

A NEW CEPHALOPOD FROM THE EARLY SILURIAN OF THE CARNIC ALPS (ITALIAN SIDE)

MAURIZIO GNOLI¹ & PAOLO SERVENTI²

Received: February 5, 2008; accepted: May 30, 2008

Key words: Nautiloid Cephalopoda, systematics, Carnic Alps, Early Silurian, Italy.

Abstract. A new Early Silurian cephalopod from the Italian side of the Carnic Alps is reported on the basis either of newly collected material or museum specimens. The genus *Serpaglioceras* gen. n. and the species *S. forojuliense* n. sp. are described. The material described originates from the *Pterospathodus celloni* biozone.

Riassunto. Viene descritto *Serpaglioceras forojuliense* gen. n., sp. n., nuovo cefalopode del Siluriano inferiore proveniente dalle Alpi Carniche. Il materiale su cui è fondato origina da collezioni museali e da nuovi esemplari raccolti nella biozona *Pterospathodus felloni*.

Introduction

Nautiloid cephalopods of the Carnic Alps have been known since the second half of the eighteenth century. In 1872, the Austrian geologist Guido Stache first drew attention to the occurrence of Silurian rocks in the Carnic Alps, recording “*Orthoceras* limestones” from many localities of the Carnic area, collecting a great number of cephalopod specimens. However, he did not produce any systematic work on these assemblages. The German geologist Fritz Frech described two species of nautiloid cephalopods (Frech 1887): *Orthoceras potens* Barrande, 1866 and *Orthoceras alticola* Barrande, 1870 from the Carnic area.

The first systematic work on the Silurian cephalopod fauna, is dated to 1909 when the Italian geologists Michele Gortani and Paolo Vinassa de Regny described 18 species of nautiloid cephalopods from Italian side of the Carnic Alps.

After the “Great War”, Franz Heritsch published (1929) “Faunen aus dem Silur der Ostalpen”, a precise paleontologic systematic study of the Silurian Nautiloid faunas. This rechecked specimens collected by himself, as well as material stored in the Geological Survey of Vienna, and belonging to the von Gaertner, Geyer and Stache collections.

After the Second World War, paleontological studies on cephalopod fauna ceased until 1968 when Heinrich Ristedt, from Bonn University, published an essential work on cephalopod early stages and protoconchs (Ristedt 1968), which included specimens from the Terranes involved in the northern margin of Gondwana during the Silurian. Renewed interest in the nautiloid cephalopods of the Carnic Alps arose close to the end of the century (Gnoli & Histon 1998; Histon 1999; Serventi 1999, 2002; Serventi et al. 1999, 2006; Gnoli et al. 2000; Serventi & Gnoli 2000; Gnoli & Serventi 2006).

The studied cephalopod faunas mostly concerns members of the orders Orthocerida Kuhn, 1940, Onco-cerida Flower in Flower and Kummel, 1950, Barrandocerida Flower in Flower and Kummel, 1950, Discosorida Flower in Flower and Kummel, 1950 and Nautilida Agassiz, 1847. Members of the order Actinocerida Teichert, 1933 have not been studied, with the exception of a few fragmentary specimens reported by Serventi & Gnoli (2000), which were left in open nomenclature.

The goal of this paper is to describe a new nautiloid on the basis of material collected in the Italian side of the Carnic Alps in the Mt. Cocco area (Fig. 1) and stored in the Friulan Museum of Natural History (MFSNgp 1037, 19911A, 20686, 23134, 23159, 23207,

¹ Department of Earth Sciences, Modena and Reggio Emilia University, L.go Sant'Eufemia 19, I-41100 Modena, Italy. E-mail: gnolim@unimore.it

² Department of the Museum of Paleobiology and Botanical Garden, Modena and Reggio Emilia University, Via Università 4, I-41100 Modena, Italy. E-mail: paolo.serventi@unimore.it

25744, 26481, 28398), Udine, in the Dept. of the Museum of Palaeobiology and Botanical Garden (IPUM 27965, 27966) (Modena and Reggio Emilia University) and in the Palaeontological Museum of the Dept. of Earth and Geological Environmental Sciences at Bologna University (MGGC 20670).

Geological remarks

In the Friuli - Venezia Giulia region (Italy) three mountain ranges are welded together: the Paleocarnic chain, the eastern section of the South-Alpine chain and the northwestern part of the Outer Dinarides. The Paleocarnic chain, about 180 km long (from Comelico to Caravanche) and 10/20 km wide, holds a metamorphic portion, bounded to the northwestern sector, and a non-metamorphic portion represented by an almost continuous Palaeozoic sedimentary succession (Carulli 2006) (Fig. 1). This succession, which is very rich in paleontological remains ranges from the Upper Ordovician to Permian in age.

The sedimentary Silurian succession is autochthonous and shows many lateral variations. Its thickness ranges from 50 to 100 m and it is irregularly distributed within the Carnic Alps. Bioclastic limestones, indicate a shallow water environment, nautiloid-bearing limestones, intercalations of limestones with shales, finally black graptolithic shales and cherts, are interpreted as reflecting deep water basinal environment (Corradini & Simonetto 2006). Therefore the Silurian rocks have been divided in four major facies (Selli 1963; Schönlaub 1997, 1998; Wenzel 1997), reflecting the depths and the different hydrodynamic conditions of the environments (Fig. 1). Proceeding from North-West towards South-East, are cropping out respectively: the Wolayer facies, characterized by proximal sediments, the Plocken and Findenig facies, with intermediate conditions, and finally Bischofalm facies with deep sediments. From Llandovery to Ludlow, Silurian sedimentation shows a transgressive trend, whereas a diffuse Prídolí carbonate sedimentation shows a more steady conditions (Schönlaub 1997). Most of Llandovery, and sometimes Lower Wenlock are lacking due to a gap between Ordovician and Silurian sediments (Histon & Schönlaub 1999).

Our material comes from the nautiloid-bearing limestones set in intermediate position between Wolayer and Plocken facies (Corradini et al. 2003).

Fossil preservation

With few exceptions, the specimens studied are fragmentary, affected by dissolution, and/or strong recrystallization. This makes the study of the key impor-

tant internal features section (e.g. connecting rings, siphuncular and cameral deposits) occasionally impossible. Preparation of the materials is difficult as most of specimens are embedded in a hard Fe-Mn cemented matrix.

Systematic palaeontology

General description of features mainly based on Treatise Part K, Mollusca 3 (Teichert et al. 1964) with additions from the Data Retrieval System Nautiloidea by T. Engeser (1997-2002), available on CD ROM by courtesy of the author. The proposed systematics of Dzik (1984) are also taken into account.

The terminology employed is essentially that advocated by Flower (1964) including the terms apicad (towards the apex of the shell) and orad (towards the aperture).

Institutional abbreviations. IPUM, Istituto di Paleontologia dell'Università di Modena e Reggio Emilia; MFSNgp = Museo Friulano di Storia Naturale geologico/paleontologico; MGGC = Museo Geologico Giovanni Capellini.

Order ind.

Family ind.

Genus *Serpaglioceras* gen. n.

Type species: *Serpaglioceras forojuliense* sp. nov.

Derivatio nominis. After Prof. Enrico Serpagli (Modena and Reggio Emilia University), who mainly devoted his research to the Palaeozoic palaeontology.

Diagnosis. The new genus *Serpaglioceras* has a breviconic, annulate shell orthoconic orad and slightly cyrtconic apicad. Siphuncle central to sub-central with strongly recumbent septal necks. Connecting rings expanded, but almost cylindrical and sharply constricted at septal foramina. Chambers moderately short, 1/4 to 1/3 their corresponding diameter. Free of cameral and siphuncular deposits. Staff ornamentation in form of a reticulate pattern formed by longitudinal ribs and subordinate transversal lirae.

Remarks. The presence of "armenoceratid-type" septal necks, strongly recumbent and the brim near to or in contact with the inferior part of the septa (see Teichert 1964: K 191, fig. 127C) could justify the attribution of *Serpaglioceras* to family Armenoceratidae Troedsson, 1926. However, the assignment of this newly proposed genus to this family is not possible because the characteristic endosiphuncular deposits are completely missing.

Comparisons and differences. The newly proposed genus *Serpaglioceras*, if compared with other Silurian genera of the family Armenoceratidae (e.g. *Elrodoceras* Foerste, 1924; *Megadiscosorus* Foerste, 1925), mainly differs in having sub-central siphuncle and cylindrical connecting rings expanded in the chambers and abruptly constricted at septal foramina.

According to the suggestion by B. Kröger (pers. com., April 2008) *Serpaglioceras* could represent a tran-

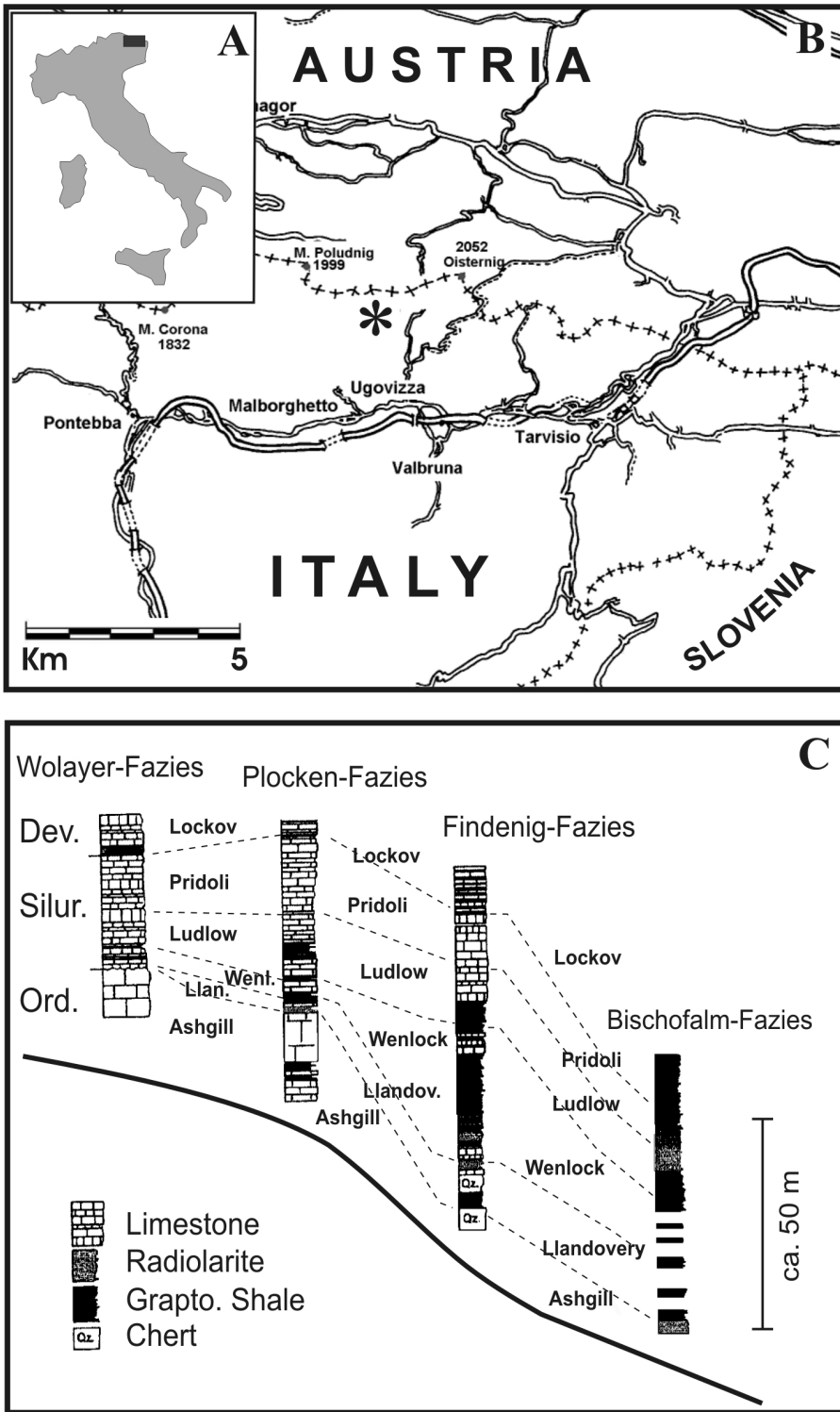


Fig. 1 - Location of the Carnic Alps (A), locality map of the Mt. Cocco area outcrop, showing position of the finding point of the studied material (indicated by an asterisk) (B), lithology of Silurian sediments of the four different lithofacies of the Carnic Alps (C) (after Wenzel 1997).

sitional form between members of Dawsonoceratidae Flower, 1962 and Spyroceratidae Foerste, 1926 on the basis of the general shape of the shell, siphuncular features as well as the outer ornamentation and annulation. However, in the first family the septal necks are shorter than in *Serpaglioceras* and the second pseudorthocerid family seems to include some of the *Serpaglioceras* fea-

tures like the siphuncular shape, but not in what concerns endosiphuncular deposit.

The genus *Dawsonoceras* Hyatt, 1884, emended by Kroger & Isakar (2006), shows septal necks suborthochoanitic to achoanitic, the shell is slender with regularly spaced annulations and a fine transverse ornamentation (Kroger & Isakar 2006); in particular *Daw-*

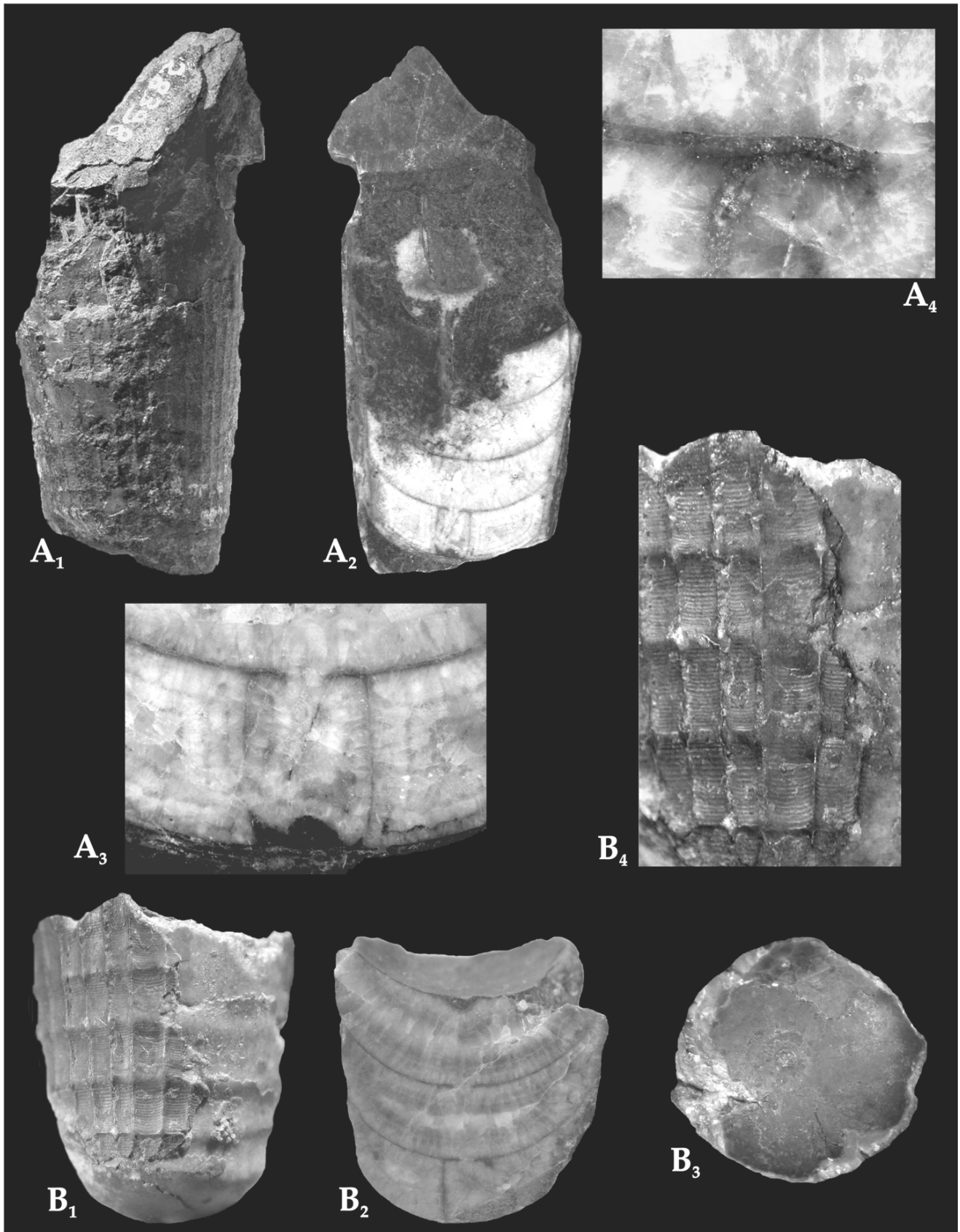


Fig. 2 - *Serpaglioceras forojuliense* gen. et sp. n. **A₁**) Holotype MFSNgp 28398 outer view, x 3. **A₂**) Polished longitudinal middle section of the same specimen showing its inner features, x 3. **A₃**) Enlarged detail of the septal neck area of the same specimen, x 9. **A₄**) Detail of the septal neck's brim, x 30. **B₁**) Paratype IPUM 27965 outer view, x 3. **B₂**) Polished longitudinal section of the same specimen showing inner features, x 3. **B₃**) The same specimen in septal view showing the sub-central siphuncle, x 3. **B₄**) Enlarged detail of the outer grid-like ornamentation, x 30.

sonoceras fenestratum (Eichwald, 1860) presents an outer ornamentation really very similar to *Serpaglioceras forojuliense* sp. nov., but the septal necks are suborthochoanitic and the angle of expansion is smaller.

Spyroceras Hyatt, 1884, shows faintly cyrtoconic apices; the surface of the shell has longitudinal lirae with transverse elements. The septal necks are cyrthochoanitic and endosiphuncular deposits of *Dolorthoceras* type are present, whilst are lacking in *Serpaglioceras forojuliense*.

On the basis of the above considerations, *Serpaglioceras* does not fit in no one of the three discussed families (Spyroceratidae, Armenoceratidae, Dawsonoceratidae), and we prefer to leave it in open nomenclature.

Serpaglioceras forojuliense n. sp.

Fig. 2A₁₋₄, B₁₋₄; Fig. 5A₁₋₃, B, C, D₁₋₂, E, F, G₁₋₂, H.

- 1929 *Orthoceras* sp. (aff. *electum* Barrande, 1868) - Heritsch: 59, figs. 639- 643.
- 1998 *Rutoceras? mulus* (Barrande, 1865) - Gnoli & Histon: 327-328, pl. 4: 7,?8a-c.
- 1999 *Kionoceras* aff. *electum* (Barrande, 1868) - Histon: 244, tab. 1.
- 2000 *Armenoceras?* sp. A - Serventi & Gnoli: 10, pl. 1: 2a-b.

Derivation of the name. After the ancient Latin adjective defining the Carnic region.

Holotype. MFSN_{gp} 28398 (Fig. 2A₁₋₄). A specimen with inner and outer features.

Type locality. Mine debris at altitude 1738 m, close to the “Antonio” tunnel (Feruglio 1970), Carnic Alps, Italy. Coordinates: IGM 33T UTM 379786 5156521 CTR 2399720 5156351.

Type horizon. The base of the brown to dark reddish iron-manganesiferous limestone at the East-North-East slope of Mt. Cocco. Lower Silurian (Telychian), *Pterospirifer celloni* Conodont biozone.

Material. Eleven fragments of phragmocone: IPUM 27965-27966, MFSN_{gp} 1037, 20686, 23134, 23159, 23207, 25744, 26481, 28398, and a juvenile specimen labelled *Cyrtooceras* sp. MGGC 20670.

Diagnosis. Annulated brevicone shell, and slightly cyrtoconic. Outer ornamentation in form of grid, produced by intersection of longitudinal ribs with transversal annulation. Inside the grids there is a pattern, made by very fine lirae, which repeats itself on the whole surface of the conch. The inner features: septal necks very short and abruptly recumbent; cylindrical connecting rings expanded in the chambers; presence of “contact layer” = adnation area of Flower (see Teichert 1964: K192, fig. 129). No evidence of cameral and/or siphuncular deposits.

Description. The holotype consists of an annulated fragment of a slightly cyrtoconic brevicone 47.5

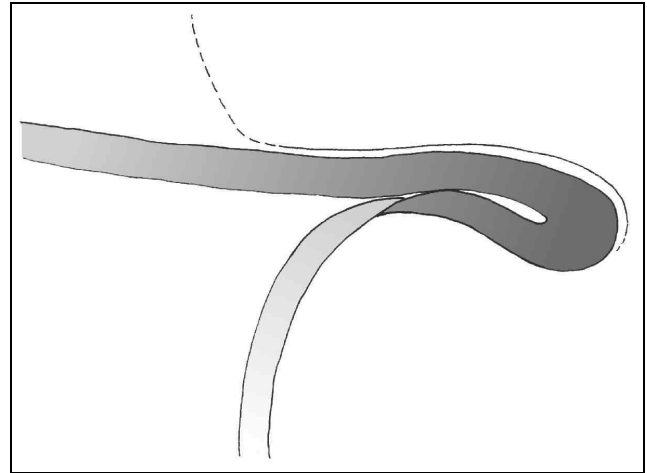


Fig. 3 - *Serpaglioceras forojuliense* gen. et sp. n. Schematic draft of the septal neck area.

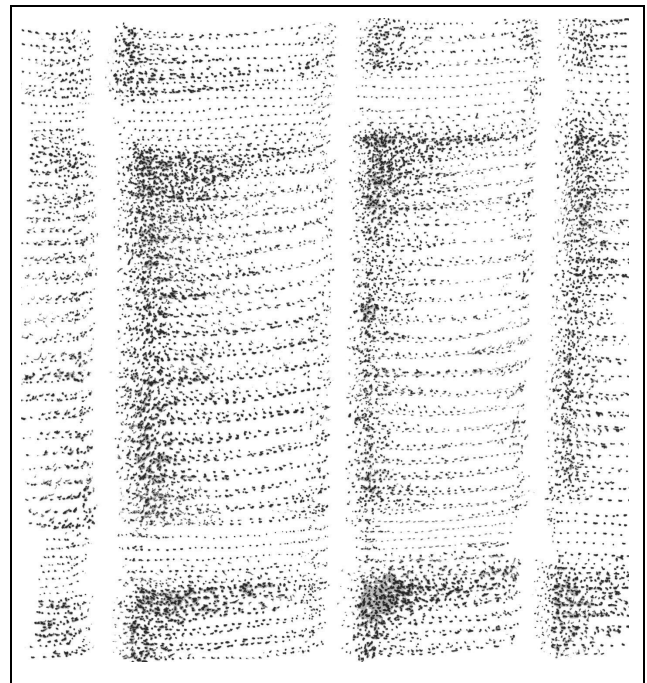


Fig. 4 - *Serpaglioceras forojuliense* gen. et sp. n. Schematic draft of the grid-like outer ornamentation.

mm long bearing 4 chambers. Diameters of the conch are 21.2 mm apicad reaching a maximum diameter of 26 mm orad. The angle of expansion of the shell is close to 13 degrees. The depth of the chambers is 1/5 their own diameter. The siphuncle is in a sub-central position occupying 1/15 of the conch diameter at the septal fora-

Tab. 1 - Measurements in mm and degrees of some members of *Serpaglioceras forojuliense* gen. et sp. n. population.

Sample No.	Chambers depth	Chambers Ø	No. of chambers	Max. Ø of siphuncle	Ø of septal foramen	Angle of expansion
MFSN _{gp} 28398	5.5	20	4	4.8	1.5	13°
MFSN _{gp} 1037	-	11	-	-	1.3	13°
IPUM 27965	5.4	19.1	3	4.3	1	12°
MFSN _{gp} 26481	-	-	-	-	-	15°
MFSN _{gp} 23134	-	-	-	-	-	13°
MGGC 20670	0.6	10.4	-	-	0.6	15°

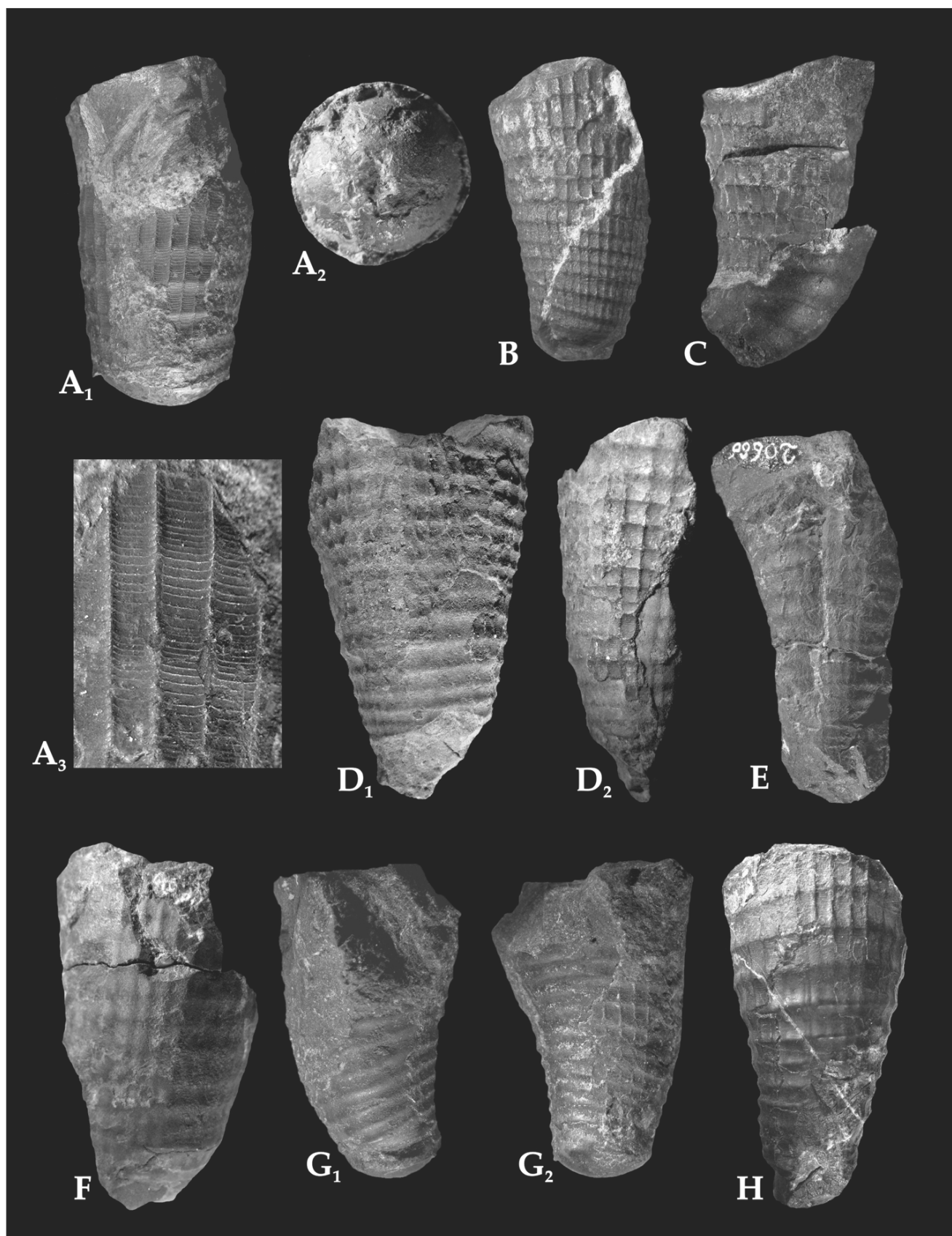


Fig. 5 - *Serpaglioceras forojuliense* gen. et sp. n. paratypes. A₁) MFSNgp 1037. Outer view, x 2,5. A₂) The same in septal view to show sub-central position of the siphuncle, x 4. A₃) Enlarged detail of the outer ornamentation of the same specimen, x 8. B) MFSNgp 23207. Lateral views, x 2,5. C) MFSNgp 23159 annulated conch outer view, x 3. D₁₋₂) Lateral view of the same specimen, both x 2. E) MFSNgp 20686, x 1,5. F) MFSNgp 25744, x 1,5. G₁₋₂) MFSNgp 20670. Outer views, both x 1,5; H) MFSNgp 26481. Outer view, x 1,5.

men. Septal necks are very short and abruptly recumbent (armenoceratid-type). Connecting rings are expanded in the chambers reaching a maximum diameter of 3.5 mm in its middle portion of the camerae that corresponds to about 1/6 of the shell diameter. Their shape is not globular but almost cylindrical and sharply constricted at the septal foramina. In the holotype there is a “contact layer” = adnation area of Flower, very similar to that illustrated by Teichert (1964: K192, fig. 129 and here in Fig. 3) extending on the upper part of the septa for about one millimetre inside the free part of the connecting ring.

The ornamentation of the shell surface consists of the junction of transverse annulations with the longitudinal ribs that produces a reticulate, regularly spaced (1.9 mm), pattern in the mature conch. The junctions of the annulations with the longitudinal ribs form elevated crenulations or frills. Between annulations and longitudinal ribs, an ornamentation bearing fine lirae is present. These ones being more closely spaced apicad, and widen orad. This pattern repeats itself in each annulation interval with number of the lirae per annulation increasing orad (Fig. 4).

The distance between annulations ranges from 3 mm apicad to 5 mm orad.

The juvenile paratype MGGC 20670 shows a curvature of the longitudinal axis corresponding to a radius of 40 mm at a shell diameter of 6 mm, and an angle of expansion of 15°.

The radius of curvature decreases orad, so that specimen MFSNgp 23207, with an expansion angle of

17 degrees and a diameter of 11mm, possesses a radius of 70 mm at shell.

Further data are reported in the Tab. 1.

Remarks. After further preparation, one specimen identified as *Rutoceras? mulus* (Barrande, 1865) by Gnoli & Histon (1998) in their preliminary investigation of Silurian nautiloid cephalopods of the Carnic Alps, labelled MFSNgp 1037, appears to fit better in the new species, mainly because of its ornamentation. For the same reason, MFSNgp 23159 here figured in Fig. 5C is also attributed to the *S. forojuliense* n. sp. despite the small size.

Stratigraphic and geographic range. Lower Silurian (Telychian) of Mt. Cocco, Carnic Alps (Italy), *Pterospathodus celloni* Conodont biozone (Corradini & Serpagli 1999).

Acknowledgements. Thanks are due to Dr. Carlo Morandini, director of MFSN for giving available for study fossil specimens stored in the Museum, to Prof. Carlo Corradini (Cagliari University) who provided stratigraphic determination of some blocks bearing fossils. Dr. Carlo Sarti gave available for study fossil cephalopods stored in the Palaeontological Museum of the Dept. of Earth and Geological Environmental Sciences at Bologna University. Mr. Giancarlo Leonardi (drawer of our institution) provided for figures. Dr. Björn Kröger is thanked for the discussion of the material. At last the authors are deeply indebted to Prof. Enrico Serpagli (Modena and Reggio Emilia University) for the critical reading of the MS, and for providing useful suggestions and advises. This research was funded by PRIN “The end and the beginning: loss and recoveries from the end-Ordovician mass extinction in the North Gondwana” project grant (responsible Prof. Annalisa Ferretti).

REFERENCES

- Barrande J. (1865-77) - Système Silurien du centre de la Bohême - I Rech. Pal., v. 2, Classe des Mollusques, Ordre des Céphalopodes; 1re Série, pls. 1-107 (1865); 2me Série, pls. 108-244 (1866); 3me Série, pls. 245-350 (1868); 4me Série, pls. 351-460 (1870); Supl. et Série tard., pls. 461-544, Texte III (1874); Texte IV (1877); Texte V (1877); 4^a Série, Distribution horizontale et verticale des Cephalopodes, dans le contrées siluriennes (1870).
- Carulli G. B. (2006) - Inquadramento geologico del Friuli. In: C. Corradini, G. Muscio & L. Simonetto (Eds) - Escursione in Friuli. In: Melis R., Romano R. & Fonda G. - Guida alle Escursioni, Giornate di Paleontologia 2006: 65-66, EUT-Trieste.
- Corradini C. & Serpagli E. (1999) - A Silurian conodont biozonation from late Llandovery to end Prídolí in Sardinia (Italy). *Boll. Soc. Paleont. Ital.*, 37: 255-273, Modena.
- Corradini C. & Simonetto L. (2006) - Il Siluriano e Devoniano Inferiore carnico: la sezione “Rio Malinfier”. In: Corradini C., Muscio G. & Simonetto L. (Eds) - Escursione in Friuli. In: Melis R., Romano R. & Fonda G. - Guida alle Escursioni, Giornate di Paleontologia 2006: 114-115, EUT-Trieste.
- Corradini C., Pondrelli M., Serventi P. & Simonetto L. (2003) - The Silurian cephalopod limestone in the Monte Cocco area (Carnic Alps, Italy): conodont biostratigraphy. *Rev. Esp. Micropaleont.*, 35(3): 285-294, Instituto Geológico y Minero de España, Madrid.
- Dzik J. (1984) - Phylogeny of the Nautiloidea. *Palaeontologia Polonica*, 45: 3-203, Warszawa.
- Engeser T. (1997-2002) - Data Retrieval System Nautiloidea, available on CD ROM thanks to the courtesy of the Author.
- Eichwald E. (1860) - Lethaea Rossica ou Paléontologie de la Russie, pp. 1-1654, Schweizerbart, Stuttgart.
- Feruglio G. (1970) - Il giacimento ferro-manganesifero del Monte Cocco. Pubblicazione No. 18: 5-43, Arti Grafiche Friulane, Udine.
- Flower R.H. (1941) - Notes on the structure and phylogeny of euryssiphonate cephalopods. *Palaeontographica Americana*, 3: 5-51, Tulsa, Oklahoma.

- Flower R.H. (1964) - Nautiloid shell morphology. *New Mexico Inst. Mines Tech., State Bureau Mines Mineral res., Mem.*, 13: 1-75, Albuquerque.
- Foerste A.F. (1924) - Notes on American Paleozoic cephalopods. *Denison Univ. Bull., J. Sci. Lab.*, 20: 193-268, Granville, Ohio.
- Foerste A.F. (1925) - Cephalopoda of Lake Timiskaming area and certain related species. In: The Palaeozoic outlier of Lake Timiskaming, Ontario and Quebec. Canada Department of Mines, *Geol. Survey, Memoir*, 145: 64-93, Ottawa.
- Frech F. (1887) - Ueber das Devon des Ostalpen, nebst Bemerkungen über das Silur und einem paläontologischen Anhang. *Zeitschrift Deutsche Geophysikalische Gesellschaft*, 39: 659-738, Berlin.
- Gnoli M. & Histon K. (1998) - Silurian Nautiloid cephalopods from the Carnic Alps: a preliminary investigation. *Boll. Soc. Paleont. Ital.*, 36: 311-330, Modena.
- Gnoli M. & Serventi P. (2006) - Indagine preliminare su stadi giovanili e protoconche di nautiloidi dal Siluriano delle Alpi Carniche. In: Fonda G., Melis R. & Romano R. (Eds) - Giornate di Paleontologia 2006, Trieste, Abstracts: 42.
- Gnoli M., Histon K. & Serventi P. (2000) - Revision of Silurian cephalopods from the Carnic Alps: the Gortani and Vinassa de Regny collection, 1909. *Boll. Soc. Paleont. Ital.*, 39: 3-12, Modena.
- Gortani M. & Vinassa de Regny P. (1909) - Fossili neosilurici del Pizzo di Timau e dei Pal nell'Alta Carnia. *Memorie della Reale Accademia dell'Istituto di Scienze, Bologna*, 183-217.
- Heritsch F. (1929) - Faunen aus dem Silur der Ostalpen. *Abh. Geol. Bund.*, 23: 1-183, Wien.
- Histon K. (1999) - Revision of Silurian nautiloid Cephalopods from the Carnic Alps (Austria) - The Heritsch (1929) Collection in the Geological Survey of Austria. *Abh. Geol. Bund*, 56(1): 229-258, Wien.
- Histon K. & Schönlaub H.P. (1999) - Taphonomy, Palaeology and Taphonomy implications of the Nautiloid fauna from the Silurian of the Cellon Section (Carnic Alps, Austria). *Abh. Geol. Bund*, 54: 259-274, Wien.
- Hyatt A. (1884) - Genera of fossil cephalopods. *Proc. Boston Soc. Nat. Hist.*, 22: 273-338, Boston [fide Hansman, 1958].
- Kobayashi T. (1935) - Restudy on *Manchuroceras* with a brief note on the classification of the endoceroids. *Geol. Soc. Japan J.*, 42: 736-752, Tokyo.
- Kröger B. & Isakar M. (2006) - Annulated orthoceridan cephalopods of the Baltoscandian Ordovician. *Fossil Record*, 9(1), 137-163, Berlin.
- Ristedt H. (1968) - Zur Revision der Orthoceratidae. *Abh. Math.-Naturwiss. Akademie der Wissenschaften und Literatur in Mainz, Klasse*, 4: 213-297, Mainz.
- Schindewolf O. H. (1935) - Bemerkungen zur Ontogenese der Actinoceren und Endoceren (Ceph. Nautil.). *Neues Jahrb. Min., Geol. Paläont., Beilage-Band*, 74B: 89-113, Stuttgart.
- Schönlaub H.P. (1997) - The Silurian of Austria. In: H.P. Schönlaub (Ed.) - IGCP-421 Inaugural Meeting Vienna. *Ber. Geol. Bund.*, 33: 1-124, Wien.
- Schönlaub H.P. (1998) - Review of the Paleozoic Paleogeography of the Southern Alps - The perspective from the Austrian side. In: Perri M.C. & Spalletta C. (Eds) - *Giornale di Geologia*, 60: 59-68. Bologna.
- Selli R. (1963) - Schema geologico delle Alpi Carniche e Giulie occidentali. *Giornale di Geologia*, S2, 30: 1-136, Bologna.
- Serventi P. (1999) - Some new Silurian cephalopods from the Italian side of the Carnic Alps. In: Histon K. (Ed.) - V° International Symposium Cephalopods - Present and Past, Vienna. Abstract - *Ber. Geol. Bund*, 46: 103, Wien.
- Serventi P. (2002) - Nuova segnalazione di Cefalopode ortocero dal Siluriano delle Alpi Carniche. *Giornate di Paleontologia 2002*, Abstracts: 50, Bolca (Vr).
- Serventi P. & Gnoli M. (2000) - Nuovi ritrovamenti di Cefalopodi nautiloidei nelle Alpi Carniche. *Giornale di Geologia*, Ser. 3^a, 62, Supplemento: 9-14, Bologna.
- Serventi P., Gnoli M. & Histon K. (1999) - Revision of Silurian Nautiloid cephalopods from the Carnic Alps from various museum collections. In: Histon K. (Ed.) - V° International Symposium Cephalopods - Present and Past, Vienna. Abstract - *Ber. Geol. Bund*, 46: 104, Wien.
- Serventi P., Corradini C., Simonetto L. & Pondrelli M. (2006) - Cefalopodi Nautiloidei Siluriani del Museo friulano di Storia Naturale: Famiglia Orthoceratidae. *Gortania*, 28: 29-57, Udine.
- Stache G. (1872) - Der Graptolithenschiefer am Osternig-Berge in Kärnten. *Jahr. Geol. Reich.* - A. 23: 175-248, Wien.
- Teichert C. (1933) - Der Bau der actinoceroideen Cephalopoden. *Palaeontographica*, Abt. A 78: 111-230, Stuttgart.
- Teichert C., Kummel B., Sweet W. C., Furnish W. M., Glenister F., Erben H. K., Moore R. C. & Nodine Zeller D. E. (1964) - Descriptions of Subclasses and Orders. Treatise on Invertebrate Paleontology, Part K, Mollusca 3. In: Moore, R.C. (Ed.) - The Geological Society of America and The University of Kansas Press.
- Troedsson G. T. (1926) - On the Middle and Upper Ordovician faunas of northern Greenland. I. Cephalopods. *Meddelelser om Grönland*, 71: 1-157, Copenhagen.
- Wenzel B. (1997) - Isotopenstratigraphische Untersuchungen an silurischen Abfolgen und deren paläozoographische Interpretation. *Erlanger geol. Abh.*, 129: 1-117, Erlangen.