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UPPER ANISIAN TO LADINIAN AMMONOIDS FROM RASA (SAN SALVATORE DOLOMITE, WESTERN SOUTHERN ALPS, ITALY)

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Key words: Rasa dolostone; Carbonate platforms; Middle Triassic; chronostratigraphy; Secedensis Zone; Systematic Paleontology.

Abstract. A rich ammonoid collection of 394 specimens from Rasa dolostone, a highly fossiliferous facies of the San Salvatore Dolomite, has been studied. The ammonoids were collected from 17 outcrops in the Rasa Valley (western Lombardy, Varese), a fossil locality known since the 19th century that was never studied in detail. Fifteen genera, 21 species and eight taxa in open nomenclature are described. *Flexoptychites*, *Ticinites*, *Aplococeras*, *Serpianites*, *Parakellnerites*, *Stoppaniceras*, *Nevadites*, *Chieseiceras*, *Hungarites*, *Eoprotrachyceras*, *Protrachyceras, Pompeckjites*, and *Proarcestes* are already known, while *Ceresioceltites* and *Rasaites* are new. *Ceresioceltites* n. gen. includes small celtitids reported in literature from several Middle Triassic carbonate platforms of Southern Alps. *Ceresioceltites fumagallii* (Stabile in Stoppani, 1860, type), and *C. paronai* (Airaghi, 1912) are revised. The new and somewhat enigmatic genus *Rasaites*, that is assigned with doubt to the family Hungaritidae, is monotypic and based on *R. rasaensis* n. gen. n. sp. The last new species described is *Flexoptychites gottardoi*.

The ammonoid faunas recognized in the 17 outcrops of Rasa dolostone succession document the Reitzi and Secedensis zones of the uppermost Anisian, as well as the Curioni and Gredleri zones of the lower Ladinian. The most fossiliferous interval is the Secedensis Zone. The occurrence of the Archelaus Zone within the stratigraphic succession cannot be confidently established, as a single specimen in open nomenclature may derive from this interval.

The ammonoid succession of the Rasa dolostone is taxonomically and chronostratigraphically equivalent to the ammonoid succession of the Besano Formation described by Rieber in 1973 from Punkt 902/Mirigioli section (Monte San Giorgio, Switzerland), a locality that is about 15 km from Rasa. The specimens from Rasa, however, are preserved as body chambers and phragmocones filled by sediment, resulting in the preservation of suture lines and of the inner whorls. Therefore the Rasa ammonoids improve the systematics of the taxa from Punkt 902/Mirigioli, that was based on description of molds of body chamber, and cast of empty phragmocones.

The ammonoid faunal similarity of Rasa dolostone with Besano Formation is surprising because the two successions were deposited in the same intraplatform basin (Besano basin, equivalent to the Grenzbitumenzone basin of Swiss authors), but in two very different settings: Rasa dolostone was deposited on the margin of the carbonate platform bounding the Besano basin, in shallow well oxygenated waters, while the Besano Formation was deposited on a deeper anoxic sea bottom.

The fauna of the Secedensis Zone from the platform margin of Rasa has been compared with the faunas of the same interval from the outer platform of Esino Limestone of Parina Valley (central Lombardy), and with the platform interior of Latemar (western Dolomites). Taking into account the very short duration of the Secedensis Zone, on the order of 350 kyr, this comparison demonstrate that ammonoids during the late Anisian were significant components of the carbonate platform ecosystems, with great adaptability to environments that are not usually considered as ideal for the group.

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Introduction

Since the 19th century the Middle Triassic sedimentary successions from Southern Alps (Italy) have provided ammonoid faunas crucial for the definition of ammonoid systematics and bio-chronostratigraphy of the Anisian and Ladinian stages (e.g., Mojsisovics 1882; Mojsisovics et al. 1895). The ammonoid record of this time interval in the Southern Alps is, still in the 21st century, one of the most important in the world, as documented by the definition of the GSSP of the Ladinian stage at Bagolino based on ammonoids (Brescia; Brack et al. 2005). In the past 60 years, several localities from Southern Alps have been studied with a more precise approach with respect to the one used in the 19th century, and some other new sites have been discovered. In this paper we describe the rich ammonoid record documented in the Middle Triassic shallow water Rasa dolostone at "Rasa di Varese", a fossil-bearing locality in western Lombardy, few kilometers SW from UNESCO World Heritage site Monte San Giorgio, selected by UNESCO for its fossil record of marine life during the Middle Triassic. This locality was discovered in the 19th century but it has never been studied in detail until 1998, when one of us (VP) started sampling all the available outcrops in "Rasa di Varese" (sometime reported in literature as "La Rasa", from here onward Rasa) area (Fig. 1). These outcrops have provided rich collections of ammonoids, gastropods (Pieroni 2025) and bivalves, with less abundant crinoids, echinoids (Jaselli & Pieroni 2023), brachiopods, dasycladacean algae (Zanin Buri 1965) and nautiloids (Pieroni & Prinoth 2021). The occurrence of gastropods and bivalves within shallow water carbonate platform facies such as Rasa dolostone is not surprising, while that of ammonoids is unusual. These ammonoids might provide support for the age calibration of the Rasa dolostone and of the other fossil groups recorded within this unit. Moreover, the ammonoid faunal composition is interesting for understanding the connections of the Rasa paleoenvironment with the nearby basins such as those of the Besano Formation and of the Buchenstein Formation (Rieber 1973a; Brack & Rieber 1986, 1993), as well as to compare the faunas from Rasa dolostone with those from the carbonate platforms east to the study area, such as the Esino Limestone of Grigne and Parina Valley in central Lombardy (Rossi Ronchetti 1960; Jadoul et al. 1992; Fantini Sestini 1994, 1996) and the Latemar platform in the western Dolomites (Manfrin et al. 2005; Brack & Rieber 2019).

A general description of the Triassic faunas collected from the Rasa Valley was published by Pieroni (2011). The reptiles have been described by Renesto & Pieroni (2013) and Bindellini & Dal Sasso (2022). Pieroni & Nützel (2014) have described a new genus and species of gastropod *Rasatomaria gentilii*, and Pieroni & Prinoth (2021) have described the new species of nautilid *Mojsvaroceras gianii*.

History of the locality

The first fossil ever found from Rasa was a badly preserved imprint of an ammonoid collected by Torquato Taramelli, cited by Mojsisovics (1880) in his discussion on the Triassic of Lombardy. This specimen was later included by Mojsisovics (1882, p. 38) in the type series of the new species *Ceratites brembanus*, without any information on the repository of this specimen, that was not figured. Therefore it is impossible to retrieve this specimen.

The first paper on the fossils from La Rasa was written by Tommasi (1886), who described *Pleuronautilus distinctus* Mojsisovics, 1882, three new species of gastropods (see Pieroni 2025), two new species of bivalves, and two taxa of bivalves and three of gastropods in open nomenclature. The provenance of the collection was uncertain and the repository was reported by Tommasi to be in the "Museo Patrio di Varese", an insitution that does not exist anymore. Five specimens from this collection have been recently found by one of us (VP) in the Museo Kosmos, Pavia (see Pieroni & Guaschi 2018). This small collection consists of one specimen of *Pleuronautilus distinctus* Mojsisovics, 1882, and four type specimens of the new taxa *Scurria cingulata*, *Straparollus varesinus* (not cited in Pieroni & Guaschi 2018), *Straparollus lottianus*, and *Pecten* (?) *rasae*. *Straparollus varesinus* and *S. lottianus* were described as gastropods, but actually they are poorly preserved ammonoids (the former could be the external mold of *Ticinites ticinensis* Rieber, 1973 see Systematic descriptions).

After Tommasi, for some tens of years not so much work was done in the area. Mariani (1904) cited the occurrence of *Ceratites brembanus* together

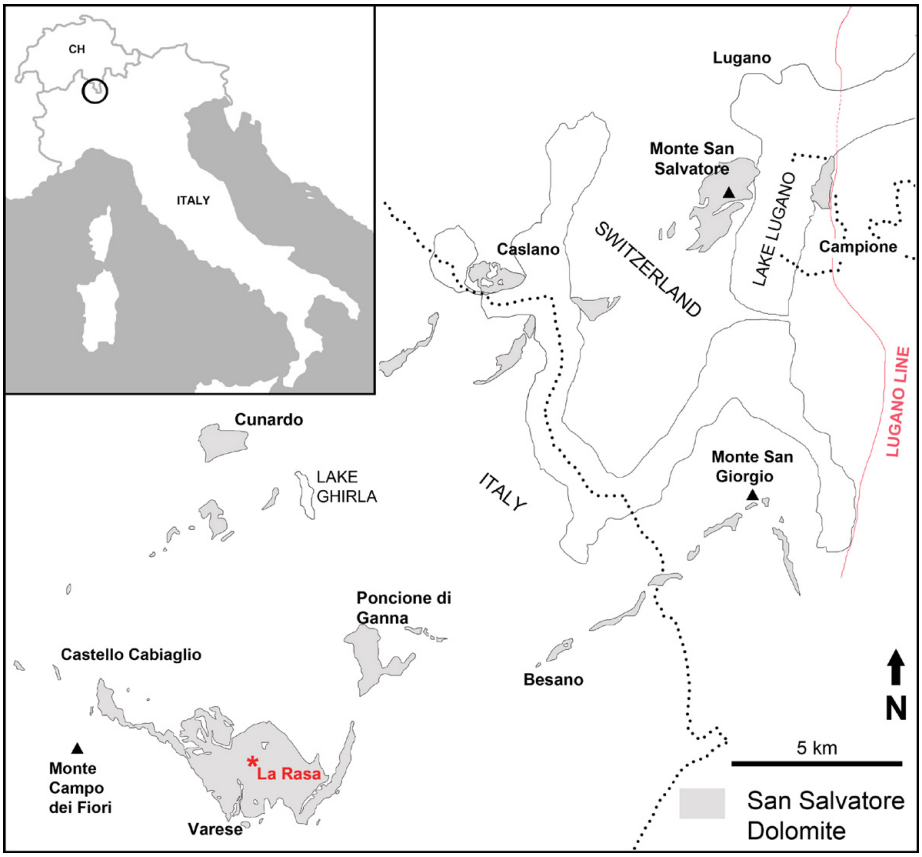

Fig. 1 - Location map of " Rasa di Varese", N of Varese (western Southern Alps), and distribution of the Middle Triassic San Salvatore Dolomite.

with *Pleuronautilus distinctus* from Rasa, however, he did not describe or figure his specimens. The second description of fossils from Rasa was published by Airaghi (1935), who described, without any illustrations, nine species of molluscs collected near to the "Villa Cagnola" (probably near SEZ. G of the present paper) and "Cava Lambertoni" (= Cava del Sasso Bianco = Cava Donati = SEZ. C). Only one species out of nine belongs to Ammonoidea, namely *Ceratites felsö-örsensis* Stürzenbaum, 1876. Airaghi collection was deposited in the Museo Civico di Storia Naturale of Milano, but was lost in August 1943 during the World War II, when the museum was destroyed by an aerial bombing. Almost all the collections stored in the Museum were lost (pers. comm. Giorgio Teruzzi, May, 2015), not only Rasa collection, but also the very important historical Middle Triassic vertebrate and invertebrate collections from Besano Formation [=Grenzbitumenzone of Swiss authors; Grenzbitumenzone is now recognized as junior synonym of Besano Formation (e.g. Bernoulli et al. 2018), therefore, from here onward we will use Besano Formation in place of Grenzbitumenzone, except when we report specific citations of Swiss authors], few km NE of Rasa. This dramatic loss of paleontologic heritage collections is in part compensated by the recent discovery in the Museo Kosmos, Pavia (Pieroni 2023) of some casts of ammonoids described by Airaghi (1912) from Besano Formation.

The new material from Rasa collected by VP together with the one previously described by Pieroni (2011) count for about 1,200 specimens and is by far the largest fossil collection ever made from Rasa.

Geographical, geological and stratigraphic setting

"Rasa di Varese" (Fig. 1, 2a-b, 3a-c) is a small village located in Rasa Valley, incised by Olona River, just north of Varese and east of Mt. Campo dei Fiori. The village consists of some small groups of houses and buildings scattered on the left- and right-hand sides of the Rasa Valley. The average elevation is from 500 to 600 m. a.s.l., the vegetation is rich and the morphology of the slopes of the valley is rather gentle. The combination of these conditions results in a poor exposure of Rasa dolostone, that is exposed in small and scattered outcrops, often located near to buildings or in road cuts. The poor exposure might be the reason why the geology and stratigraphy of Rasa Valley have never been studied in detail.

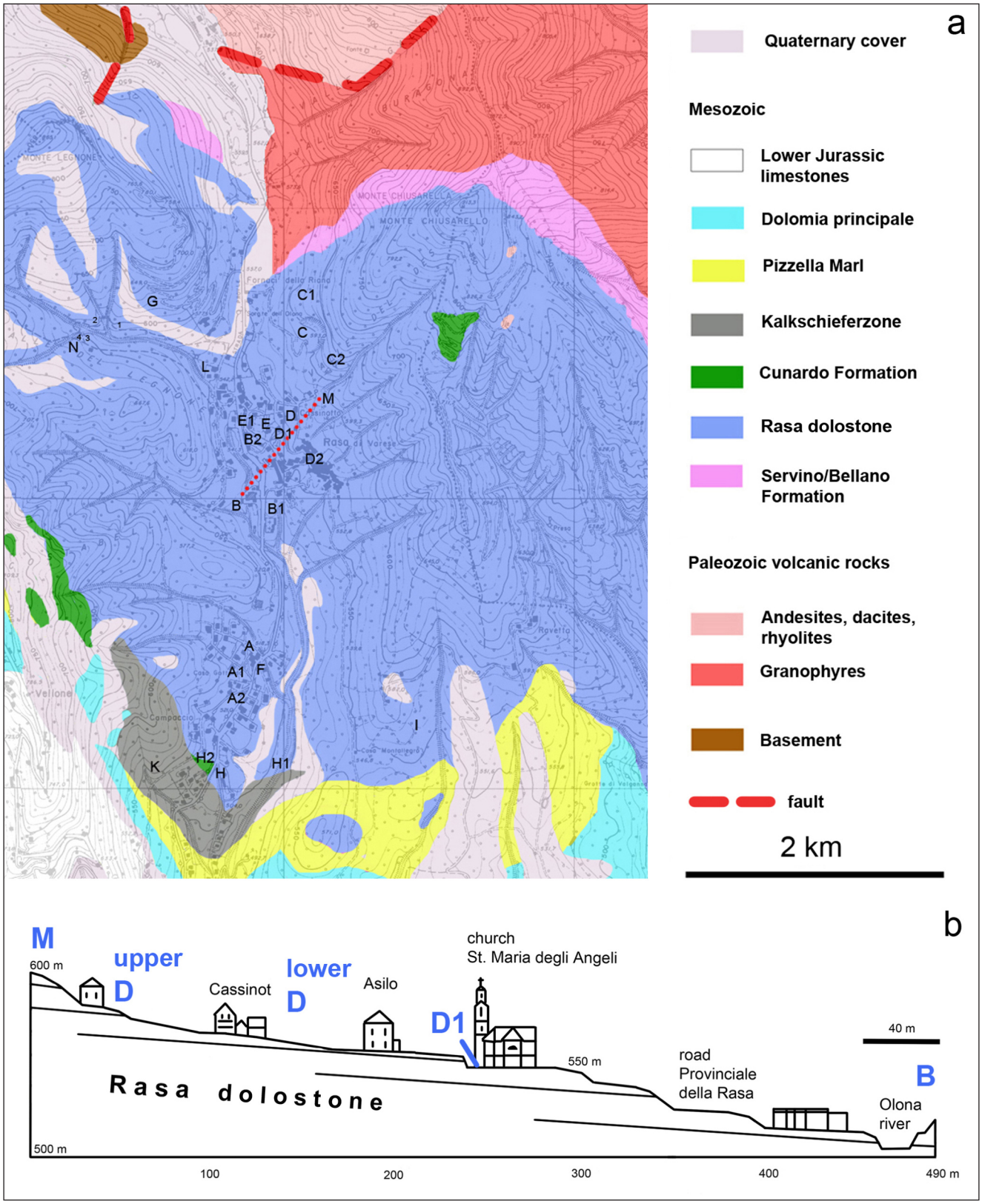

Fig. 2 – Geological setting of the study area. A: Simplified geological sketch map of Rasa Valley (modified from De Sitter 1939) with the geographic position of the fossiliferous localities; b: Simplified north-south oriented geological cross sections in the middle part of the study area, from SEZ. B to SEZ. M. The trace of the section is marked by a red dotted line in 2a.

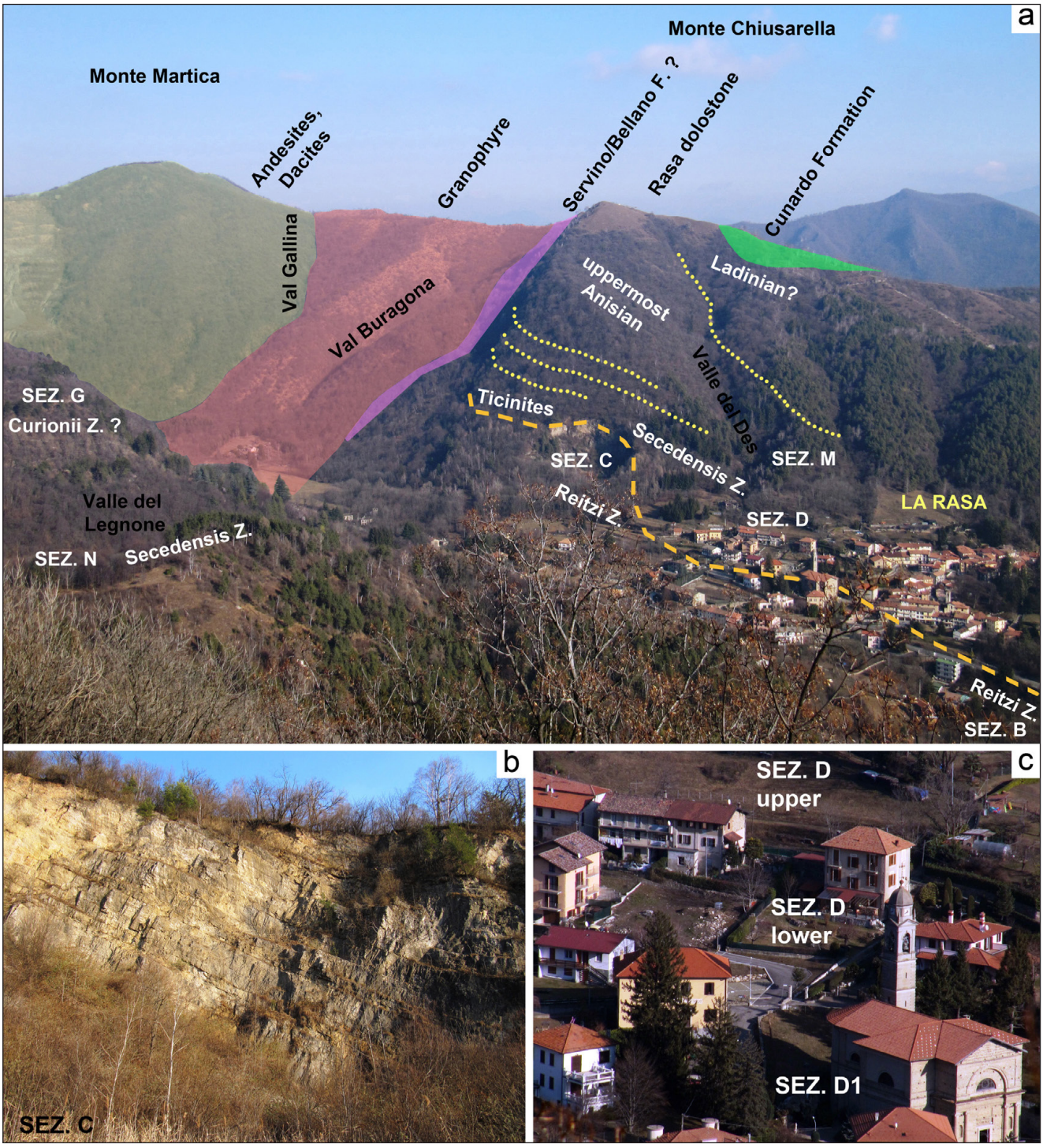

Fig. 3 - General views of the study area. A: outline of lithostratigraphy and position of the main ammonoid localities and corresponding chronozones. Dotted lines for the bedding, dashed line for the *Ticinites* level, lowermost part of the Secedensis Zone (see chapter "Chronostratigraphy of Rasa dolostone"); b: The Ex Donati Quarry (SEZ. C) with massive dolostones of Rasa dolostone; c: The central part of Rasa village corresponding to the middle of the geological cross section (see Fig. 2).

The first descriptions of the geology of the Rasa Valley, supported by geological maps, date back to the 1920s. Senn (1924) included a geological cross sections of Rasa Valley in his geological map of the area between Varese and Mendrisio. Leuzinger (1926) studied the area Campo dei Fiori-Lake Lugano. In regard to the Anisian-Ladinain stratigraphy he assigned the dolomitic succession exposed in Rasa Valley to the San Salvatore Dolomite (Zorn 1971; Bernoulli et al. 2018), and reported the lateral

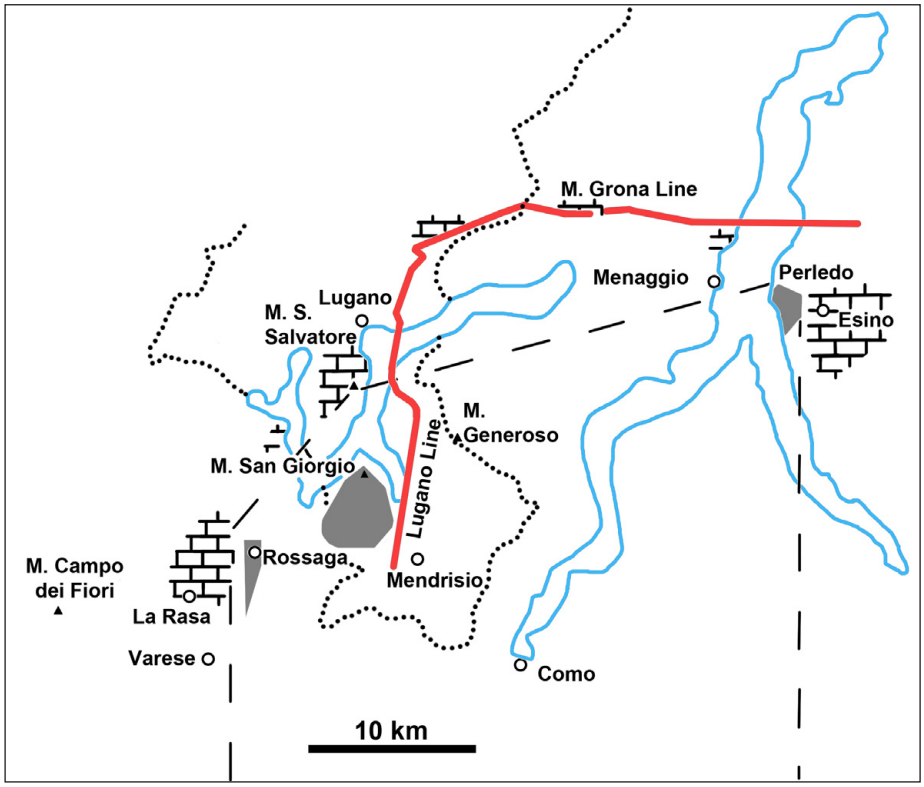

Fig. 4 - The paleogeographic reconstruction of the western Lombardy and Canton Ticino during the late Anisian-early Ladinian. The Besano Formation (grey) was deposited in a basinal setting, bounded to the West and to the North by the carbonate platform of the San Salvatore Dolomite (modified from Bernasconi 1991, fig. 2.4).

desappearance of the Grenzbitumenzone (=Besano Formation), from NE, where the unit is well developed, to SW. A synthetic geological map, integrating the data from Senn (1924) and Leuzinger (1926) was published by De Sitter (1939).

The dolostones outcropping in Rasa Valley were afterwards mapped as "Dolomia infraraibliana" in the sheet "Varese" of the geological map of Italy, 1:100,000 scale, published in the 1930s (Mattirolo et al. 1932), but the area has never been remapped since that time.

The very limited knowledge on the Triassic of Rasa Valley is not due only to difficult local conditions, such as the poor outcrops, but it reflects the poor knowledge on the entire Triassic north of Varese, with respect to the rich literature published since the early 1960s in central Lombardy (Lecco, Bergamo and Brescia areas). The lithostratigraphy of the Upper Triassic in the Campo dei Fiori-Valcuvia-Valganna area was formalized in the late 1960s (Allasinaz 1968b, 1968c, 1968d; Gnaccolini 1968), especially as regard to the Carnian units. Age assignment to the lithostratigraphic units was often based on stratigraphic position than on fossils, and was not very accurate, as demonstrated by Calabrese & Balini (1995), who referred the Cunardo Formation previously regarded as Carnian, to the late Ladinian on the basis of a newly discovered ammonoid fauna. The rhaetian succession was described by Gnaccolini (1968) and it has been revised by Jadoul et al. (2005).

The Middle Triassic successions North of Varese have not been studied with the same accuracy than the Upper Triassic ones, but for these successions there is an important reference area, NE of our study area, between the Mt. Orsa-Prabello (IT) and Mt. San Giorgio-Mt. San Salvatore (CH) (Zorn 1971; Bernasconi 1991; Bernoulli et al. 2018).

Zorn (1971) studied in detail the San Salvatore Dolomite in the Lugano-Campione-Mt. San Salvatore area (Fig. 1). For Zorn this unit documents shallow water carbonate deposition from the late Anisian to the Ladinian and probably early Carnian (see Zorn 1972: tab. 1), coeval with the deeper water sedimentation in the intraplatform basin of Monte San Giorgio documented by the Besano Formation (=Grenzbitumenzone sensu Zorn) and Meride Limestone. The margin of the carbonate platform of the San Salvatore Dolomite, facing to the south the Besano Formation (Fig. 4; Grenzbitumenzone in Zorn 1971), that was located by Zorn (1971; fig. 14) south of Lugano and traced SW to Cuasso al Monte and Pogliana (1971; fig. 1). Bernasconi (1991; fig. 2.4) assigned the carbonatic succession of Rasa to

the San Salvatore Dolomite and extended the margin of the carbonate platform from Cuasso down South to Varese, just east of Rasa. According to this paleogeographic model, Rasa was located along the margin of the carbonate platform to the west, in a very close position to the intraplatform Besano basin (Grenzbitumenzone basin in Bernasconi 1991).

Material and methods

Fossil collection in the study area was done by VP for over 25 years. VP visited all the natural and artificial exposures, with special care on the temporary exposures due to excavations for buildings and roads. Some of these temporary outcrops are not anymore exposed. VP collected fossils from beds, but also from blocks, whitout any selection on fossil group. The resulting collection is stored at Museo di Storia Naturale "Antonio Stoppani", Via Pio XI, 32, Venegono Inferiore (Varese).

Fossil preparation was carried out mechanically with small hammer and sharpened steel needles. Silicon rubber casts (Siligum Gedeo, silicone molding paste) were produced from molds, while fragile shells were hardened with cianoacrylate or varnishes.

The specimens were studied under stereomicroscope and the photographs were taken with a Canon PowerShot SX200 IS camera equipped with Canon Zoom lens 12x IS 50-60 mm.

Classification of ammonoids has been done with comparison with the collection studied by Rieber (1973a) and Brack & Rieber (1986, 1993) housed in the Paläontologisches Institut und Museum der Üniversität, Zurich, with Mojsisovics' collection (1882) deposited at Geologische Bundesanstalt Wien, with specimens collected by Salomon (1895) housed at Naturhistorisches Museum Wien and at Bayerischen Staatssammlung für Paläontologie und Geologie of München, and with some specimens of the Gervasutti Collection (Esino Limestone, Parina Valley) housed in the Museo Civico di Scienze Naturali "Enrico Caffi", Bergamo. An additional collection of casts of specimens from Besano Formation described by Airaghi (1912) and stored in the Museo Kosmos, Pavia has been crucial for the classification of some taxa. This collection was rediscovered by one of us (Pieroni 2023). The original specimens were deposited by Airaghi in the Museo di Storia Naturale di Milano, but was lost when the museum was destroyed during WWII.

Stratigraphy of Rasa Valley

The sedimentary succession exposed in Rasa Valley is south dipping with the older unit outcropping to the north, and the younger unit to the south (Fig. 2a, 3a). On the left side of the Olona River the succession dip with the slope SSW/ 25°, with a lower inclination than on the right side of the valley, where the succession is faulted. The Triassic stratigraphic succession of Rasa Valley spans from the Anisian to the Norian (Fig. 2) and consists of Bellano Formation, San Salvatore Dolomite, Cunardo Formation, Kalkschieferzone, Pizzella Marl, and Dolomia Principale.

The name Rasa dolostone was proposed in literature by Airaghi (1935), for the fossil rich dolostones of Rasa. This name has never been formalized and it is here regarded as a fossiliferous facies of the San Salvatore Dolomite. The overall thickness of the Rasa dolostone is about 300 m at Rasa village, but according to Senn (1924) it might reach about 900 m between the Motta Rossa pass and the Bregazzana village (Varese). The fossiliferous part of the unit is no more than 50 m thick.

Fossiliferous localities

The Rasa dolostone crops out between Campasc (south of Rasa Valley, locality H1 in Fig. 2) and Passo della Motta Rossa (slightly north of locality C1 in Fig. 2a). Due to the gentle slopes and the low elevation most of the Rasa dolostone is actually covered, and the outcrops are very small. This notwithstanding many fossil localities have been found, and the ammonoids are very common, being documented in 17 out of 25 localities. The localities are identified by letters, following the acronym SEZ. (see Pieroni 2011, Jaselli & Pieroni 2023).Very close localities share the letter and are more precisely identified by numbers (e.g., SEZ. B1 and B2).

In some of the localities the fossils have been found directly from beds, but sometimes they were collected from blocks. These blocks are considered almost in place because of the very gentle slope of the side of Rasa Valley.

On the left-hand side of Rasa Valley the bedding with the slope is SSW/ 25°, locally 30° (Fig. 3a-b), thus we have restored the stratigraphic succession of the fossiliferous localities on the basis of their topographic position and elevation a.s.l. (Fig. 2b). There are unexposed beds between several lo-

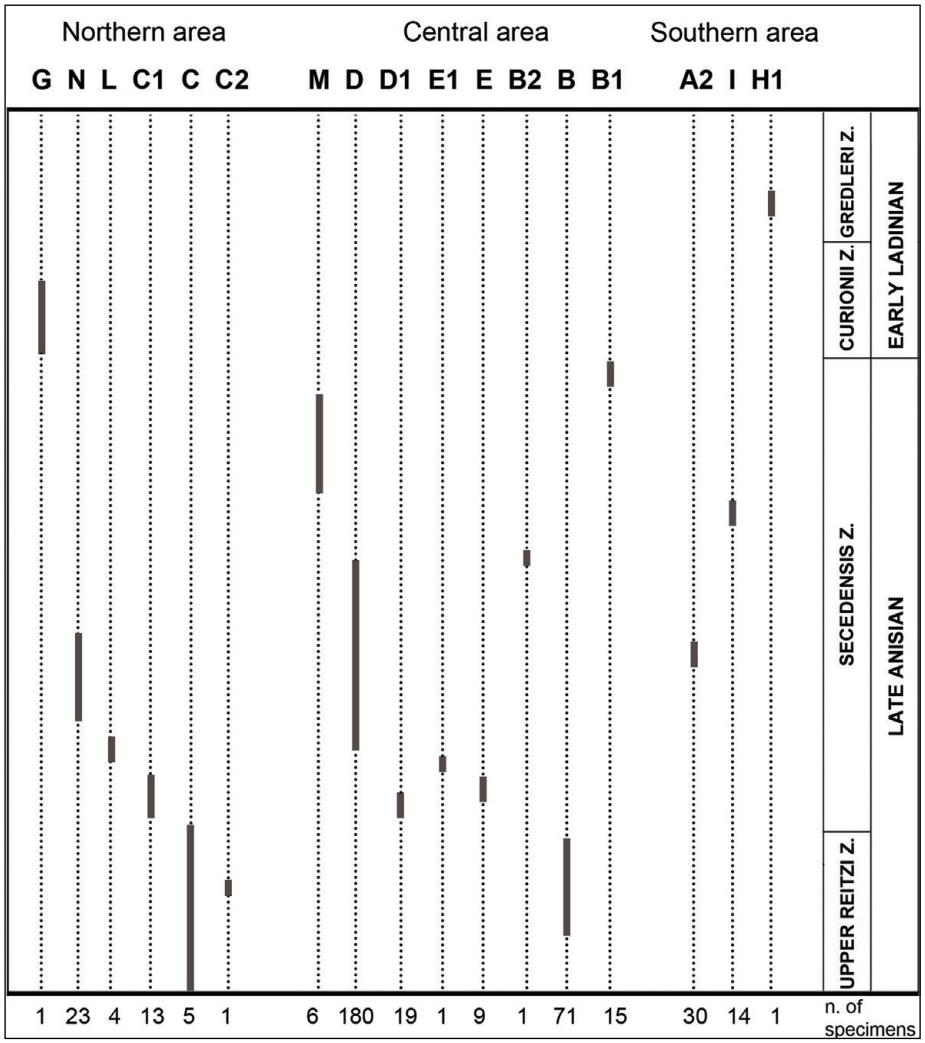

Fig. 5 - Stratigraphic position of the studied outcrops described in this paper (scale is not proportional; geographic position shown in Fig. 2 and 3; letters correspond to SEZ. = section/outcrop). The localities with ammonoids are grouped in three areas. The northern area includes SEZ. C, SEZ. C1, SEZ. C2, SEZ. G, SEZ. L, SEZ. N. The central area, located in La Rasa, consists of SEZ. B, SEZ. B1, SEZ. D (lower and upper), SEZ. D1, SEZ. E, SEZ. E1, SEZ. M. The southern area includes SEZ. A2, SEZ. H1 and SEZ. I. Other outcrops are described in Pieroni (2011). For chronostratigraphy see Figs. 8-10. Chronostratigraphic scale is from Brack & al. (2005). The stratigraphic postion of SEZ. E is here based on ammonoid fauna collected from beds at this site, and not on the specimens from loose blocks. Many years ago an industrial lime kiln was active at SEZ. E, and block of rocks where brought at this site from several nearby quarries.

calities, however three transects have been restored (Fig. 5). The correlations between the three transects are based of the chronostratigraphic assignment of the ammonoid faunas and will be presented in the chapter "Chronostratigraphy of Rasa dolostone".

Most of the localities are in the center of Rasa village, in the middle part of the study area. The stratigraphic succession here consists of SEZ. B (at the confluence of Sesnivi torrent with Olona river: 520 m a.s.l.) that is the lowest locality with ammonoids in Rasa Valley, followed in stratigraphic order, by SEZ. E-E1 (sporting field-oratory), SEZ. D1 (parish church St. Maria degli Angeli), SEZ. D lower (Asilo San Gottardo), SEZ. D upper (Cassinot quarter), SEZ. M (lower part of "Des" valley at 620 m a.s.l.). The outcrop SEZ. B1 (behind the cemetery) is located slightly above the outcrop SEZ. B.

The stratigraphic succession of the six localities identified in the northern part of the study area consists of SEZ. C, SEZ. C1, SEZ. C2, SEZ. L, SEZ. N and SEZ. G, while in the southern part the succession only three localities have been found, with SEZ. A2, and SEZ. I in a close position, and SEZ. H1 in a much higher position. SEZ. H1 is the uppermost outcrop in Rasa Valley, being located near the boundary of the Cunardo Formation with the Kalkschieferzone.

Ammonoid taphonomy and implication for systematics

The majority of the ammonoids (>250 specimens) was collected from SEZ. B and D, a more limited number of specimens was found from SEZ. A2, B1, B2, C, C1, C2, D1, E, E1, G, H1, I, L, M, N (Fig. 5; for a complete description see Pieroni 2011). Overall, the available collection of ammonoids consist of 394 specimens.

Macrofossils occur in local accumulations of displaced shells. Ammonoids might be found in assemblages with benthic fossils, or in associations

composed by juvenile to adult-sized ammonoids [e.g., locality SEZ. C1, dolostone block C 26 with 9 specimens of *Ticinites ticinensis,* one specimen of *Stoppaniceras variabile* Rieber, 1873, and two *S. artinii* (Airaghi, 1912)].

The faunas are strongly similar or even nearly equivalent to those described by Rieber (1973a) from the Besano Formation (=Grenzbitumenzone sensu Rieber) at Monte San Giorgio (see chapter "Correlation with the Besano Formation at Monte San Giorgio"). Besano Formation consists of a monotonous alternation of dolomite and bituminous shale (e.g., Bernasconi 1991; Röhl et al. 2001), that was deposited in an intraplatform basin (see Introduction). The ammonoids from this unit are mostly preserved within the dolomitic beds, but their taphonomic history and preservation differ from that of the ammonoids from Rasa dolostone.

The taphonomic history of the ammonoids fossilized within the dolomitic beds of the Besano Formation (Rieber 1973a) started with burial accompanied by infilling the body chambers without any infilling of the phragmocones, followed first by sediment compaction and cementation, then by dissolution of test and septa. As results, the ammonoids from Besano Formation are preserved as internal molds of body chambers and completely empty external molds of the phragmocones.

The study of ammonoids with such a preservation requires a complex preparation consisting of silicon rubber casting of the empty phragmocones before the extraction of the mold of the body chamber from the rock matrix. If the preparation is carefully done (e.g., Rieber 1973a) the composite specimens (silicon rubber+rock mold) are suitable for accurate systematic descriptions, but with two weak points. Usually these composite specimens do not show any suture line, and the innermost whorls are not well preserved.

The ammonoids from Rasa dolostone are preserved as external molds, with body chamber and at least some chambers of the inner whorls of the phragmocone filled by sediment. Molds and shells are usually covered with fine dolomite crystals. Cathodoluminescence analysis of thin sections (Conti 2017) shows two generations of dolomite cements similar to those described by Bernasconi (1991: 62, fig. 3.22b) from Besano Formation. Despite of this common late diagenetical feature, the early taphonomic history of the Rasa ammonoids differs from that of the ammonoids from Besano Formation because before and/or during burial the phragmocones were at least in part infilled by sediment. Cementation of the sediment inside and outside the specimens led to the formation of internal molds of the phragmocones. As final result, Rasa ammonoids retain suture lines and exhibits 3D-preserved innermost whorls.

Due to the peculiar preservation, the ammonoids from Rasa dolostone provide additional information to improve the definition of the taxa from Besano Formation described by Rieber (1973a).

These new taxa were described on the basis of medium to large sized specimens, with type series large enough to illustrate their individual variability, but without any information on their suture lines. Moreover, most of the ammonoid cross sections very well illustrated by Rieber (1973a) in several figures (e.g. fig. 6, 7, 10, 13, 17) actually exhibit nearly flat innermost whorls, and an unusually slight slope of the umbilical wall of the outher whorls, that is extremely rare or even unknown in the Ceratitoidea from open marine settings.

Since Rieber (1973a) the family group assignment of the genera from Besano Formation, relied only on geometry and ornamentation of the shell, and not on their evolutionary relationships. Specialists never tried to integrate the Besano "endemic" taxa in the same lineages with open marine taxa, thus leaving the subliminal impression that these taxa are not related to open marine taxa.

The specimens from Rasa dolostone conspecific with the taxa from Besano Formation (e.g., *Serpianites curionii* Rieber, 1973, *Parakellnerites frauenfelderi* Rieber, 1973, *P. meriani* Rieber, 1973, *Stoppaniceras grandinodum* Rieber, 1973) exhibit vertical or overhanging umbilical walls thus providing evidence that the slight slope of the umbilical wall of the specimens from Besano Formation is taphonomic, not primary.

Although phylogeny reconstruction are far beyond the scope of this work, we may here emphasize that the revision of the ontogeny of the umbilical wall/umbilical margin makes much easier future phylogenetical comparison of the Ceratitidae from Besano Formation with all the other Ceratitidae. Ammonoid faunas occupying the Besano Formation intraplatform basin do not necessarily represent endemic lineages independent from the lineages developed in open marine environments, but could be much more closely related to open marine faunas.

Ammonoid taxonomy

Fifteen genera, 21 species and eight taxa in open nomenclature have been recognized in the studied collection of 394 ammonoids. The literature on a small part of the taxa we have identified is complex, with doubts or different opinions. We have followed a prudent and conservative approach by revising only the taxa historically defined in the San Salvatore Dolomite and Besano Formation, such as *Ceresioceltites* n. gen. *fumagallii* (Stabile in Stoppani, 1860) and *Ceresioceltites* n. gen. *paronai* (Airaghi, 1912). Taxonomic issues recognized for taxa whose type localities and type units are far from our study area are reported in the Systematic descriptions, but these taxa [e.g. *Parakellnerites waageni* (Mojsisovics, 1882)] have not been revised in this work due to the unavailability of new topotypic, bed-by-bed collections.

The ammonoid collection under study includes both leiostracan and trachyostracan taxa, with all their different taxonomic implications that this informal, but highly practical, ammonoid subdivision implies. Leiostracan ammonoid species and genera, whose taxonomy is mostly based on differential diagnoses, are much less abundant and diversified than trachyostracan. Leiostracan are represented by the *Flexoptychites* Spath, 1951, and *Proarcestes* Mojsisovics, 1893. *Pompeckjites* Mojsisovics, 1902 is regarded as leiostracan, even if there is not so much literature on this rare genus. Within the leiostracan, *F. gottardoi* n. sp. and *Pompeckjites donelioi* n. sp. have been described.

Two new genera, *Ceresioceltites* and *Rasaites,* of trachyostracan have been recognized , while the other trachyostracan are *Ticinites* Rieber, 1973, *Aplococeras* Hyatt, 1900, *Serpianites* Rieber, 1973, *Parakellnerites* Rieber, 1973, *Stoppaniceras* Rieber, 1973, *Nevadites* Smith, 1914, *Chieseiceras* Brack & Rieber, 1986, *Hungarites* Mojsisovics, 1879, *Eoprotrachyceras* Tozer, 1980, and *Protrachyceras* Mojsisovics, 1893. Very few ammonoids have been unclassified mostly due to poor completeness, we here mention only one Danubitidae gen. et sp. indet. (Pl. 2, fig. 7).

The suture lines of 15 taxa out of 29 have been drawn. These are: *Flexoptychites gottardoi* n. sp., *Ceresioceltites* n. gen. *fumagallii*, *Serpianites curionii* Rieber, 1973, *S. serpianensis* (Airaghi, 1912), *S.* cf. *serpianensis*, *S. zinae* (Airaghi, 1912), *S.* cf. *zinae*, *Parakellnerites frauenfelderi* Rieber, 1973, *P. meriani* Rieber, 1973, *P. waageni* (Mojsisovics, 1882), *Stoppaniceras variabile* Rieber, 1973, *S. grandinodum* Rieber, 1973, *Nevadites ambrosionii* (Airaghi, 1912), *Chieseiceras chiesense* (Mojsisovics, 1882), and *Rasaites rasaensis* n. gen. n. sp. The suture line is visible also in one *Ticinites ticinensis*, but it is not well preserved.

It is worth mentioning that the suture lines of *Serpianites* and *N. ambrosionii* were previously unknown, and that the suture lines of *Parakellnerites*, and *Stoppaniceras* were known only in terms of number of elements and reported as with indented lobes (Rieber 1973a, p. 17, 36). Outside the Besano basin, a single suture line of *Ticinites brescianus* Brack & Rieber, 1993 from Buchenstein Formation of Marcheno (Trompia Valley) and one of *Chieseiceras chiesense* were illustrated from Bagolino (Caffaro Valley, Brescia) (Brack & Rieber 1993, fig. 17a, pl.1, fig. 11).

Systematic descriptions

Family-group taxonomy follows that of Tozer (1994), which updates that published in 1981 (Tozer 1981a). For the organization of families into suborders we have followed Shevyrev (2006).

The nomenclature of the elements of suture lines is the traditional one for the lobes: external (E), lateral (L), umbilical (U), while the saddles are identified on the basis of the position with respect to the shoulder: first lateral saddle (S1), second lateral saddle (S2), umbilical saddle (SU). The suture of the studied ammonoids has usually the following formula: E (usually specularly subdivided by a secondary or "median" ventral saddle V), L, U2, U3, (U4).

Repository of the collection. The studied collection from Rasa is deposited at Museo di Storia Naturale "A. Stoppani" (MSNVI), Seminario Arcivescovile "Pio XI", Via Papa Pio XI, 32, Venegono Inferiore (VA), Italy.

Acronyms. Some specimens from literature are cited with their inventory numbers. PIMUZ: Paläontologisches Institut und Museum der Universität, Zurich; SNSB: Bayerischen Staatssammlung für Paläontologie und Geologie of München; MCSNB: Museo Civico di Scienze Naturali "Enrico Caffi", Bergamo; MSNPV: Museo Kosmos, Pavia.

Numbering of specimens. Each specimen mentioned in the text is identified by acronym of the museum, and the outcrop letter followed the number of the specimen. For example MSNVI M 11 is the eleventh specimen collected at locality SEZ. M. Specimens collected from the same block are labelled with section, number, and a letter specific of the specimen (e.g., C 26a: specimen "a" from SEZ. C1, block C 26).

Dimensions. D= diameter; H= max. whorl height in D; h= min. whorl height in D; U= umbilical width in D; W= whorl width in H. All measurements are in mm. WER = [D : (D – aperture height)]^2.

Order **Ceratitida** Hyatt, 1884
Suborder **Ptychitina** Hyatt & Smith, 1905
Superfamily Ptychitoidea Mojsisovics, 1882
Family Ptychitidae Mojsisovics, 1882
Genus *Flexoptychites* Spath, 1951

Type species: *Ptychites flexuosus* Mojsisovics, 1882

Flexoptychites gottardoi n. sp.

Pl. 1, fig. 1a-1c, 2a-2b,3a-3b, 4

Zoobank ID:urn:lsid:zoobank.org:act:ED3552EC-5AE6-4D1D-A5A3-9A611EDA8D71

Derivatio nominis: from San Gottardo (Saint Gotthard) patron saint of Rasa village.

Diagnosis: *Flexoptychites* with very involute coiling, with umbilicus that is 5 to 8% of diameter, compressed semioval whorl section on the inner whorls, with rounded venter becoming narrow and subacute at large size. Maximum width located at periumbilical margin or close to it.

Locus typicus: SEZ. D, Rasa, located just above the nursery school "San Gottardo".

Stratum typicum: Lower Rasa dolostone, stratigraphically corresponding to the middle San Salvatore Dolomite.

Type series: Holotype MSNVI D 48 and the three paratypes MSNVI C 25, MSNVI B 39 and MSNVI B 79.

Description. The holotype MSNVI D 48 is the largest and best preserved specimen of the type series. It consists of phragmocone and about 250° of body chamber. Two molds of this specimen have been obtained from the rock matrix. The first mold is from the phragmocone, that is preserved in three dimensions (Pl. 1, fig. 1b, 1c). The second mold shows one complete side, most of the venter and a small portion of the opposite side (Pl. 1, fig. 1a). The paratype MSNVI B 39 is a juvenile (Pl. 1, fig. 2a, 2b), partly included in the rock matrix, and is an internal mold covered by replaced test. The second paratype MSNVI C 25 (Pl. 1, fig. 3a, 3b) consists of phragmocone and a small part of the body chamber, but it is preserved only on one side. Most of the description is based on the holotype, but all the type specimens exhibit the very typical small size of the umbilicus. The third paratype MSNVI B 79 is a small juvenile (Pl. 1, fig. 4) partly included in the rock matrix, and is an internal mold covered by replaced test.

The coiling is very involute at all stages of growth. At D = 20.60 the juvenile MSNVI B 79 exhibits U = 8.73% of D, while in the juvenile MSNVI B 39 (D = 43.00) U is 5.8% of D. The umbilicus is still 5.3 % of D in the large-sized holotype MSNVI D 48 (D = 120.00).

The umbilical wall is vertical, even on the body chamber of the holotype. The periumbilical margin is rounded, and the whorl section is semioval with maximum width at the periumbilical margin or near to it. On the last quarter of body chamber of the holotype, starting from about 110 mm of D, the maximum width slightly moves towards the middle part of the flank.

The venter is rounded on the phragmocone and the whorl section is compressed (H/W=2.5 and 1.91) and semioval (Pl. 1, fig. 2a). The venter becomes subacute on the outher whorl of the largest specimen, but the flanks are still slightly convex.

The ornamentation of the phragmocone consists of weak sinuous-falcoid ribs, more sculptured on the external half of the flank. Ribbing becomes more irregular and weaker on the body chamber. Ribbing is evanescent on the juvenile paratype MSNVI B 39.

Suture line is ammonitic, but never well preserved. In MSNVI D 48 and MSNVI C 25 (Pl. 1, fig. 3b) it consists of 7 indented saddles on the flank.

Dimensions (mm)

	D	H	W	U	H/W	U/D
Holotype MSNVI D 48	120.00	61.20	32.00	7.0	1.91	0.053
Paratype MSNVI C 25	54.00	28.40	-	-		
Paratype MSNVI B 39	43.00	25.00	10.0	2.5	2.50	0.058
Paratype MSNVI B 79	20.60	11.40	6.8	1.8	1.67	0.087

Discussion. The genera *Flexoptychites* Spath, 1951 and *Parasturia* Spath 1951 are easy to distinguish by comparing their suture lines, otherwise the differences between the two genera are so small that errors in classification are possible if the specimens are not well preserved (e.g. Urlichs 1978; Urlichs & Kurzweil 1997). The specimens from Rasa do not exhibit a well preserved suture line, but they are assigned to *Flexoptychites* Spath, 1951 on account of their semioval whorl section with rounded venter, that becomes subacute only at large size (Pl. 1, fig. 1b). At large size the flanks of these specimens are still slightly convex, while in *Parasturia* the flanks are almost flat in the vicinity of the venter, in a way that the whorl section looks subtriangular and the general shape of the shell is discoidal. These peculiar characters are well visible in the oral view of the type specimen of *Meekoceras emmrichi* Mojsisovics, 1882, type of the genus (Mojsisovics 1882, pl. 50, fig. 4b, here refigured in

Pl. 1, fig. 5), and in the specimens with suture line illustrated by Vidaković et al. (2023, pl. 8, fig. 2b, 3, 6b, 7b). The small umbilicus (from 5 to 8% of diameter) is common in *Parasturia* Spath, 1951 but some species of *Flexoptychites* Spath, 1951, such as *F. angustoumbilicatus* (Boeckh, 1873) exhibits exactly the same small sized umbilicus.

The species more similar to *F. gottardoi* n. sp. are *Flexoptychites angustoumbilicatus* (Böckh, 1873), *Flexoptychites acutus* (Mojsisovics, 1882) and *Flexoptychites noricus* (Mojsisovics, 1882). Due to the different interpretations of these three species available from literature, we compare *F. gottardoi* n. sp. to the original descriptions and measurements of their type specimens.

F. noricus exibits a thicker whorl section with a wider umbilicus. Following the original description by Mojsisovics (1882, p. 259), H/W is comprised between 1.5-1.64 and U is between 7.69-8.69% of D. A thicker whorl section is shown also by the topotypes illustrated by Manfrin et al. (2005).

F. angustoumbilicatus is similar to *F. gottardoi* n. sp. in the small umbilicus (Böckh 1873, p. 161: U/D 6.94; Mojsisovics 1882, p. 258: U/D 5.4), but differs from the new species mostly in the oval whorl section, with maximum width located at about 1/3 of whorl height, and in the rounded venter that at large size is not subacute as in *F. gottardoi* n. sp. This type of outline is well visible on both the drawings provided independently by Böckh (1873, pl. 8, fig. 8b) and by Mojsisovics (1882, pl. 66, fig. 1a).

Flexoptychites acutus is very close to *F. gottardoi* n. sp. in the compressed whorl section (H/W=1.88 and 2.39: Mojsisovics, 1882, p. 263), but it differs in the wider umbilicus, that is 10 and 8.33% of D respectively on intermediate and mature specimens (Mojsisovics 1882, p. 263). The same relatively wide umbilicus (U=10% of D) is shown by the specimens of *F. acutus* from Esino Limestone of Parina Valley, studied by Fantini Sestini (1996) and examined by VP at Museo "E. Caffi". These specimens are important because their chronostratigraphic position is much better constrained than that of the type specimens. Fantini Sestini (1996, p.223) reported the species from localities S1060 and S938, assigned to the Secedensis Zone, because of the co-occurrence with *Parakellnerites waageni* and *Nevadites ambrosionii*, therefore these *F. acutus* are nearly coeval with *F. gottardoi* n. sp.

Occurrence and age. *Flexoptychites gottardoi* n. sp. is known from the middle part of the San Salvatore Dolomite at Rasa. The species is documented in the upper part of Reitzi Zone (SEZ. B; SEZ. C lower, Cava del Sasso bianco) and the lower part of the Secedensis Zone at SEZ. D, late Anisian.

Suborder **Ceratitina** Hyatt, 1884
Superfamily Danubitoidea Spath, 1951
Family Danubitidae Spath, 1951

Genus *Ticinites* Rieber, 1973

Type species: *Ticinites ticinensis* Rieber, 1973

Remark on the systematic position of the genus. The genus is here included in the family Danubitidae Spath, 1951, following Tozer (1981a) and Brack & Rieber (1993), but it is excluded from the subfamily Bulogitinae, erected by Manfrin et al. (2005) within the family Ceratitidae. The assignment by Manfrin et al. (2005) was followed by Vörös (2018), but we prefer to keep *Ticinites* in the Danubitidae because this genus is much younger than the other members of the Bulogitinae, therefore ancestor/descendant relationships cannot be advocated, at least on the available data. Bulogitinae includes several Pelsonian genera such as *Bulogites* Arthaber, 1912*, Salterites* Diener, 1915 and *Reiflingites* Arthaber, 1896, while *Ticinites* Rieber, 1973 is

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Plate 1

Flexoptychites from Rasa dolostone (Varese) and *Parasturia* from Clapsavon (Udine).

Fig. 1 – *Flexoptychites gottardoi* n. sp., MSNVI D 48, holotype, SEZ. D, Secedensis Zone: a) Lateral view of phragmocone (silicon rubber cast) and body chamber (replaced test); b) oral view; c) lateral view of the phragmocone showing part of the inner whorls, exposed by the removing the body chamber.

Fig. 2 – *Flexoptychites gottardoi* n. sp., MSNVI B 39, paratype, SEZ. B, Reitzi Zone: a) oral view; b) lateral view. Specimen with replaced test.

Fig. 3 – *Flexoptychites gottardoi* n. sp., MSNVI C 25, paratype, SEZ. C, Reitzi Zone: a) Lateral view; b) suture line. Silicon rubber cast.

Fig. 4 – *Flexoptychites gottardoi* n. sp., MSNVI B 79, paratype, SEZ. B, Reitzi Zone: lateral view of replaced test.

Fig. 5 – *Parasturia emmrichi* (Mojsisovics, 1882), holotype by monotypy, original figure after Mojsisovics (1882, pl. 50, fig. 4b). Oral view.

The rounded venter typical of *Flexoptychites* is marked by arrows in fig. 1b and 2a. The bar in the upper left corner is for all the figures, except for fig. 3b, 4 and 5.

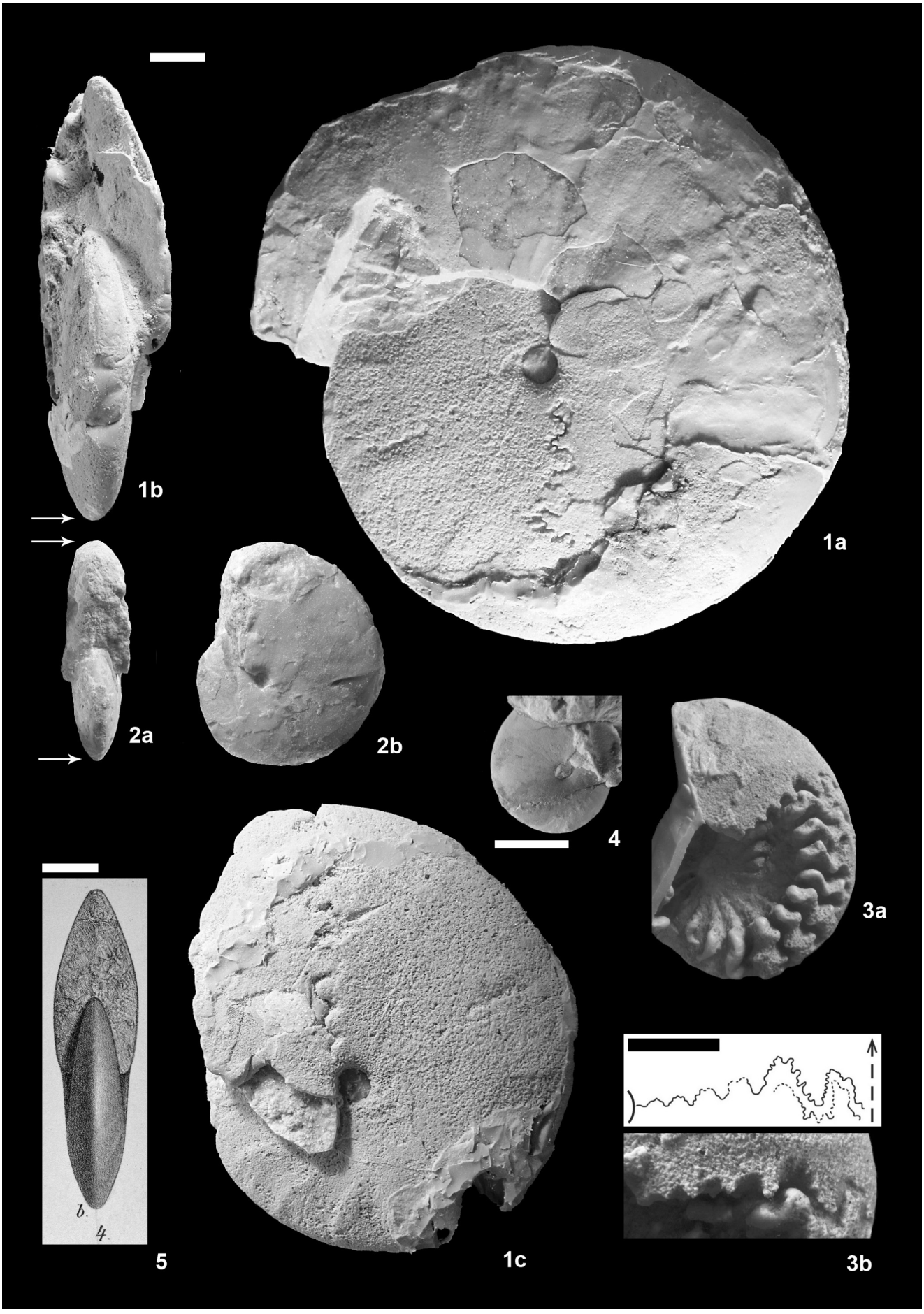

Plate 1

late Illyrian. The stratigraphic record of *Asseretoceras* Balini 1992, included by Manfrin et al. (2005) in Bulogitinae, but excluded by Vörös (2018), does not overlap neither with the range of the Pelsonian members of the subfamily nor with that of *Ticinites*. *Asseretoceras* is typical of the upper Trinodosus Zone (Balini 1992; Camunum to Pseudohungaricum subzones of Vörös 2018) while *Ticinites* is limited to the lowermost Secedensis Zone (Brack & Rieber 1993).

Ticinites ticinensis Rieber, 1973

Pl. 2, fig. 8-10; Pl. 3, fig.1a-b

?v 1886 *Straparollus varesinus* Tommasi, p. 203, pl. 1, fig. 3.
v 1912 *Celtites fumagalli* Stabile – Airaghi, p. 9, pl. 4, fig. 1.
v 1973a *Ticinites ticinensis* Rieber, p.56, pl. 7, fig. 1-5,8-10; pl. 10, fig. 7; Text-fig. 17q-x.
? 2018 *Ticinites* cf. *ticinensis* Rieber – Vörös, p. 109, pl. 28, fig. 1.

Locus typicus: Punkt 902/Mirigioli section, Canton Ticino, Switzerland (Rieber 1973a, p. 58).

Stratum typicum: bed 58, Besano Formation (Rieber 1973a, p. 58).

Material: Eleven specimens: MSNVI C 26a, MSNVI C 26b, MSNVI C 26c, MSNVI C 26d, MSNVI C 26k, MSNVI C 26m, MSNVI C 26n, MSNVI C 26o, MSNVI C 26p, MSNVI D 05, MSNVI D 96. Two specimens, MSNVI C 19 and MSNVI C 22, from SEZ. C upper, are attributed to *T. ticinensis* by *confronta.*

Description. The available specimens range from 25 to about 50 mm in D. They are relatively smaller with respect to the average size of the specimens described by Rieber (1973a) from the Besano Formation. Being the coiling of the species very evolute, the specimens from Rasa can be directly compared with the inner whorls of the type specimens.

The specimen MSNVI C 26b is the largest and best preserved specimen. Its coiling is very slow growing and very evolute (U/D = 0.49), but in other specimens the coiling is even more evolute with U/D reaching 0.55 or even more than 0.6. The specimen MSNVI C 26b exhibits a slightly depressed whorl section, with a very weak median elevation, especially at the beginning of the last preserved whorl. In other specimen the whorl section might be slightly depressed to very slightly compressed.

The specimens from Rasa show the typical ornamentation of *T. ticinensis*, which consists of primary and strong ribs and two rows of nodes in periumbilical and ventrolateral position.

The specimen MSNVI C 26b exhibits in 360° about 20 primary ribs and only one secondary rib. The periumbilical nodes are always strong and subspiny. The ventrolateral nodes are very weak or even not developed on the smaller specimen (MSNVI C 26n, D about 27 mm). At larger size they become strong (e.g., MSNVI C 26d, D about 34 mm) and commonly they get stronger than the periumbilical ones.

Suture line is visible on the specimen D 96, but it is not well preserved. The external suture consists of saddles S1, S2 and half of S3, but no details of indentitions are preserved.

Dimensions (mm)

	D	H	W	U	H/W	U/D
MSNVI C 26b	48.54	15.00	16.00	24.00	0.93	0.49
MSNVI C 26a	28.5	7.3	-	16.2	-	0.56
MSNVI C 26c	43	12	13	22.5	0.92	0.52
MSNVI C 26d	33.5	8.5	8	19	1.06	0.56
MSNVI C 26m	34.5	9	9	19	1	0.55
MSNVI C 26o	46.5	10	12.5	29	0.8	0.62

Remarks. The weak median elevation on the venter, that is visible on the specimen MSNVI C 26b, is documented also on some of the smaller type specimens of both *Ticinites ticinensis* and *T. polymorphus* (e.g., Rieber 1973a, fig. 17e, 17g, 17k, 17r, 17w; VP pers. obs. on types, 2014). This feature is most probably a juvenile feature, that is not documented in the final stages of growth.

The type specimen of *Straparollus varesinus* Tommasi, 1886, recently rediscovered by one of us (VP) in the collection of Museo Kosmos di Storia Naturale, Università di Pavia, MSNPV 23461, is not a gastropod with low-spired coiling and wide umbilicus as reported by Tommasi, but it is actually an ammonoid with planispiral, very evolute coiling. This specimen exhibits a typical combination of ribs and two rows of nodes of *Ticinites ticinensis*, but it is referred to this species with doubt, because of its incompleteness.

The specimen identified by Airaghi (1912) as *Celtites fumagallii* is referred to *T. ticinensis* for its cross section, coiling and for the nodose termination of ribs at the shoulder that is typical of *T. ticinensis* (see synonymy of the species).

The specimen described by Vörös (2018, p. 109, pl. 28, fig. 1) consists of only a quarter of whorl, but exhibits some features of the species, such as the subquadrate whorl section and two rows of strong and spiny nodes. Because of its incom-

pleteness we refer this specimen to *T. ticinensis* with a doubt.

Occurrence and age. *Ticinites ticinensis* Rieber, 1973 is known only from the Besano basin, from both the Besano Formation (Grenzbitumenzone of Rieber 1973a) and the Rasa dolostone, equivalent to the Middle and lowermost Upper San Salvatore Dolomite. At Punkt 902/Mirigioli, *T. ticinensis* occur in bed 58, lowermost part of the Secendensis Zone of Brack et al. (2005), late Anisian. At Rasa, the species has been found in one block of dolomite (C 26) from locality Sez. C1, together with *Stoppaniceras artinii* and *S. variabile*. Block C 26 is assigned to the lower part of the Secedensis Zone (see chapter "Chronostratigraphy of Rasa dolostone"). The specimen by Vörös (2018, p. 109) was not collected in place, probably from the Crassus subzone, that is equivalent to the lower part of the Secedensis Zone of Brack et al. (2005).

Ticinites polymorphus Rieber, 1973

Pl. 2, fig. 11

v 1973a *Ticinites polymorphus* Rieber, p. 60; pl. 7, fig. 6-7; pl. 8, fig. 1-8; pl. 10, fig. 5-6,12; Text-fig. 17a-n e p.

Locus typicus: Punkt 902/Mirigioli section, Canton Ticino, Switzerland (Rieber 1973a, p. 60).

Stratum typicum: bed 58, Besano Formation (Rieber 1973a, p. 60).

Material: The specimen MSNVI D 06 is assigned to the species. The specimens MSNVI D 50c and MSNVI N 09 are attributed to *T. polymorphus* by *confronta*.

Description. The two specimens are preserved as external molds, but their poor preservation prevents from any illustration. The specimen MSNVI D 06 exhibits the bifurcation of ribs and the reduction of the sculpture of ribbing on the body chamber, that are peculiar of *T. polymorphus*. The coiling of this specimen is also faster than the coiling of *T. ticinensis*, and this is another feature distinguishing the two species.

The suture line is not visible.

Dimensions (mm)

	D	H	W	U	U/D
MSNVI D 06	47.3	18.5	-	16.6	0.35

Occurrence and age. *Ticinites polymorphus* Rieber, 1973 is only known from the Besano basin, as *T. ticinensis*, from Besano Formation (Rieber 1973a) and Rasa dolostone (this work). In the Besano Formation *T. polymorphus* co-occur with *T. ticinensis* in bed 58 of Punkt902/Mirigioli, lower part of the Secedensis Zone of Brack et al. 2005, late Anisian.

The two specimens from Rasa were collected from SEZ. D (lower part), that is assigned to the lower part of the Secedensis Zone.

Genus *Ceresioceltites* n. gen.

Type species: *Ammonites fumagallii* Stabile, 1860

Zoobank ID:urn:lsid:zoobank.org:act:BEB8AEB6-5284-46A3-ACBE-1E14FAD3C39F

Preliminary remarks. The genus *Celtites* Mojsisovics, 1882 is a basket genus that included 32 species and 13 taxa in open nomenclature already at the beginning of the 20th century (Diener 1915). Most of these species, as many other defined in the 19th century (Balini et al. 2010, p. 253), were erected on the basis of few specimens, sometimes incomplete or deformed, whose variability and even stratigraphic position was often poorly known. *Celtites epolensis* Mojsisovics, 1882, the type species of *Celtites* Mojsisovics, 1882, is classic example of this kind of species. According to Tozer (pers. comm. to MB, 1993) the deformation of the type specimens of *C. epolensis* and their lack of suture line do not provide significant support to the definition of the genus *Celtites*. For these reasons the genus was regarded by Tozer (1971, p. 1026; 1981a, p. 94) as *nomen dubium*.

We cannot solve here the doubtful status of *Celtites*, but based on the study of new specimens from Rasa and the re-examination of specimens from literature, we recognize that some taxa of basket *Celtites* sensu Diener, 1915 differ enough from the other species to justify their separation in the new genus *Ceresioceltites*.

Derivatio nominis: The genus has been named after the Lake Ceresio (Lago Ceresio or Lago di Lugano).

Diagnosis: Very evolute coiling with very slow growing whorls. Small or no overlaps between whorls. Whorl section subquadrate or depressed-subrectangular depending on species. Shoulders always well marked, umbilical wall usually low. Venter wide, very slightly convex, with a very low and weak keel on the outer surface of the test. Ribs are strong, primary and prorsiradiate. They start at the umbilical margin with a weak node-like or bullae-like thicknening, depending on the species, and decrease on the flank. Depending on the species, the ribs fade on the outher part of the flank, or they reach the shoulder forming a tiny and weak node then disappearing near to the ventrolateral shoulder. Suture line ceratitic: deep external lobe divided by a very small ventral saddle, very large and rounded ventrolateral saddle, small lateral lobe, small umbilical saddle, simple umbilical lobe.

Composition of the genus. *Ammonites fumagallii* Stabile, 1860 (type species), *Celtites paronai* Airaghi, 1912, and *Celtites taramellii* Airaghi, 1912.

Three taxa in open nomenclature are in a doubtful position. The first two were described by Salomon (1895) from Marmolada Limestone (Dolomites) as *Celtites* (?) nov. sp. ind. A and as *Celtites* (?) nov. sp. ind. B. The specimens from Latemar platform (Dolomites) figured by Manfrin et al. (2005, fig. 9: 11,15-19 and fig. 9: 4-8) and identified as *Celtites* sp. A (sensu Salomon, 1895) and *Celtites* sp. B (sensu Salomon, 1895) are probably corresponding to the two taxa by Salomon above cited. A third taxon was classified as *Celtites* (?) by Fantini Sestini (1996) from the Esino Limestone of Parina Valley. The specimens are stored in the Museo Civico di Scienze Naturali "E. Caffi" di Bergamo (MCSNB 9394 and MCSNB 9392a).

Remarks on the composition of the genus. The new genus *Ceresioceltites* includes two well documented species, *Ceresioceltites fumagallii* (Stabile, 1860) and *C. paronai* (Airaghi, 1912) that we describe below, and *C. taramelli* (Airaghi, 1912) that we discuss here. Here we also discuss the position of *Celtites evolutus* Salomon, 1895, and of the two taxa described by Salomon (1895) in open nomenclature that are in doubtful position.

Celtites taramellii was erected by Airaghi (1912) on the basis of an incomplete specimen from Besano Formation. The specimen was lost during the bombing of the Museo Civico di Storia Naturale di Milano, but a cast of this specimen has been recently discovered in the Museo Kosmos, Pavia, and re-described by Pieroni (2023). The coiling and whorl section of this specimen is consistent with the one of *Ceresioceltites*, however, Airaghi (1912, p. 15) reported in his description of *C. taramellii* the occurrence of two rows of tiny nodes in umbilical and marginal position. These very weak nodes are visible on the plastotype (Pieroni 2023), and are here regarded as a specific feature of this species together with the presence of secondary ribs.

Celtites evolutus Salomon, 1895 is not included in the new genus *Ceresioceltites* on the basis of its rounded whorl section and the suture line with two saddles on the flank, with nearly the same size (pers. obs. VP, 2019; see Appendix 1). In the same monograph Salomon shortly described *Celtites* (?) nov. sp. ind. A and B, all based on very few and very incomplete specimens. These two taxa share with *Ceresioceltites* the subquadrate whorl section but this feature is not enough for the revision of their generic assignment.

Celtites (?) nov. sp. ind. A Salomon, 1895, and *Celtites* (?) nov. sp. ind. B Salomon, 1895 are left in doubtful position (see Appendix 1) because of the lack of suture line, even if their whorl section, coiling and ribbing are consistent with *Ceresioceltites* n. gen. The specimens classified as *Celtites* (?) by Fantini Sestini (1996), from the Esino Limestone of Parina Valley, probably belong to diverse species. Among them, some show the main features of *Ceresioceltites* (MCSNB 9392A and MCSNB 9394, from locality S 1060 E and S 1058), whereas others are more similar to *Celtites evolutus* Salomon, 1895.

Comparison with other genera. *Ceresioceltites* n. gen. is characterized by a combination of evolute coiling, subquadrate/subrectangular whorl section, peculiar ribbing and ceratitic suture line, that do not occur in other Danubitidae.

The most similar Danubitidae are *Celtites* Mojsisovics, 1882 and *Orthoceltites* Spath, 1951.

The genus *Celtites* was defined by Mojsisovics (1882) based on two groups of species of late Anisian to early Carnian age. The genus was included

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Plate 2

Aplococeras and *Ticinites* from Rasa dolostone.

Fig. 1 – *Aplococeras* cf. *misanii* (Mojsisovics, 1882), MSNVI A 14, lower Secedensis Zone: lateral view.

Fig. 2 – *Aplococeras* cf. *misanii* (Mojsisovics, 1882), MSNVI A 22, lower Secedensis Zone: a) oral view; b) lateral view.

Fig. 3 – *Aplococeras* cf. *misanii* (Mojsisovics, 1882), MSNVI A 19, lower Secedensis Zone: a) lateral view; b) ventral view.

Fig. 4 – *Aplococeras* cf. *misanii* (Mojsisovics, 1882), MSNVI A 21, lower Secedensis Zone: lateral view.

Fig. 5 – *Aplococeras* cf. *misanii* (Mojsisovics, 1882), MSNVI A 29, lower Secedensis Zone: lateral view.

Fig. 6 – Assemblage with benthic fossils and small specimens of *Aplococeras* cf. *misanii* (Mojsisovics, 1882), MSNVI A 30, lower Secedensis Zone: lateral view.

Fig. 7 – Gen. et sp. indet., MSNVI D 64, lower Secedensis Zone: lateral view. Silicon rubber cast.

Fig. 8 – *Ticinites ticinensis* Rieber, 1973, MSNVI C 26d, SEZ. C1, base of Secedensis Zone: Lateral view. Silicon rubber cast.

Fig. 9 – *Ticinites ticinensis* Rieber, 1973, MSNVI C 26a, SEZ. C1, base of Secedensis Zone: lateral view. Silicon rubber cast.

Fig. 10 – *Ticinites ticinensis* Rieber, 1973, MSNVI C 26c, SEZ. C1, base of Secedensis Zone: lateral view. Silicon rubber cast.

Fig. 11 – *Ticinites polymorphus* Rieber, 1973, MSNVI D 06, SEZ. D, base of Secedensis Zone. Lateral view. Silicon rubber cast.

Short bar scale is for Fig. 1-5 and is 2 mm. Long bar scale is for Fig. 6-11 and is 10 mm.

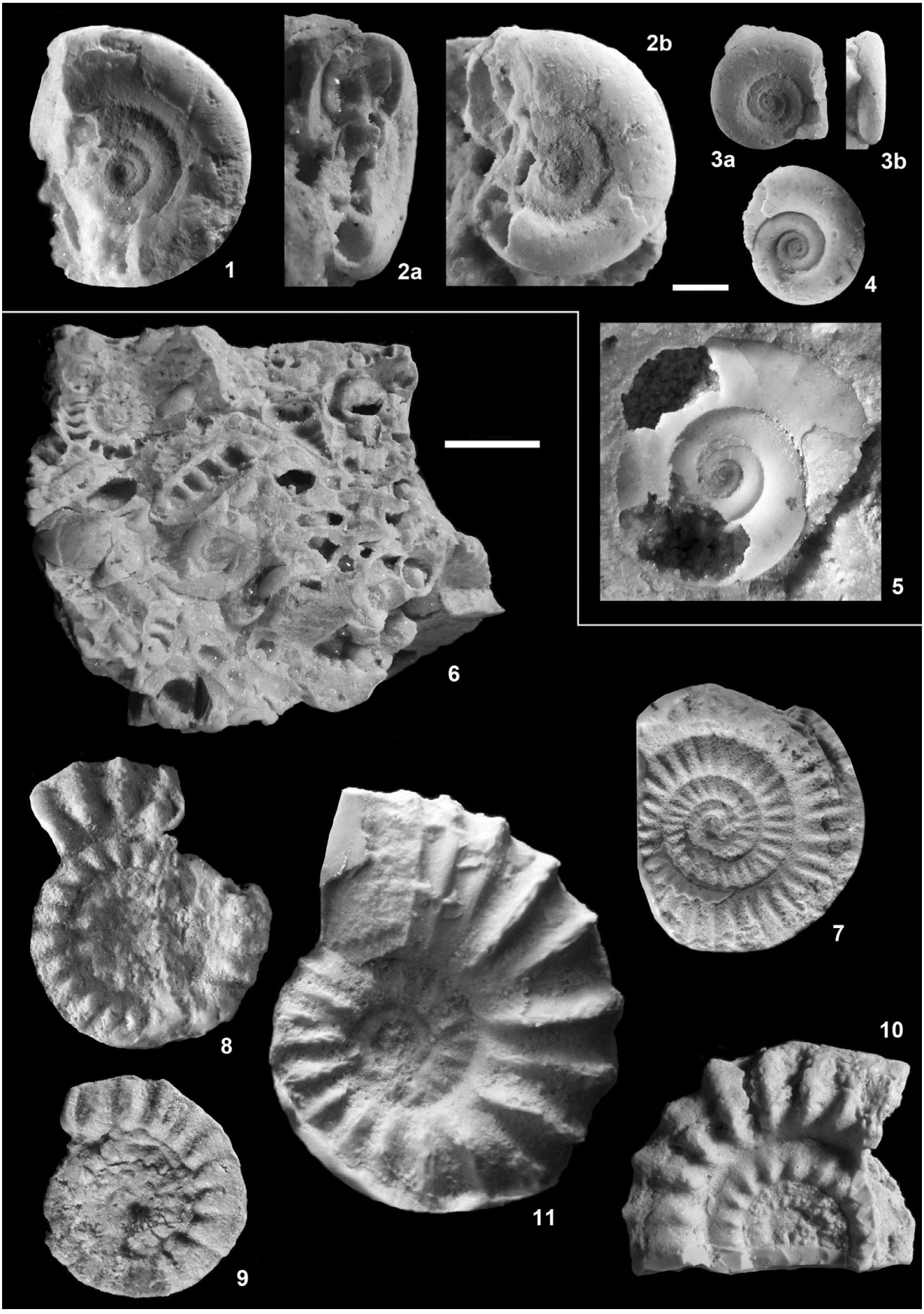

PLATE 2

in the Treatise on Invertebrate Paleontology (Arkell et al. 1957, p. L171), while Tozer (1971, p. 1026; 1981a, p. 94) regarded this taxon as *nomen dubium* because its type species *Celtites epolensis* Mojsisovics, 1882 (selected by Hyatt & Smith 1905), was based on deformed specimens, lacking of suture line (pers. comm. to MB, 1993). This uncertainty led Tozer (1981a) to propose the possible synonymization of *Celtites* Mojsisovics, 1882 with *Orthoceltites* Spath, 1951, another problematic Danubitidae.

We agree in part with Tozer, because the suture line of *C. epolensis* is not known, but in our opinion the figured type specimens, even if slightly deformed, show some primary features of the whorl section and of ribbing. The whorl section is not subquadrate as in *Ceresioceltites*, but looks to be semioval. This feature is mostly visible on the syntype of Mojsisovics (1882, plate 29, fig. 2; refigured by Balini 1994, pl. 3, fig. 3), that does not show any evidence of shoulder, because the transition from the flank to the venter is gently rounded.

As regards the comparision to *Orthoceltites* Spath, 1951, known only from the Carnian (Spath 1951; Arkell et al. 1957; Tozer 1981a, 1994), we remark that the taxonomy of its type species *Goniatites buchii* Klipstein 1845 is also complex (see discussion in Spath 1951, p. 96-98). Taking the specimens figured by Mojsisovics (1882) on pl. 30, fig. 7 and 9 as reference, as suggested by Spath (1951), the ribbing of *G. buchii* covers the whole flank, and does not fade on the external part of it. The coiling is also faster than in *Ceresioceltites* (whorl expansion rate of *C. buchi* = 2.10, while in *Ceresioceltites fumagallii* is 1.59). Besides these specific features, the typical whorl section of all the species attributed to *Orthoceltites* is ovoid, and not subquadrangular (e.g., Mojsisovics 1882, pl. 30, fig. 9; Tozer 1994, p. 125).

Ceresioceltites n. gen. might be also compared to some late Anisian Nathorstitoidea, such as *Tropigastrites* Smith, 1914 and *Tozerites* Silberling & Nichols, 1982.

The whorl section of these genera, however, is not subquadrate as in *Ceresioceltites*, but semioval. In addition to this difference, *Tropigastrites* exhibits acute to subacute venter. In *Tozerites* the venter is broad, rounded to weakly fastigate, and the ribs are strongly projected and fading on outer whorl. The suture line is deeply indented to weakly ammonitic in *Tropigastrites*, while it is goniatitic to weakly indented ceratitic in *Tozerites*.

Occurrence and age. The new genus *Ceresioceltites* is documented in the Secedensis Zone of San Salvatore Dolomite (Rasa Valley; Varese, Italy and Monte San Salvatore, Lugano, Switzerland) and Besano Formation (Monte San Giorgio; Late Anisian). The specimens from the Esino Limestone of Parina Valley, described by Fantini Sestini (1996) as *Celtites* (?), that could be included in *Ceresioceltites* n. gen. (see Composition of the genus) are from the Secedensis (MCSNB 9392a, locality S 1060 E) and Gredleri zones (MCSNB 9394, locality S 1058), from late Anisian to early Ladinian.

Ceresioceltites fumagallii (Stabile in Stoppani, 1860)

Pl. 3, fig. 2a-2b, 3a-3b; Fig. 6J

	1860 *Ammonites fumagallii* Stabile in Stoppani, p. 10
	1861 *Ammonites fumagallii* – Stabile, p. 25
	1901 ? *Celtites fumagallii* – Mariani, p. 50, fig. on page 50
v non	1912 *Celtites fumagallii* – Airaghi, p. 9, pl. 4, fig. 1-4
v	1971 *Celtites fumagallii* – Zorn, p. 16
v?	1973a *Celtites* sp. indet. – Rieber, p. 70, pl. 17, fig. 7-10, 16

Original locus typicus and stratum typicum: Capo di San Martino (Monte San Salvatore), Canton Ticino, Switzerland (Merian 1854; Stabile 1856). San Salvatore Dolomite, "Mittlerer Salvatoredolomit" (Zorn 1971).

Neotype: Specimen MSNVI N 01, SEZ. N, Pl. 2, fig. 3a-b; Fig. 76J. The neotype is deposited in the Museo di Storia Naturale "A. Stoppani", Venegono Inferiore (VA), Italy.

Revised locus typicus and stratum typicum: The selection of neotype implies the change of locus typicus and stratum typicum (ICZN 1999, art. 76.3). The locality of collection of the neotype is SEZ. N, near Rasa village, "Val del Legnone" (Fig. 2a, 3a). The lithostratigraphic unit is Rasa dolostone, informal unit equivalent to San Salvatore Dolomite.

Material: Neotype MSNVI N 01 from SEZ N; and two specimens: MSNVI I 35 from SEZ. I, MSNVI D 95 from SEZ. D. Two specimens (MSNVI D 117 and MSNVI D 157) are attributed by *confronta* to the species.

Revised diagnosis. *Ceresioceltites* with very slightly overlapping whorls. Whorl section subquadrate. Smooth, rounded venter, with weak median keel on the outer surface of test. Ornamentation with only primary ribs, prorsiradiate, starting near the umbilical margin with a weak rounded thickening, and ending at the shoulder. Suture: see the diagnosis of genus.

Description. Coiling very slow, very evolute, with very slightly overlapping whorls. Only 1/8 of H is covered by the next whorl. Flank gradually decreasing on the umbilical seam, in a way that there is no distinct periumbilical margin. Subquadrate whorl section with weakly convex venter and very weak median keel. This feature is visible on the outer surface of the test, while the internal mold is slightly convex and smooth.

Ribs are primary, rectiradiate to slightly prorsiradiate. Ribs start near the umbilicus usually with a thickening that in some specimens might even looks like a node/tubercle. About 22 ribs in a whorl.

The ceratitic suture line is well preserved on the specimen N 01 (Fig. 6J). The very wide saddle S1 is two times larger than S2.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI I 35	24.78	5.58	5.20	15.23	0.61	1.07
MSNVI N 01	23.82	5.18	-	13.31	0.55	-

Reasons for the selection of the neotype. The selection of a neotype is an option provided by ICZN that is applied very rarely in Systematics. The case of *Ammonites fumagallii* Stabile in Stoppani, 1860 is one of those for which the selection is useful.

The species has been recognized by several authors (see Synonymy), but: 1) the type was only a fragment; 2) its original description was not very informative; 3) the locality of collection, at Capo San Martino, is unknown; 4) the original type was lost during the World War II bombing of the Museo Civico di Storia Naturale di Milano.

The selection as neotype of a very good specimen from Rasa Valley, about 15 km from Capo di San Martino, has several advantages, namely the stabilization of the diagnosis and of the synonymy, and the improvement of the information on the species. Moreover the neotype is from a stratigraphic succession at Rasa, with very good chronostratigraphic calibration, thus providing a precise age assignment to *Ceresioceltites fumagallii*. This decision has been taken after the study of all the other specimens thus far collected from Monte San Salvatore area (Canton Ticino).

The original type (holotype by monotypy fide Mariani 1901) was very incomplete, with a poorly preserved whorl section that looks restored from Mariani's figuration (Mariani 1901, p. 50), and without suture line. These features are crucial for the systematic of celtitids. The locality of collection was Capo San Martino, a site discovered and sampled by Stabile (Stabile 1854, 1856), but after Stabile no one could find any fossils from this site. Stabile did not report any details on the locality, namely if the fossils from this site were collected from beds or from blocks. Nowadays the area is densely inhabited, then it might be even possible that Stabile's locality is not anymore exposed.

The area of Monte San Salvatore was extensively studied by Zorn (1971), who was very accurate in collecting fossils. He cited in the text (p. 16) only two fragments of *Celtites fumagallii* (PIMUZ 31386a-b) from the San Salvatore Dolomite, "Punkt 820.3", Monte San Salvatore. Zorn collection is housed at the Paläontologischen Institut und Museum der Universität Zürich, that was visited by VP. The specimens from Monte San Salvatore are labeled as collected from a loose block, 100 m NE from "Punkt 820.3", then they do not have position in a stratigraphic succession. These specimens are incomplete, consisting of only a quarter of whorl and a portion of venter.

Zorn collection includes also a third specimen (PIMUZ 31381), not mentioned in his 1971 publication, from Fornace (Campione d'Italia), on the opposite site of Lake Ceresio. This specimen is preserved only as half whorl, but it is better preserved than those from Punkt 820.3. Unfortunately, no information is available on the locality and level of collection of this specimen, therefore this specimen is not useful to provide a stratigraphic reference to the original type specimen collected by Stabile on the opposite side of the lake.

Comparison of the specimens from Monte San Salvatore with those from Rasa. The three specimens collected from Monte San Salvatore by Zorn share with the specimens from Rasa the coiling, the general outline of the whorl section and the ornamentation. Only the specimen from Fornace (PIMUZ 31381), shows some remains of test on the ventral side, which looks weakly keeled. The portion of venter (PIMUZ 31386a) from Monte San Salvatore, without test, shows a gentle trace of keel, as the specimens from Rasa with test. In this respect, these last two specimens are fully consistent with the specimens from Rasa preserved with test.

Stabile (1861) cited the lack of keel on his specimen, which was figured with rounded venter in the restored whorl section by Mariani (1901). However, neither Stabile nor Mariani reported the presence/lack of test, then the description of the venter given by Stabile is incomplete.

Chronostratigraphic position. The neotype is from SEZ. N, that is assigned to the Secedensis Zone, because of the co-occurrence of *Serpianites curionii* and *Ticinites* (see the chapter "Chronostratigraphy of Rasa dolostone". The specimens from

"Punkt 820.3" at Monte San Salvatore probably might be referred to the same Secedensis Zone, because Rieber (in Zorn 1971, p. 15, footnote 1) classified some specimens from this locality as *Paraceratites luganensis* (Merian) correlated with bed 58 of the Punkt 902/Mirigioli section of Besano Formation at Monte San Giorgio. Afterwards, *Paraceratites luganensis* (Merian) was assigned by Rieber (1973a) to *Serpianites* Rieber, 1973.

The chronostratigraphic position of the original type of *Ammonites luganensis*, probably is not that different from the one of the neotype. Stabile (in Merian 1854; Stabile 1854) collected from Capo San Martino a second ammonoid, described as *Ammonites pemphix* Merian, 1854, afterwards regarded by Brack & Rieber (1986) as similar to *Chieseiceras chiesense* (Mojsisovics, 1882). *C. chiesense* is limited to the uppermost part of the Secedensis Zone (e.g., Brack et al. 2005), however, no information is available on the bed of collection of *Ammonites luganensis* and *A. pemphix*.

Remarks on synonymy. The specimens MSNVI N 01 and MSNVI I 35 are consistent in the coiling, whorl section and pattern of ribbing to the poorly preserved specimen described by Stabile (in Stoppani 1860) and subsequently by Mariani (1901, p. 50), which was lost during World War II. The suture line of this historical specimen was not described, therefore probably it was not preserved.

The specimens figured by Airaghi (1912, fig. 1-4, pl. 4) are probably juveniles of *Ticinites ticinensis* because they show (see Pieroni 2023) a faster coiling with whorls that are more overlapping and umbilical wall that is higher with respect to *C. fumagallii*, either taking as reference the original type, either the neotype here designated. Moreover, their ornamentation includes occasional branching of ribs and a second row of small nodes in marginal position (see Airaghi 1912, pl. 4, fig. 1), never occurring in *C. fumagallii*.

The specimens classified as *Celtites* sp. indet. by Rieber (1973a) might also be juveniles of *Ticinites* but their strong deformation by compaction prevents from a final decision.

Occurrence and age. The species is known from the San Salvatore Dolomite in Canton Ticino (Switzerland) at Capo di San Martino (Stabile in Stoppani 1860, fide Zorn, 1971), Monte San Salvatore (Zorn 1971) and Fornace (Zorn, unpblished). The neotype has been selected from the San Salvatore Dolomite at Rasa (Varese), where the species is documented in the Secedensis Zone, late Anisian.

Ceresioceltites paronai (Airaghi, 1912)

Pl. 3, fig. 4a-4b, 5

1912 *Celtites paronai* Airaghi, p. 14, pl. 3, fig. 7.

Locus typicus: Tre Fontane (Airaghi 1912, p. 7).
Stratum typicum: Besano Formation (Airaghi 1912, p. 7).
Material: Four specimens: MSNVI I 06, MSNVI I 31, MSNVI I 34, MSNVI M 12.

Revised diagnosis. *Ceresioceltites* with very slightly overlapping whorls. Whorl section subquadrate becoming subrectangular and depressed at mature stage. Venter wide, slightly convex, with a very low keel. Flank decreasing to the umbilical seam, with a very low umbilical wall. Ornamentation with only rounded proverse to projected primary ribs, well-spaced, rather strong. Ribs very prominent at the umbilical seam with a bullae-like thickening, and decreasing on the flank, towards the ventrolateral margin.

Description. The specimen MSNVI I 31 (Pl. 3, fig. 4a-b) is more complete than the other specimens.

The coiling is very slow and the subrectangular whorl section is distinctly depressed (H/W=0.6). The venter is wide, slightly convex, with a very low keel. The wide umbilicus is bordered by a very low umbilical wall. Ribs are rather strong, very prominent at the umbilical seam, typically proverse and become more and more forward-projected on the outer volutions. Nine ribs in half whorl can be counted on specimen MSNVI I 31.

The suture line is not preserved.

Discussion. The specimens from SEZ. I and SEZ. M closely correspond to the figurations of *Celtites paronai* by Airaghi (1912, pl. 3, fig. 7) in coiling and in the typical ribbing. Our specimens provide complementary information to the types, which allowed us to revise the diagnosis of the species.

Ceresioceltites paronai differs from *C. fumagallii* in the depressed whorl section (e.g., H/W 0.6 *vs* 1 or slightly more than 1), faster coling, stronger, proverse and more widely spaced ribs. Moreover in *C. paronai* the ribs are much more prominent and thickened at the umbilical margin than in *C. fumagallii*.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI I 31	17.88	4.18	6.91	10.66	0.59	0.60

Occurrence and age. *Ceresioceltites paronai* is known from Besano Formation (Airaghi 1912) and

from Rasa dolostone. The stratigraphic position is known only from Rasa (this work) where this species has been found in the Secedensis Zone, late Anisian. The specimens described by Airaghi (1912) from the old mine Tre Fontane, 1300 m WSW of Monte San Giorgio, near the village Serpiano, lack of stratigraphic position. His list of taxa is consistent with the Secedensis Zone (see Pieroni 2023).

Superfamily Ceratitoidea Mojsisovics, 1879
Family Aplococeratidae Spath, 1951
Genus *Aplococeras* Hyatt, 1900

Type species: *Dinarites avisianus* Mojsisovics, 1882

Aplococeras cf. ***misanii*** (Mojsisovics, 1882)

Pl. 2, fig. 1, 2a-b, 3a-b, 4, 5, 6

Material: Nineteen specimens, collected from SEZ. A2 (10 specimens), SEZ. I (2 specimens), SEZ. L (1 specimen) and SEZ. N (6 specimens).

Description. The specimens are of small size, most of them are less than 15 mm in diameter. Their coiling is involute, but with U/D ratio varying from 0.39 to 0.52. The whorl section is nearly oval (Pl. 2, fig. 2a, 3b) and the specimens are completely smooth. No one shows the suture line.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI A 19	6.9	2.4	2.2	2.7	0.39	1.09
MSNVI A 21	5.1	1.6	1.5	2	0.39	1.06
MSNVI A 22	11.4	4	3	4.7	0.41	1.33
MSNVI A 29	13.3	4	-	6.5	0.48	
MSNVI A 30	8.5	2.4	-	4.5	0.52	

Discussion. The specimens are closely similar to *Aplococeras* cf. *misanii* figured by Rieber (1973a). Assereto (1969) and Brack & Rieber (1993) assigned *Dinarites misanii* Mojsisovics, 1882 to the genus *Aplococeras* Hyatt, 1900, while Manfrin et al. (2005) and Vörös (2018) included this species in *Lecanites* Mojsisovics, 1882, but for the time being we prefer to refer the species to *Aplococeras*.

The genus *Lecanites* Mojsisovics, 1882, is based on *Ammonites glaucus* Münster, 1834, from San Cassian Formation (Dolomites), that is early Carnian in age. The Anisian species of *Lecanites* from North America, described by Hyatt & Smith (1905) and Smith (1914), were assigned by Spath (1951) to *Pseudoaplococeras* Spath, 1951. This genus was afterward synonymized with *Aplococeras* by Assereto (1969), and Tozer (1971, 1981a). The occurrence of *Lecanites* in the late Anisian of the western Tethys has not yet been fully demonstrated. According to Manfrin et al. (2005) the separation of *Lecanites* from *Aplococeras* is justified by difference in shell morphology and by goniatitic versus ceratitic suture line, while Vörös (2018) emphasized the suture line as most significant feature, as documented in his fig. 80 and 81. Unfortunately no suture lines were figured by Manfrin et al. (2005) to support their point of view. The Anisian specimens of *Aplococeras* and *Lecanites* studied by Assereto (1969) and examined by one of us (MB) show extremely subtle differences in the suture line, as the lobe indentations of *Aplococeras s.s.* are very weak and are easily obliterated by recrystallization.

Family Ceratitidae Mojsisovics, 1879
Subfamily Beyrichitinae (Spath, 1934)
Genus *Serpianites* Rieber, 1973

Type species: *Ceratites serpianensis* Airaghi, 1912

Serpianites curionii Rieber, 1973

Pl. 3, fig. 6a-b, 7; Fig. 7D-E

v 1973a *Serpianites curionii* Rieber, p. 44, pl. 3, fig. 12; pl. 8, fig. 9-19; pl. 10, fig. 8, 11, 13-15; text.fig. 13a-f.

Locus typicus: Punkt 902/Mirigioli section, Canton Ticino, Switzerland (Rieber 1973a, p. 44).

Stratum typicum: Bed 58, Besano Formation (Rieber 1973a, p. 44).

Material: Nine specimens: MSNVI D 67, MSNVI D 65, MSNVI D 78a, MSNVI D 78b, MSNVI D 78c, MSNVI D 79, MSNVI D 80, MSNVI D 94, MSNVI D 147. MSNVI N 07 is attributed by *confronta* to the species.

Description. The specimens MSNVI D 94, MSNVI D 67 and MSNVI D 79 are the most complete, even if they show some evidences of compression. The specimen MSNVI D 79 is slightly larger than the largest type specimen (Rieber 1973a, p. 46).

The specimen show all the typical features of *S. curionii*, namely the trapezoidal whorl section, the ventral keel on the inner whorls which fade on the outher whorl, the small umbilicus, the smooth inner whorls with ornamentation starting very late during ontogeny. On MSNVI D 94 the lateral nodes appear

at about 17 mm of H, while on MSNVI D 67 the shell is smooth at least until H=20 mm.

The suture line is visible only on specimen MSNVI D 94 (Fig. 7D-E), and it is ceratitic. The septa are very closely spaced and in the last 90° of the phragmocone there are about 7 septa. Three saddles are exposed on the flank: L is large and slender, S2 is rounded and irregular, U2 is large, SU is rounded, U3 large with a small internal singular digitation (U1?), small internal saddle.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI D 79	66.00	32.00	22.00	10.50	0.15	1.45
MSNVI D 94	40.00	20.50	-	7.20	0.18	-

Remarks. The available specimens, and especially the large sized MSNVI D 79, are very useful for the reconstruction of the juvenile stage and ontogeny of *S. curionii* Rieber, 1973. The umbilicus and the inner whorls of the type specimens are flattened (Rieber, 1973a, fig. 13a-c) while they are preserved in 3D in the Rasa specimens.

Occurrence and age. *Serpianites curionii* Rieber, 1973 is known only from the Besano basin. At Punkt 902/Mirigioli, the species was found in bed 102, Secedensis Zone, late Anisian. The specimens from Rasa were found from little outcrop located behind the parish church "St. Maria degli Angeli" (SEZ. D1), and SEZ. D lower, corresponding to the base of Secedensis Zone, late Anisian.

Serpianites serpianensis (Airaghi, 1912)

Pl. 3, fig. 11a-b, 12; Pl. 4, fig. 1a-c, 2a-b, 3a-b, 4; Fig. 6I

1912 *Ceratites serpianensis* Airaghi, p. 15, pl. 2, fig. 2, 4.
? 1912 *Ceratites serpianensis* Airaghi, p. 15, pl. 2, fig. 3, 5.
1912 *Ceratites besanensis* Airaghi, p. 23, pl. 3, fig. 1-2.
1912 *Ceratites comotti* – Airaghi, p. 12.
v 1973a *Serpianites serpianensis* – Rieber, p. 48, pl. 13, fig. 1-4, 10-13.
? 1995 *Serpianites* aff. *serpianensis* – Mietto & Manfrin, p. 551, pl. 3, fig. 1.
v 2011 *Serpianites serpianensis* – Pieroni, p. 60, pl. 7cefal., fig. 1-5.

Locus typicus: Tre Fontane (Airaghi 1912, p. 15).
Stratum typicum: Besano Formation (Airaghi 1912, p. 15).
Material: more than 30 specimens have been collected. Ten of them have been prepared and numbered: MSNVI D 57, MSNVI D 57a, MSNVI D 57b, MSNVI D 57c, MSNVI D 57d, MSNVI D 73, MSNVI D 74, MSNVI D 90, MSNVI D 91, MSNVI D 93.

Description. *Serpianites serpianensis* is the most common *Serpianites* from Rasa, and it is easy recognized for the peculiar ornamentation well described by Rieber (1973a) in his revision of the species. The best preserved specimen of the collection is MSNVI D 73 (Pl. 3, fig. 13), a silicon cast from an external mold. The suture line is visible on MSNVI D 90, that is preserved as external mold on one side (Pl. 4, fig. 3a-b), while part of the phragmocone is visible on the other side (Pl. 3, fig. 12). The suture line (Fig. 6I) consists of L large (not complete), S2 small, U2 corresponding about the half height of L, SU very shallow, U3 very small.

Dimensions (mm)

	D	H	W	U	U/D
MSNVI D 73	60.00	26.00	-	14.00	0.23
MSNVI D 90	66.00	-	-	16.00	0.24
MSNVI D 93	40.00	-	-	8.80	0.22

Plate 3

Ticinites, *Ceresioceltites* n. gen., and *Serpianites* from Rasa dolostone.
Fig. 1 – *Ticinites ticinensis* Rieber, 1973, MSNVI C 26b, SEZ. C1, base of Secedensis Zone: a) lateral view; b) oral view. Silicon rubber cast.
Fig. 2 – *Ceresioceltites fumagallii* (Stabile in Stoppani, 1859-60), MSNVI I 35, SEZ. I, Secedensis Zone: a) lateral view; b) oral view. Silicon rubber cast.
Fig. 3 – *Ceresioceltites fumagallii* (Stabile in Stoppani, 1859-60) MSNVI N 01, neotype, SEZ. N, Secedensis Zone: a) lateral view; b) oral view. Original.
Fig. 4 – *Ceresioceltites paronai* (Airaghi, 1912), MSNVI I 31, SEZ. I, Secedensis Zone: a) lateral view; b) oral view. Silicon rubber cast.
Fig. 5 – *Ceresioceltites paronai* (Airaghi, 1912), MSNVI I 06, SEZ. I, Secedensis Zone: lateral view.
Fig. 6 – *Serpianites curionii* Rieber, 1973, MSNVI D 94, SEZ. D1, base of Secedensis Zone: a) lateral view of internal mold (Steinkern with suture line); (b) suture line, see also Fig. 7D-E.
Fig. 7 – *Serpianites curionii* Rieber, 1973, MSNVI D 79, SEZ. D1, base of Secedensis Zone: lateral view of replaced test.
Fig. 8 – *Serpianites* cf. *serpianensis* (Airaghi, 1912), MSNVI D 88, SEZ. D, Secedensis Zone: lateral view with partially preserved suture line. Silicon rubber cast. Suture line in Fig. 6F.
Fig. 9 – *Serpianites zinae* (Airaghi, 1912), MSNVI D 89, SEZ. D, Secedensis Zone: lateral view. Suture lines in Fig. 6G and 6H. Silicon rubber cast.
Fig. 10 – *Serpianites* cf. *zinae* (Airaghi, 1912), MSNVI D 87, SEZ. D, Secedensis Zone: lateral view of external mold, covered with dolomite crystals. Suture line is in Fig. 6E.
Fig. 11 – *Serpianites serpianensis* (Airaghi, 1912), MSNVI D 73, SEZ. D, Secedensis Zone: a) lateral view; b) ventral view. Silicon rubber cast.
Fig. 12 – *Serpianites serpianensis* (Airaghi, 1912), MSNVI D 90, SEZ. D, Secedensis Zone: lateral view, suture line partially visible. Silicon rubber cast.
Bar scale is 10 mm. The bar in the lower right corner is for all the figures, except for fig. 3b and 6b.

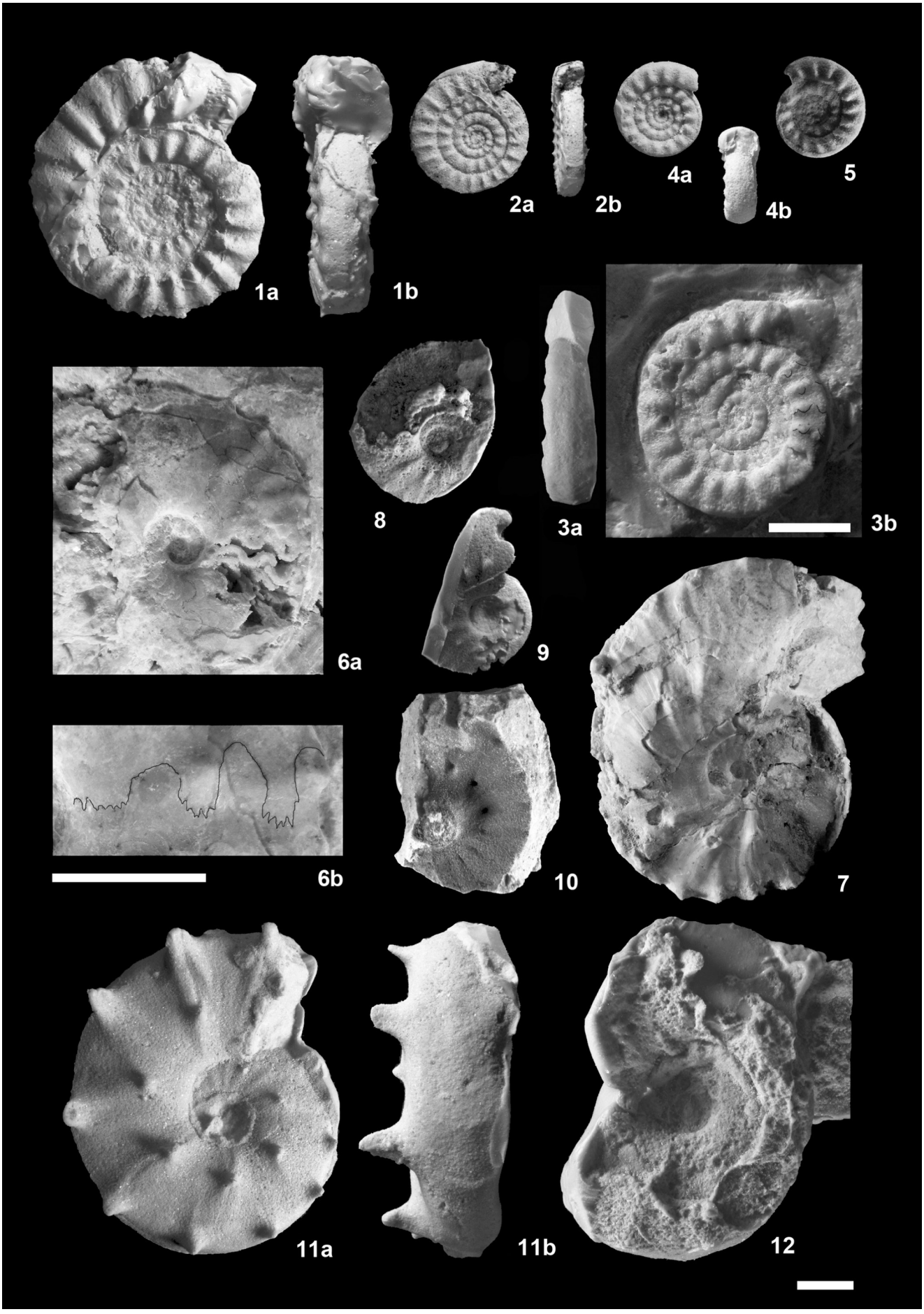

PLATE 3

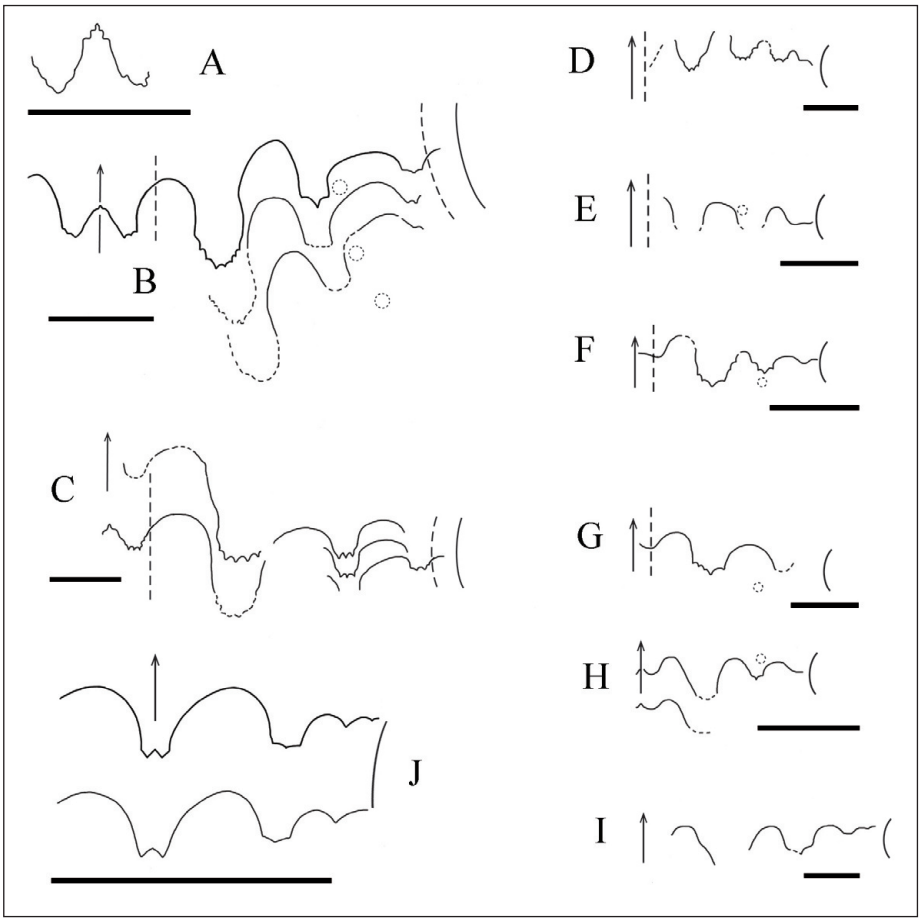

Fig. 6 - Suture lines of ammonoids from Rasa dolostone described in this paper. Shoulder and periumbilical margin are shown with dashed line, dotted lines are for nodes. Bar scales are 5 mm. A) *Parakellnerites meriani* Rieber, 1973, MSNVI B 11, ventral saddle (mirrored) H = 20 mm, SEZ. B (Pl. 5, fig. 3). B) Same speciemen, complete suture line with position of the lateral nodes (mirrored) H = 18 mm. C) *Parakellnerites meriani* Rieber, 1973, MSNVI B 60 (mirrored) H = 24.5 mm, SEZ. B (Pl. 6, fig. 1). D) *Parakellnerites waageni* (Mojsisovics, 1882), MSNVI D 41bis, H = 20 mm, SEZ. D (Pl. 6, fig. 3). E) *Serpianites* cf. *zinae* (Airaghi, 1912), MSNVI D 87 (mirrored), H = 13 mm, SEZ. D (Pl. 3, fig. 10). F) *Serpianites* cf. *serpianensis* (Airaghi, 1912), MSNVI D 88, H = 12 mm, SEZ. D (Pl. 3, fig. 8). G) *Serpianites zinae* (Airaghi, 1912), MSNVI D 89, H = 15 mm, SEZ. D (Pl. 3, fig. 9). H) idem, H = 9 mm. I) *Serpianites serpianensis* (Airaghi, 1912), MSNVI D 90 (mirrored), H = 24 mm, SEZ. D (Pl. 3, fig.12). J) *Ceresioceltites fumagallii* (Stabile in Stoppani, 1860), MSNVI N 01, neotype, H = 4 mm, SEZ. N (Pl. 3, fig. 3a-b).

Remarks. The specimens from Rasa show the same infraspecific variability as those from Monte San Giorgio (Rieber 1973a). Most of them show smooth innermost whorls (e.g., Rieber 1973a, pl. 13, fig. 5) while only very few of them exhibit weakly and densely ribbed innermost whorls (e.g., Rieber 1973a, pl. 13, fig. 4).

Occurrence and age. *Serpianites serpianensis* (Airaghi, 1912) has been reported only from the Besano basin. Rieber (1973a) collected the species from beds 104, 106 and 109 of Punkt 902/Mirigioli, Secedensis Zone, late Anisian. At Rasa the species is very common in the upper part of SEZ. D, that is referred to the Secedensis Zone, late Anisian.

Serpianites cf. ***serpianensis*** (Airaghi, 1912)

Pl. 3, fig. 8; Fig. 6F

Material: two specimens MSNVI D 88 and MSNVI I 26.

Remarks. The two specimens are of small to medium size, and show the typical ornamentation of *Serpianites*. They are close to *S. serpianensis* but their incompleteness prevents from a full specific assignment. Despite of these limitations, the two specimens show the internal subdivision of the phragmocone, and MSNVI D 88 also the suture line.

The external suture of MSNVI D 88 (Fig. 6F) is ceratitic and consists of 4 saddles. At H= 12 mm the elements are as follows: E short, S1 rounded, L large and shallow, S2 small, U2 about the half of L, SU wide and very shallow, U3 very small.

Dimensions (mm)

	D	H	W	U	U/D
MSNVI D 88	30.60	13.30	-	7.70	0.25

Occurrence and age. The two specimens were collected from the upper part of SEZ. D. This interval yielded both *S. serpianensis* and *S. zinae*, as well as *Nevadites ambrosionii* and belongs to the Secedensis Zone, late Anisian.

Serpianites zinae (Airaghi, 1912)

Pl. 3, fig. 9; Pl. 4, fig. 5a-b, 6a-c, 7a-b; Fig. 6G-H

1912 *Ceratites zinae* Airaghi, p. 14, pl. 1, fig. 1.
v 1973a *Serpianites zinae* – Rieber, p. 50, pl. 10, fig. 9-10; pl. 12, fig. 4, 7; pl. 13, fig. 5-9, 14.
v 2011 *Serpianites zinae* – Pieroni, p. 61, pl. 8cefal., fig. 1-3.

Locus typicus: Tre Fontane (Airaghi, 1912, p. 7).
Stratum typicum: Besano Formation (Airaghi, 1912, p. 7).
Material: more than 50 specimens were collected from the upper part of the SEZ. D and from SEZ. M. Five of them have been prepared: MSNVI D 57e, MSNVI D 57f, MSNVI D 57g, MSNVI D 89, MSNVI M 16.

Description. The specimens fit very well with the revised description of the species provided by Rieber (1973a). The specimen MSNVI D 89 is of special interest because exhibits two suture lines and about 180° of distance (Fig. 6G-H). At about H=9 mm, E is very small and simple, divided by secondary saddle; L is large and slightly V-shaped, S2 well rounded, U2 small, SU rounded, U3 small. At the nearly mature stage (H= 15 mm) the S1 is well rounded and L is wide and shallow.

Dimensions (mm)

	D	H	W	U	U/D
MSNVI D 89	30.50	15.00	-	5.70	0.18

Remarks. *Serpianites zinae* differs from *S. serpianensis* in the more dense ribbing and the related number of marginal tubercles (Rieber 1973a). The former shows about 12-14 marginal nodes, while in the latter these nodes are 5-6 at D>50-60 mm.

Occurrence and age. *Serpianites zinae* is the youngest representative of *Serpianites* documented by Rieber (1973a) from bed 112, Punkt 902/Mirigioli section, middle part of the Secedensis Zone; late Anisian. At Rasa the species has been found in SEZ. D and SEZ. M, in the middle-upper part of the Secedensis Zone, late Anisian.

Serpianites cf. ***zinae*** (Airaghi, 1912)

Pl. 3, fig. 10; Fig. 6E

Material: four specimens MSNVI D 35, MSNVI D 87, MSNVI I 07, and MSNVI M 11.

Description. The specimens are not well preserved. However, it is worth mentioning the specimen MSNVI D 87 which shows the suture line (Fig. 6E), even if it is not well preserved. The suture is probably ceratitic and shows L and U2 having nearly the same dimension.

Dimensions (mm)

	D	H	W	U
MSNVI D 87	-	13.00	-	7.00

Occurrence and age. The four specimens were collected from outcrop SEZ D, SEZ. I and SEZ M, that are referred to the middle-upper part of the Secedensis Zone

Subfamily Paraceratitinae Silberling, 1962
Genus *Parakellnerites* Rieber, 1973

Type species: *Parakellnerites frauenfelderi* Rieber, 1973

Parakellnerites frauenfelderi Rieber, 1973

Pl. 5, fig. 1a-b, 2a-c; Fig. 7A-B

v 1973a *Parakellnerites frauenfelderi* Rieber, p. 18.
v 2011 *Parakellnerites* cf. *frauenfelderi* – Pieroni, p. 62, pl. 12cefal., fig. 3.
? 2018 *Parakellnerites frauenfelderi* – Vörös, p. 86, pl. 11, figs. 7-9; text-fig. 44-45.

Locus typicus: Punkt 902/Mirigioli section, Canton Ticino, Switzerland (Rieber 1973a, p. 20).
Stratum typicum: Bed 45, Besano Formation (Rieber 1973a, p. 20).
Material: Seven specimens: MSNVI B 03, MSNVI B 02, MSNVI B 59, MSNVI B 68, MSNVI B 81, MSNVI B 93, MSNVI C 27 (one specimen with fragments of other specimens). Two specimens that are not very well preserved, MSNVI B 04 and MSNVI B 10, are referred to *P. frauenfelderi* by *confronta*.

Description. Three specimens are of rather large size. The diameter of MSNVI B 03 (PL. 5, fig. 1) is about 90 mm, almost the same size of MSNVI B 02 (not figured), while in MSNVI B 59 (Pl. 5, fig. 2) is about 78 mm. MSNVI B 59 consists of phragmocone and about 200° of body chamber, while the preserved body chamber of MSNVI B 03 is only about 180°.

The coiling of the innermost whorls is very involute, but during the ontogeny the umbilicus becomes wider due to an umbilical egression. The coiling of the adult stage is just a little involute. The whorl section of the inner whorls is compressed and subtrapezoidal, but it becomes thicker and subrectangular on the body chamber. The periumbilical margin is visible on the inner whorls, but it disappears already on the phragmocone, as in all the *Parakellnerites*. On the inner whorls (MSNVI B 59) the venter is strongly keeled, but the keel is already

reduced to a median elevation at the beginning of the body chamber. The venter looks nearly flat on the body chamber of the larger MSNVI B 03.

The ornamentation of the inner whorls is weaker than on the body chamber. The ornamentation of the body chamber consists of strong, dense, proverse ribs, with sinuous course. Rib type is mostly primary and intercalatory. Three rows of nodes occur at the beginning of the body chamber. The umbilical nodes are weak, the lateral nodes cover all the preserved part of the body chamber of MSNVI B 59, while on the larger MSNVI B 03 they desappear after 90°. The specimen MSNVI B 02 shows the same sinuous ribbing of the previous two specimens, but differs in the sculpture of the body chamber, that decreases notably.

The suture line is visible on both MSNVI B 03 and MSNVI B 59. The suture of the former specimens is however, better preserved (Fig. 7A). It is ceratitic with E short, L deep and large, S2 large and rounded, U2 small, SU rounded and less large than S2, U3 smaller than U2, very little lobe on the umbilical rim. The suture of MSNVI B 59 (Fig. 7B) is exposed on the last 90° of the phragmocone, and is basically similar to that of MSNVI B 03. It is ceratitic and consists of E short, L deep and large, S2 large and rounded, U2 small, U3 smaller than U2 and similar to the little lobe on the umbilical rim.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI B 03	90.00	42.20	29.50	23.00	0.25	1.43
MSNVI B 59	66.23	29.54	20.64	17.50	0.26	1.43

Remarks. The specimens from Rasa are attributed to *Parakellnerites frauenfelderi* Rieber, 1973. Rieber subdivided *P. frauenfelderi* in five subspecies but the specimens here described do not fit easily in any of them. The accommodation of the *P. frauenfelderi* from Rasa with respect to the subspecies described from Besano Formation, would require a re-evaluation of the Besano collections, that is far beyond the purpose of this work.

P. frauenfelderi frauenfelderi Rieber, 1973 seems to be similar to the Rasa specimens in whorl section, type of keel, and in the ornamentation. This subspecies, however, does not show any umbilical egression (e.g., Rieber 1973a, pl. 1, fig. 1-13), even at a size equivalent to that of MSNVI B 59. The other subspecies differ mostly in the narrower umbilicus, more involute coiling and weaker ornamentation (*P. f. fastigatus* Rieber, 1973 and *P. f. laevis* Rieber, 1973), in a more compressed whorl section from middle to large size (*P. f. angustus* Rieber, 1973), or in the pattern of ribbing, with notably weakened secondary ribs (*P. f. dorsolatus* Rieber, 1973).

Remarks on synonymy. The specimens from Balaton Highland (Hungary) classified by Vörös (2018) as *P. frauenfelderi* and *P.* cf. *frauenfelderi* are left in an open status because they differ from the type specimens described by Rieber (1973a) in some features.

The suture line (Vörös 2018, text-fig. 45) consists of elongated saddles and lobes, with the larger lobe (L) indented for about 50% of its depth. The saddles of the holotype (Rieber 1973a: pl. 1, fig. 1) are rounded and wider, and the lobes are narrower and shallower. As regard the ventral keel, in the specimens from Balaton the strong keel persists also on the body chamber of large specimens (e.g., pl. 11, fig. 9b) while in the type specimens and in the specimens from Rasa the keel disappear on the phragmocone, and the body chamber is flat (e.g., Rieber 1973a, pl. 1, fig. 2; fig. 6 and 7).

Plate 4

Serpianites from Rasa dolostone.
The specimens with catalogue number MSNVI D 57 are from the same assemblage of *S. serpianensis* and *S. zinae*.
Fig. 1 – *Serpianites serpianensis*, MSNVI D 57, SEZ. D, Secedensis Zone: a) left lateral view; b) oral view; c) right lateral view. Silicon rubber cast.
Fig. 2 – *Serpianites serpianensis* (Airaghi, 1912), MSNVI D 57c, SEZ. D, Secedensis Zone: a) lateral view; b) ventral view. Silicon rubber cast.
Fig. 3 – *Serpianites serpianensis* (Airaghi, 1912), MSNVI D 90, SEZ. D, Secedensis Zone: a) oral view; b) right lateral view; see Pl. 2, fig. 11 for the left lateral view. Silicon rubber cast.
Fig. 4 – *Serpianites serpianensis* (Airaghi, 1912), MSNVI D 57a, SEZ. D, Secedensis Zone: lateral view. Silicon rubber cast.
Fig. 5 – *Serpianites zinae* (Airaghi, 1912), MSNVI D 57f, SEZ. D, Secedensis Zone: a) lateral view; b) ventral view. Silicon rubber cast.
Fig. 6 – *Serpianites zinae* (Airaghi, 1912), MSNVI D 57e, SEZ. D, Secedensis Zone: a) lateral view; b) ventral view; c) oral view. Silicon rubber cast.
Fig. 7 – *Serpianites zinae* (Airaghi, 1912), juvenile, MSNVI D 57g, SEZ. D, Secedensis Zone: a) lateral view; b) oral view. Silicon rubber cast.
Bar scale is 10 mm.

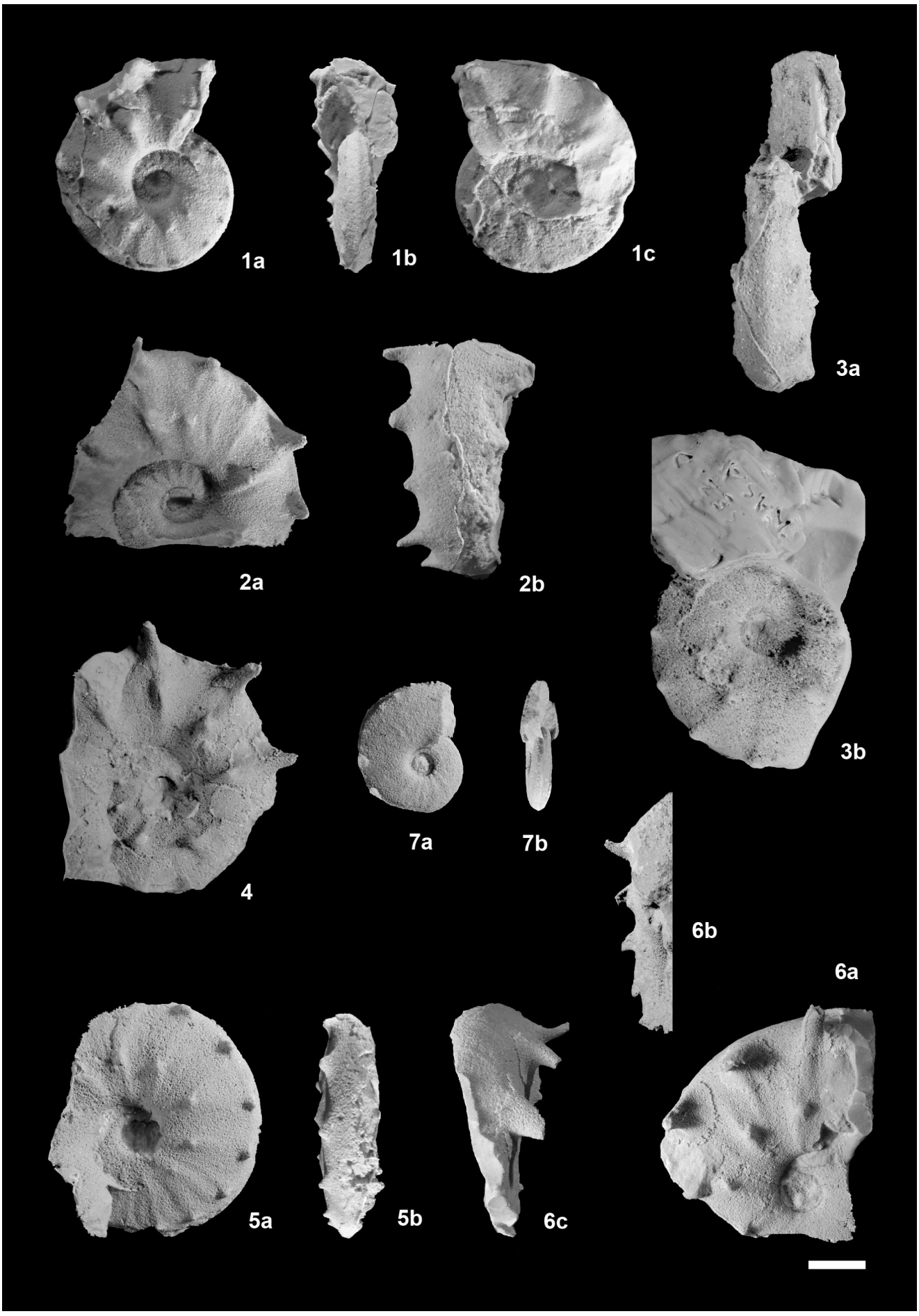

PLATE 4

Occurrence and age. *Parakellnerites frauenfelderi* Rieber, 1973, is known from Besano Formation, Punkt 902/Mirigioli section, beds 41-45 (Rieber 1973a), Reitzi Zone, and from Rasa SEZ. B and SEZ. C2, assigned to the same Reitzi Zone. The age is late Anisian.

The occurrence in the Balaton Highland (Hungary; Vörös 2018) is doubtful for the above mentioned reasons, but the chronostratigraphic position, reported by Vörös (2018) as ranging from Liepoldti to Avisianum subzones, middle and upper part of the Reitzi Zone (Vörös 2018), is nearly coincident with the position in the Besano basin.

Parakellnerites carinatus Rieber, 1973

Pl. 6, fig. 5

v 1973a *Parakellnerites carinatus* Rieber, p. 29, pl. 4, fig. 8-10; pl. 5, fig. 1-7, 13.

Locus typicus. Punkt 902/Mirigioli, Canton Ticino, Switzerland (Rieber 1973a, p. 29).

Stratum typicum. Bed 47, Besano Formation (Rieber 1973a, p. 29).

Material: two specimens, MSNVI B 56 is better preserved than MSNVI B 62.

Description. The specimen MSNVI B 56 is in part included in the rock matrix. The venter is narrow and the flanks are inflated, suggesting a subtrapezoidal whorl section, that are typical of the species. The umbilicus is quite small and deep, and is very well preserved on specimen MSNVI B 56. This specimen exhibits well developed umbilical nodes on at least the last four whorls. The ribs are typically straight and prorsiradiate.

In both the specimens the subdivision in chambers of the phragmocone is visible, but the septa are in part broken (Pl. 6, fig. 5), and the suture line is not well preserved enough to be drawn.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI B 56	39.61	21.33	10.14	6.49	0.16	2.10

Remarks. The umbilical area of the type specimens of *P. carinatus* Rieber, 1973 is not well preserved, then for this feature the specimens from Rasa are complementary to the types.

Occurrence and age. *Parakellnerites carinatus* Rieber, 1973 is known only from Besano Formation (Rieber 1973a), and now from Rasa, from the upper part of Reitzi Zone (late Anisian). The species occurs only in bed 47 of Punkt 902/Mirigioli section and in the locality SEZ. B at Rasa.

Parakellnerites meriani Rieber, 1973

Pl. 5, fig. 3a-c; Pl. 6, fig. 1a-b, 2a-b; Fig. 6A-C

? 1935 *Ceratites felsö-örsensis* – Airaghi, p. 195.
v 1973a *Parakellnerites meriani* Rieber, p. 30, pl. 6, fig. 1-12.
? 2011 *Repossia acutenodosa* – Pieroni, p. 64, pl. 3cefal., fig. 2.
2011 *Parakellnerites meriani* – Pieroni, p. 62, pl. 6cefal., fig. 3.
2011 *Repossia acutenodosa* – Pieroni, p. 64, pl. 10cefal., fig. 2, 2a, 4.

Locus typicus: Punkt 902/Mirigioli section, Canton Ticino, Switzerland (Rieber 1973, p. 30).

Stratum typicum: Bed 49, Besano Formation (Rieber 1973, p. 30).

Material: seven specimens: MSNVI B 11, MSNVI B 13, MSNVI B 26, MSNVI B 60, MSNVI B 61, MSNVI B 64, MSNVI B 65. The specimen MSNVI B 05 is attributed to the species by *confronta.*

Description. The specimens from Rasa show the typical combination of features of *Parakellnerites meriani* Rieber, 1973, namely the suboval whorl section, the prominent keel, the ornamentation with ribs and three rows of nearly spiny nodes. The keel of the specimens from Rasa is, on average, slightly less elevated above the shoulders than in the type specimens. In the figured specimens MSNVI B 11 and MSNVI B 65 the keel is not high enough to be visible on the lateral view. The keel is slightly higher in MSNVI B 60, and it is well visible on the lateral view on specimen MSNVI B 64 (not figured).

The outline of the keel in cross section is exactly as in the types (cf. Rieber 1973a, fig. 6 and 7). The venter is flat, the keel is distinct from the shoulders.

Plate 5

Parakellnerites from Rasa dolostone.

Fig. 1 – *Parakellnerites frauenfelderi* Rieber, 1973, MSNVI B 03, SEZ. B, Reitzi Zone: a) lateral view; b) ventral view poorly preserved suture line (see Fig. 7A). Internal mold (Steinkern).

Fig. 2 – *Parakellnerites frauenfelderi* Rieber, 1973, MSNVI B 59, very close to *P. frauenfelderi frauenfelderi* Rieber, 1973, SEZ. B, Reitzi Zone: a) lateral view with suture line (Fig. 7B); b) ventral view; c) oral view. Internal mold (Steinkern).

Fig. 3 – *Parakellnerites meriani* Rieber, 1973, MSNVI B 11, SEZ. B, Reitzi Zone: a) lateral view; b) ventral view with suture line; (c) particular from b) with ventral saddle and external lobe (see Fig. 6A-B). Internal mold (Steinkern).

Bar scale is 10 mm. The short bar is for all the figures, except for fig. 3c.

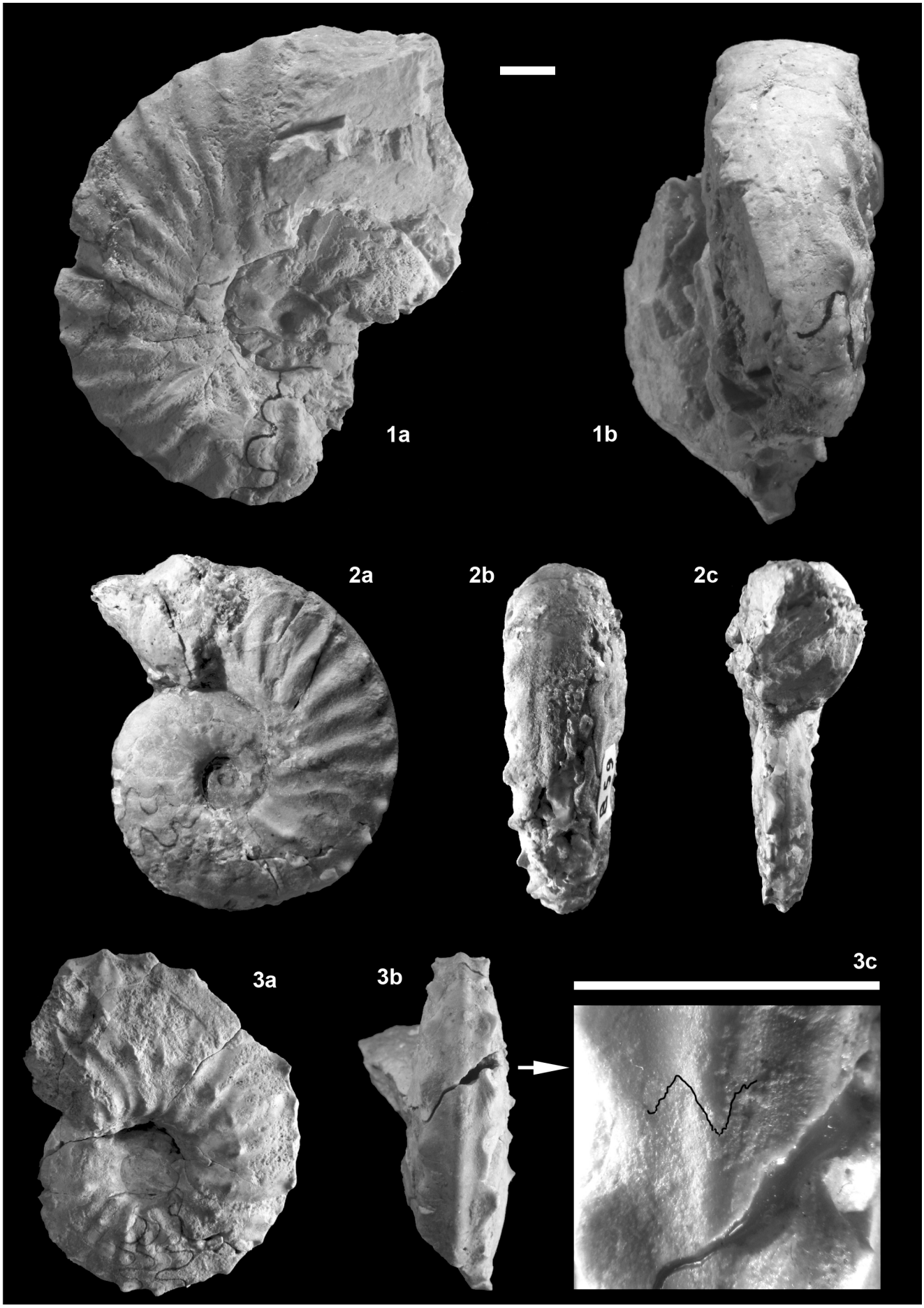

PLATE 5

The suture line is ceratitic and visible in specimens MSNVI B 11 and MSNVI B 60 (Fig. 6A-C). Three saddles are exposed on the flank, and a fourth one is located on the periumbilical wall. In MSNVI B 11 the lobe E is very shallow, the secondary ventral saddle (Fig. 6A; Pl. 5, fig. 3c) is acute, S1 is large and rounded, L is deep and slender with indentitions of both sides, S2 is large rounded and asimmetrical, U2 small, SU shallow and wide, U3 smaller than U2. In MSNVI B 60 E is shallow, S1 large, L large and deep, S2 ill-preserved, U2 small and trifid, SU shallow and wide, U3 smaller than U2.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI B 11	64.00	28.20	17.00	15.50	0.24	1.65
MSNVI B 60	69.00	34.0	22.0	-	-	1.54
MSNVI B 65	45.12	21.52	14.09	10.55	0.23	1.52

Remarks. The available specimens provide the best preserved sutures for *Parakellnerites* from Rasa. These sutures are more similar to those of *P. frauenfelderi* and *P. f. frauenfelderi*, than to those of. *P. waageni* (see below). In both the group of *P. frauenfelderi* and *P. meriani*, the lobe E is very shallow, U2 is narrow and shallow, S2 is wide and nearly flat.

Remarks on synonymy. The description of the specimen from Rasa classified by Airaghi (1935) as *Ceratites felsöörsensis* suggests the assignment to *P. meriani*. Unfortunately, this specimen was not figured by Airaghi, and it is lost.

Occurrence and age. As for many other species from Rasa, *Parakellnerites meriani* is thus far known only from the Besano Formation (Rieber 1973a). At Punkt 902/Mirigioli, *P. meriani* is the stratigraphically highest species of the genus, and occurs only in bed 49, uppermost part of the Reitzi Zone (late Anisian). At Rasa the species has been found only in SEZ. B (uppermost part of Reitzi Zone, late Anisian).

Parakellnerites waageni (Mojsisovics, 1882)

Pl. 6, fig. 3a-b; Fig. 6D

1882 *Balatonites waageni* Mojsisovics, p. 82, pl. 16, fig. 3-5.
1895 *Balatonites waageni* – Salomon, p. 181, pl. 6, fig. 8-10.
1895 *Balatonites waageni* var. *anguste-umbilicata* – Salomon, p. 181, pl. 6, fig. 9.
1982 *Parakellnerites waageni* – Casati et al., p. 430, pl. 32, fig. 3.
v 1993 *Parakellnerites*? *waageni* – Brack & Rieber, p. 467, pl. 4, fig. 19.
1996 *Parakellnerites waageni* – Fantini Sestini, p. 218, pl. 2, fig. 1-8.
v 2011 *Parakellnerites frauenfelderi angustus* – Pieroni, p. 62, pl. 6cefal., fig. 1, 1a.
v 2011 *Parakellnerites* cf. *costatus* – Pieroni, p. 63, pl. 12cefal., fig. 2.

Locus typicus: the type specimens were collected between Fedaia and the Marmolada glaciers on the valley side of Fedaia (Mojsisovics 1882, p. 83). According to Mietto & Manfrin 1995) this locality is equivalent to Pian dei Fiacconi, identified by Conti et. al. (1992).

Stratum typicum: Marmolada Limestone (Mojsisovics 1882).

Material: Six specimens, MSNVI D 10, MSNVI D 41bis, MSNVI D 57i, MSNVI D 59, MSNVI D 76, and MSNVI E 17.

Description. The best specimen from Rasa is MSNVI D 41bis (Pl. 6, fig. 3a-b), that is relatively small but shows the suture line. The keel is well visible on the larger specimens and is crenulated. The crenulation is not well developed on MSNVI D 41bis, probably because of preservational issues. The suture line is ceratitic, with 4 saddles between the venter and the umbilical seam. E is deep, L is slightly V-shaped, U2 and U3 are both quite wide, with small lobe near the umbilical rim.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI D 41bis	38.03	19.41	9.00	7.43	0.19	1.21

Discussion. *Parakellnerites waageni* has never been reported from the Besano Formation/ Grenzbitumenzone of M. San Giorgio, but it is a typical component of the upper Anisian ammonoid assemblages from carbonate platform facies (e.g., Pian dei Fiacconi, Marmolada, western Dolomites, type locality of Crassus Subzone: see Mietto & Manfrin, 1995; Manfrin et al. 2005). In literature some specimens assigned to this species do not conform precisely to the types figured by Mojsisovics (1882, pl. 16, fig. 3-5) and a revision of the species is probably necessary. Such a revision would require the examination of large ammonoid collections stored in several Museums of northern Italy and Austria, but this work is far beyond the purpose of our paper.

The specimens from Rasa are closely similar in the narrow umbilicus to those figured by Fantini Sestini (1996) from the Esino Limestone of Parina Valley. The suture line is also very similar in the number of saddles and the relative size of the lobes, in particular as regard L and U2, which are wider than S1 and S2 (cf. Fantini Sestini 1996, fig. 4).

In regard to the comparison with *Parakellnerites meriani*, the suture line of *P. waageni* exhibits deeper lobe E, and wider L and U2. S2 is also very different, being very wide and nearly flat in *P. meriani*.

Occurrence and age. *Parakellnerites waageni* (Mojsisovics, 1882) is known from several localities of Southern Alps, such as Marmolada (Mojsisovics 1882; Salomon 1895; Brack & Rieber 1993), Stabin in the Anisei Valley (Casati et al. 1982), Parina Valley (Fantini Sestini 1996), Rasa dolostone (Pieroni 2011). The species is referred to the Crassus subzone sensu Mietto and Manfrin (1995), equivalent to the middle upper part of the Crassus subzone sensu Manfrin et al. (2005). Fantini Sestini reported it from the Nevadites Zone (= Secedensis Zone of Brack et al. 2005). At Rasa the species has been found in SEZ. D and SEZ. E., in the middle part of the Secedensis Zone (Fig. 11). The age is late Anisian.

Parakellnerites costatus Fantini Sestini, 1996

Pl. 6, fig. 4

v 1996 *Parakellnerites costatus* Fantini Sestini, p. 220, pl. 2, fig. 9-12; text-fig. 5.

Locus typicus: locality S1060I, Parina Valley (Fantini Sestini 1996, p. 220).

Stratum typicum: Esino Limestone, Parina Valley (Fantini Sestini 1996, p. 220).

Material: specimen MSNVI B 66.

Description. This species is represented only by the specimen MSNVI B 66 collected from SEZ. B. Although incomplete, this specimen exhibits a perfectly preserved pattern of ornamentation (Pl. 6, fig. 4) as well as the tabulate and keeled venter (not figured). The ornamentation consists of large-sized, radially-elongated umbilical nodes, accompanied by small and tiny lateral and ventrolateral nodes. The sinuous ribs start at the umbilical node. Usually in boundles, but sometimes in group of three. Occasionally only one rib starts from the umbilical node. The umbilical nodes do not occur only on the last preserved whorl, but they are also developed on at least three innermost whorls.

Ribbing is very dense. Ribs are narrow between the umbilical and lateral node, then on the outer part of the flank they became wider and flat.

The suture line is not visible.

Dimensions (mm)

	D	H	W	U	U/D
MSNVI B 66	42.00	23.00	-	7.00	0.16

Remarks. *Parakellnerites costatus* was known only from the Esino Limestone of Val Parina (see Fantini Sestini 1996). The holotype MCSNB 9382 has been directly compared with the MSNVI B 66, from Rasa. The umbilical area with the innermost whorls is never visible on the types specimens, then the specimen MSNVI B 66 from Rasa provides complementary information to the type series.

Occurrence and age. The species has been reported from the lower part of Secedensis Zone of Esino Limestone (Fantini Sestini 1996) and from Rasa (this work). In the Rasa dolostone the single specimen, with a fragment of the same species, was collected from SEZ. B, upper Reitzi Zone, in association with *P. frauenfelderi* and *P. meriani*. The species is late Ansian in age.

Genus *Stoppaniceras* Rieber, 1973

Type species: *Stoppaniceras variabilis* Rieber, 1973

Stoppaniceras variabile Rieber, 1973

Pl. 6, fig. 6a-b; Fig. 7J

v 1886 *Straparollus lottianus* Tommasi, pag. 204, tav.1, fig. 4.
1916 *Ceratites gosaviensis* – Frauenfelder, p. 284.
v 1973a *Stoppaniceras variabilis* Rieber, p. 36, pl. 9, fig. 1-20; pl. 10, fig. 1-4; pl. 14, fig. 11.
v 1974a *Stoppaniceras variabilis* – Rieber, p. 171, textfig. 2c, pl. 2, figs. 1-10.

Locus typicus: Punkt 902/Mirigioli, Canton Ticino, Switzerland (Rieber 1973a, p. 36).

Stratum typicum: bed 61, Besano Formation (Rieber 1973a, p. 36).

Material: Four specimens, MSNVI C 26e, MSNVI C 26f, MSNVI L 01, MSNVI L 03. The specimen MSNVI E 27 is attributed by *confronta*.

Description. The available specimens are of small to medium size. They are attributed to the species on the basis of the position of the lateral node, that is very close to the umbilical one. From the morphological point of view these specimens do not add information to the very good description of the species given by Rieber (1973a). The specimen MSNVI L 03, although juvenile, shows the suture line, consisting of short lobe E, shallow and large L, small S2, very similar U2 and U3. This suture is also quite consistent with the suture described by Rieber (1973a, p. 37) from PIMUZ 3692.

Dimensions (mm)

	D	H	W	U	U/D
MSNVI L 03	24.50	9.51	8.00	10.00	0.40

Remarks. The specimen used by Tommasi (1886) to describe the new species of planispiral gastropod *Straparollus lottianus*, in the first work on fossils from Rasa, is preserved only as external mold (MSNP 20845, personally observed by VP in the Museo Kosmos, Università di Pavia, see Pieroni & Guaschi 2018). The features visible on this mold are consistent with the external mold of *Stoppaniceras variabile*, however the inclomplete preservation of the type of *Straparollus lottianus* Tommasi, 1886 and reasons of stability of nomenclature, prevent us from the application of the priority of the name *Straparollus lottianus* Tommasi, 1886 over *Stoppaniceras variabile* Rieber, 1973, that is in turn the type species of the genus *Stoppaniceras* Rieber, 1973.

Vörös (2018, p. 103, pl. 25, fig. 2), in his comprehensive review of the upper Anisian ammonoid faunas from Balaton Highland assigned three incomplete specimens to *S. variabile*, but with *confronta*. These specimens are very incomplete, and we agree with the author who left them in open nomenclature, therefore we do not synonymize this taxon with *S. variabile*.

Occurrence and age. *Stoppaniceras variabile* Rieber, 1973 is known only from the Besano Formation, Tre Fontane and Punkt 902/Mirigioli (Frauenfelder 1916, Rieber 1973a) and Rasa dolostone (Tommasi 1886; this work). At Rasa, the species has been found in localities SEZ. C1 and SEZ. L. In the type locality Punkt 902/Mirigioli Rieber (1973a, p. 41) collected *S. variabile* only from bed 61 of the section, where it co-occurs with *Ticinites polymorphus*, at the base of the Secedensis Zone. The stratigraphic position in the Rasa succession is excactly the same (Fig. 10). The age is late Anisian.

Stoppaniceras grandinodum Rieber, 1973

Pl. 6, fig. 8a-b; Fig. 7C

v 1973a *Stoppaniceras grandinodus* Rieber, p. 41, pl. 12, fig. 2-3

Locus typicus: Punkt 902/Mirigioli section, Canton Ticino, Switzerland (Rieber 1973a, p. 41).

Stratum typicum: Bed 61, Besano Formation (Rieber 1973a, p. 41).

Material: two specimens MSNVI E 28, MSNVI L 02.

Description. The specimen MSNVI E 28 is nearly identical to the holotype of the species, as regard the features of the outher whorl. The inner whorls are way much better preserved in MSNVI E 28 than in the holotype. Therefore the specimen MSNVI E 28 is crucial for the understanding of the ontogeny of *S. grandinodum*.

The ribs and nodes, are weak on the inner whorls but become notably stronger on the body chamber. The periumbilical nodes, developed on the inner whorls, disappear at D about 43 mm. The disappearance of periumbilical nodes occurs together with a significant change in the whorl section, namely the disapperance of the periumbilical margin that on the inner whorls separates the vertical umbilical wall, from the flank. After this change the flanks decrease gradually to the umbilical seam and the ventrolateral nodes become very strong and very spiny. The whorl section that is subrectangular and compressed on the inner whorls, then becomes thicker and nearly subquadrate, as illustrated by Rieber (1973a). The venter is keeled on the inner whorls, but the keel descrease and disappear on the body chamber.

Plate 6

Parakellnerites and *Stoppaniceras* from Rasa dolostone.

Fig. 1 – *Parakellnerites meriani* Rieber, 1973, MSNVI B 60, SEZ. B, Reitzi Zone: a) lateral view with suture line partially visible; b) oral view. Internal mold (Steinkern). For the suture line, see Fig. 6C.

Fig. 2 – *Parakellnerites meriani* Rieber, 1973, MSNVI B 65, SEZ. B, Reitzi Zone: a) lateral view; b) oral view. Internal mold covered by replaced test.

Fig. 3 – *Parakellnerites waageni* (Mojsisovics, 1882), MSNVI D 41bis, SEZ. D, Secedensis Zone: a) lateral view; b) ventral view. Suture line visible of the last preserved septum (Fig. 6D). Silicon rubber cast.

Fig. 4 – *Parakellnerites costatus* Fantini Sestini, 1996, MSNVI B 66, SEZ. B, Reitzi Zone: lateral view. Replaced test.

Fig. 5 – *Parakellnerites carinatus* Rieber, 1973, MSNVI B 56, SEZ. B, Reitzi Zone: lateral view. Replaced test and internal mold with partially preserved suture line.

Fig . 6 – *Stoppaniceras variabile* Rieber, 1973, MSNVI L 03, SEZ. L, Secedensis Zone: a) lateral view with suture line of the last preserved septum (Fig. 7J); b) oral view. Silicon rubber cast.

Fig. 7 – *Stoppaniceras artinii* (Airaghi, 1912), MSNVI C 26j, SEZ. C1, base of Secedensis Zone: lateral view. Silicon rubber cast.

Fig. 8 – *Stoppaniceras grandinodum* Rieber, 1973, MSNVI E 28, SEZ. E1, Secedensis Zone: a) lateral view; b) oral view. For the suture line see Fig. 7C). Silicon rubber cast.

Bar scale is 10 mm.

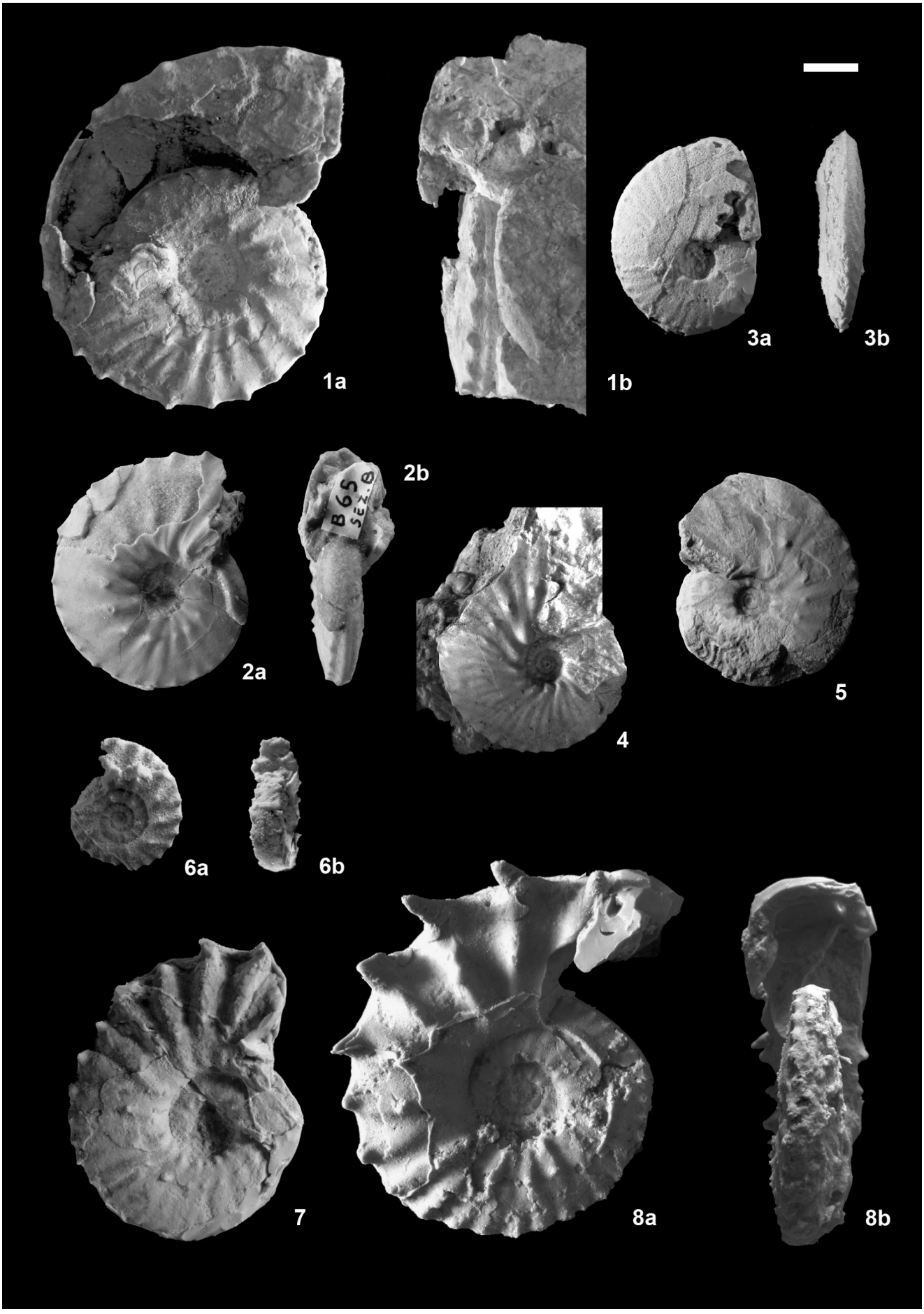

PLATE 6

The suture line (Fig. 7C) is not well preserved but it is clearly ceratitic: E little and short, S1 large, L shallow, S2 rounded, U2 and U3 not well preserved.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI E 28	69.90	30.00	26.00	21.00	0.30	1.15

Discussion. Rieber suggested to VP (pers. comm., 2014) a possible sexual dimorphism between *Stoppaniceras grandinodum* and *S. variabile*, which were collected in the same level (bed 61) at M. San Giorgio Punkt 902/Mirigioli. However, the ornamentation of the inner (juvenile) whorls of *S. grandinodum* specimen MSNVI E 28 is more similar to *S. artinii* than to *S. variabile*, in the position of the lateral nodes, that are located at about 40% (1/3) of H in MSNVI E 28, while in *S. variabile* they are located at <25% (<1/4) of H. Such similarity does not support the possible dimorphism of *S. variabile* and *S. grandinodum*, but would suggest a relationship between *S. grandinodum* and *S. artinii*. These two species have been found from two different beds at Punkt 902/Mirigioli (respectively beds 61 and 74-76), while their record at Rasa seems to be slightly different, because *S. artinii* exhibits a much extended range than in the Besano Formation, but it has not been found together with *S. grandinodum* (see chapter "Correlation with the Besano Formation at Monte S. Giorgio"). For the time being this problem remains without a solution.

Occurrence and age. The species has been reported from the Besano Formation, section Punkt 902/Mirigioli (bed 61, lower part of the Secedensis Zone) and from Rasa SEZ. E and L, Secedensis Zone. The age is late Anisian.

Stoppaniceras artinii (Airaghi, 1912)

Pl. 6, fig. 7

1912 *Ceratites artinii* Airaghi, p. 23, pl. 3, fig. 5.
v 1912 *Ceratites repossii* Airaghi, p. 23, pl. 2, fig. 6.
v 1973a *Stoppaniceras artinii* – Rieber, p. 42, pl. 14, fig. 1. 3, 4, 6, 9, 10.
v 2011 *Stoppaniceras variabilis* – Pieroni, p. 63, pl. 8cefal., fig. 4.

Locus typicus: Tre Fontane (Airaghi 1912, p. 4).
Stratum typicum: Besano Formation (Airaghi 1912, p. 4).
Material: Two specimens: MSNVI C 26j and MSNVI C 26l. Five other specimens are referred to *S. artinii* with *confronta* MSNVI D 57l, MSNVI D 92, MSNVI D 154, MSNVI D 155 and MSNVI E 21.

Description. The available specimens are of medium size, with respect to the type specimens described by Rieber (1973a), however they show the peculiar increasing in the sculpture of ribbing and in the marginal nodes which become spiny. The specimen MSNVI C 26j (Pl. 6, fig. 7) is well matching with Rieber's specimen figured on pl. 14, fig. 10. A peculiar feature visible on MSNVI C 26j is the change of the umbilical wall during the ontogeny. On the inner whorls the umbilical wall is vertical and it is separated from the flank by a rounded periumbilical margin. The periumbilical margin disappears just before the strengthening of the ribs and marginal nodes, together with a reduction of the steepness of the umbilical wall.

The suture line is not exposed.

Discussion. See the discussion of the previous species.

Occurrence and age. The species is known only from the type locality and from Punkt 902/Mirigioli (beds 74 and 76, middle Secedensis Zone) and from Rasa, localities SEZ. C1, and with *confronta*, D and E, Secedensis Zone. The age is late Anisian.

Subfamily Nevaditinae Tozer, 1994
Genus *Nevadites* Smith, 1914

Type species: *Nevadites merriami* Smith, 1914

Nevadites dealessandrii (Airaghi, 1912)

Pl. 7, fig. 1, 3

1912 *Balatonites De Alessandrii* Airaghi, p. 27, pl. 4, fig. 12.
1912 *Balatonites Sordellii* – Airaghi, p. 28, pl. 4, fig. 7.
1912 *Balatonites Bassanii* – Airaghi, p. 26, pl. 4, fig. 8.
1912 *Balatonites* sp. nov. – Airaghi, p. 28, pl. 4, fig. 9.
1912 *Balatonites* sp. nov. – Airaghi, p. 29, pl. 4, fig. 6.
1912 *Balatonites* sp. nov. – Airaghi, p. 29, pl. 4, fig. 11.
1916 *Protrachyceras* sp. indet. – Frauenfelder, p. 286.
1916 *Trachyceras* (*Anolcites*) sp. indet. – Frauenfelder, p. 286.
v 1973a *Protrachyceras dealessandrii* – Rieber, p. 66, pl. 15, fig. 1-4, 6-9, 13, 15.
v 2011 *Nevadites dealessandrii* – Pieroni, p. 65, pl. 9cefal., fig. 1, 1a, 1b.

Locus typicus: Tre Fontane (Airaghi 1912, p. 4).
Stratum typicum: Besano Formation (Airaghi 1912, p. 4).
Material: two specimens, MSNVI B 37 from the outcrop SEZ. B2 and MSNVI E 25a, collected from one block at SEZ. E, but probably from a higher stratigraphic position.

Description. The species was revised by Rieber (1973a) who illustrated in detail its variability. Both the available specimens are closely similar to Rieber's specimens, but the inner whorls are

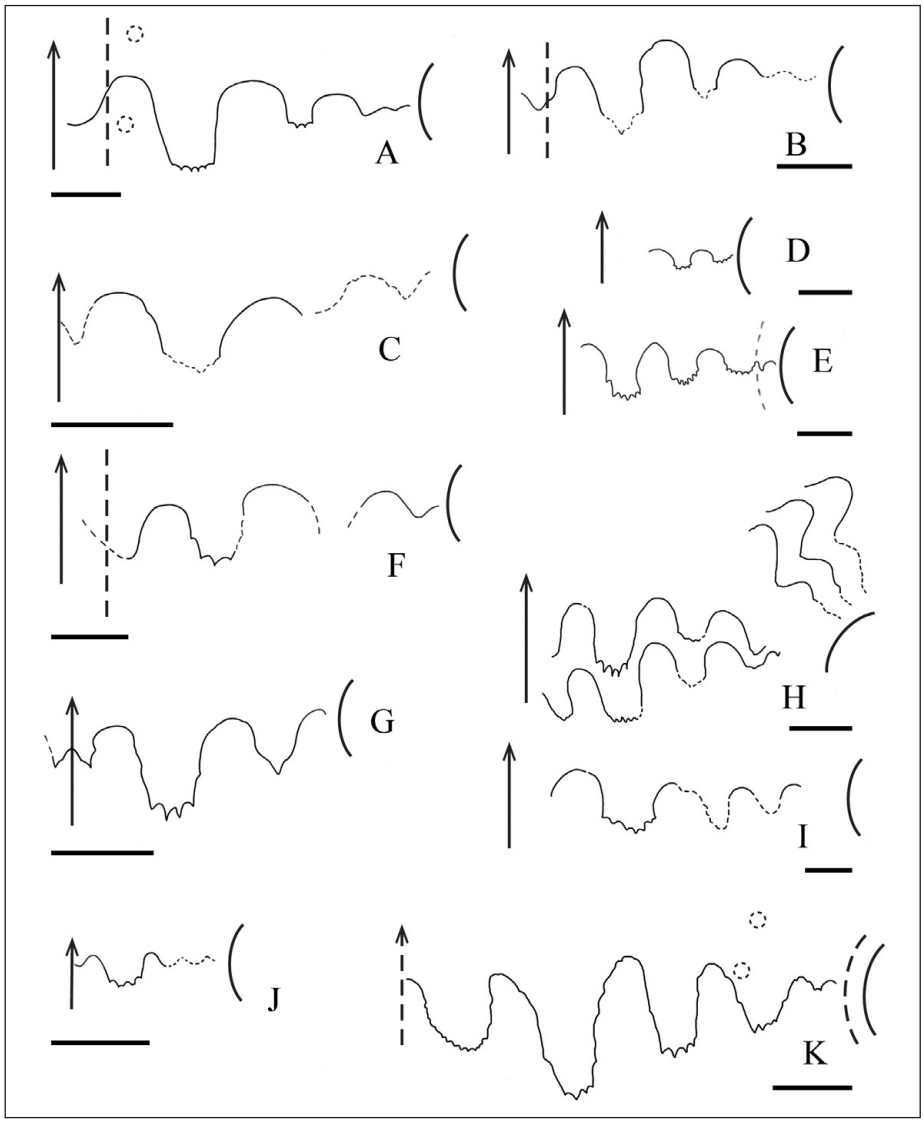

Fig. 7 - Suture lines of ammonoids from Rasa dolostone described in this paper. Shoulder and periumbilical margin is shown with dashed line, dotted lines are for nodes. Bar scales are 5 mm. A) *Parakellnerites frauenfelderi* Rieber, 1973, MSNVI B 03, H = 27 mm, SEZ. B (Pl. 5, fig. 1a-b). B) *Parakellnerites frauenfelderi* Rieber, 1973, MSNVI B 59 (mirrored), H = 20 mm, SEZ. B (Pl. 5, fig. 2a-c). C) *Stoppaniceras grandinodum* Rieber, 1973, MSNVI E 28, H = 17 mm, SEZ. E1 (Pl. 6, fig. 8a-b). D) *Serpianites curionii* Rieber, 1973, MSNVI D 94 (mirrored), H = 13,5 mm, SEZ. D1 (Pl. 3, fig. 6a-b). E) same specimen, H = 18 mm. F) *Chieseiceras chiesense* (Mojsisovics, 1882), MSNVI B 09 (mirrored), H = 30,5 mm, SEZ. B1 (Pl. 7, fig. 8a-b). G) *Nevadites ambrosionii* (Airaghi, 1912), MSNVI D 56 (mirrored), H = 12 mm, SEZ. D (Pl. 7, fig. 6a-b). H) *Rasaites rasaensis* n. gen. n. sp., MSNVI B 67 (mirrored), H = 27 mm, SEZ. B (Pl. 8, fig. 1a-b). I) same specimen, H = 37 mm. J) *Stoppaniceras variabile* Rieber, 1973, MSNVI L 03 (mirrored), H = 8 mm, SEZ. L (Pl. 6, fig. 6a-b). K) *Rasaites rasaensis* n. gen. n. sp., MSNVI D 47, holotype, (mirrored), H = 30,5 mm, SEZ. D (Pl. 8, fig. 3a-b).

better preserved on the specimens from Rasa. The specimen MSNVI B 37 (Pl. 7, fig. 3) is especially close to Rieber's specimen PIMUZ L/1250 figured on pl. 15, fig. 7 in its dense ribbing, while ribbing of the other large sized specimens is slightly stronger. The specimen MSNVI B 37 exhibits distinct and prominent umbilical nodes on the inner whorls, until about 17 mm of H, while in most of Rieber's specimens the umbilical nodes persist on the outher whorl.

The specimen MSNVI E 25a (Pl. 7, fig. 1) is preserved on the ventral side and part of the flanks. One of the flanks seems to be entirely preserved, and shows one umbilical node.

The suture line is not exposed.

Occurrence and age. The species occurs in in the type locality Tre Fontane (Airaghi 1912) and beds 106 and 112 of Besano Formation, Punkt 902/ Mirigioli section, Secedensis Zone (Rieber 1973a; Brack et al. 2005). From the old mine Val Porina of Mt. San Giorgio was documented a single specimen (Rieber 1973a, specimen PIMUZ L/1254, pl. 15, fig. 15) without stratigraphic informations. At Rasa it has been found from SEZ. B2 and E (scattered block of rock), upper part of the Secedensis Zone. The age is late Anisian.

Nevadites ambrosionii (Airaghi, 1912)

Pl. 7, fig. 2, , 5, 6a-b; Fig. 7G

1912 *Balatonites Ambrosionii* Airaghi, p. 27, pl. 4, fig. 10.

v 1973a *Protrachyceras ambrosionii* - Rieber, p. 68, pl. 15, fig. 10-12 16-19.

1995 "*Nevadites*" *ambrosionii* – Mietto & Manfrin, p. 554, pl. 3, fig. 9.

v 2011 *Nevadites* cf. *ambrosionii* – Pieroni, p. 65.

Locus typicus: Tre Fontane (Airaghi 1912, p. 4).

Stratum typicum: Besano Formation (Airaghi 1912, p. 4).

Material: Five specimens: MSNVI D 56, MSNVI D 63, MSNVI D 69, MSNVI D 70, from outcrop D, and MSNVI E 25b col-

lected together with MSNVI E 25a (*Nevadites dealessandrii*) from one block (E 25) at section E, but probably from a higher stratigraphic position.

Description. The available specimens share the subquadrate whorl section, that is one of the typical features of the species (Rieber 1973a). The largest specimen MSNVI D 70 (cast of external mold; Pl. 7, fig. 5) is nearly identical to the neotype (Rieber 1973a, pl. 15, fig. 11-12) and to the specimen PIMUZ L/1262 (ibd., pl. 15, fig. 16) in the widely spaced strong ribs, and the position of lateral spines, which are slightly stronger than the umbilical ones. On the contrary, the inner whorl of MSNVI D 70 (Pl. 7, fig. 5) shows strong and prominent umbilical nodes, that look stronger than the lateral ones. The smaller specimen MSNVI D 56 (Pl. 7, fig. 6) is preserved as internal mold and is similar to the inner whorl of MSNVI D 70 in the relative size of umbilical and lateral spines. The same type of umbilical and lateral nodes can be found also in the small specimen MSNVI D 69 (Pl. 7, fig. 2). The specimen MSNVI E 25b (Pl. 7, fig. 4) is nearly identical to D 70, but shows the ventral side (not figured) with ventral nodes in alternating position on both sides.

The suture line of MSNVI D 56 is preserved enough to be drawn (Fig. 7G). E is very short (divided by short ventral saddle), S1 rounded, L deep and denticulate with 4 digitations, S2 large and irregular, U2 large with only one acute digitation, SU is not complete.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI D 56	47.00	16.00	15.00	21.00	0.44	1.06

Remarks. The suture line of *N. ambrosionii* was unkwnown, and it is figured here for the first time. As in other species of *Nevadites*, the external suture consists of three saddles with indentations only in the lobe L. The outline of the second saddle S2 is not perfectly rounded.

Occurrence. The species is known from several localities in the Southern Alps, such as Tre Fontane (Airaghi 1912) and Punkt 902/Mirigioli in the Monte San Giorgio area (Rieber 1973a), Punta Zonia (Mietto & Manfrin 1995), and Rasa (Pieroni 2011). At Monte San Giorgio and Rasa the species occurs in the upper part of Secedensis Zone, late Anisian. The occurrence at Punta Zonia was referred to Fassanian (early Ladinan) by Mietto & Manfrin (1995), but in the framework of the chronostratigraphic scale with the Anisian/Ladinian boundary traced at the base of the Nevadites Zone. Therefore this occurrence is late Anisian in age.

Genus *Chieseiceras* Brack & Rieber, 1986

Type species: *Trachyceras chiesense* Mojsisovics, 1882

Chieseiceras chiesense (Mojsisovics, 1882)

Pl. 7, fig. 7a-d, 8a-b; Pl. 9, fig. 6a; Fig. 7F

? 1854 *Ammonites Pemphix* Merian, p. 88.
? 1855 *Ammonites Pemphix* – Hauer, p. 410, pl. 1, fig. 3-4.
1881 *Trachyceras (Ceratites) chiesense* – Bittner, p. 255.
1882 *Trachyceras chiesense* Mojsisovics, p. 95, pl. 34, fig. 4.
v 1882 *Ceratites Zezianus* Mojsisovics, p. 44, pl. 37, fig. 3-4.
? 1882 *Ceratites pemphix* – Mojsisovics, p. 41, pl. 39, fig. 9.
1898 *Protrachyceras chiesense* – Geyer, p. 134.
1905 *Ceratites Zezianus* – Diener, 780.
1906 *Ceratites planus* – Mariani, p. 652.
1913 *Anolcites doleriticus* – Tommasi, p. 66, pl. 4, fig. 25.
1914 *Protrachyceras chiesense* – Horn, p. 22, fig. 63, 67, 70.
1914 *Ceratites Zezianus* – Horn, p. 63.
1943 *Ceratites Zezianus* – Boni, p. 81.
1967 *Protrachyceras chiesense* – Jacobshagen, p. 21.

PLATE 7

Nevaditinae from Rasa dolostone.

Fig. 1 – *Nevadites dealessandrii* (Airaghi, 1912), MSNVI E 25a, SEZ. E, Secedensis Zone: ventral view. Silicon rubber cast.
Fig. 2 – *Nevadites ambrosionii* (Airaghi, 1912), MSNVI D 69, SEZ. D, Secedensis Zone: lateral view. Silicon rubber cast.
Fig. 3 – *Nevadites dealessandrii* (Airaghi, 1912), MSNVI B 37, SEZ. B2, Secedensis Zone: lateral view. Silicon rubber cast.
Fig. 4 – *Nevadites ambrosionii* (Airaghi, 1912), MSNVI E 25b, SEZ. E, Secedensis Zone: ventral view. Silicon rubber cast.
Fig. 5 – *Nevadites ambrosionii* (Airaghi, 1912), MSNVI D 70, SEZ. D, Secedensis Zone: lateral view. Silicon rubber cast.
Fig. 6 – *Nevadites ambrosionii* (Airaghi, 1912), MSNVI D 56, SEZ. D, Secedensis Zone: a) lateral view; b) ventral view with suture line (see also Fig. 7G). Silicon rubber cast.
Fig. 7 – *Chieseiceras chiesense* (Mojsisovics, 1882), juvenile, MSNVI B 07, SEZ. B1 Secedensis Zone: a) and c) lateral views; b) oral view; d) oblique view. Silicon rubber cast.
Fig. 8 – *Chieseiceras chiesense* (Mojsisovics, 1882), MSNVI B 09, SEZ. B1, Secedensis Zone: a) ventral view; b) lateral view with suture line (Fig. 7E). Internal mold (Steinkern) and plaster cast from external mold.
Bar scale is 10 mm.

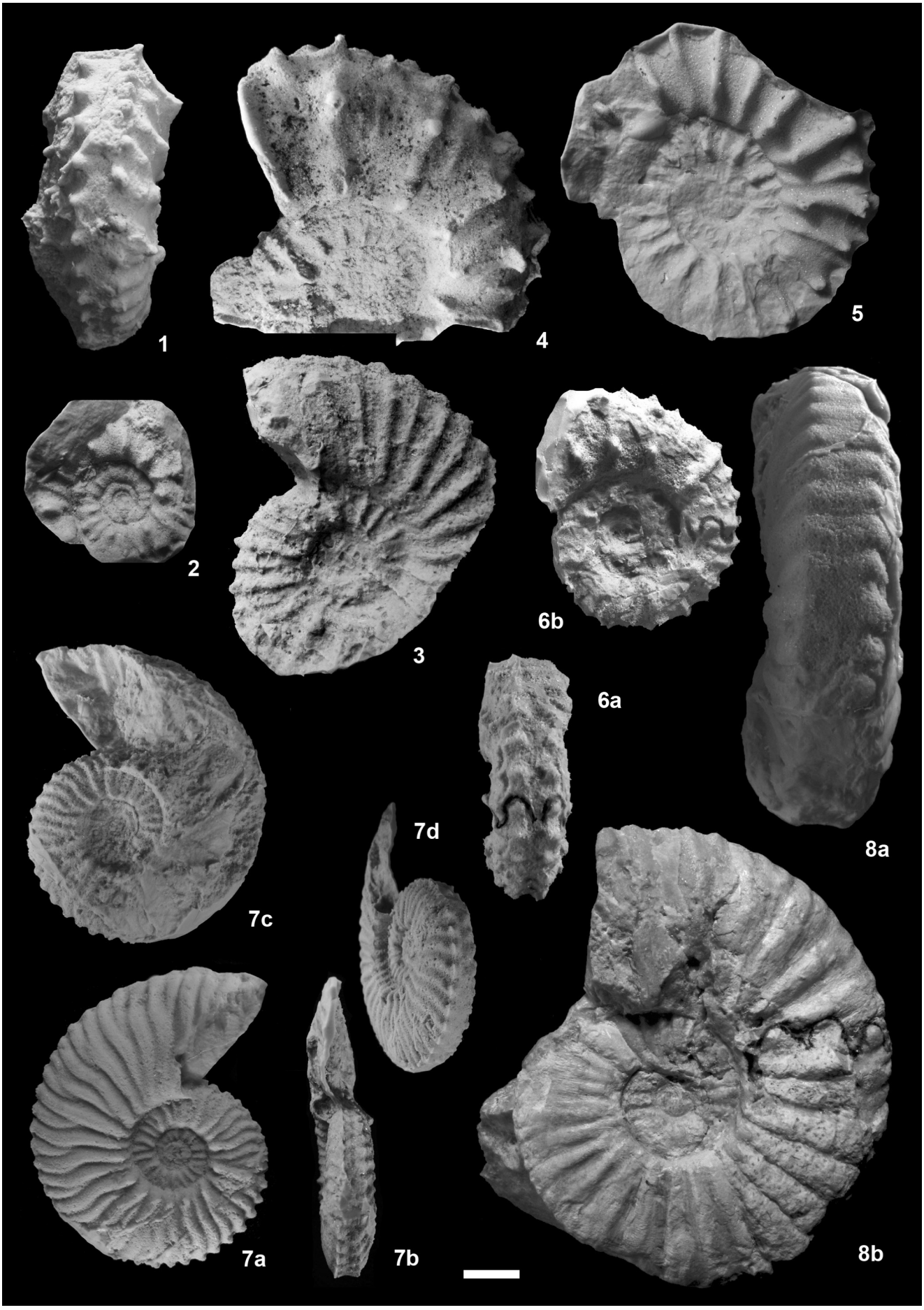

PLATE 7

v? 1973a *Protrachyceras* cf. *gortanii* – Rieber, p. 69, pl. 15, fig. 14.
v 1986 *Chieseiceras chiesense* – Brack & Rieber, p. 195, pl. 1, fig. 1-11; pl. 2, fig. 1, 3, 4, 9; pl. 4, fig. 7; text-fig. 9a-f.
1993 *Chieseiceras chiesense* – Gaetani, pl. 7, fig. 1-3, 5.
v 1995 *Chieseiceras chiesense* – Mietto & Manfrin, p. 556, pl. 3, fig. 8; pl. 4, fig. 5.
v 1995 *Chieseiceras chiesense* – De Zanche et al., text-fig. 6; pl. 3, fig. 2, 3, 7.
2008 *Chieseiceras chiesense* – Vörös et al., p. 329, pl. 1, fig. 2; pl. 2, figs. 2-3.
v 2011 *Chieseiceras chiesense* – Pieroni, p. 66, pl. 11cefal., fig. 3, 3a, 3b.
v? 2011 *(Eo)protrachyceras* cf. *gortanii* – Pieroni, p. 68, pl. 11cefal., fig. 1, 1a, 1b, 1c; p. 69 (juv.).
2018 *Chieseiceras chiesense* – Vörös, p. 114, pl. 29, fig. 6.
? 2018 *Chieseiceras chiesense* – Vörös, p. 114, pl. 30, fig. 1.

Locus typicus: below the village of Prezzo, Giudicarie, Italy (Mojsisovics 1882, p. 96).

Stratum typicum: Buchenstein Formation (Mojsisovics 1882, p. 96).

Material: one adult specimen MSNVI B 09, one subadult MSNVI B 07, and three juveniles MSNVI B 08, MSNVI B 42, MSNVI B 43. The specimen MSNVI D 120 was collected from an isolated outcrop near the SEZ. D1.

Description and remarks. *Chieseiceras chiesense* was so well revised by Brack & Rieber (1986) on the basis of a large collection of stratigraphically well constrained specimens that the new specimens from la Rasa provide only additional information to the species, namely on the ornamentation of juveniles, and on its suture line.

The juvenile MSNVI B 07 (Pl. 7, fig. 7), preserved as cast of external mold, exhibits the peculiar ribbing of the species, as visible on the specimen with the same size figured by Brack & Rieber (1986, pl. 1, fig. 7). The ribs are nearly flat on the outer part of the flank.The branching point often occur on the inner part of the flank, while in the last quarter of whorl the branching point is moving from the middle to the outer part of the flank.

The specimens from Rasa exhibit weak but distinct umbilical nodes, a row of weak nodes very close to the shoulder, and one row of prominent nodes at the shoulder, in ventral position. The umbilical nodes are also visible on the specimens illustrated by Brack & Rieber (1986, pl. 1, fig. 1, 7), while the row of lateral nodes close to the shoulder, best visible on the specimen MSNVI B 07 (Pl. 7, fig. 7b, 7d), has never been reported so far in *Chieseiceras*. The umbilical nodes, usually prominent, can be found in all the species of *Chieseiceras*, namely *C. chiesense* (Mojsisovics, 1882), *C. perticaense* Brack & Rieber, 1986, and *C. dolomiticus* Brack & Rieber, 2019.

The suture line is preserved on the large specimen MSNVI B 09 (Fig. 7F) and shows some differences with respect to the suture line figured by Brack & Rieber (1986) on a juvenile form. The mature specimen from Rasa exhibits a trace of E with large ventral saddle, a shallow L, and a small lobe near the umbilical rim.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI B 09	87.50	33.20	19.50	27.00	0.30	1.70

Occurrence and age. Our specimens from Rasa are not the first report of *C. chiesense* from San Salvatore Dolomite s.l., because Hauer (1855) decribed as *Ammonites Pemphix* one specimen (lost, right now) that according to Brack & Rieber (1986) is actually belonging to *C. chiesense* (see above the description of *Ceresioceltites fumagallii*). Apart from this occurrence, *Chieseiceras chiesense* (Mojsisovics 1882) is known from many localities and facies of the Southern Alps, but it is also reported from Balaton Highland (see synonymy). It is a well recognized marker of the uppermost Secedensis Zone ("Chiesense groove" in the pelagic Buchenstein Formation, Brack & Rieber 1986, 1993; Brack et al. 2005), and of the latest Anisian.

Family Hungaritidae Waagen, 1895
Genus *Hungarites* Mojsisovics, 1879

Type species: *Ceratites mojsisovicsi* Roth, 1871

Remark. The historical overview provided by Vörös (2018) made clear the synonymy between *H. mojsisovicsi* (Roth 1871) and *H. zalaensis* (Boeckh, 1872).

Hungarites cf. ***mojsisovicsi*** (Roth, 1871)
Pl. 8, fig. 7

Material: one specimen, MSNVI D 55, collected in the outcrop SEZ. D1.

Description. The specimen from Rasa is a juvenile (D about 22 mm) that is very similar to *H. mojsisovicsi* (Roth, 1871) in the involute coiling, the ornamentation consisting of ribs, the flat and relatively wide venter with distinct keel in its middle part. The reason for the attribution in open nomenclature is in its small size.

Dimensions (mm)

	D	H	W	U	U/D
MSNVI D 55	21.7	11.3	-	2.7	0.12

Occurrence. The specimen is from the middle part of the Secedensis Zone, Late Anisian.

Family Hungaritidae ? Waagen, 1895
Genus *Rasaites* n. gen.

Type species: *Rasaites rasaensis* n. gen. n. sp.
Zoobank ID:urn:lsid:zoobank.org:act:70FDE764-F4B1-42A3-99BF-C6A98712991D

Derivatio nominis: From Rasa village (Varese).

Diagnosis: Medium to large sized ammonoids, with very involute coiling, compressed subtriangular whorl section, and an extremely narrow shouldered and keeled venter. Small, but open and deep umbilicus with high umbilical wall mostly vertical to the umbilical seam. Umbilical edge angular and smooth. Sculpture characterized by evanescent and sigmoid ribs and one row of tiny lateral nodes at about ¼ of whorl height. Early representatives of the genus exhibit a second row of tiny nodes in periumbilical position. No significant changes in coiling, whorl section, venter and ornamentation during ontogeny. External suture line with five saddles, sometimes linguoid or very slightly wavy.

Composition of the genus: type species only.

Family assignment and comparison with other genera. The new genus *Rasaites* exhibits a peculiar combination of features that justifies its definition, but at the same time this combination makes the family assignment quite complex. *Rasaites* n. gen. exhibits similarities with some genera of the subfamily Longobarditinae Spath, 1951 (family Longobarditidae Spath, 1951), but other characters of the new genus suggest assignment to the superfamily Ceratitoidea Mojsisovics, 1879, family Hungaritidae Waagen, 1895. For the time being we prefer the attribution to Hungaritidae, but with some uncertainty.

The involute coiling with small umbilicus, and the subtriangular whorl section with very narrow venter could suggest comparision to Longobarditinae. However, in several Longobarditinae (e.g. *Grambergia* Popov, 1961; *Intornites* Assereto, 1966), as in many other Longobarditidae, the coiling, the venter and the ornamentation of the inner whorls are very different from the outher whorls. This is not the case of *Rasaites* n. gen. whose inner features, above all the lateral nodes, but also coiling, whorl section and venter, are persisting on the outher whorls. Within Longobarditinae only *Longobardites* Mojsisovics, 1882 does not show any significant changes in the coiling and ornamentation from the inner whorls to the outher whorl. However, the venter of *Longobardites* is not narrow shouldered, but it is sharp acute to fastigate (see Assereto 1966). Even more important, *Longobardites* does not have any nodes, anywhere. The nodes are, to us, the main argument against the assignment to Longobarditidae, because no one member of this family exhibits lateral nodes throughout the entire coiling untill the mature body chamber. Last but not least, except for *Longobardites*, all the other Longobarditinae are known only from the Pacific and Arctic paleobioprovinces, then the attribution of *Rasaites* to this subfamily would be difficult to support from an evolutionary and paleobiogeographic perspective, as this genus appears to lack relationships with all the known genera of the subfamily.

The combination of keeled venter with lateral and umbilical nodes suggest comparison of *Rasaites* n. gen. with Ceratitoidea. Within this large superfamily, family Hungaritidae Waagen, 1895 is the one with the more similarities. This family is known to have undergone a wide differentiation in the Tethys during the late Anisian-early Ladinian and with numerous evolutionary adaptations to shallow-water marine environments, both within the Tethys Realm and the shallow epicontinental basins of the Sephardic Province, along the southern margin of the Neotethys.

Focusing on systematic comparisions, the Hungaritidae are characterized by compressed whorl section, more or less strongly keeled venter, various type of ornamentation, including rows of nodes, and suture lines with slighlty more elements than in Paraceratitinae Silberling, 1962. *Rasaites* is very close to Hungaritidae in these features, but differs from most of the members of the family in the nearly subtriangular whorl section. In several Hungaritidae the venter is actually wider than in *Rasaites* (e.g. *Hungarites* Mojsisovics, 1879, *Bullatihungarites* Vörös, 2018 and *Nodihungarites* Vörös, 2018; see the revision of *Hungarites* Mojsisovics, 1879 by Vörös 2018). Only *Negebites* Parnes, 1962 exhibits a venter as narrow as in *Rasaites*, resulting in a nearly oxycone shape (e.g. Parnes 1986, pl. 2, fig. 2-4). The venter of *Negebites*, however, becomes wider and nearly tricarinate on the second half of the body chamber. Moreover, *Negebites* does not have any rows of nodes and is characterized by a

ceratitic suture line with 2nd lobe (L) very wide and divided in two parts (Parnes 1986, pl. 23, fig. 5-6).

Occurrence and age: The new genus *Rasaites* in known only from Rasa dolostone, from the upper part of the Reitzi Zone and the Secedensis Zone, late Anisian.

Rasaites n. gen. ***rasaensis*** n. sp.

Pl. 8, fig. 1a-b, 2a-c, 3a-b, 4, 5, 6; Fig. 7H, 7I, 7K

Zoobank ID:urn:lsid:zoobank.org:act:0F885C9A-FA9D-4D5A-A266-9DFAEE338A41

Material: A total number of 11 specimens are attributed to this species. The type series consists of four specimens from SEZ. D: Holotype MSNVI D 47, preserved as internal mold, and three paratypes MSNVI D 48a preserved with test, while MSNVI D 47b and MSNVI D 118 are incomplete. All the types are preserved only on one side. The specimen MSNVI D 56a (preserved one side and part of the other) from the same locality is as large as the holotype, but exhibit a slight umbilical egression.

Five specimens from locality SEZ. B, and one from SEZ. I are attributed to the species but excluded from the type series: one, relatively well preserved specimen MSNVI B 67 (part of both sides), and five poorly preserved specimens MSNVI B67aa (one flank), MSNVI B 90a-c (mostly on one side), and MSNVI I 46 (one side).

Derivatio nominis: From Rasa village (Varese).

Locus typicus: Rasa Valley, SEZ. D, Rasa Valley, Varese, Italy.

Stratum typicum: Rasa dolostone, outcrop SEZ. D.

Diagnosis: See the diagnosis of the genus.

Description. The description of the species is based on the type series. The whorl section is always very compressed, nearly subtriangular, with sharp keel on the very narrow venter. The venter is so narrow that the keel seems to be directly starting from the weak shoulders. The flanks are weakly convex with the whorl maximum width at ¼ of height, where the spiral row of nodes is located. The umbilicus is deep and the umbilical wall is high and smooth. The whorl section does not show any evidence of late ontogenetic changes (see the body chamber of the holotype).

Ornamentation consisting of two rows of nodes and evanescent ribs. The umbilical nodes are limited to the inner whorls and visible only on the small paratype MSNVI D 118 at about 30 mm of diameter. All the other paratypes are of larger size and exhibit only the lateral nodes. The lateral nodes occur on medium to large sized specimens. On the medium sized specimen MSNVI D 48a (Pl. 8, fig. 2) there are about 13 lateral nodes in half whorl. On the holotype MSNVI D 47 (Pl. 8, fig. 3) the lateral nodes are relatively narrowly spaced until the beginning of the body chamber, then the spacing becomes irregular and the nodes get weaker. Overall, eight weak nodes occur on the last half whorl of the body chamber.

The sigmoidal evanescent ribs start from the lateral nodes and fade on the shoulder.

Suture line of holotype MSNVI D 47 (Fig. 7K): lobe E large and indented, S1 large and inclined toward the venter, L very deep and slender, S2 irregular and slender, U2 similar to L but less deep, SU irregular, U3 large.

Description of the additional specimens. Four of the additional specimens are of small size, and are preserved only on one side. The umbilical nodes are visible on the two smaller specimens, MSNVI B 90b (see Pl. 8, fig. 6) and MSNVI B 90c, at a diameter that is consistent with the diameter of the paratype MSNVI D 118. The umbilical nodes fade at larger diameter, and are not anymore visible on specimen MSNVI B 90a, whose diameter is about 38 mm. The umbilical areas is not preserved on fourth specimen MSNVI I 46.

The specimens MSNVI B 67 (cast of the inner surface of the test) and MSNVI D 56a (internal mold of part of phragmocone and part of the body chamber) are of medium-large size and exhibit a whorl section that looks to be more wider and more subtriangular than the restored cross section of the holotype MSNVI D 47. The lateral nodes occur on both the specimens, also on the body chamber, in

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Plate 8

Hungaritidae from Rasa dolostone.

Fig. 1 – *Rasaites rasaensis* n. gen. n. sp., MSNVI B 67, SEZ. B, Reitzi Zone: a) lateral view with suture line; b) oral view. Silicon rubber cast. The suture line is in Fig. 7H. The arrow marks the row of lateral nodes.

Fig. 2 – *Rasaites rasaensis* n. gen. n. sp., MSNVI D 48a, paratype, SEZ. D, Secedensis Zone: a) lateral view; b) oral view; c) outline of the oral view. Replaced test.

Fig. 3 – *Rasaites rasaensis* n. gen. n. sp., MSNVI D 47, holotype, SEZ. D, Secedensis Zone: lateral view of the internal mold (Steinkern) with suture line (Fig. 7K); b) cross section of the specimen obtained by mirroring the right side of the specimen.

Fig. 4 – *Rasaites rasaensis* n. gen. n. sp., MSNVI B 90a, SEZ. B, Reitzi Zone: lateral view. Silicon rubber cast.

Fig. 5 – *Rasaites rasaensis* n. gen. n. sp., MSNVI D 118, paratype, SEZ. D, Secedensis Zone: lateral view. Silicon rubber cast.

Fig. 6 – *Rasaites rasaensis* n. gen. n. sp., MSNVI B 90b, SEZ. B, Reitzi Zone: lateral view. Silicon rubber cast.

Fig. 7 – *Hungarites* cf. *mojsisovicsi* (Roth, 1871), MSNVI D 55, SEZ. D1, Secedensis Zone: lateral view.

Bar scale is 10 mm.

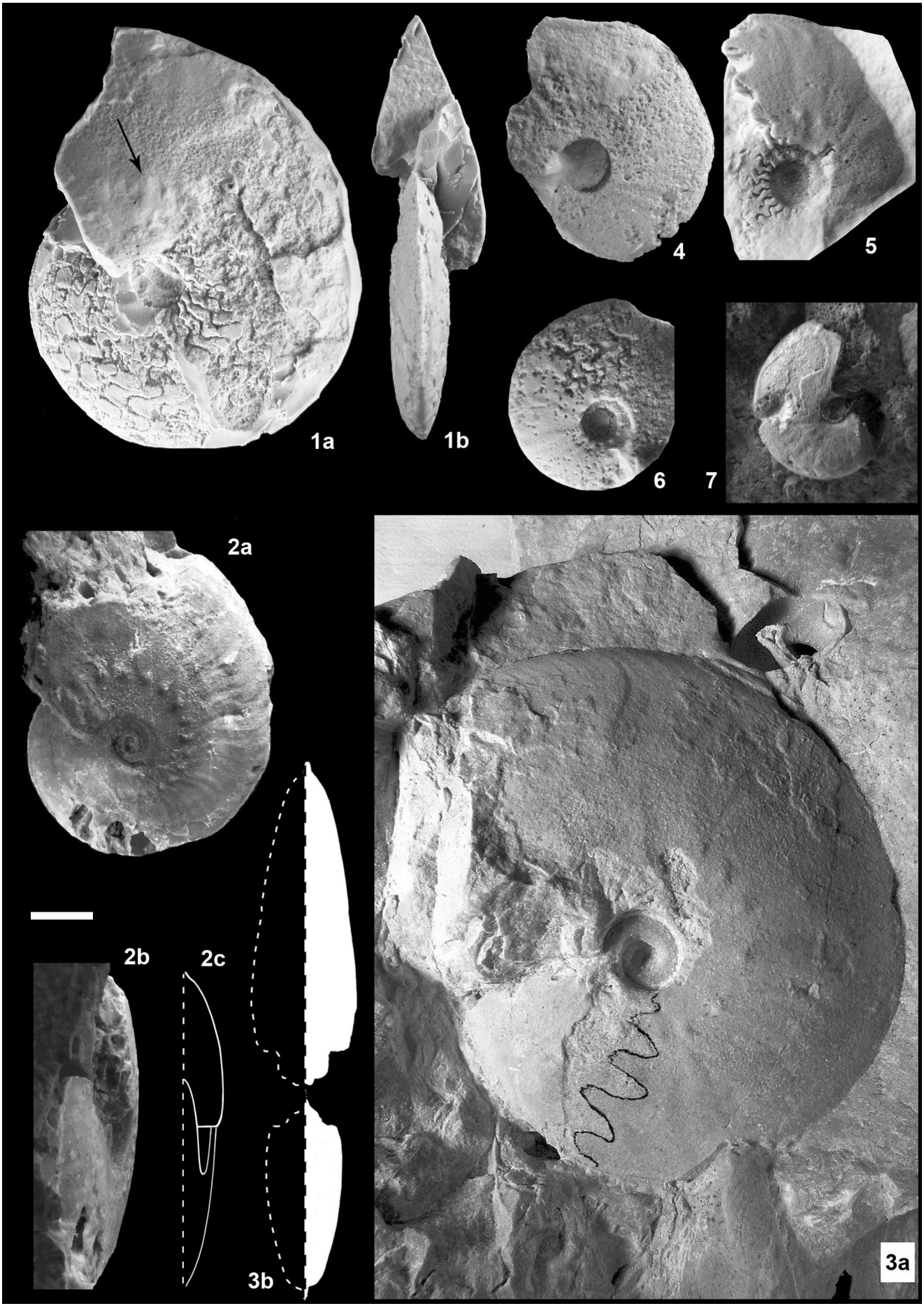

PLATE 8

the same position of the holotype. Ribbing weak and not very well preserved, but consistent with the ribbing of the holotype.

The suture line is visible on both the specimen MSNVI B 67 (Fig. 7H, 7I) and MSNVI D 56a, but it is strongly dolomitized. The saddles of both the specimens are not elongated, as in the holotype (Fig. 7K), and are more rounded. Six lobes are visible between the shoulder and the umbilical margin.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI D 47 holotype	100.50	52.70	-	13.27	0.13	-
MSNVI D 48a paratype	55.80	29.60	-	7.45	-	-
MSNVI D 118 paratype	39	18.7	9	7.7	0.19	2.07
MSNVI B 67	79.00	44.00	23.00	9.00	0.11	1.91
MSNVI B 67aa	40	21	-	-	-	-
MSNVI B 90a	38.5	20	-	7	0.18	-
MSNVI B 90b	32.5	18	7?	5.5	0.17	2.57?
MSNVI B 90c	34	17.5	-	6.5	0.19	-

Discussion. *Rasaites rasaensis* n. gen. n. sp. is based on four types out of 11 specimens. All the types are from the same locality SEZ. D, and consist of the best preserved medium to large sized specimens of the 11 available. The types, however, are preserved only on one side, as most of the 6 specimens that are excluded from the type series. This second group of specimens seems to differ a little from the types in the apparently thicker and more subtriangular whorl section and in the suture line with rounded instead of linguoid saddles. The limited number of specimens available, and their incomplete preservation do not allow to test if these differences are intraspecific or if they might be due to an evolutionary trend.

Following the discussion of the similarities at genus level (see chapter "Family assignment and comparison with other genera") *Rasaites rasaensis* n. gen. n. sp. might be compared with *Negebites zaki* Parnes 1962. *N zaki*, the only species of *Negebites* Parnes, 1962, is similar to *R. rasaensis* n. gen. n. sp. in the compressed subtriangular whorls section, but notably differs for the variation of the venter during ontogeny. The venter of *N. zaki* is truncated on the inner whorls, then it becomes narrow and carinate, but in the large size body chamber the venter becomes wider and nearly subtricarinate (Parnes 1986). The ornamentation of *N. zaki* consists only of weak ribs, while *R. rasaensis* gen. n. sp. exhibits two rows of nodes, with the lateral row persisting on the large sized body chambers. The suture line of *N. zaki* (Parnes 1986, pl. 23, fig. 5,6) consists of five saddles, with lobe L very wide and subdivided into two parts, while the suture of *R. rasaensis* n. gen. n. sp. does not exhibit any subdivision of lobes. On average, the lobes of *N. zaki* are wider and shallower than the lobes of *R. rasaensis* n. gen. n. sp., also on the inner part of the flank.

Within the genus *Hungarites* Mojsisovics, 1879 *Hungarites mojsisovicsi* (Roth, 1871)[= *Hungarites zalaensis* (Boeckh, 1872) see above] might be compared to *R. rasaensis* n. gen. n. sp. for its coiling and the size of the adult specimens. *H. zalaensis*, however, never show lateral nodes. Its venter is always flat, with keel that is well separated from the shoulders, while in *R. rasaensis* gen. n. sp. the keel is directly connected to the shoulders. Moreover, at the adult stage *H. zalaensis* shows a thickening of the whorl and widening of the venter that are not developed in *R. rasaensis* n. gen. n. sp. despite the large size of the holotype.

Other taxa that can be comparted to *R. rasaensis* n. gen. n. sp. are *Israelites ramonensis gracilis* Parnes 1962 and *Iberites nodosus* Fantini Sestini, 1994. *Israelites ramonensis gracilis* is similar to *R. rasaensis* n. gen n. sp. in the whorl section with narrow and carinate venter. Its venter, however, is wider than the venter of *R. rasaensis* in a way that the section is more subtrapezoidal than subtriangular (e.g. Parnes 1986, pl. 2, fig. 8). The body chamber of *I. r. compressus*, and of all the *Israelites*, is binodose, with lateral and ventrolatral nodes, while *R. rasaensis* n. gen. n. sp. exhibits lateral nodes and weak and tiny umbilical nodes on the inner whorls.

The whorl section of *Iberites nodosus* Fantini Sestini, 1994 is somewhat similar to the whorl section of *R. rasaensis* n. gen. n. sp., for the flank converging to the narrow venter. The venter however, is not as narrow as in *R. rasaensis* n. gen. n. sp. and, more important, is tricarinate (Fantini Sestini 1994). Moreover, the lateral nodes of *I. nodosus* are much stronger and widely spaced than in *R. rasaensis* n. gen. n. sp.

Occurrence and age. The new species is known only from Rasa dolostone, where it has been found in SEZ. D, in co-occurrence with *Nevadites ambrosionii* in the Secedensis Zone, SEZ. B from the upper part of Reitzi Zone and SEZ. I, Secedensis Zone, late Anisian.

Superfamily Clydonitoidea Hyatt, 1877
Family Trachyceratidae Haug, 1894
Subfamily Protrachyceratinae Tozer, 1971
Genus *Eoprotrachyceras* Tozer, 1980

Type species: *Eoprotrachyceras matutinum* Tozer, 1980

Eoprotrachyceras sp. ind.
Pl. 9, fig. 1

Material: only specimen MSNVI G 01, from the outcrop SEZ. G.

Remarks. Section SEZ. G has provided several gastropods but only one ammonoid, MSNVI G 01. This specimen is of small size (D=23 mm) and it is not very well preserved. The coiling of the inner whorls is evolute, then it becomes involute. The whorl section is compressed. The ornamentation consists of ribs and about four rows of nodes. The attribution to *Eoprotrachyceras* is suggested by the number of rows of nodes, because *Protrachyceras* usually shows 5 or more rows of nodes [e.g., *Protrachyceras archelaus* (Laube, 1869); *P. ladinum* (Mojsisovics, 1882); *P. longobardicum* (Mojsisovics, 1882)]. However, the small size and the preservation prevent from any specific attribution.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI G 01	23	11.6	6.2	5.8	0.25	1.87

Occurrence. *Eoprotrachyceras* Tozer, 1980 is limited to the early Ladinian (Tozer 1980, 1981a, 1981b, 1994; Brack et al. 2005). For its stratigraphic position, the specimen from Rasa can be referred to the lower part of Curionii Zone, early Ladinian.

Genus *Protrachyceras* Mojsisovics, 1893

Type species: *Trachyceras archelaus* Laube, 1869

Protrachyceras cf. ***archelaus*** (Laube, 1869)
Pl. 9, fig. 2a-b

Material: only specimen MSNVI E 00, from debris.
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Description. The specimen was collected from a loose block of bioclastic limestone at site SEZ. E. It is preserved as undeformed imprint, from which we obtained the cast. The whorl section is rather thick. The ornamentation consists of ribs and at least six rows of spiny nodes. The nodes from the rows 1, 3, 5 and 6 are stronger than the others. In particular the most prominent spines are those from row 3. Ventral nodes are single-spined and occupy alternate positions on both sides of the venter.

Remarks. The specimen is attributed to *Protrachyceras* Mojsisovics, 1893 for the high number of rows of nodes with respect to *Eoprotrachyceras* Tozer, 1980. The thickness of the whorl and the ornamentation suggest the attribution to *P. archelaus* (Laube, 1869). The attribution by *confronta* is due to the small size of the specimens, with respect to the average size of the type specimens (see the holotype refigured by Mojsisovics 1882, pl. 16, fig. 2).

Occurrence and age. The specimen MSNVI E 00 was collected from a loose block at SEZ. E. The block is from Rasa dolostone, but its provenance in unknown. Due to the classification in open nomenclature its assignment to the Archelaus Zone is doubtful.

Protrachyceras ? sp. ind.
Pl. 9, fig. 3a-b

Material: specimen MSNVI H 02 collected in outcrop at SEZ. H1.

Remarks. The specimen is a poorly preserved mold (D is about 30 mm), that is tentatively attributed to *Protrachyceras* on account of the six rows of nodes. The whorl section is much more compressed that the one of *Protrachyceras* cf. *archelaus* MSNVI E 00.

Dimensions (mm)

	D	H	W	U	H/W
MSNVI H 02	30?	11.2	8.6	-	1.30

Occurrence and age. The specimen can be referred to the late Ladinian.

Suborder **Pinacoceratina** Waagen, 1895
Superfamily Pinacoceratoidea Mojsisovics, 1879
Family Pinacoceratidae Mojsisovics, 1879
Genus *Pompeckjites* Mojsisovics, 1902

Type species: *Ammonites layeri* Hauer, 1847

Preliminary remarks. The genus *Pompeckjites* Mojsisovics, 1902 was erected on the basis of *Pinacoceras layeri* Hauer, 1847, that for many decades

was the only species of the genus. In the past 40 years two species have been assigned to *Pompeckjites*: *Pinacoceras philopater* (Laube, 1869) by Bizzarini (1988) and *Pinacoceras urlichsi* Bizzarini, 1988 by Spatzenegger & Polting (2023). The position of these two species, however, cannot be considered fully clarified, because the specimens studied by Bizzarini (1988) and by Spatzenegger & Polting (2023) are of small size. Moreover the value of *Pinacoceras philopater* was questioned by Krystyn (1973) and Urlichs (1974) who considered this species as synonym of *Pompeckjites layeri* (Hauer, 1847). Due to these uncertainties for our comparison and discussion we refer only to *P. layeri* (Hauer, 1847).

Pompeckjites donelioi n. sp.

Pl. 9, fig. 6b, 7a-b, 8

v 1994 *Pompeckjites* sp. ind. Fantini Sestini, p. 251, tab. 1.

Zoobank ID:urn:lsid:zoobank.org:act:4263B2E7-2C2E-44D6-9DE4-ED65B3C14ED9

Derivatio nominis: the species is dedicated to Don Elio Gentili, parish priest of Rasa Village and mentor of the study of the paleontology of Rasa Valley.

Diagnosis: *Pompeckjites* with slow coiling and open, concentric umbilicus.

Locus typicus: SEZ. B1, Rasa, located behind the cemetery.

Stratum typicum: Middle Rasa dolostone (*Chiesense* horizon), stratigraphically corresponding to the Gervillienhorizont of San Salvatore Dolomite.

Type series: holotype MSNVI B 43b, paratype MSNVI B 19, both collected from the outcrop SEZ. B1. The specimen MCSNB 9257 from Parina Valley, studied by Fantini Sestini (1994), is also included in the new species, but excluded from the type series.

Description. The specimens are small, the larger is 16 mm in diameter and exhibits the typical sinuous folds on the ventral portion of the flanks. The whorls are highly compressed, with acute and sharp venter. The coiling of the inner whorls is quite slow (e.g. holotype MSNVI B 43b ; Pl. 9, fig. 7), the umbilicus is open and concentric. Suture line not visible.

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI B 19 paratype	16	9	-	2	0.12	-
MSNVI B 43b holotype	12	6	2	2.2	0.18	3

Discussion. The specimens are attributed to *Pompeckjites* Mojsisovics, 1902 because of the very compressed whorl section, the acute and sharp venter, and the folds, limited to the external part of the flank and to the venter. In addition to these similarities, there are however some differences that suggest the separation of Rasa specimens from *Pompeckjites layeri* (Hauer, 1847), despite of their small size. The ontogeny of *P. layeri*, the only species of the genus *Pompeckjites* Mojsisovics, 1902, has been described by Mojsisovics (1873, p. 63, pl. 23, fig. 1-6; 1902, p. 298, pl. 19, fig. 4; pl. 20, fig. 1), and in this species the coiling is involute with closed umbilicus since the inner whorls. The opening of the umbilicus with excentric egression start from about 30 mm (e.g., Mojsisovics 1873, pl. 23, fig. 5) to about 40 mm of diameter (e.g., Mojsisovics 1902, pl. 19, fig. 4), depending on the specimens. The size of our specimens is comparable to the size of the specimen illustrated by Mojsisovics in pl. 23, fig. 6, with diameter ranging from 21 to 29 mm. This specimen exhibits already at this size a closed and excentric umbilicus.

Plate 9

Protrachyceratinae, Pinacoceratidae and Arcestidae from Rasa dolostone.

Fig. 1 – *Eoprotrachyceras* sp. ind., MSNVI G 01, SEZ. G, lower part of Curionii Zone; a) oral view; b) lateral view. Silicon rubber cast.

Fig. 2 – *Protrachyceras* cf. *archelaus* (Laube, 1869), MSNVI E 00, block from unknown bed collected at SEZ. E (see text for explantion): a) lateral view; b) ventral view. Silicon rubber cast.

Fig. 3 – *Protrachyceras* ? sp. ind., MSNVI H 02, SEZ. H1, Late Ladinian: a) lateral view; b) ventral view. Silicon rubber cast.

Fig. 4 – *Proarcestes* sp. ind., MSNVI B 18, SEZ. B1, upper Secedensis Zone (Chiesense Horizon): a) lateral view; b) oral view. Silicon rubber cast.

Fig. 5 – *Proarcestes* sp. ind., MSNVI B 80, SEZ. B, Reitzi Zone: a) oral view, b) and c) lateral views.

Fig. 6 – Silicon rubber cast from a dolostone slab with ammonoid assemblage, MSNVI B 43, SEZ. B1, Secedensis Zone (Chiesense Horizon): a) juvenile *Chieseiceras chiesense*; b) *Pompeckjites donelioi* n. sp.; c) three specimens of *Proarcestes* sp. Another juvenile specimen of *Chieseiceras* cf. *chiesense* is visible in the lower part of the picture.

Fig. 7 – *Pompeckjites donelioi* n. sp. (the same specimen in Fig. 6b), holotype, MSNVI B 43b, SEZ. B1, Secedensis Zone (Chiesense Horizon): a) lateral view; b) ventral view. Silicon rubber cast.

Fig. 8 – *Pompeckjites donelioi* n. sp., paratype MSNVI B 19, SEZ. B1, Secedensis Zone (Chiesense Horizon): lateral view. Silicon rubber cast.

Bar scale is 10 mm. Short bar is for fig. 1-5, long bar is for fig. 6-8.

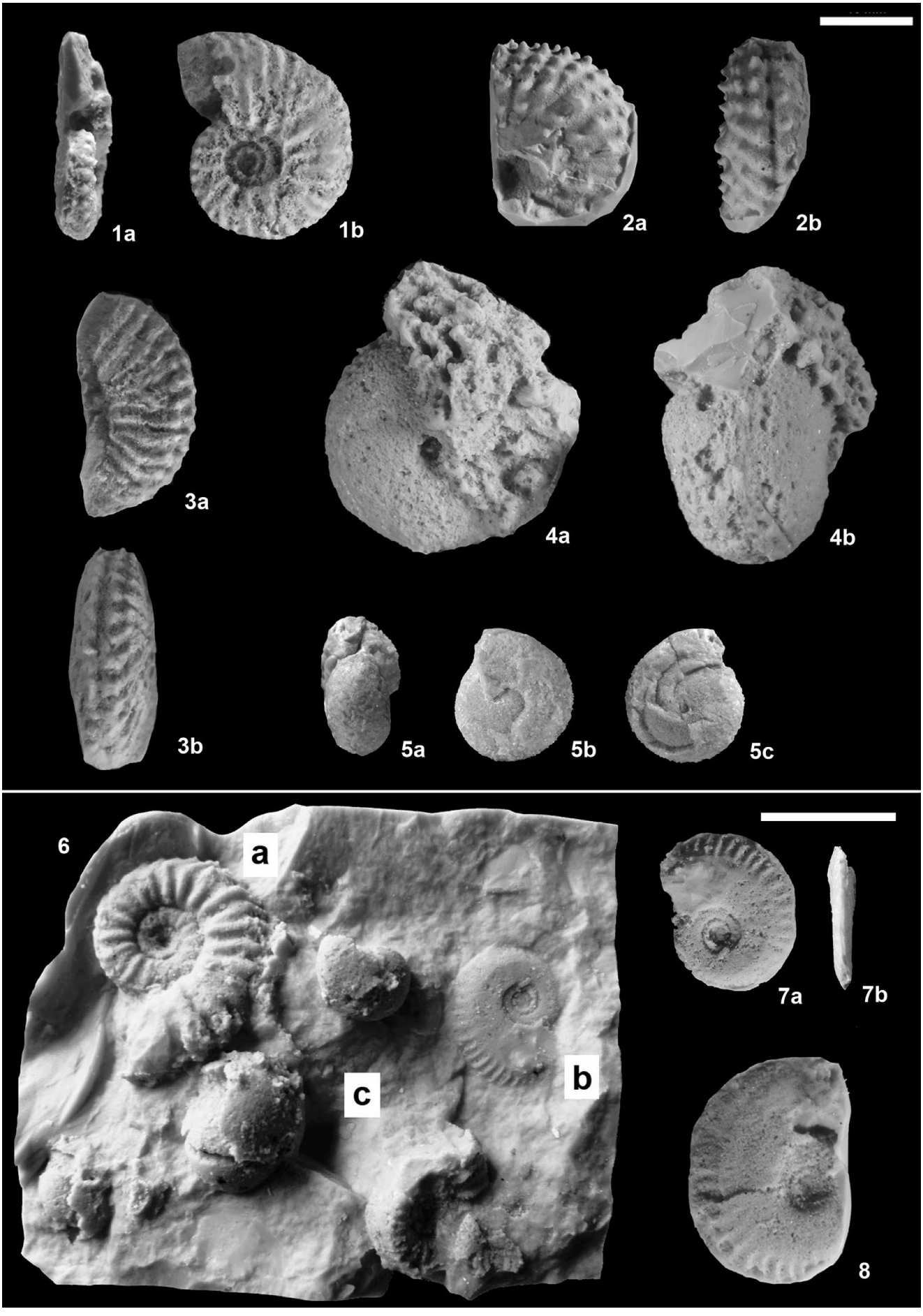

PLATE 9

The specimen MCSNB 9257 from the Esino Limestone of Parina Valley, classified as *Pompeckjites* sp. ind. by Fantini Sestini (1994, p. 251, tab.1) has been examined by us. It exhibits a concentric umbilicus and is conspecific with the type specimens of *Pompeckjites donelioi* n. sp. from Rasa Valley. Its umbilicus is slightly more open than the umbilicus of Rasa type specimens, but we regard this small difference as intraspecific.

Occurrence and age. The new species *Pompeckjites donelioi* is known from locality SEZ. B1, Rasa Valley, Secedensis Zone, late Anisian, and from locality S 1010D, Parina Valley, Curioni Zone, early Ladinian. The new species is the oldest of the genus *Pompeckjites* Mojsisovics, 1902. *P. layeri*, the type of the genus, is known from the Carnian as documented by Mojsisovics (1873, 1902) from the Aonoides, Austriacum and Ellipticus zones, while Krystyn (1973) reported the species only from the Aon and Aonoides zones. *P. layeri* has been also identified by some other authors from some localities of the Western Tethys (e.g., Ganev 1961; Simionescu 1913; Allasinaz 1968a; Entcheva 1972), but some of these identifications would need a revision. Moreover, the chronostratigraphic calibration of some of these identifications is not very precise, due to the lack of bed-by-bed collections or to the occurrence in condensed facies (e.g. Hagigiol, Dobrogea: Simionescu 1913).

Suborder **Arcestina** Hyatt, 1884
Superfamily Arcestitoidea Mojsisovics, 1875
Family Arcestidae Mojsisovics, 1875
Genus *Proarcestes* Mojsisovics, 1893

Type species: *Arcestes bramantei* Mojsisovics, 1869

Proarcestes sp. ind.
Pl. 9, fig. 4a-b, 5a-c

Material: about ten specimens from SEZ. B1 (specimen MSNVI B 18, and specimens from blocks MSNVI B 43 and MSNVI B 08), SEZ. B (specimen MSNVI B 80), and SEZ. N.

Remarks. The available specimens are very small sized (D<10 mm) and just a little depressed in their whorl section as the U/D is comprised between 1 and 0.8. They are attributed to *Proarcestes* Mojsisovics 1875 on account of their globose, sphaeric shape. They are similar, but with smaller size, to *Proarcestes boeckhi* (Mojsisovics, 1875). The specimens are not as depressed as the *P. extralabiatus* identified by Rieber (1973a, p. 70, pl. 17, fig. 19, 22-23, 25) from the Besano Formation (=Grenzbitumenzone).

Dimensions (mm)

	D	H	W	U	U/D	H/W
MSNVI B 18	29	18.5	23	2	0.06	0.8
MSNVI B 80	18	11	11?	1	0.05	1?
MSNVI N	12					

Occurrence and age. The genus *Proarcestes* is a long ranging leiostraca, regarded by Tozer (1981a) as middle Anisian to Carnian in age. The specimens from Rasa are from the Reitzi Zone (SEZ. B), the Secedensis Zone (SEZ. N) and uppermost part of the Secedensis Zone (SEz. B1), where they co-occur with *Chieseiceras chiesense* and *Pompeckjites donelioi* n. sp.

Chronostratigraphy of Rasa dolostone

The abundant and diverse ammonoid faunas from Rasa dolostone can be correlated with the ammonoid-based chronostratigraphic scale of the upper Anisian/Ladinian. This scale is probably the best defined and best calibrated of the entire Triassic, especially as regard the western Tethys, mostly because of the huge amount of work carried out in the 1990s and 2000s that led to the definition of the GSSP of the Ladinian on an ammonoid event at Bagolino (Brescia; Brack et al. 2005). In the past decades ammonoid taxonomy and historical zonations have been revised, starting from Besano Formation (Grenzbitumenzone in Rieber 1973a), then including the faunas from the Buchenstein Formation (Brack & Rieber 1986, 1993, 1994, 1995; Rieber & Brack 2004). Crucial historical localities of the Balaton Highland (Hungary) were also revised (Vörös 1989, 1993, 2010, 2014, 2018; Vörös & Palfy 1989), and new faunas from carbonate platforms in Southern Alps were described by Brack & Rieber (1993), Fantini Sestini (1994, 1996) and Manfrin et al. (2005). Calibration of the Western Tethys scale with that of the North America has been reviewed by Balini et al. (2010), Vörös (2014) and Jenks et al. (2015).

Figure 8 shows the distribution of the identified taxa in the studied localities of Rasa Valley.

	LATE ANISIAN															EARLY LADINIAN	
	Reitzi Z.			Secedensis Z.												Curionii Z.	Gredleri Z.
Outcrops	B	C lower	C2	C upper	C1	D1	E	E1	L	A2	I	N	D lower	D upper	B2	M	B1	G	H1
Flexoptychites gottardoi n. sp.	*	*											*						
Ceresioceltites fumagallii											*	*	*						
Ceresioceltites paronai											*					*			
Aplococeras cf. *misanii*									*	*	*	*							
Serpianites curionii						*							*						
Serpianites serpianensis														*					
Serpianites cf. *serpianensis*											*			*					
Serpianites zinae														*		*			
Serpianites cf. *zinae*											*			*		*			
Parakellnerites frauenfelderi	*		*																
Parakellnerites carinatus	*																		
Parakellnerites meriani	*																		
Parakellnerites cf. *meriani*		*																	
Parakellnerites waageni							*						*	*					
Parakellnerites costatus	*																		
Stoppaniceras variabile						*			*										
Stoppaniceras grandinodum								*	*										
Stoppaniceras artinii						*													
Stoppaniceras cf. *artinii*							*							*					
Ticinites ticinensis						*							*						
Ticinites cf. *ticinensis*				*															
Ticinites polymorphus													*						
Nevadites dealessandrii															*				
Nevadites ambrosionii													*	*					
Chieseiceras chiesense																	*		
Hungarites cf. *mojsisovicsi*						*													
Rasaites rasaensis n. gen. n. sp.	*										*		*						
Eoprotrachyceras sp. indet.																		*	
Protrachyceras? sp. indet.																			*
Pompeckjites donelioi n. sp.																	*		
Proarcestes sp. indet.	*											*					*		
Gen. et sp. indet.													*						

Fig. 8 - Range chart of the ammonoid species described in this paper (some taxa are only cited in the text and/or in the figures).

Faunal composition changes notably from localities to locality. A significant portion of the taxa recognized in the ammonoid collections from Rasa Valley are short ranging trachyostracan with well calibrated chronostratigraphic assignment (Rieber 1973a; Brack & Rieber 1986, 1993). These taxa lead to recognize four ammonoid zones: the Reitzi and Secedensis zones of the upper Anisian and the Curionii and Gredleri zones of the lower Ladinain.

The chronostratigraphic attribution of the ammonoid faunas from the studied localities (Fig. 9) validates both the geological cross section in the central part of Rasa village (Fig. 2b) and the restored stratigraphic relationships of these localities (Fig. 5). The geologically older localites occupy the lower part of the left-hand side of Rasa Valley (e.g. SEZ. B), while the younger are in higher topographic position (e.g. SEZ. M).

Reitzi Zone. The Reitzi Zone is documented in the localities SEZ. C, SEZ. C2 and SEZ. B and is recognized by the occurrence of *Parakellnerites frauenfelderi* Rieber, 1973, *P. carinatus* Rieber, 1973 and *P. meriani* Rieber, 1973. These species were described from the Besano Formation (Punkt 902/Mirigioli, Monte San Giorgio) in the Reitzi Zone sensu Brack & Rieber (1993). Faunal composition of this zone in Rasa Valley include *Parakellnerites costatus* Fantini Sestini (1996), *Flexptychites gottardoi* n. sp., as well as *Rasaites rasaensis* n. gen. n. sp. The occurrence of *P. costatus* in the Reitzi Zone at Rasa Valley is in a lower position with respect to occurrence of this species in its type locality (Parina Valley, locality S1060I), attributed by Fantini Sestini (1996) to the Nevadites Zone.

The occurrence of *Flexoptychites* in the Reitzi Zone in Rasa dolostone is not surprising because this genus is long ranging and known to occur even higher up in the uppermost Anisian (e.g., Vörös 2018, tab. 16; Manfrin et al. 2005, tab. 1).

Secedensis Zone. Most of the ammonoid faunas discovered in Rasa Valley are typical of the

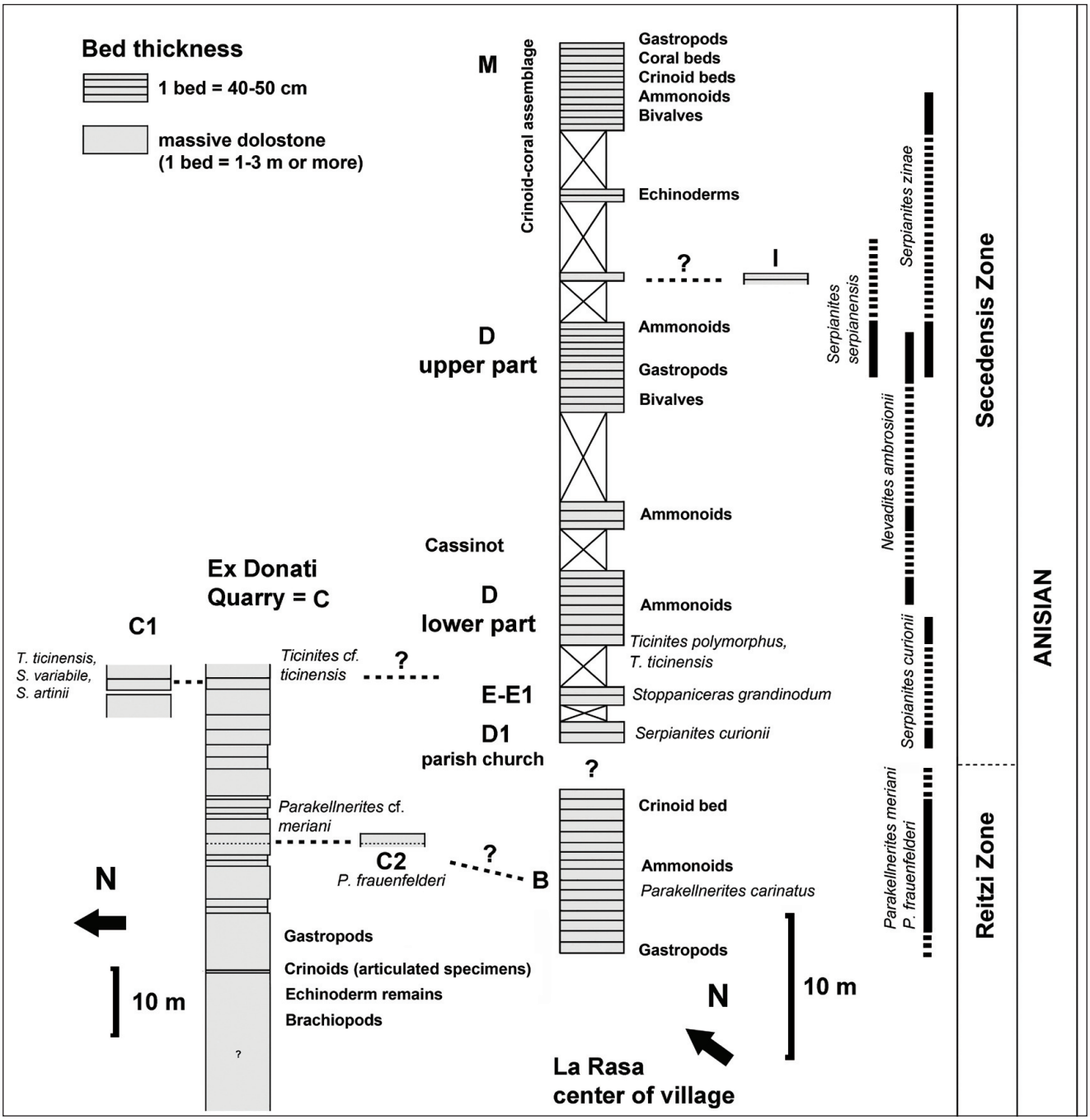

Fig. 9 - Ammonoid chronostratigraphy of the two more complete stratigraphic successions in the Rasa Valley: the succession exposed in the Ex Donati Quarry (SEZ. C; lower part of the northern area in Fig. 5), and the succession exposed in the center of the Rasa village (from SEZ. B to SEZ. M ; central area in Fig. 5). Three secondary outcrops (SEZ. C1, SEZ. C2 and SEZ. I) are also indicated.

Secedensis Zone. This zone was defined by Brack & Rieber (1993) and Brack et al. (2005), in a comprehensive review of all the most important stratigraphic sections straddling the Anisian/Ladinian boundary of the Southern Alps. The Secedensis Zone is comprised between the FO (First Occurrence) of *Ticinites polymorphus* and the LO (Last Occurrence) of *Chieseiceras chiesense*, and is equivalent to the upper part of the Polymorphus Zone and the lower part of the Reitzi Zone sensu Rieber (1973a) at Monte San Giorgio (Punkt 902/Mirigioli, beds 58 to 112), but includes also the beds 138-144 yielding *Chieseiceras chiesense* (Brack & Rieber 1986; Brack et al. 2005).

Faunal composition of this zone is very rich, and the boundaries are comprised between the FO of *Ticinites* and the FO of *Eoprotrachyceras*.

The lower part of the Secedensis Zone is documented at SEZ C upper-C1 and D lower and is here emphasized as *Ticinites* level (Fig. 3a). This level is characterized by the occurrence of *Ticinites* and *Stoppaniceras*, co-occurrence that is documented also at Monte San Giorgio and Bagolino (Brack et al. 2005).

The co-occurrence of *Serpianites* and *Nevadites* is peculiar of the upper part of the Secedensis Zone (Brack et al. 2005), and is documented at SEZ. D upper. This site yielded also some *Stoppaniceras* in open nomenclature. The locality SEZ. M is also attributed to the upper part of the Secedensis Zone by the occurrence of *Serpianites zinae*, that is the youngest species of *Serpianites* at Monte San Giorgio (Rieber 1973a). *Nevadites* was not found in this locality, but this lack is not significant because only three ammonoids were found at SEZ. M.

The uppermost part of the Secedensis Zone is recognized at loc SEZ. B1 (Fig. 5, 8) by the occurrence of *Chieseiceras chiesense*, a very typical marker of this chronostratigraphic interval. This occurrence at SEZ. B1 provides the calibration of the FO of *Pompeckjites*, that was previously known from the Curioni Zone of the lower Ladinian (Fantini Sestini (1994) and the Carnian (Mojsisovics 1873, 1904; Krystyn 1973).

Among all the localities where the Secedensis Zone is documented, locality SEZ. E requires a particular description. At this site *Parakellnerites waageni*, *Stoppaniceras* cf. *variabile*, and *Stoppaniceras* cf. *artinii* were collected from beds, while some specimens have been collected from blocks (see below).

Curionii and Gredleri zones. The Curioni and Gredleri zones are not well documented in the Rasa dolostone, being identified by single specimens of *Eoprotrachyceras* sp. ind., at locality SEZ. G, and of *Protrachyceras* sp. ind. from SEZ. H1 (Fig. 5).

Archelaus Zone (?). One *Protrachyceras* cf. *archelaus* was collected from a lose block at SEZ. E. This ammonoid is classified in open nomenclature, so cannot be used as a reliable evidence of the Archelaus Zone in Rasa dolostone. Moreover, the provenance of the block from which the specimen has been collected and the stratigraphic position of the specimen is unknown because in the past an industrial kiln for the production of magnesian lime was active at site SEZ. E, and dolomitic blocks treated in the kiln were brought from several nearby quarries.

Correlation with the Besano Formation at Monte San Giorgio

Chronostratigraphy

The ammonoid faunas from Rasa dolostone are nearly coincident with those described from the Besano Formation at Punkt 902/Mirigioli, Monte San Giorgio (Rieber 1973a, Brack & Rieber 1986, 1993; Brack et al. 2005). These faunal similarities, discussed here and in the next chapter, are perfectly consistent with the location of the two sites (Rasa and Monte San Giorgio) in the same Besano basin (=GBZ in Bernasconi 1991, fig. 2.3, 2.4; Fig. 4) during the late Anisian. Punkt 902/Mirigioli, that was quarried from 1950 to 1968 by a team from Paläontologisches Institut and Museum, Zurich (PIMUZ), is the best studied stratigraphic section of Besano Formation, therefore it is the best biochronostratigraphic reference for the Besano basin. The PIMUZ team carried out accurate bed-by-bed samplings of the section, and collected not only the vertebrates from the bituminous layers, but also the invertebrates from both bituminous layers and dolomitic beds. The invertebrate record is dominated by ammonoids, but includes also daonellids (Rieber 1968, 1969), coleoidea (Rieber 1970, 1974b; Pohle & Klug 2024) gastropods (Pieroni & Furrer 2020), and nautiloids (Pieroni 2022). The high resolution biochronostratigraphy of the Punkt 902/Mirigioli succession is also complemented by geochemistry (Bernasconi, 1991), and U-Pb radioisotopic dating of zircons from tuff layers (Mundil et al. 1996), that provided crucial support, together with tuff layers from Bagolino and Seceda (Brack et al. 2005) to the numerical calibration of the Ladinian GSSP. A comprehensive integrated review of the paleontologic data as well as of facies, has been presented by Röhl et al. (2001).

Figure 10 shows the correlations between Rasa Valley localities and the bed-by-bed sampled succession of Punkt 902/Mirigioli section that are here briefly discussed.

SEZ B, SEZ. C and SEZ. C2 are correlated to beds 41-49 of Punkt 902/Mirigioli by the occurrence of *Parakellnerites frauenfelderi* and *Parakellnerites meriani*. The assemblage collected in the SEZ. C1, dominated by *Ticinites ticinensis*, but yielding also *Stoppaniceras variabile* and *Stoppaniceras artinii*, seems to equivalent to the beds 58-76 of Mirigioli.

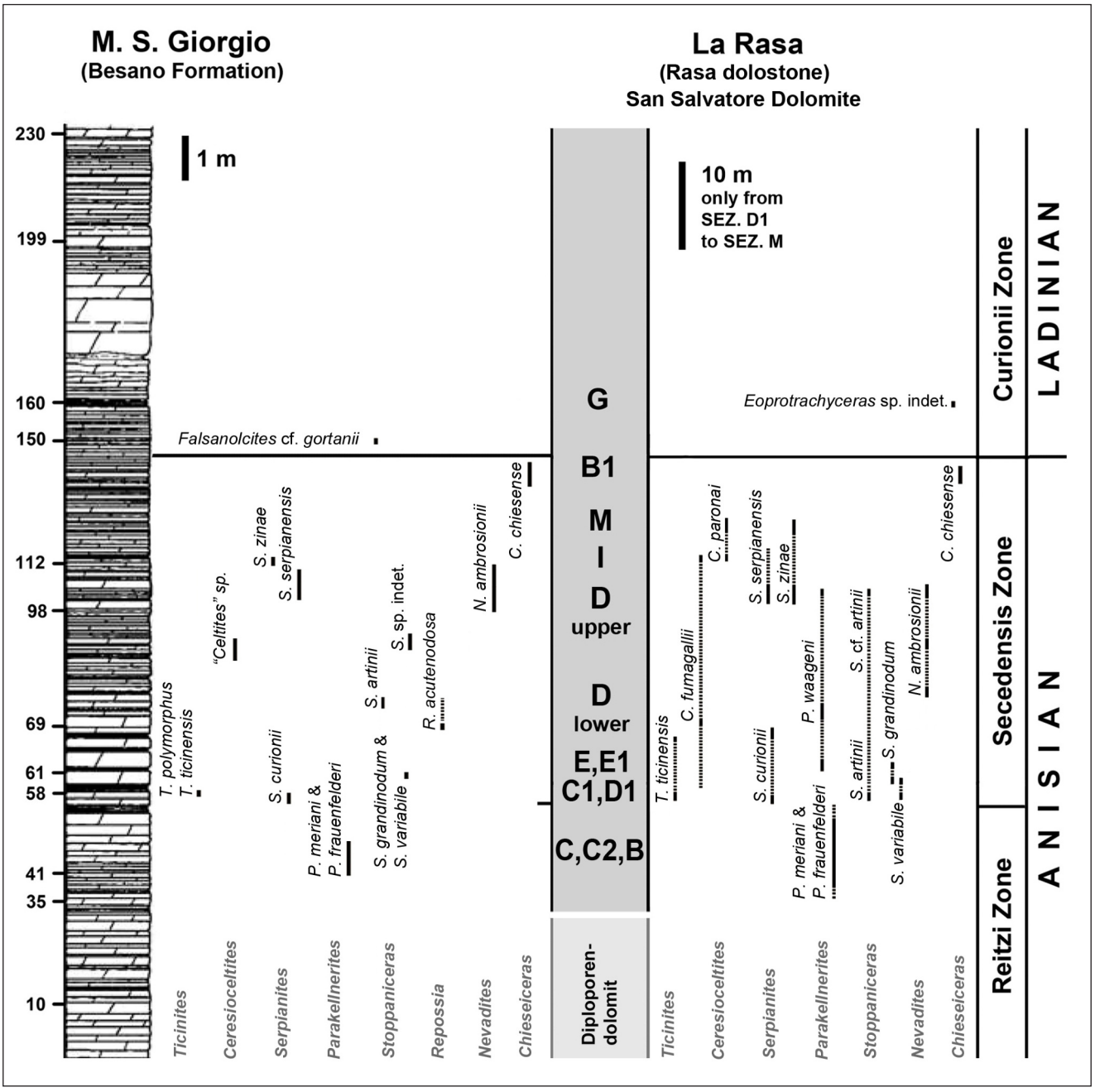

Fig. 10 - Chronostratigraphic correlations between the Besano Formation exposed at Punkt 902/Mirigioli at Monte San Giorgio (after Rieber 1973a and Brack et al. 2005) and the succession of Rasa dolostone (San Salvatore Dolomite) exposed in Rasa Valley (Fig. 8-9).

The stratigraphic position of SEZ. D1 (behind the parish church "St. Maria degli Angeli") is not very precise. The outcrop is stratigraphically below the position of SEZ. D, but SEZ. D1 yields abundant *Serpianites curionii* that at Punkt 902/Mirigioli occurs in the bed 58, in a lower position.

The assemblage collected in the upper part of SEZ. D corresponds to the beds 104-112 of Mirigioli because of the occurrence of *N. ambrosionii* and *S. serpianensis*. At Rasa *Serpianites zinae* and *Serpianites serpianensis* become more abundant in the upper part of SEZ. D. However, this increasing in abundance might be of very local value, because the former species is endemic of the Besano basin, while the latter might be also documented in Dolomites and Cadore (*Serpianites* aff. *serpianensis*: Mietto & Manfrin 1995, p. 556). The occurrence of *Chieseiceras chiesense* in the SEZ. B1, allows the correlation with the beds

138-144 of Punkt 902/Mirigioli, in the upper part of the Secedensis Zone. The uppermost locality at Rasa, SEZ. G, cannot be directly correlated by fossils to Punkt 902/Mirigioli, because thus far *Eoprotrachyceras*, that occurs at SEZ. G, has not been reported from Monte San Giorgio. The correlation might be done with Bagolino, and then Monte San Giorgio (e.g. Brack et al. 2005, fig. 7).

The best documented interval at Rasa is the Secedensis Zone, in this regard it might be possible to provide additional details.

Repossia acutenodosa seems to be absent in the Rasa dolostone, but there are many poorly preserved specimens, some of which are similar to this species.

Ceresioceltites n. gen. is documented from many outcrops (SEZ. B, D, I, M, N) and its stratigraphic position is well calibrated to Secedensis Zone (sensu Brack et al. 2005), but it does not co-occur with *Chieseiceras* in the uppermost part of the Secedensis Zone.

Faunal correlation and paleoenvironment

The almost complete equivalence of Rasa dolostone ammonoid faunas with those from Besano Formation at Punkt 902/Mirigioli is intriguing because the paleoenvironmental settings of Punkt 902/Mirigioli and Rasa in the Besano basin were notably different. Rasa was located on the platform margin of Rasa dolostone, in well oxygenated water, while Punkt 902/Mirigioli was located some kilometers from the platform margin, in the middle part of the 30 to 100 m deep basin with anoxic sea bottom (Bernasconi 1991; Röhl et al. 2001, both cum lit.).

We just want here to highlight this unexpected result, because the reconstruction of a depositional model for the ammonoids of the Besano Formation is far beyond the purpose of this paper. The mode of life of ammonoids is not known in detail (e.g. at genus level) to be used as a key for paleoenvironmental reconstruction or even integration of this group in the depositional models thus far proposed for the Besano Formation. All the available reconstructions (e.g., Rieber 1973b; Bernasconi 1991; Röhl et al. 2001; Schatz 2005) refer to the bivalve *Daonella* as a key fossil for paleoenvironmental reconstruction, especially as regard the oxygenation of the sea bottom, but do not take into account this paleoecologically difficult group of cephalopods.

Stratigraphic remarks on the Rasa dolostone and correlation with San Salvatore succession

The rich ammonoid faunas discovered in the Rasa Valley are useful key to calibrate the correlation with the middle and upper Salvatore Dolomite, that was already proposed in broad sense in Jaselli & Pieroni (2023).

All the fossiliferous beds described in this paper are from the middle and upper Rasa dolostone, which seem to correspond to the middle and the base of the upper San Salvatore Dolomite (Zorn 1971; see Jaselli & Pieroni 2023). These two subdivisions of the San Salvatore Dolomite are separated by the "Gervillienhorizont", (Zorn 1971, following Frauenfelder 1916). Jaselli & Pieroni (2023, fig. 2) suggested the correlation of the "Gervillienhorizont" to the uppermost part of the Secedensis Zone. This horizon is probably corresponding to the SEZ. B1, where *Chieseiceras chiesense* occurs together with very aboundant bivalve *Bakevellia costata ticinensis*, typical of the "Gervillienhorizont", and small gastropods (see Pieroni 2025) similar to those collected by Zorn (1971) in this level on the Monte San Salvatore (Lugano).

The succession underlying the "Gervillienhorizont" was referred by Zorn (1971) as "Lumachelle" facies, from which he collected rare ammonoids including some specimens of *Serpianites luganensis* (see systematics). This taxon, however, does not seem to occur in the Rasa dolostone, so the correlation of the San Salvatore "Lumachelle" facies is right now still unsolved.

The ammonoids in Rasa dolostone are very common in lenses and pockets, and this occurrence suggests an accumulation driven by storm-induced bottom currents on a morphologically complex carbonate platform.

The faunas from the upper Curionii Zone are poorly known because the dolomitization and recristallization obliterated the primary textures of this part of Rasa dolostone. Only few specimens assigned to *Eoprotrachyceras* sp. indet. (SEZ. G) and *Protrachyceras* ? sp. indet. (SEZ. H1) have been collected in the Rasa Valley.

Dolomitization affected also the base of Rasa dolostone, directly overlying the Bellano Formation (Anisian) near the Motta Rossa Pass, North of Rasa Valley. The dolostone here documented yielded

only some dasycladacean algae and *Platychilina* sp., so this basal part is interpreted as "Diploporendolomit" (lower San Salvatore Dolomite).

Carbonate platform represented by the Rasa Valley-Monte Chiusarella and the Poncione di Ganna (Fig. 1) can be considered as the South-West margin of the basin of Besano Formation (Bernasconi 1991, fig. 2.4; Fig. 4).

Rasa ammonoid faunas compared with coeval faunas from carbonate platforms

The abundance of ammonoid data from other coeval carbonate platform facies from Southern Alps provides the opportunity to discuss the adaptation of the ammonoids, usually regarded as marine to open marine group, in shallow water reef-related environments.

The time frame selected for faunal comparison is equivalent to the Secedensis Zone sensu Brack et al. (2005) that is the best represented chronostratigraphic interval at Rasa (this work). The time duration of this chronozone is very short, on the order of 350 kyr, based on high resolution dating and calibrations by Wotzlaw et al. (2018) and Storck et al. (2019). Moreover, the Secedensis Zone is well documented in the Esino Limestone in Parina Valley (Fantini Sestini 1996), and in the Latemar platform (Dolomites; Brack & Rieber 1993, 2019; Manfrin et al. 2005 and references therein).

Some well known and rich ammonoid faunas from Esino Limestone are excluded from this comparison because they are from a higher chronostratigraphic position. This is the case of the faunas from Grigne (east of Lake Como), known since the 19th century (e.g., Stoppani 1858; Benecke 1876; Mojsisovics 1880, 1882), and more recently described by Rossi Ronchetti (1960) and Fantini Sestini (1996). These faunas include long ranging leiostraca, but also upper Ladinian trachyostraca, and late Ladinian age is consistent with their stratigraphic position, referred by Gaetani et al. (1992) to the upper edifice of Esino Limestone platform, equivalent to the upper Ladinian sequence L3 of Gaetani et al. (1998).

Data selection

Figure 11 shows the faunal lists of the taxa of the Secedensis Zone identified at Rasa dolostone, the taxa described by Fantini Sestini (1996) from the Nevadites Zone (basically equivalent to the Secedensis Zone of Brack et al. 2005) in Parina Valley, and those reported by Manfrin et al. (2005 and Brack & Rieber (2019) from the Secedensis Zone of Latemar. It is worth mentioning that the zonation used by Manfrin et al. (2005) differs from that of Brack et al. (2005), therefore we have used only part of the Manfrin et al. (2005) dataset. Manfrin et al. (2005) traced the lower boundary of the Nevadites Zone at the base of the Crassus subzone, at level L 2 of Latemar section, based on the FO of *Halilucites* (Manfrin et al. 2005, table 1). This event is in a lower position with respect to the FO of *Ticinites*, the marker event of the Secedensis Zone sensu Brack et al. (2005, fig. 3, 6). In order to use a consistent chronostratigraphic frame, we have selected for comparision only the taxa documented from the Latemar level LA 23 (Manfrin et al. 2005, tab. 1), where the authors recognized the FO of *Ticinites*, to the top of the section (level L 0). The large dataset by Manfrin et al. (2005) has been here integrated with the data by Brack & Rieber (2019, fig. 2) who reported the occurrence of *Chieseiceras* (*C. dolomiticum*), from the top of the Upper Tepee Facies.

The data from Parina Valley, are from localities S954, S1060I, S1034, S1060L and S1060B-E, referred to the Nevadites Zone by Fantini Sestini (1996, tab. 2, eastern area, Group C). We included in the faunal list from these localities *Proarcestes* ? sp. for small (usually 10-15 mm in diameter) juvenile Arcestidae that were not reported by Fantini Sestini from these samples. These juveniles often represent the 40 to 60% of the ammonoid assemblages (MB personal observation, 1999).

Discussion

Ammonoid faunas of upper Anisian carbonate platform-related environments selected for this comparison are quite rich, and show a high diversity, documented by 13 genera in Rasa dolostone, 13 genera in the Esino Limestone of Parina Valley and a good 24 genera in the Latemar platform (Fig. 11). The faunal lists from the three sites are not affected by systematic issues so their comparison is reliable.

The only exception is probably in the relationships between *Aplococeras*, right now documented at Rasa and Parina Valley vs *Lecanites* recognized in the Latemar platform (see the Discussion of the systematic description of *Aplococeras* cf. *misanii*).

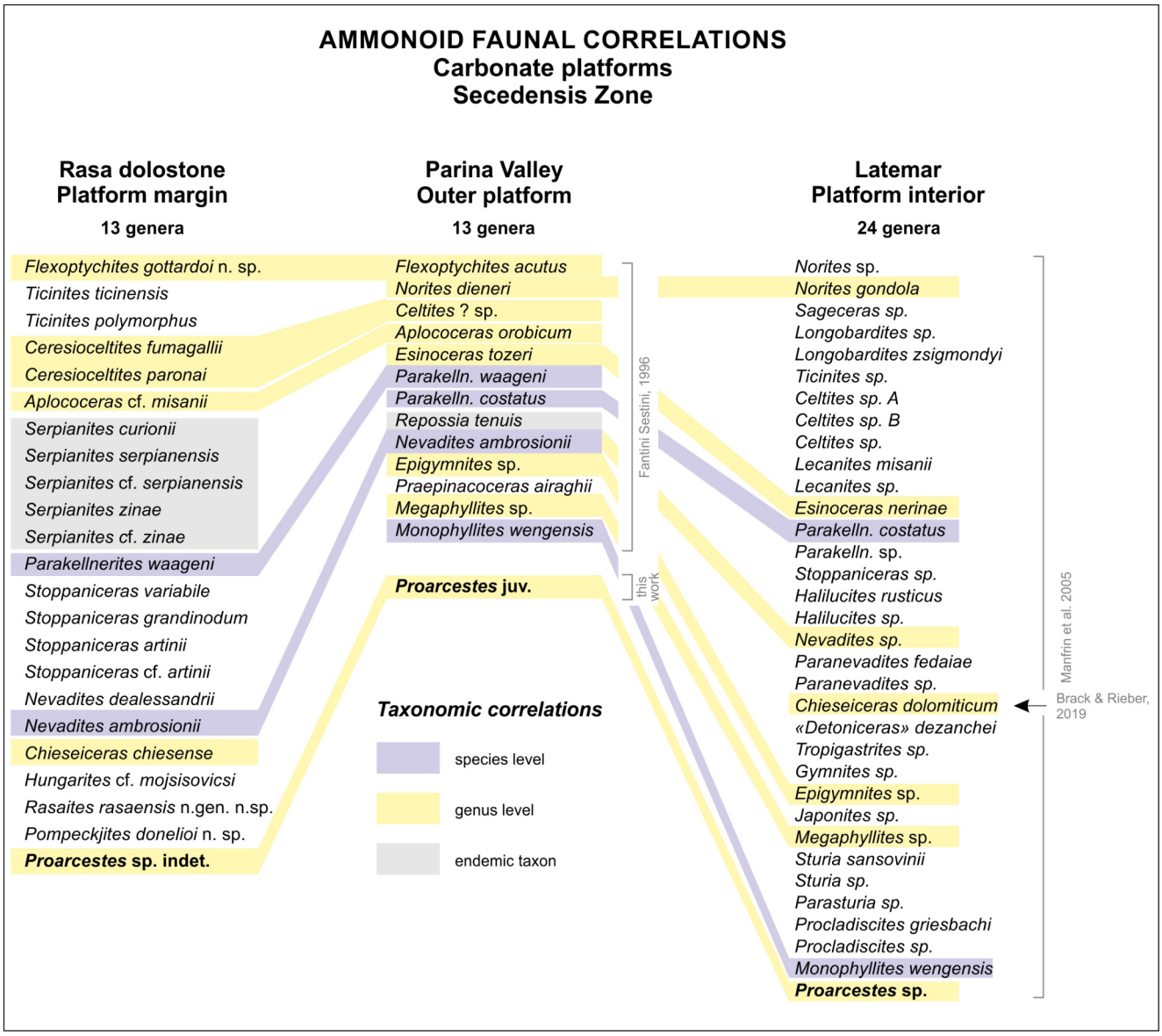

Fig. 11 - Faunal lists and taxonomic correlations of the Secedensis Zone ammonoid faunas from three different late Anisian carbonate platform settings of Southern Alps: Rasa dolostone (platform margin: this work), Esino Limestone from Parina Valley (outer platform: Fantini Sestini 1996) and Latemar (platform interior: Manfrin et al. 2005; Brack & Rieber 2019). For explanation see text.

The interpretation of the data illustrated in Fig. 11, in term of paleoecology is not easy, mostly because many details on the ammonoid mode of life are unknown (e.g. buoyancy, bathimetry, swimming, food source), especially at low taxonomic rank. However, despite of these open problems, it is possible to make some considerations from Fig. 11 by using the facies as reference, at least for a first analysis.

The highest number of genera is documented in the platform interior of Latemar, while the diversity of outer platform of Esino Limestone in Parina Valley is nearly 50% lower. It might be possible that the Latemar ammonoid faunas were transported in the inner platform in storm deposits, as suggested by Manfrin et al. (2005, 479), but even if the Latemar ammonoids were transported from the outer platform to the inner lagoon by storms, the difference with the outer platform of Parina Valley is striking.

Five genera out of the 24 from Latemar are usually very common in open marine, deeper water environments such as the Ammonitico Rosso-like, Hallstatt or Bulog limestones (e.g., Mojsisovics 1875, 1882, 1893; Hauer 1887, 1892, 1896). These genera are long ranging leiostracan: *Megaphyllites*, *Sturia*, *Procladiscites*, *Proarcestes* and *Monophyllites*. Only three of them, *Megaphyllites*, *Proarcestes* and *Monophyllites,* are documented in Parina Valley, but *Proarcestes* in Parina

Valley is often the dominant member of the assemblages, with 40 to 60 % of dominance (MB personal obs., 1999). The composition of Rasa dolostone assemblages does not conform with the Parina Valley and Latemar assemblages, and only *Proarcestes* out of the five leiostraca of Latemar has been found. At Rasa the leiostracan are also represented by *Flexoptychites*, that occurs also in Parina Valley but not in Latemar, at least not in the Secedensis Zone. Overall, only 14 specimens of *Flexoptychites* and *Proarcestes* have been collected from Rasa dolostone, out of 394 ammonoids. The first conclusion from the distribution of leiostracan ammonoids in the Latemar, Parina Valley and Rasa ammonoid faunas is that these ammonoids were not limited/restricted to open marine, deep-water environments, but were normal components of the carbonate platform ammonoid assemblages, at least on the outer platform settings. The rare occurrence of leiostracan in Rasa dolostone might be explained as due to the local paleogeography: Rasa dolostone was a platform margin facing on a small, anoxic intraplatform basin, not directly facing on an open sea as Parina Valley and Latemar platforms.

The carbonate platform environments were also occupied by ornamented, short-ranging trachyostracan ammonoids such as *Parakellnerites*, *Ticinites*, *Nevadites*, and *Chieseiceras* that are very common of open marine and deeper environments, such as those of deposition of the Buchenstein Formation and Vászoly Formation in Southern Alps and Bakony (Brack & Rieber 1986, 1993, 2019; Vörös 2018). These genera are often documented in the carbonate platform environments by different species with respect to those living in open seas. This is the case of *Parakellnerites costatus*, documented in Rasa, Parina Valley and Latemar, and *Nevadites ambrosionii*, never found in basinal units. *Chieseiceras* might be the only exception, because *C. chiesense* occurs in Rasa dolostone, but also in the Buchenstein Formation (Brack & Rieber 1986).

A further demonstration that ammonoids in the late Anisian were common components of carbonate platform ecosystem is represented by *Serpianites*, *Esinoceras* and the new genus *Ceresioceltites*, that have never been found in open marine units, despite of the rich literature. These genera are here regarded as endemic of carbonate platforms, and are further evidence of the high dynamic adaptability of ammonoids to shallow water environments in the late Anisian.

Conclusions

For the first time a large collection of ammonoids, consisiting of 394 specimens, from 17 localities from Rasa dolostone in Rasa Valley (north of Varese, Southern Alps) has been studied. The fossil locality "La Rasa" was first cited in literature by Mojsisovics (1880), then locality was visited by some other authors, but only few ammonoids were described from this site. The new large collection is a true rediscovery of the site. A number of results have been achieved, and are here summarized.

- Fifteen genera, 21 species and eight taxa in open nomenclature are described. These taxa included the new genera *Ceresioceltites* and *Rasaites*, the new species *Flexoptychites gottardoi*, *R. rasaensis* and *Pompeckjites donelioi*.
- The new genus *Ceresioceltites* is based on *Ceresioceltites fumagallii* (Stabile in Stoppani, 1860; type of the genus) and *Ceresioceltites paronai* (Airaghi, 1912). These species were poorly known and have been revised. A neotype from Rasa has been designated for *C. fumagallii*.
- The new monotypic genus *Rasaites* is assigned with doubt to the family Hungaritidae and is known only from the San Salvatore Dolomite.
- Most of the species from Rasa were previously described from the Besano Formation at Punkt 902/Mirigioli, Monte San Giorgio. Due to different taphonomic history, the specimens from Rasa exhibit features that are not preserved in the specimens from Besano Formation, such as suture line and 3D preservation of the phragmocone. As results, the new specimens are crucial to improve the understanding of several genera and species from Besano Formation.
- The 17 fossil localities in Rasa Valley are very small, and have been organized in stratigraphic succession on the basis of their position and elevation a.s.l. with respect to the monoclinal setting of the Rasa dolostone. Their chronostratigraphic assignment is based on the faunal composition, because most of the taxa recognized are short ranging, and age-diagnostic.
- Four chronozones have been recognized in stratigraphic succession: Reitzi, Secedensis, Curionii, and Gredleri. They document the upper Illyrian (upper Anisian) and the Fassanian (lower Ladinian).
- A single *Protrachyceras* cf. *archelaus* was collected from a block at SEZ. E. This specimen could be

from the Archelaus Zone (upper Ladinian), but its open nomenclature status does not allow to use it for a reliable age assignment.

- The Rasa Valley succession is very well correlated with Punkt 902/Mirigioli section of Besano Formation. Sixteen species of Rasa are documented at Punkt 902/Mirigioli. This high faunal similarity is surprising because the two sites were located in the Besano intraplatform basin, but in two very different settings: Rasa was located on a shallow, well oxygenated, margin of a carbonate platform (Rasa dolostone = San Salvatore Dolomite), while Punkt 902/Mirigioli was located in the deeper part of the basin with anoxic sea bottom.

The Secedensis Zone is the most fossiliferous interval of Rasa Valley succession, but it is also well documented in other carbonate platforms of Southern Alps, in the Esino Limestone of Parina Valley (Bergamo; Fantini Sestini 1996) and Latemar platform (western Dolomites; Manfrin et al. 2005; Brack & Rieber 2019). This chronozone is also of special interest because its duration is short, on the order of 350 kyr (Wotzlaw et al. 2018; see also Storck et al. 2019), based on U/Pb age dating on zircons from tuffitic levels. Faunal comparison emphasizes the following results:

- In late Anisan, the ammonoids were common in the carbonate platform ecosystem, as documented by the 13 genera in the platform margin of Rasa dolostone, 13 in the outer platform of Parina Valley, and 24 genera in the inner platform of the Latemar. These numbers are very large, considering the short time documented by the Secedensis Zone.
- The carbonate platform ammonoid faunas included three groups of taxa: 1) long ranging leiostracan, such as *Megaphyllites*, *Sturia*, *Procladiscites*, *Proarcestes* and *Monophyllites*, usually very abound-ant in open marine faunas, as those documented in the Hallstatt-and Bulog limestones; 2) short ranging trachyostracan, usually common in pelagic units (e.g., Buchenstein Formation), such as *Parakellnerites*, *Ticinites*, *Nevadites*, and *Chieseiceras.* These genera, however, are sometimes represented by species peculiar of the carbonate platform, that are not documented in basinal successions; 3) endemic genera of carbonate platforms such as *Serpianites*, *Esinoceras* and possibly *Ceresioceltites* n. gen.

As final conclusion we emphasize in the late Anisian the ammonoids demonstrated a great ability to colonize environments that are not normally considered ideal for the group.

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Appendix 1

Remarks on *Celtites evolutus* Salomon, 1895 (VP)

In 1895 Salomon provided the description and illustration of three taxa of *Celtites* from Marmolada, that for many years were taken as reference for the Anisian *Celtites*. Fantini Sestini (1996) suggested the possibility of separation of these forms as a new genus, but she did not formalize this new taxon due to the lack of suture lines.

Marmolada fossiliferous locality was discovered by Reyer in 1875 on the northern slope of Marmolada (below the glacier). The same locality was studied also by Mojsisovics (1879) and Kittl (1895). Kittl specified in the introduction of his work on gastropods (1895) the occurrence of 27 specimens of "*Celtites* n. f. aff. *C. epolensis* Mojs." from Reitzi Zone of Marmolada, collected by Reyer. These specimens were reported by Kittl as stored in Naturhistorisches Museum Wien. They were studied by Mojsisovics (1882), who provided the first classification reported by Kittl (1895), and by Salomon (1895), who described the specimens.

Salomon (1895) erected *Celtites evolutus* n. sp. (type series previously stored in the Strassburger Museum, but at present stored in the Bayerischen Staatssammlung of München), and described *Celtites* (?) nov. sp. ind. A and *C.* (?) nov. sp. ind. B (figured specimens stored in the Bayerischen Staatssammlung of München), whereas the specimens not figured were deposited in the Naturhistorisches Museum in Wien.

Comparison and discussion. The Salomon's specimens stored in the Bayerischen Staatssammlung of München, have been studied. There is a noteworthy difference between *C. evolutus* and the other taxa in open nomenclature documented by Salomon. In particular "*Celtites*" nov. sp. ind. A, "*Celtites*" nov. sp. ind. B show a subquadrate section and a clear wide ventral weak keel that are similar to *Ceresioceltites* n. gen. The lack of suture lines, however, suggest us to keep the two taxa in doubtful position (see Systematic descriptions).

Celtites evolutus was described on four types, but only one was figured by Salomon (1895, pl. 6, fig. 16). This specimen, however, does not show the suture line. The suture line figured by Salomon (1895, pl. 6, fig. 17) was obtained from one type specimen (SNSB 1887 XI-781), but the study of this specimen reveals that the drawing by Salomon was taken from a weathered part of the specimen. Some better preserved suture lines are visible on the same specimen, and show an external suture with three lobes, with the umbilical one large (same width as the second saddle), rounded and unindented.

"*Celtites*" *evolutus* is more serpenticone than *Ceresioceltites* and its whorl section is almost subcircular, with rounded shoulders. Moreover, the suture line of *Ceresioceltites* exhibits very small umbilical elements and a very wide and rounded first saddle (e.g. Fig. 7J).

The examination of the Salomon's specimens stored in the Naturhistorisches Museum in Wien, under the labels "*Celtites*" *evolutus* Salomon, 1895, "*Celtites*" nov. sp. ind. A, "*Celtites*" nov. sp. ind. B and "*Celtites*" nov. sp. ind. cf. B, confirm the results of the study of the type specimens.

Celtites nov. sp. ind. A and B have been also recognized by Manfrin et al. (2005) from Latemar. However, the suture line of these specimens is not exposed.

Appendix 2

Locality-by-locality list of the specimens classified in this paper, with inventory numbers (some numbers correspond to more than one specimen; ammonoids without inventory numbers are reported in brackets). The specimens are deposited Museo di Storia Naturale "A. Stoppani" (MSNVI), Seminario Arcivescovile "Pio XI", Via Papa Pio XI, 32, Venegono Inferiore (VA), Italy. Acronym MSNVI.

SEZ. A2 (DELLE GINESTRE STREET)

Aplococeras cf. *misanii* A 14, A 19, A 21, A 22, A 25, A 26, A, 27, A 28, A 29, A 30

SEZ. B (CONFLUENCE OLONA RIVER/SESNIVI TORRENT)

Flexoptychites gottardoi n. sp. B 39, B 79
Ticinites? sp. B 01, B 27
Parakellnerites frauenfelderi B 02, B 03, B 59, B 68, B 81, B 93
Parakellnerites cf. *frauenfelderi* B 04, B 10
Parakellnerites carinatus B 56, B 62
Parakellnerites meriani B 11, B 13, B 26, B 60, B 61, B 64, B 65, B 82, B 92
Parakellnerites cf. *meriani* B 05, B 25, B 38
Parakellnerites costatus B 66
Rasaites rasaensis n. gen. n. sp. B 90c, B 67, B 90
(38 specimens without inventory numbers are classified as *Parakellnerites* sp. group of *P. frauenfelderi-P. meriani*)

SEZ. B1 (CEMETERY)

Chieseiceras chiesense B 07, B 08, B 09, B 42
Chieseiceras chiesense juv., *Proarcestes* sp., *Pompeckjites donelioi* n. sp. B 43
Pompeckjites donelioi n. sp. B 19
Proarcestes sp. B 18

SEZ. B2 (S. GOTTARDO STREET/PROVINCIAL ROAD OF RASA)

Nevadites dealessandrii B 37

SEZ. C lower ("SASSO BIANCO" QUARRY)

Flexoptychites gottardoi n. sp. C 25
Flexoptychites? C 36
Parakellnerites cf. meriani C 24

SEZ. C upper ("SASSO BIANCO" QUARRY)

Ticinites cf. *ticinensis* C 19, C 22
Stoppaniceras? C 35

SEZ. C1 (FORNACI DELLA RIANA)

Ticinites ticinensis C 26a, C 26b, C 26c, C 26d, C 26k, C 26m, C 26n, C 26o, C 26p
Stoppaniceras variabile C 26e, C 26f
Stoppaniceras artinii C 26j, C 26l

SEZ. C2 (DES VALLEY, area between "SASSO BIANCO" QUARRY and SEZ. M)

Parakellnerites frauenfelderi C 27

SEZ. D lower (ASILO SAN GOTTARDO)

Flexoptychites gottardoi n. sp. D 48
Ticinites ticinensis D 05, D 96
Ticinites polymorphus D 06
Ticinites cf. *polymorphus* D 50c
Ceresioceltites fumagallii D 95
Ceresioceltites cf. *fumagallii* D 157
Gen. et sp. indet. D 64 (Pl. 2, fig. 7)
Serpianites curionii D 67
Serpianites sp. D 02
Parakellnerites waageni D 10, D 41bis
Nevadites ambrosionii and *R. rasaensis* n. gen. n. sp. D 56
Nevadites ambrosionii and *Aplococeras* D 63
Rasaites rasaensis n. gen. n. sp. D 47, D 48a, D 118
(12 specimens without inventory numbers are ammonoids not classified)

SEZ. D upper (CASSINOT)

Serpianites zinae D 57e, D 57f, D 57g, D 89
Serpianites cf. *zinae* D 35, D 87
Serpianites serpianensis D 57, D 57a, D 57b, D 57c, D 57d, D 73, D 74, D 90, D 91, D 93
Serpianites cf. *serpianensis* D 88
Serpianites sp. juv. D 75a
Serpianites sp. D 57h
Parakellnerites waageni D 57i, D 59, D 76
Stoppaniceras cf. *artinii* D 57l, D 92, D 154, D 155
Stoppaniceras n. sp. ? D 81
Stoppaniceras sp. D 57m
Nevadites ambrosionii D 69, D 70
(24 are classified as *Serpianites serpianensis*; 49 are classified as *Serpianites zinae*; 45 are ammonoids not classified)

SEZ. D1 (PARISH CHURCH St. MARIA DEGLI ANGELI)

Ceresioceltites cf. *fumagallii* D 117
"*Celtites*" sp. indet. D 148
Serpianites curionii D 65, D 78a, D 78b, D 78c, D 79, D 80, D 94, D 147
Hungarites cf. *mojsisovicsi* D 55

NEAR SEZ. D1, ISOLATED OUTCROP
Chieseiceras chiesense D 120
(8 are ammonoids not classified)

SEZ. E (SPORTING FIELD)
Collected from beds
Parakellnerites waageni E 17
Stoppaniceras cf. *variabile* E 27
Stoppaniceras cf. *artinii* E 21

SEZ. E, COLLECTED FROM BLOCKS OF UNKNOWN PROVENANCE:
Protrachyceras cf. *archelaus* E 00
Nevadites dealessandrii and *N. ambrosionii* E 25

SEZ. E1 (ORATORY)
Stoppaniceras grandinodum E 28

SEZ. G (VILLAGGIO CAGNOLA)
Eoprotrachyceras sp. indet. G 01

SEZ. H1 (OLONA RIVER, UNDER CHIUSARELLA STREET)
Protrachyceras sp. indet. H 02

SEZ. I (ROCCOLO DELLA RASA)
Ceresioceltites fumagallii I 35
Ceresioceltites paronai I 06, I 31, I 34
Aplococeras cf. *misanii* I 08
Serpianites cf. *serpianensis* I 26
Serpianites cf. *zinae* I 07
Stoppaniceras sp. forma juv. I 36
Rasaites rasaensis n. gen. n. sp. I 46

SEZ. L (LEGNONE STREET)
Stoppaniceras variabile L 01, L 03
Stoppaniceras grandinodum and *Aplococeras* cf. *misanii* L 02

SEZ. M (DES VALLEY)
Ceresioceltites paronai M 12
Ceresioceltites? sp. M 21
Serpianites zinae M 16
Serpianites cf. *zinae* M 11

SEZ. N (LEGNONE VALLEY)
Ticinites cf. *polymorphus* N 09
Ceresioceltites fumagallii N 01
Ceresioceltites sp. N 02
Aplococeras cf. *misanii* N 06b, N 06c, N 06d, N 06e, N 06f
Serpianites cf. *curionii* N 07
(the fauna includes also 12 incomplete/poorly preserved *Aplococeras* and *Proarcestes*)