,5 cm respectively, they show a ceratitic outline with evident entire saddles (cf. Mietto & Manfrin 1995b, Broglio Loriga et al. 1999).

PLATE 5

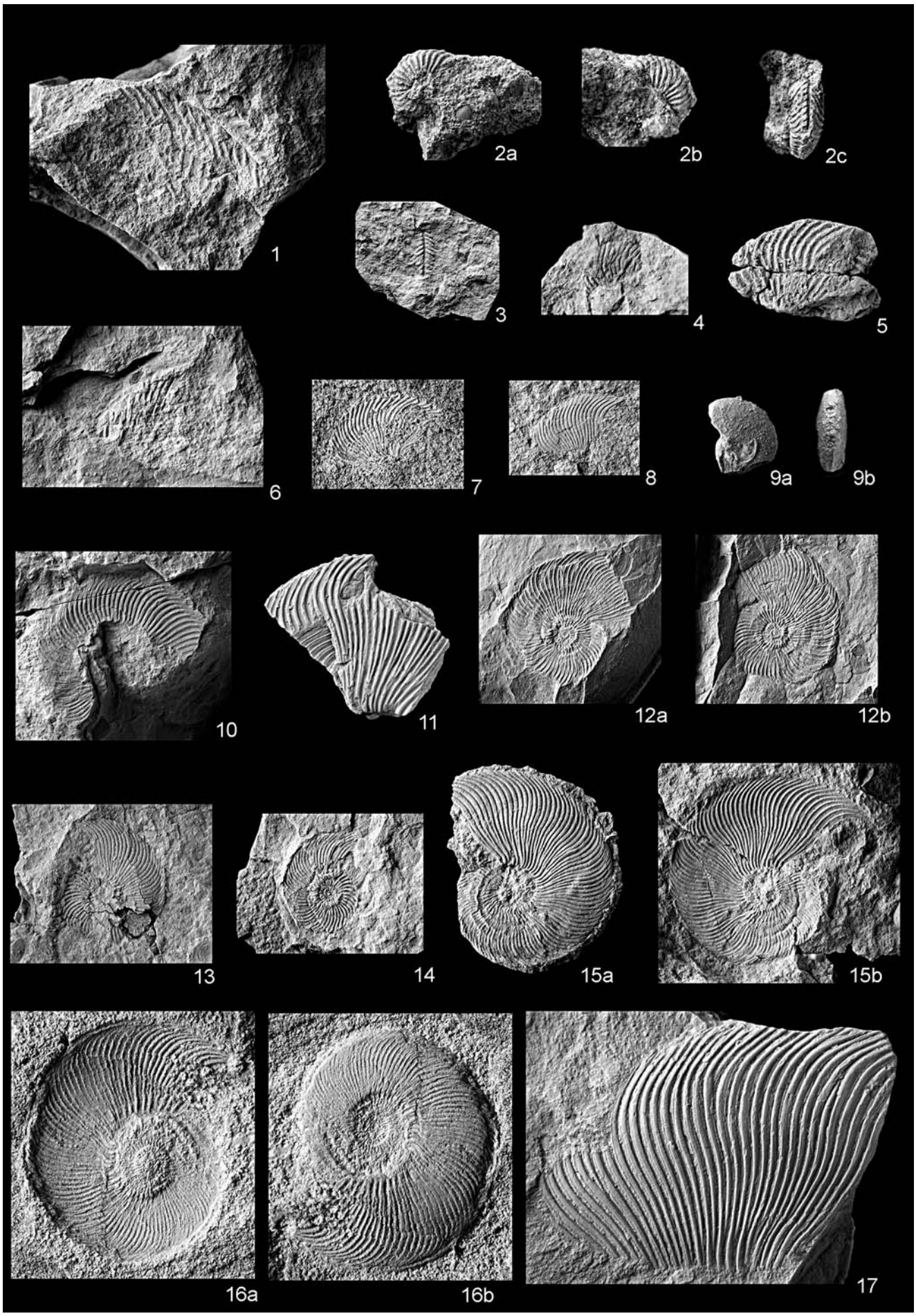
Figs. 1, 3-6 - *Daxatina* sp., *canadensis* Subzone: 1) sample ASA dtbase.1, Antersass section, external composite mould, lateral view; 3) sample PSR 4.1, Prati di Stuores/Stuores Wiesen section, internal composite mould, ventral view; 4) sample PSR 1B.1, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view; 5) sample SW 5A.4a, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view; 6) sample SW 4.3, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view.

Fig. 2 - *Daxatina canadensis* (Whiteaves, 1889), *canadensis* Subzone: sample SW dt.1, Prati di Stuores/Stuores Wiesen section, preserved test, 2a. lateral view, 2b. lateral view, 2c. ventral view;

Figs. 7-17 - *Frankites apertus* (Mojsisovics, 1893): 7) sample SW dt.3, *canadensis* Subzone, Prati di Stuores/Stuores Wiesen section, internal side of shell with suture line, lateral view; 8) sample ASA 17B.5b, *canadensis* Subzone, Antersass section, internal composite mould, lateral view; 9) sample EA 31, *canadensis* Subzone, Rü de Stores, preserved test, 9a. lateral view, 9b. ventral view; 10) sample PSR 8.1, *canadensis* Subzone, Prati di Stuores/Stuores Wiesen section, external composite mould, lateral view; 11) sample ASA 3.12, Antersass section, *canadensis* Subzone, internal composite mould, lateral view; 12) sample GRH 2a.3(a-b), *regoledanus* Subzone, Punta Grohmann section, lateral view, 12a. (a), external composite mould, 12b. (b), internal composite mould *; 13) sample SCI.3, *regoledanus* Subzone, Sass Ciampac, preserved test, lateral view; 14) sample SCI.4, *regoledanus* Subzone, Sass Ciampac, preserved test, lateral view; 15) sample PCL 16.3(a-b), *canadensis* Subzone, Bec de Roces section, lateral view, 15a. (a), internal composite mould, 15b. (b), external composite mould; 16) sample GRH 3.1, Punta Grohmann section, *canadensis* Subzone, lateral view, 16a. external mould, 16b. 180° turned print of 16a*; 17) sample ASA dtbase.11, Antersass section, *canadensis* Subzone; internal composite mould, lateral view.

All specimens are illustrated in natural size.

* This specimen was erroneously reported as natural size in Mietto & Manfrin (1995b) and Broglio Loriga et al. (1998a).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Comparison and Discussion. Even if the lack of undeformed specimens at disposal hampers the objective evaluation of the morphometric parameters, a comparison with casts of the type specimens, allows to attribute our material to *Daxatina canadensis*, without open nomenclature as previously stated (see also Mietto et al. 2004). The comparison between the material of the Southern Alps with that of the British Columbia emphasized practically identical morphological features of the shell and of the suture line. In particular, the comparison of Whiteaves's type (1889, pl. 18, fig. 4) with specimen SW10.1 from Prati di Stuores/Stuores Wiesen section, is impressive (Pl. 5, fig. 17). It is particularly more consistent if we consider that the Prati di Stuores/Stuores Wiesen sample is the internal part of the shell and the Whiteaves type is an internal mould.

Instead, the attribution to *Daxatina canadensis* of the finely ornamented specimens illustrated by Tozer (1994, pl. 85, figs. 5, 6), is not convincing. With respect to the more strongly ornamented specimens, specimen of fig. 6 at the same diameter shows almost twice as much rows of tubercles associated to much denser ribs. Also the specimen of fig. 5 shows a portion of the venter which is too finely ornamented. So wide a infraspecific variability is not proved and, at present, the attribution of finely ornamented morphotypes to *D. canadensis* is premature. With reference to one of the specimens of *Daxatina* illustrated by Balini et al. (2007) and Balini & Jenks (2007) from South Canyon (Nevada), considering the lack of most of the test, we refer this sample with open nomenclature to *D. canadensis* for its morphological features.

Occurrence and Age. *Daxatina canadensis* is reported in the Boreal Domain (Svalbard: Böhm 1903, 1904; Dagys et al. 1993; Dagys & Weitschat 1993; Mørk, 1994; Mørk et al. 1989, 1990, 1992a, 1992b; Tozer & Parker 1968; Weitschat & Dagys 1989), in Canada (British Columbia: Whiteaves 1889; McLearn 1947; Silberling & Tozer 1968; Smith 1927; Tozer 1961a, 1961b, 1984, 1994), in Alaska (Martin 1926), in the Southern Alps (Dolomites: Mietto & Manfrin 1995a, 1995b; Broglio Loriga et al. 1999), in the Himalayas (Krystyn et al. 2004). Moreover, the quoted species possibly occurs in Turkey (Taurus: Assereto & Monod 1974) and in Nevada (Balini et al. 2007, fig. 8L-M; Balini & Jenks 2007, fig. 7C-D).

Daxatina canadensis marks the base of Carnian Stage (as proposed by Mietto & Manfrin 1995a, 1995b; Broglio Loriga et al. 1999) and is confined to the lower part of the Julian Substage, correlatable with the *sutherlandi* Subzone 2 in Canada (Tozer 1994) and the *desatoyense* Zone in Nevada (cf. Balini et al. 2007; Balini & Jenks 2007).

Daxatina cf. **laubei** Tozer, 1994

Fig. 10b; Pl. 6, figs 1-6

v 1999 *Trachyceras bipunctatum* (Münster) - Broglio Loriga et al., pl. 2, fig. 1.

Material. (12 specimens) *Bec de Roces section* (Livinallongo del Col di Lana): PCL 2.6 (MGPD 30253) -.9 (MGPD 30255) -.15 (MGPD 30260), 11.7 (MGPD 30283), 105.5 (MGPD 30346), 120.8 (MGPD 30439), dt.9 (MGPD 30572) -27 (MGPD 30587) -.67b (MGPD 30687b); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW 6.1 (MGPD 30154); *Col da Oi* (Badia/Abtei): OI-E.5a (MGPD 30635a); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASAdt.6 (MGPD 30146).

PLATE 6

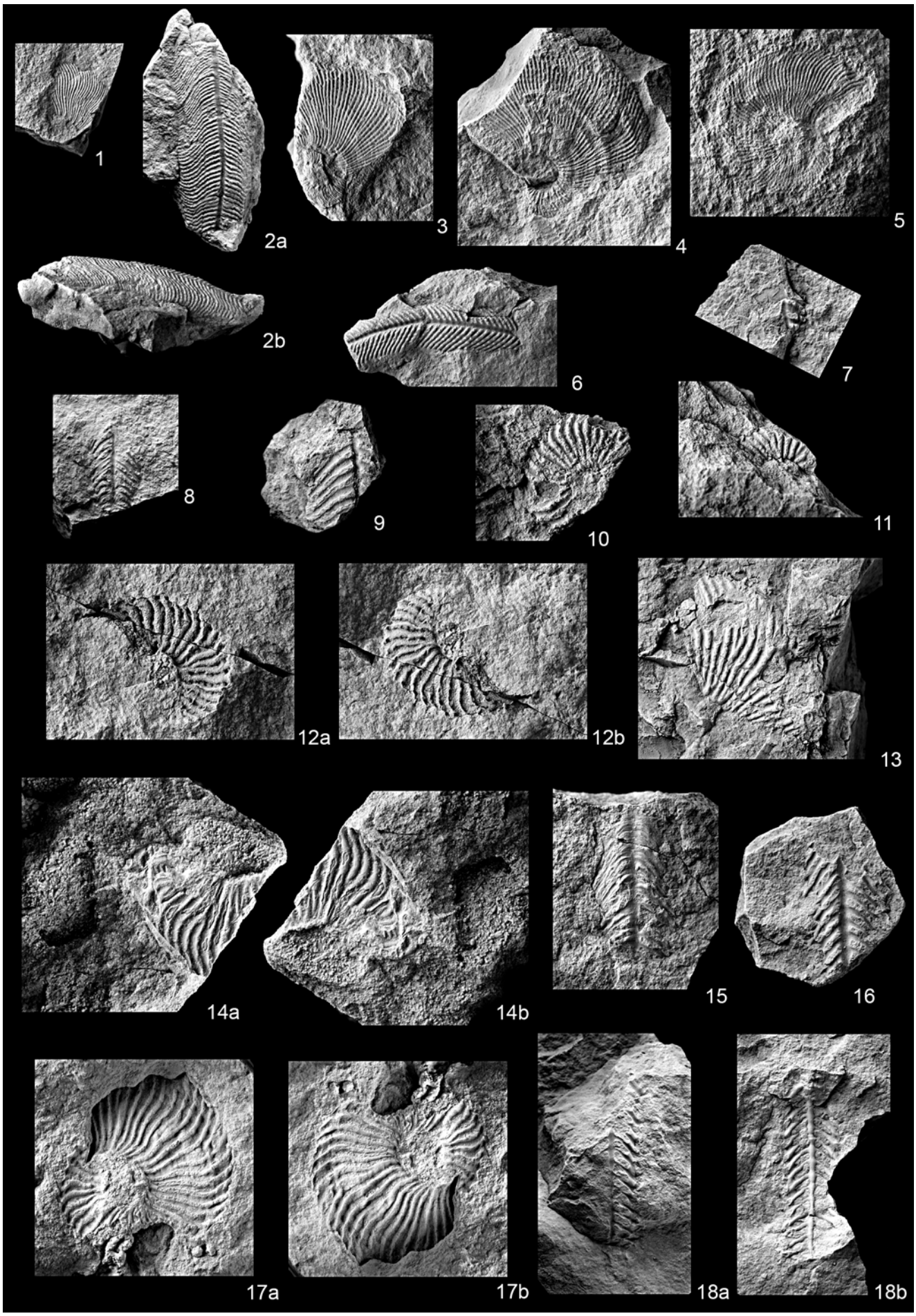
Figs. 1-6 - *Daxatina* cf. *laubei* Tozer, 1994, *canadensis* Subzone: 1) sample PCL 105.58, Bec de Roces section, internal composite mould, lateral view; 2) sample ASA dt.6, Antersass section, internal composite mould, a. ventral view, b. lateral view; 3) sample PCL dt.27, Bec de Roces section, external composite mould, lateral view; 4) sample OI-E.5, Col da Oi, internal composite mould, lateral view; 5) sample PCL dt.9, Bec de Roces section, internal composite mould, lateral view; 6) sample PCL 2.6, Bec de Roces section, internal composite mould, ventral view.

Figs. 7-18 - *Daxatina canadensis* (Whiteaves, 1889), *canadensis* Subzone: 7) sample PCL 125.18, Bec de Roces section, internal composite mould, ventral view; 8) sample SW 4.1, Prati di Stuores/Stuores Wiesen section, internal composite mould, ventral view*; 9) sample SW 5A.2, Prati di Stuores/Stuores Wiesen section, internal composite mould, ventral view; 10) sample SW 5A.3, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view; 11) sample CUZ dt.1, Rio Cuzze section, internal composite mould, lateral view; 12) sample SW 10.2, Prati di Stuores/Stuores Wiesen section, 12a. inner side of the shell with suture line, lateral view, 12b. 180° turned print of 12a; 13) sample SW 5B.7, Prati di Stuores/Stuores Wiesen section, preserved test, lateral view; 14) sample SW 10.11, Prati di Stuores/Stuores Wiesen section, 14a. 180° turned print of 14b;14b. internal side of shell with suture line, lateral view; 15) sample ASA dt.7, Antersass section, internal composite mould, ventral view; 16) sample ASA dtbase.2, Antersass section, internal composite mould, ventral view; 17) sample SW 10.1, Prati di Stuores/Stuores Wiesen section, 17a. inner side of the shell, lateral view, 17b. 180° turned print of 17a**; 18) sample PSR 3.2, Prati di Stuores/Stuores Wiesen section, ventral view, 18a. internal composite mould, 18b. external composite mould.

All specimens are illustrated in natural size.

* This specimen was erroneously reported as natural size in Mietto & Manfrin (1995b) and Broglio Loriga et al. (1998a).

** This specimen was erroneously reported as natural size in Mietto & Manfrin (1995b) and Broglio Loriga et al. (1998a, 1999)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Description. The best preserved material comes from Bec de Roces, Antersass and Col da Oi (Badia Valley). It is generally constituted by fragmented specimens which sometimes show the venter. The external area is broad, well rounded, characterized by a marked shallow furrow in the venter midline. The general ornamentation of the shell consists of dense, delicate, quite numerous ribs that bear frequent rows of nodes, tiny and rounded in shape, barely visible and in equidistant position. In sample OI-E.5, at a whorl height of 2.4 cm, at least eighteen rows of nodes are visible (Pl. 5, fig. 4). The ribs, slightly biconcave in shape, are moderately projected in the outer part of the flank. Among the ribs, long intercalatory and bifurcations in the lower-lowermost part of the flank mostly occur.

Suture line not visible.

Comparison and discussion. The species that most resembles *Daxatina* cf. *laubei* is *Trachyceras bipunctatum* (see below). Nevertheless, at the considered diameters, the attribution of these specimens to *Daxatina* is due to the lack of the raised couple of nodes structure, typical of *Trachyceras* and apparently present in *D. laubei* Tozer only in early growth stages. The dense and very fine ornamentation of the examined material is impressively comparable with Tozer's species (1994, pl. 85, fig. 1). Nevertheless, the fragmentary samples at our disposal and the lack of the suture line, prevents a sure attribution.

Occurrence and Age. The examined specimens come from Bec de Roces, Prati di Stuores/Stuores Wiesen and Antersass sections and also from Col da Oi locality, in stratigraphic intervals referred to the *canadensis* Subzone. Besides, *Daxatina laubei* is documented in the correlatable *sutherlandi* Subzone 2 of the British Columbia (Tozer 1994) and most probably in Nevada (Balini et al. 2007, fig. 8B-C; Balini & Jenks 2007, fig. 7A-B).

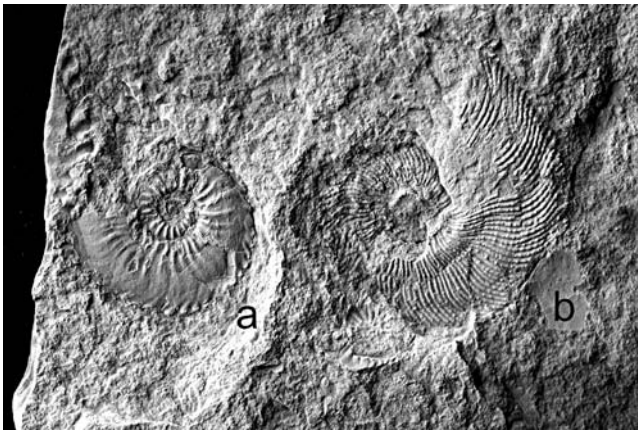


Fig. 10 - Sample PCLdt.67, Bec de Roces section from debris, *canadensis* Subzone, 1x; a) *Zestoceras lorigae* Mietto & Manfrin sp. n., internal composite mould, lateral view; b) *Daxatina* cf. *laubei* Tozer, 1994, internal composite mould, lateral view.

Daxatina sp.

Pl. 5, figs 1, 3-6

Material. (9 specimens) *Pralongià* (Badia/Abtei) SW 11.1 (MGPD 30763) -.2 (MGPD 30764); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW 4.3 (MGPD 29533), 5A.4 (MGPD 29443), PSR 1B.1 (MGPD 29453), 4.1 (MGPD 29467); *Bec de Roces section* (Livinallongo del Col di Lana): PCL 20.15a (MGPD 30718a); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASAdtbase.1 (MGPD 30106) -.13 (MGPD 30117).

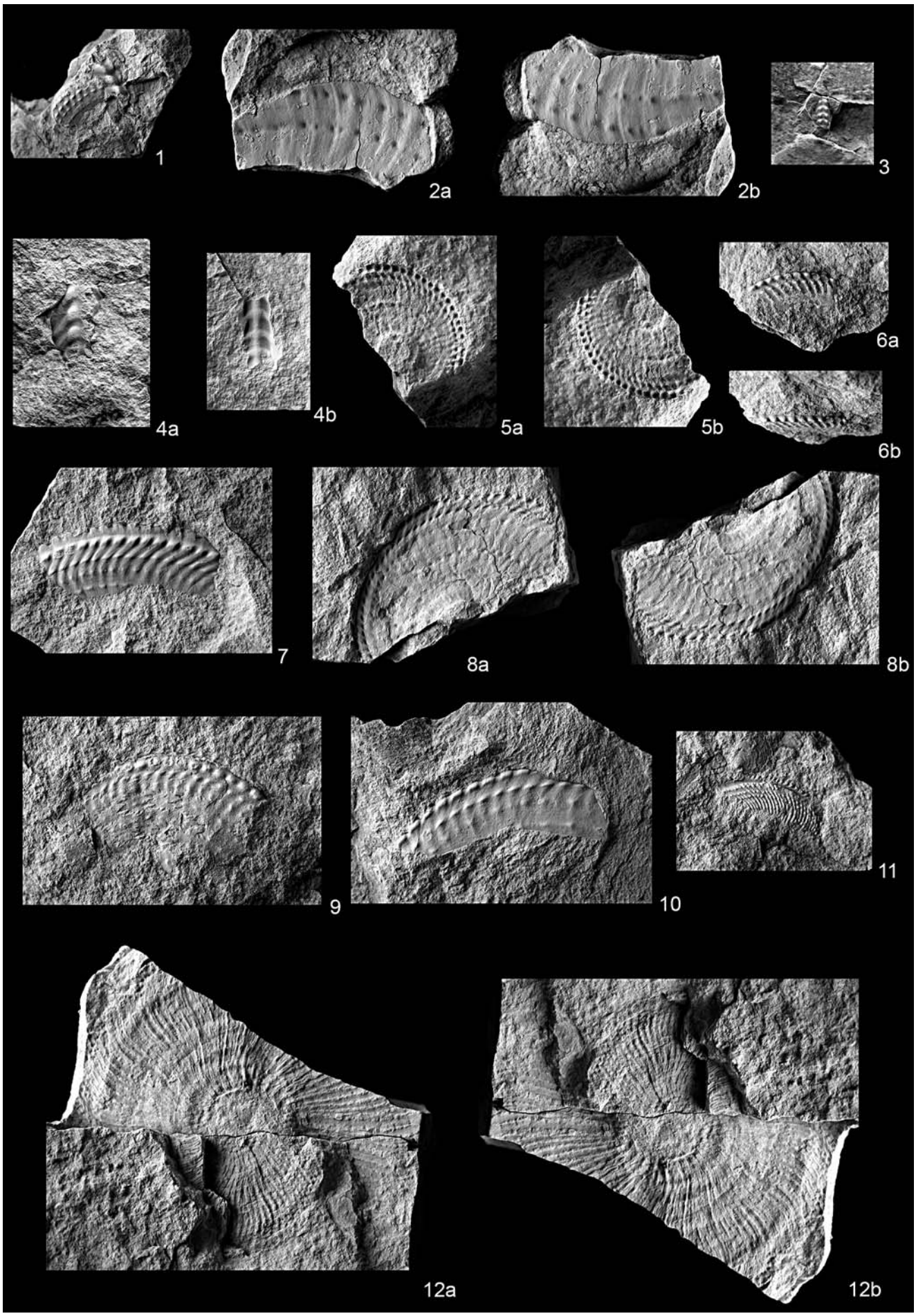
Description. Among several fragments referable to *Daxatina* we picked out specimens identified as SW 4.3, SW 5A.4, PSR 4.1, ASA.dtbase.1 which show morphological characters intermediate between *Daxatina laubei* and *Daxatina canadensis* (see above). With respect to the former, this material shows a less number of tubercles and stronger ribs. At a comparable diameter, the small fragment PSR 4.1 shows wider ribs than *D. laubei*. Instead, the quoted specimens have, with respect to *D. canadensis*, finer ribs with a higher number of rows of tubercles. This form seems to be comparable with the specimens illustrated by Tozer (1962: pl. 6, fig. 12; 1994: pl. 85, figs. 5-6) as *Daxatina canadensis*, not referred to this species by the writers.

PLATE 7

Figs. 1-10 - *Sirenotrachyceras thusneldae* (Mojsisovics, 1893), *canadensis* Subzone: 1) sample SW 5B.19, Prati di Stuores/Stuores Wiesen section, internal composite mould, lateral view and a fragment of a second conspecific exemplar (ventral view); 2) sample PSR 9.1, Prati di Stuores/Stuores Wiesen section, lateral view, 2a. internal side of shell, 2b. 180° turned print of 2a; 3) sample PSR 10.7, Prati di Stuores/Stuores Wiesen section, internal composite mould, ventral view; 4) sample GJ 2.24(a-b), Col de Frea section, ventral view, 4a. (a), internal composite mould, damaged, 4b. (b), external composite mould; 5) sample GJ 5.6, Col de Frea section, lateral view, 5a. external composite mould, 5b. 180° turned print of 5a; 6) sample GJ 5.1, Col de Frea section, internal composite mould, 6a. lateral view, 6b. ventral view; 7) sample GJ 2.19a, Col de Frea section, internal composite mould, ventrolateral view; 8) sample GJ 2.15, Col de Frea section, lateral view, 8a. external composite mould, 8b. 180° turned print of 8a; 9) sample ASA 17B.3a, Antersass section, internal composite mould with suture line, lateral view; 10) sample ASA 17B.4a, Antersass section, internal composite mould, lateral view.

Figs. 11-12 - *Trachyceras bipunctatum* (Münster, 1834): 11) sample ASA 1.11b, *aon* Subzone, Antersass section, internal composite mould, ventrolateral view; 12) sample ASA 20.3, *canadensis* Subzone, lateral view, 12a. composite mould, 12b. 180° turned print of 12a.

All specimens are illustrated in natural size.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Subfamily Sirenitinae Tozer, 1971

Genus *Sirenotrachyceras* Krystyn, 1978

Type species: *Protrachyceras (Trachyceras) Hadwigae* Mojsisovics, 1893, p. 624, pl. 166, figs. 4-5.

Sirenotrachyceras thusneldae (Mojsisovics, 1893)

Fig. 9i; Pl. 1, figs 2, 4, 6, 13; Pl. 7, figs 1-10

v *1893 *Anolcites (Trachyceras) Thusneldae* E. v. Mojsisovics. Mojsisovics, p. 697, pl. 162, fig. 20.

v 1893 *Anolcites (Trachyceras) Lenaui* E. v. Mojsisovics. Mojsisovics, p. 698, pl. 162, fig. 19.

v cf. 1893 *Anolcites (Trachyceras) Carnerii* E. v. Mojsisovics. Mojsisovics, pp. 698-699, pl. 162, fig. 17.

v 1893 *Protrachyceras (Trachyceras) Rudolphi*. Mojsisovics, p. 623, pl. 166 (only var. *Aldegondae*), fig. 3, non fig. 2.

cf. 1913 *Protrachyceras Rudolphi* Mojs. - Simionescu, p. 293, pl. 2. fig. 4, non fig. 3.

v pars 1995b *"Anolcites"* ex gr. *laricum* (Mojsisovics, 1882) - Mietto & Manfrin, pl. 2, fig. 3, non figs 4-6 (= *Zestoceras lorigae* sp. n.)

v 1998a *"Anolcites"* ex gr. *laricus* (Mojsisovics, 1882) - Broglio Loriga et al., pl. 2, fig. 3.

v pars 1999 *"Anolcites"* ex gr. *laricus* (Mojsisovics) - Broglio Loriga et al., pl. 1, fig. 12, non fig. 11 (= *Zestoceras lorigae* sp. n.)

Material. (48 specimens) *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): SW 4.2 (MGPD 29532), 5B.3 (MGPD 30149) -.8b (MGPD 30150b) -.16 (MGPD 30152) -.19 (MGPD 30153), PSR 3.10 (MGPD 30176) -.dt5a,b (MGPD 29459/29460), 9.1 (MGPD 30224); *Bec de Roces section* (Livinallongo del Col di Lana): PCL 21.6 (MGPD 30327), 27.2a (MGPD 30337a) -.101.3 (MGPD 30341), 104.2 (MGPD 30345), 105.12a (MGPD 30347a) -.13 (MGPD 30348), 125.8 (MGPD 30486) dt.73 (MGPD 30733); *La Locomotiva section* (Canazei): SJ 19.19 (MGPD 30526), 26.1 (MGPD 30527), 100.1 (MGPD 30529); *Col de Frea section* (Corvara in Badia/Kurfar): GJ 2.7 (MGPD 30531) -.14 (MGPD 30532) -.15 (MGPD 30658) – 17a (MGPD 30740a) -.19 (MGPD 30533) -.21 (MGPD 30534) -.22 (MGPD 30535) -.23 (MGPD 30536) -.24 (MGPD 30537), 5.1 (MGPD 30538) -.2 (MGPD 30539) -.6 (MGPD 30540) -.7 (MGPD 30541) -.10 (MGPD 30542) -.11 (MGPD 30543), 5t.1 (MGPD 30546), dt.2 (MGPD 30544) -.3 (MGPD30545); *Passo Gardena section* (Corvara in Badia/Kurfar): GJ 301.1 (MGPD 29691) -.4 (MGPD 29692), 306*.8 (MGPD 29699) -.10 (MGPD 29701) -.14 (MGPD 30550); *Pizzes da Cir* (Corvara in Badia/Kurfar): CIR-C.2 (MGPD 30555); *Col da Oi* (Badia/Abtei): OI.1 (MGPD 30666); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASA 4.2 (MGPD 30107), 17B.3 (MGPD 30109) -.4 (MGPD 30110), dtbase.8 (MGPD 30136).

Description of the monotipic holotype. The type is provided with test. The shell is very compressed, involute, with a high trigonal whorl section quickly increasing in height. The maximum width is in the inner third of the flank but clearly above the umbilical rim. The latter is rounded and devoid of nodes. The flank is slightly convex. The venter is narrow, flattened and bordered by elongated external nodes in corresponding position and slightly connected with those of the opposite flank. Just below the external, separated by a clear depression, a row of tiny rather elongated marginal nodes occurs quickly followed by the appearance of another row of faint nodes below it (Figs 11a, 11b). The marginal one are in equidistant position between the others. Afterwards, in the last part of the shell three further rows of small, barely visible tubercles are checked. Projected ribs occur only in the upper part of the flank, ever more marked towards the external area. The feature of the suture line is not estimable. Mojsisovics (1893), describing *Anolcites Thusneldae*, notes that the suture line is not well visible but probably shows a ceratitic outline. Nevertheless, the direct examination of the type specimen allows us to notice that the suture line is just the trace of septa into the damaged portion of the phragmocone (Fig. 11c).

Description of the material. A fairly large number of specimens referred to this species is examined. It is preserved as fragments of composite moulds or, less commonly, as internal sides of shells. The best material belongs to Col de Frea and Antersass sections and in particular specimens GJ 2.15, 2.17, 2.19, 5.1, 5.6 and

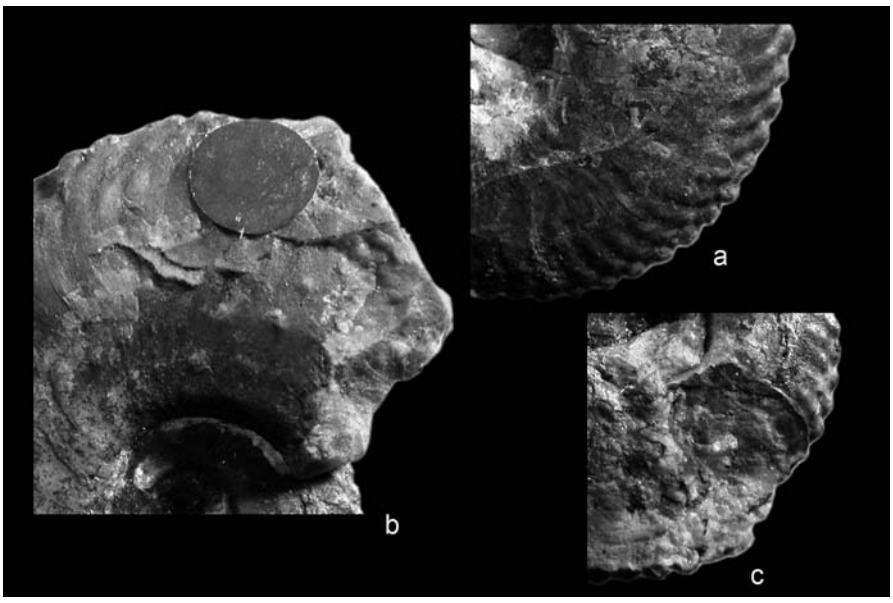


Fig. 11 - Enlarged portions of flank area of the monotypic holotype of *Sirenotrachyceras thusneldae* (Mojsisovics) (GBA 1893/001/0627): a) detail of nodes in the marginal and external position; b) detail of nodes in the inner part of the flank; c) traces of suture line.

ASA 17B.3, 17B.4. Among several whorl fragments also portions of ventral areas are documented.

The shell is involute, markedly increasing in height and with a high trigonal whorl section. The latter character is inferred on the basis of the flank outline. In early growth stages the venter is flattened, then more or less depressed, always bordered by the external row of nodes elongated towards the venter midline (Pl. 6, figs 3, 4). However, also in fragments of large specimens, the venter maintains the presence of a shallow furrow. The umbilical rim is rounded. The ornamentation on the flanks changes during ontogeny. The ribs are evanescent, approximated, barely visible or, more commonly, nearly absent on the inner two-thirds of the flank. Only in the outer third, homogeneous, regularly spaced, scarcely elevated ribs occur, wider than the interspaces, when the test is preserved. During growth, up to seven rows of nodes are noticed. They are more or less in equidistant position when all seven rows are present. External and marginal nodes firstly occur, quickly followed by those located just below the marginal one. Afterwards, three rows of tubercles situated in the lower part of the flank contemporaneously occur. Later on, a further row appears in the midflank. Complete flanks of large specimens are not at our disposal, so that the appearance of further rows of nodes cannot be checked. The nodes are small, weak, generally elongated in the coiling direction in the upper part of the flank, rounded in its lower part. Umbilical nodes are absent with the first lateral row just above the umbilical rim. The external tubercles, always in opposite position, are the most developed, rounded, slightly elongated, often scarcely elevated. They may be laterally projected, due to the compaction of the shell. In early growth stages a marked depression between the external and the marginal nodes occurs. This character seems to be not persistent during ontogeny.

The suture line, checked in specimen ASA 17B.3, is subammonitic. Saddles and lobes are deeply denticulated as for the genus.

Comparison and Discussion. The revision of some specimens of the Mojsisovics' Collection, stored in the GBA, allow the writers to recognize the identity among *Anolcites (Trachyceras) Thusneldae, Anolcites (Trachyceras) Lenaui* and, dubitatively, *Anolcites (Trachyceras) Carnerii*. Also Mojsisovics (1893), describing these taxa, argued the resemblance between the former two species. The direct comparison of Mojsisovics' taxa permits to deem that *A. lenaui* is the inner whorl of *A. thusneldae*. The choice of the latter taxon as a valid name is due because greater in shape and best preserved. The peculiar ornamentation prevents wrong attribution, whenever only fragments are at disposal. Another specimen referable to the quoted species is *Protrachycheras (Trachyceras) rudolphi* var. *aldegondae* (Mojsisovics 1893: pl. 166, fig. 3). This assumption is due by the presence of evident ribs only in the outer part of the flank and rows of very small tubercles often rounded in shape in its lower part. These characters discriminate *Sirenotrachyceras thusneldae* from other congeneric species.

Unlike our specimens, Mojsisovics' material is preserved with test, so that some morphological features are different. This is particularly evident in the ventral area of the young specimens in which the external nodes, in opposite position, are connected by a weak rib if the shell occurs, which is not visible in the internal mould. For the same reason, during ontogeny the external tubercles are subdued so that the ventral furrow is less evident.

The quoted species was previously referred with open nomenclature to *Trachyceras laricum*. This was due to the similarity of some morphological features, as the inferred whorl section, the degree of involution and the outline of the venter.

Occurrence and Age. To date, this species is documented in the Hallstatt Limestone of Northern Calcareous Alps (Mojsisovics 1893: Feuerkogel and Raschberg) and in the Southern Alps (Tarvisian area, Carnia, Dolomites). The bed by bed findings in the Southern Alps indicate a range of *Sirenotrachyceras thusneldae* including at least the lower part of the *canadensis* Subzone.

Subfamily Trachyceratinae Hyatt in Meek, 1877

Genus *Trachyceras* Laube, 1869

Type species: *A. (Cerat.) aon* Münster, 1834, p. 13, pl. 1, fig. 4.

Trachyceras bipunctatum (Münster, 1834)

Pl. 1, fig. 3; Pl. 67, figs. 11-12; Pl. 8, figs. 1, 3

*1834 *A. (Cerat.) Aon*, var.? *bipunctatus*. Münster, p. 13.

1841 *Ceratites bipunctatus* - Münster in Wissmann & Münster, pp. 131-132, pl. 14, fig. 17.

? 1843 *Ceratites brevicostatus*. Klipstein, pp. 134-135, pl. 8, fig. 6.

1847 *Aon punctatus*. Quenstedt, p. 236, pl. 18, fig. 6a-b.

v 1869 *Trachyceras dichotomum* Münster sp. - Laube, pp. 71-72, pl. 39, fig. 1.

v pars 1882 *Trachyceras bipunctatum* (Graf Münster) E. v. M. - Mojsisovics, p. 135, pl. 23, fig. 11; pl. 24, fig. 13,? fig. 12 [=? *Paratrachyceras klipsteini* (Müller)].

v pars 1882 *Trachyceras Aon* (Graf Münster) Laube – Mojsisovics, pp. 129-131, pl. 21, fig. 37, non figs. 19, 22-24, 26, non figs. 1-11, 25, 28, 29 [= *Brotheotrachyceras brotheus* (Münster)], non figs. 12-18, 21 [= *Brotheotrachyceras difforme* (Münster)], non figs. 30-35 [= *Trachyceras muensteri* (Wissmann in Wissmann & Münster)], non fig. 38 [= *Trachyceras* cf. *muensteri* (Wissmann in Wissmann & Münster)], non fig. 20 (= *Trachyceras* sp.). (non vidimus figs. 2, 13, 15, 17, 19, 20, 26, 30, 37).

non 1974 *Paratrachyceras bipunctatum* (Münster) - Urlichs, pl. 1, fig. 12 [= *Paratrachyceras klipsteini* (Müller)].

1994 *Trachyceras bipunctatum* (Münster) - Urlichs, pp. 15-18, fig. 5b, pl. 2, figs 6, 7.

non 1995 *Trachyceras (Tr.) bipunctatum* (Münster) - Neri et al., pl. 1, fig. 15 [= *Trachyceras humboldti* (Klipstein)].

? 1999 *Trachyceras* cfr. *bipunctatum* (Münster, 1834) - Baracca & Bizzarini, pp. 201-202, pl. 1, figs. 1, 2.

v non 1999 *Trachyceras bipunctatum* (Münster) - Broglio Loriga et al., pl. 2, fig. 1 (= *Daxatina* cf. *laubei* Tozer).

Material. (9 specimens) *Le Rocchette* (San Vito di Cadore): ROC.6 (MGPD 30762); *Pralongià* (Badia/Abtei) URL 4b.1 (MGPD 30771) -.2 (MGPD 30772); *Settsass* (Livinallongo del Col di Lana) SS 2.2 (MGPD 30767) -.3 (MGPD 30768) -.4 (MGPD 30769); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASA1.11b (MGPD 30100b) -.18a (MGPD 30101a), 20.3 (MGPD 30126).

Description. The better material at our disposal comes from Anterass section (Badia Valley) and Le Rocchette (San Vito di Cadore). The shell is involute and sculptured by dense, highly multinodate ribs, thinner in the periumbilical area. The ribs, generally primary and bifurcated, are slightly biconcave but well projected in the outer part of the flank. The branching point is in the inner half of the flank. Nevertheless, in sample ASA 20.3, a bifurcation in its upper part is noticed. The nodes are tiny and low rounded, not equally spaced along the ribs, but more serried and marked in the upper part of the flank where they could be slightly elongated in the coiling direction. On the contrary, in the inner part of the flank the nodes are more spaced and attenuated, often barely visible. In sample ASA 20.3, at ca. 2 cm whorl height, 15-18 rows of nodes are visible along the flank. On the ventral area (specimens ASA 1.11b, ASA 1.18a) the typical rised double rows of nodes structure is well evident and slightly separated from the next row of tubercles.

Suture line is not preserved.

Comparison and discussion. Our remarks are in general agreement with the revision stated by Urlichs (1994).

The name originally assigned to the species is most probably due to the reduced number of rows of nodes in early growth stages. The examination of the historical material stored in the GBA (Laube's and Mojsisovics' collections) points out that the successive occurrence of further rows of nodes on the flank occurs from the external towards the umbilical area during ontogeny. Unfortunately, in our material the suture line is not shown, so that the impressive morphological resemblance with the ornamentation of *Daxatina laubei* Tozer must be taken into account. However, in medium-large sized specimens, *D. laubei* lacks the typical ventral rised double rows of nodes structure. Moreover, the external rows of nodes are always in equidistant position.

We agree with Urlichs (1994) in considering the specimen depicted by Laube (1869) as *Trachyceras dichotomum* a representative of *T. bipunctatum.* In fact, the former species chiefly differs by the presence of well marked, proverse, flattened and broader ribs which bifurcate at the umbilical rim or just above. Moreover, the number of rows of nodes is clearly lower.

In disagreement with Neri et al. (1995) the specimen at pl. 1, fig. 15 has best resemblance with representatives of *Trachyceras humboldti* of the same diameter (see also Urlichs 1994: pl. 2, fig. 3). The ribs appear more elevated, rectilinear and proverse, bearing well marked rows of tubercles along the flank.

Occurrence and Age. At present, *Trachyceras bipunctatum* is documented only in the Southern Alps from the upper part of the *canadensis* Subzone to the top of the following *aon* Subzone.

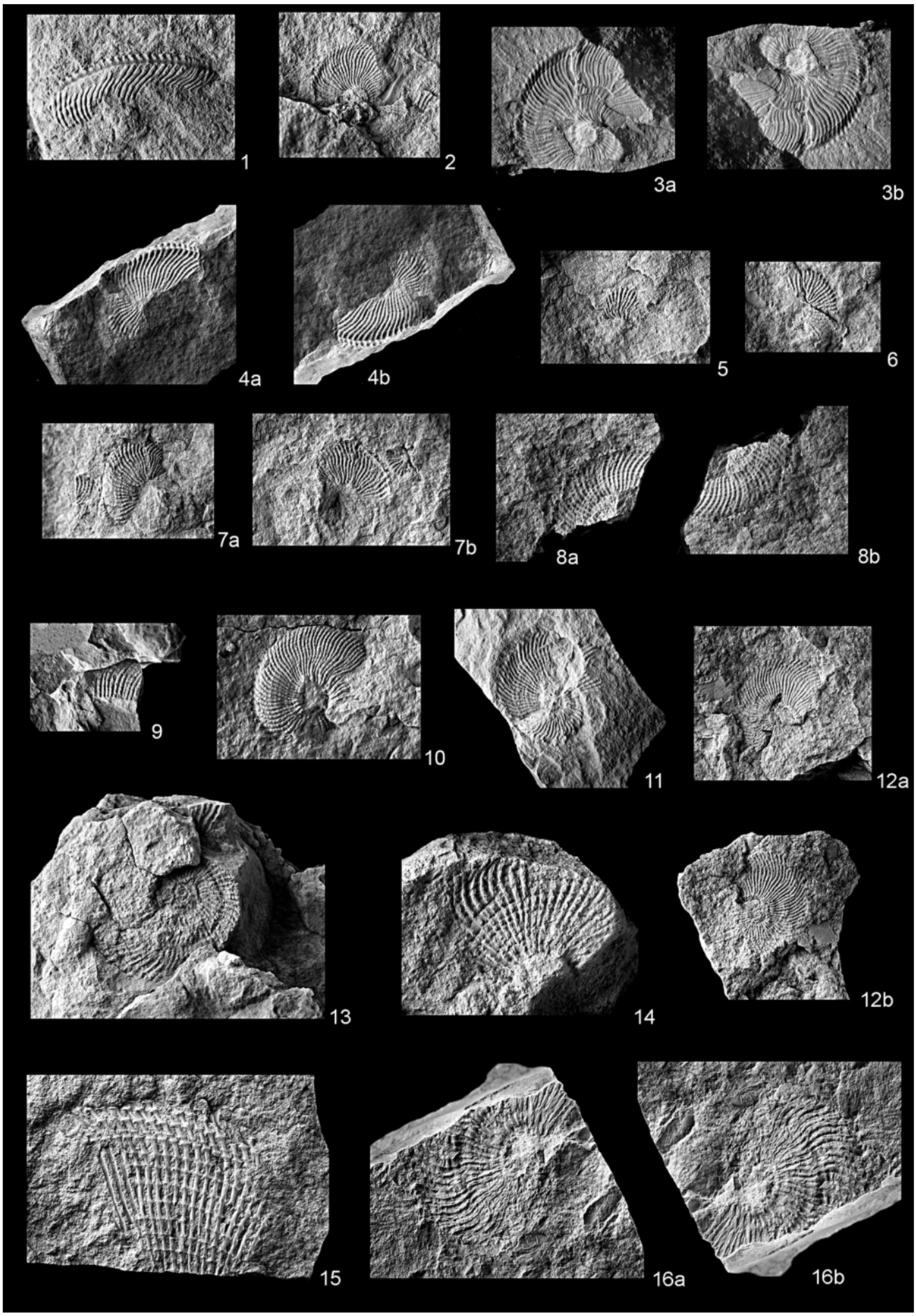
PLATE 8

Figs. 1, 3 - *Trachyceras bipunctatum* (Münster, 1834): 1) sample ASA 1.18a, Antersass section, *aon* Subzone, internal composite mould, ventrolateral view; 3) sample ROC 2.6, Le Rocchette, external composite mould, 3a. lateral view, 3b. 180° turned print of 3a.

Figs. 2, 4-16 - *Trachyceras muensteri* (Wissmann in Wissmann & Münster, 1841): 2) sample ASA 1.18b, Antersass section, *aon* Subzone, external composite mould, lateral view; 4) sample SKB 1.4, Piz d'la Varella section, *canadensis* Subzone, lateral view, 4a. external composite mould, 4b. 180° turned print of 4a; 5) sample ASA 17B.2a, Antersass section, *canadensis* Subzone, external composite mould, lateral view; 6) sample PCL 2.11, Bec de Roces section, internal composite mould, lateral view; 7) sample PCL 2.10(a-b), Bec de Roces section, *canadensis* Subzone, lateral view, 7a. (a), internal composite mould, 7b. (b), external composite mould; 8) sample PCL 124.5, Bec de Roces section, *canadensis* Subzone, lateral view, 8a. external composite mould, 8b. 180° turned print of 8a; 9) sample PSR 10.15, Prati di Stuores/Stuores Wiesen section, *canadensis* Subzone, internal composite mould, lateral view; 10) sample PSR 3.dt1, Prati di Stuores/Stuores Wiesen section, *canadensis* Subzone, internal composite mould with suture line, lateral view*; 11) sample PCM dt.1, Crep de Mont section, *canadensis* Subzone, composite mould, lateral view; 12) sample PCL 11.12(a-b), Bec de Roces section, *canadensis* Subzone, lateral view, 12a. (a), internal composite mould, 12b. (b), external composite mould; 13) sample PSR 3.33a, Prati di Stuores/ Stuores Wiesen section, *canadensis* Subzone, internal composite mould, lateral view; 14) sample PCL dt.31, Bec de Roces section, external composite mould, lateral view; 15) sample ASA 17C.1b, Antersass section, *canadensis* Subzone, internal composite mould, lateral view; 16) sample ASA 1.26, Antersass section, *aon* Subzone, lateral view with traces of suture lines, 16a. external composite mould, 16b. 180° turned print of 16a.

All specimens are illustrated in natural size.

* This specimen was erroneously reported as natural size in Mietto & Manfrin (1995a, 1995b) and Broglio Loriga et al. (1998a).


1
2
3a
3b
4a
4b
5
6
7a
7b
8a
8b
9
10
11
12a
12b
13
14
15
16a
16b

Trachyceras muensteri (Wissmann in Wissmann & Münster, 1841)

Fig. 9g; Pl. 8, figs 2, 4-16

*1841 *Ceratites Münsteri*. Wissmann. Wissmann in Wissmann & Münster, pp. 133-134, pl. 15, fig. 21.

1843 *Ammonites noduloso-costatus*. Klipstein, pp. 123-124, pl. 7, fig. 5; pl. 9, fig. (2 sic!) 3.

1843 *Ceratites Zeuschneri.* Klipstein, pp. 131-132, pl. 8, fig. 2.

? 1843 *Goniatites ornatus*. Klipstein, p. 138-139, pl. 8, fig. 12.

v pars 1869 *Trachyceras Aon* Münster - Laube, pp. 65-68, pl. 38, figs. 3, 5 non figs. 1, 2, 4, non figs. 6, 7 [= *Brotheotrachyceras difforme* (Münster)] (vidimus figs. 3, 6, 7).

v non 1869 *Trachyceras Münsteri* Wissmann sp. - Laube, pp. 72-73, pl. 39,? fig. 2d, non figs. 2a-c [= *Trachyceras aon* (Münster)], (vidimus 2b-d).

v 1869 *Trachyceras Candaules* Laube. Laube, pp. 76-77, pl. 41, fig. 1.

v pars 1882 *Trachyceras Aon* (Graf Münster) Laube - Mojsisovics, pp. 129-131, pl. 21, figs. 30-35,? fig. 38, non figs. 19, 22-24, 26; non figs. 1-11, 25, 28-29 [= *Brotheotrachyceras brotheus* (Münster)]; non figs. 12-18, 21 [= *Brotheotrachyceras difforme* (Münster)], non fig. 37 [= *Trachyceras bipunctatum* (Münster)], non fig. 20 (= *Trachyceras* sp.). (non vidimus figs. 2, 13, 15, 17, 19-20, 26, 30, 37).

v 1882 *Trachyceras Candaules* Laube - Mojsisovics, p. 136, pl. 23, fig. 12.

v 1882 *Trachyceras Zeuschneri* (v. Klipstein) E. v. M. - Mojsisovics, p. 123, pl. 24, fig. 18.

1910 *Trachyceras Aon* - Fraas, pl. 46, fig. 4.

? 1913 *Trachyceras dobrogiacum* n. f. Simionescu, pp. 296, 352-353, pl. 3, fig. 10.

1956 *Trachyceras aon* (Graf Münster) - Zia, pp. 3-5, fig. 1.

1966 *Trachyceras* cfr. *medusae* Mojsisovics, 1889 - Creutzburg et al., pp. 186-188, fig. 2.

1974 *Trachyceras muensteri* (Wissmann) - Urlichs, pl. 1, figs. 6-8.

1978 *Trachyceras (Trachyceras) aon* (Münster, 1834) - Krystyn, pl. 1, fig. 1.

1994 *Trachyceras (Trachyceras) muensteri* (Wissmann) - Urlichs, pp. 23-25, fig. 5g-h, pl. 2, figs. 11-15.

v 1995a *Trachyceras muensteri* (Wissmann, 1841) - Mietto & Manfrin, pl. 5, fig. 5.

v 1995b *Trachyceras muensteri* (Wissmann, 1841) - Mietto & Manfrin, pl. 2, figs. 16, 17.

v 1998a *Daxatina* cf. *canadensis* (Whiteaves, 1889) - Broglio Loriga et al., pl. 2, fig. 16 (type error).

v 1998a *Trachyceras muensteri* (Wissmann, 1841) - Broglio Loriga et al., pl. 2, fig. 17.

? 1999 *Trachyceras muensteri* (Wissmann, 1841) - Baracca & Bizzarini, pp. 202, 205, pl. 1, figs. 3a, 3b.

v 1999 *Trachyceras muensteri* (Wissmann) - Broglio Loriga et al., pl. 2, figs. 2-5.

Material. (34 specimens) *Le Rocchette* (San Vito di Cadore): ROC-PL.4 (MGPD 30638) -.5 (MGPD 30639) -.6 (MGPD 30640) -.7 (MGPD 30641), 2.5 (MGPD 30761); *Bec de Roces section* (Livinallongo del Col di Lana): PCL 2.10a,b (MGPD 30256a,b) -.10c (MGPD 30256c) -.11 (MGPD 30258), 11.13 (MGPD 30289), 18.10 (MGPD 30710), 106.1 (MGPD 30350), 122.2 (MGPD 30440), 124.5 (MGPD 30453), 125.15 (MGPD 30493), dt.31 (MGPD 30600); *Crep de Mont section* (Corvara in Badia/Kurfar): PCM 2.1 (MGPD 30623), dt.1 (MGPD 30624); *Pralongià* (Badia/Abtei) SW p.4.1 (MGPD 30770), URL 12.1 (MGPD 30626); *Prati di Stuores/Stuores Wiesen section* (Livinallongo del Col di Lana): PSR 2.5c (MGPD 30162c), 3.33 (MGPD 29463) -.dt1 (MGPD 30173), 5.1 (MGPD 30209), 10.15 (MGPD 29469), SW 10.4 (MGPD 30244); *Piz d'la Varella section* (Badia/Abtei): SKB 1.4 (MGPD 30521); *Antersass section* (S. Martino in Badia/St. Martin in Thurn): ASA 1.18b (MGPD 30101b) -.26 (MGPD 30102), 17B.2 (MGPD 30108), 17C.1 (MGPD 30112), 19.2b (MGPD 30114b), 19bis.2 (MGPD 30122); *Regola di Brenta/Brenteriegel* (Braies/Prags): PG 01.76a (MGPD 30741); *Monte Riva/Astspitz* (Braies/Prags): BRA dt.1 (MGPD 30742).

Description. The material at our disposal includes several ammonoids with more or less complete flanks, often fairly well preserved. The ornamentation is characterized by numerous, serried, sigmoid, generally biconcave ribs in early-intermediate growth stages, less sigmoid later on, but always moderately projected in the outer third of the flank. The ribs are homogeneous in shape, fairly marked, superficially rounded, moderately wider than the interspaces. They bear numerous rows of pointed nodes generally in equidistant position and of uniform strenght. In large specimens, some rows of nodes are spirally elongated. The branching point mostly occurs in the inner third of the flank but infrequent bifurcations in higher position may be present. In specimen PSR 3.dt1, at a whorl height of ca 1.2 cm, at least twelve rows of nodes occur along the flank. In sample SKB 1.4 a portion of the external area is visible (Pl. 8, fig. 4). As usual for the representatives of *Trachyceras*, the typical raised double nodes structure borders the ventral furrow. In this couple, the nodes in distal position with respect to the ventral midline are stronger and more elevated.

As stated in Broglio Loriga et al. (1999), the suture line is partly visible in specimen PSR 3.dt1. The second lateral saddle is roughly subrectangular in shape, elongated and frilled, associated by a wide, deeply indented first lateral lobe (Fig. 9g). The quoted suture line in slightly weathered. Traces of suture are recognizabled also in the specimen ASA 1.26 (Pl. 8, fig. 16) from the *aon* Subzone of the Antersass section.

Comparison and discussion. In agreement with Urlichs (1994: p. 14), *Trachyceras muensteri* could be mistaken for *T. aon*. Nevertheless, the latter is characterized, from juvenile/intermediate growth stages, by broader ribs, about twice as wide as the interspaces, or even more when the test is preserved. The ribs of *T. aon* are coarsely rectilinear, proverse at first then slightly sigmoid and strongly projected already from the upper part of the flank. Afterwards, the ribs become more or less flattened in shape, and bear a less number of rows of tubercles (2-3) at the same diameter than *T. muensteri*. The tubercles, rounded and less wide than ribs during growth, become spirally elongated in the outer part of the flank. *T. muensteri* can also be distinguished from *T. aon* because of its less indented subammonitic suture line.

Occurrence and Age. Outside the Southern Alps domain, *Trachyceras muensteri* is also documented in Sicily (Zia 1956) and in Kreta Island (Creutzburg et al., 1966). It encompasses the interval between the lower

part of the *canadensis* Subzone to the top of the following *aon* Subzone.

Bio- Chronostratigraphy and Conclusions

As already shown in Mietto & Manfrin (1995b) and Broglio Loriga et al. (1998b, 1999), three ammonoid biozones are documented in the Prati di Stuores/Stuores Wiesen section, namely, *regoledanus*, *canadensis* and *aon* subzones. The upper part of the section described by Urlichs (1974, 1994), which marginally overlaps with the Global Stratotype boundary Section, encompasses the *aon* and *aonoides* subzones and is not considered in this study. The Bec de Roces section is fully within the *canadensis* Subzone, while at Antersass the boundary between the *canadensis* and *aon* subzones is well documented.

The *regoledanus* Subzone is documented at Prati di Stuores/Stuores Wiesen, from meters -20 to 45, where meter 0 corresponds to the lithostratigraphic boundary between the Wengen and San Cassiano formations (cf. Broglio Loriga et al. 1999: fig. 13). The faunal association is relatively poor (Tab. 1), but includes significant elements as fragments of probable *Protrachyceras* and *Zestoceras* cf. *enode*, which are not present in the overlying *canadensis* Subzone. *Z.* cf. *enode* is well comparable with the canadian taxon illustrated by Tozer (1994: pl. 82, fig. 2), and found in other sections of the Dolomites (Sass Ciampac, Val Giaule), always associated with faunas of clear Late Ladinian affinity. In the upper *regoledanus* Subzone, the subzonal marker is not present at Prati di Stuores/Stuores Wiesen, where is replaced by *Frankites apertus*.

The *canadensis* Subzone is well documented at Prati di Stuores/Stuores Wiesen, within the San Cassiano Formation (Unteren Cassianer Schichten and lowermost part of the Oberen Cassianer Schichten of Urlichs 1974), from meters 45 to 194.30. This subzone is also recognizable at Bec de Roces and Antersass, as well as at Crep de Mont, Passo Campolongo, Pallua (Arabba), Locomotiva section at Passo Sella, Col de Frea and Passo Gardena sections, Kerpatscha, Col da Oi, Rio Cuzze at Borca di Cadore, and Pista Nera near Sappada. These sections and/or localities provide a rather complete picture of the biozone throughout the Dolomites. Prati di Stuores/Stuores Wiesen is, however, the most significant section for the continuous occurrence and abundance of ammonoids.

There, the base of the biozone is marked by the first appearance of genus *Daxatina*, in bed SW4, m 45 from the base of the San Cassiano Formation. The first species to appears, *D. canadensis*, is characterized by coarse ornamentation. *D.* cf. *laubei*, a species with fine ornamentation, is present from meter 61.50. This taxon was previously ascribed to *Trachyceras bipunctatum* (Mietto & Manfrin 1995b; Broglio Loriga et al. 1998b, 1999; Mietto et al. 2007b).

The genus *Trachyceras* occurs from meter 78.80 with *T. muensteri*. *T. bipunctatum* appears in the upper part of the biozone, as documented at Antersass and, doubtfully, at Bec de Roces.

Zestoceras lorigae sp. n. first occurs at Prati di Stuores/Stuores Wiesen at meter 52.40, i.e., less than 10 m above the base of the biozone, followed at meter 78.80 by the first occurrence of *Zestoceras barwicki*. The latter is also documented in Nevada and British Columbia, while the former, at present, only in Canada.

Frankites apertus already occurs in the upper *regoledanus* Subzone, and is still present in the lower *canadensis* Subzone, at least. The north-American species *F. sutherlandi* is considered a junior synonym of *F. apertus*. Another taxon, *Frankites* sp. A, occurs at meter 71.00 in the Prati di Stuores/Stuores Wiesen section. This taxon is also present in the lower *regoledanus* Subzone, as documented in the Val Giaule 2 section; it is also present in Nevada and British Columbia. As recently stated (Mietto et al. 2007b), the faunal assemblage of the *canadensis* Subzone is easily correlatable with that of the north-American *sutherlandi* Subzone 2 (Tozer 1994). It must be pointed out the that base of the two subzones is not isochronous because the latter is sensibly older (Broglio et al. 1999: p. 46). Recent works (Balini & Jenks 2007; Balini et al. 2007; Balini 2008) on the South Canyon (New Pass Range) succession of Nevada, where the superposition of *sutherlandi* and *desatoyense* subzones is documented, suggest that a revision of this north-American biostratigraphic interval is needed. The first occurrences of trachyceratids at Stuores are however in perfect homotaxis with Nevada, and most of the key taxa from Stuores are also present in North America.

The FAD of *Daxatina canadensis* is adopted as primary marker for the definition of the Carnian GSSP. This bioevent has a great correlation potential at the global scale across diverse climate zones and palaeogeographic domains. Besides North America, in fact, *Daxatina* is present in the Himalayas (Balini et al. 1998, 2001; Krystyn et al. 2004) and in the Boreal Domain (Weitschat & Dagys 1989; Mørk et al. 1989; Dagys & Weitschat 1993; Dagys et al. 1993; Mørk 1994). *Daxatina* is associated with *Trachyceras* at Prati di Stuores/Stuores Wiesen as well as in other localities of the Southern Alps, in Nevada and, most probably, in British Columbia and Himalayas. Hence, using the FAD of *Daxatina* as primary marker for the base of the Carnian, permits to maintain the historical meaning of the quoted Stage in the type area, as stated by Mojsisovics (1869) and Mojsisovics et al. (1895), as already anticipated in Mietto & Manfrin (1995b, 1999), Gaetani (1995), Bro-

glio Loriga et al. (1998b, 1999) and Mietto et al. (2007a, 2007b).

The choice of the FAD of *Daxatina* as primary marker for the base of the Carnian Stage and consequently the Prati di Stuores/Stuores Wiesen section as Global Stratotype boundary Section and the bed SW4, in which *D. canadensis* appears, as Point for the base of the Carnian guaranties a global correlation among several domains. This correlation potential is also confirmed by other taxonomic groups (e.g. the practically coeval appearance of the conodont species *Paragondolella polygnathiformis noah*) as well as by physical signals (Mietto et al. 2007a, 2007b).

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