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On the first Belgian record of the Eifelian (Middle Devonian) ammonoid cephalopod *Subanarcestes* (Suborder Anarcestina)

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ABSTRACT

Ammonoid cephalopods are extremely rare in the Lower and Middle Devonian sedimentary rocks of Belgium, which contrasts with the neighboring sedimentary basins. However, searches in old collections and recent collecting efforts show that ammonoids do occur in these beds in Belgium, which allows to enlarge our knowledge of Lower and Middle Devonian ammonoid occurrences. Here, a record of the Eifelian (Middle Devonian) anarcestid ammonoid genus *Subanarcestes* is described for the first time from Belgium based on a specimen from the Jemelle Formation (Chavées Member). This specimen was collected more than a century ago by Eugène Maillieux at Trou Bodet near Couvin. It laid unrecognized as an ammonoid cephalopod for many decades in the collections of the Royal Belgian Institute of Natural Sciences, while being previously identified as *Cryptoceras* or '*Nautilus*' fossil, which if correct, constituted Belgium's oldest Nautilida fossil. Micro-CT imaging greatly helped in the taxonomic assignment of the specimen.

KEYWORDS

Devonian,
Ammonoidea,
Cephalopoda,
Nautilida,
Solenochilus,
micro-CT

Article history

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1. Introduction

Lower and Middle Devonian strata in Belgium are not at all renowned for ammonoid cephalopod records, much in contrast to neighboring sedimentary basins such as the Rhenish Mountains or the Prague Basin (see e.g., d'Archiac & de Verneuil, 1842; Sandberger & Sandberger, 1850–1856; Barrande, 1865; Erben, 1960, 1964; Chlupáč & Turek 1983; Bockwinkel et al., 2013; De Baets et al., 2013a). Prior to the recognition of the occurrence of *Ivoites schindewolfi* De Baets et al., 2013a by De Baets et al. (2013b) in the Emsian strata of Steffeshausen (Fig. 1), not a single record of Early Devonian ammonoids was known from Belgium.

For the Eifelian, only Maillieux (1924, 1933, 1938) reported a single find of *Agoniatites transitorius* Phillips, 1841 from the 'Schistes à Calcéoles Co2c' (now Jemelle Formation) at Fond des Vallaines (now Fond des Valennes), Rochefort (Fig. 1), but without supplying a detailed description, drawings and/or photographs. The specimen is currently considered lost, for which Maillieux's taxonomic assignation cannot be discussed. However, most probably, the species level assignation must be incorrect as *Agoniatites transitorius* is a species described by Phillips (1841, p. 140, pl. 60, fig. 227*, as *Goniatites transitorius*) based upon a Givetian specimen from Wolborough quarry in Newton Abbot, Devon, England (see House, 1963, who also refigured the holotype on pl. 1, fig. c, d).

No other ammonoid occurrences have yet been accounted for in Belgian Eifelian sediments. However, recent collecting has brought to light the presence of the ammonoid *Pinacites jugleri* (Roemer, 1843) in the Jemelle Formation at the *Mur des douaniers*, Vireux, a famous French locality just across the Belgian border (Becker in Schraut, 2000), and the same species was recently recognized in several Belgian localities (Goolaerts in van Viersen et al., 2019).

Here, we report on another ammonoid occurrence in the Jemelle Formation, namely of the genus *Subanarcestes*. It is based on a specimen collected by Eugène Maillieux prior to 1911, which is stored already for many decades in the collections of the Royal Belgian Institute of Natural Sciences, in a drawer labelled 'Couvinien supérieur – Assise de Couvin – Céphalopodes', the same drawer that presumably once held the *Agoniatites transitorius* specimen. It was identified as a nautilid fossil, which would be, if correct, the oldest Belgian fossil of the Order Nautilida.

2. Material and methods

Specimen IRSNB a13851, previously Invert-08254-0078, is stored in the collections of the Royal Belgian Institute of Natural Sciences (RBINS), Brussels, Belgium. The specimen is part of the collection of 'young' Eugène Maillieux, which, according to the registrar, was acquired by the RBINS on April 11th, 1911, receiving the general inventory (IG) number 8254. It contained

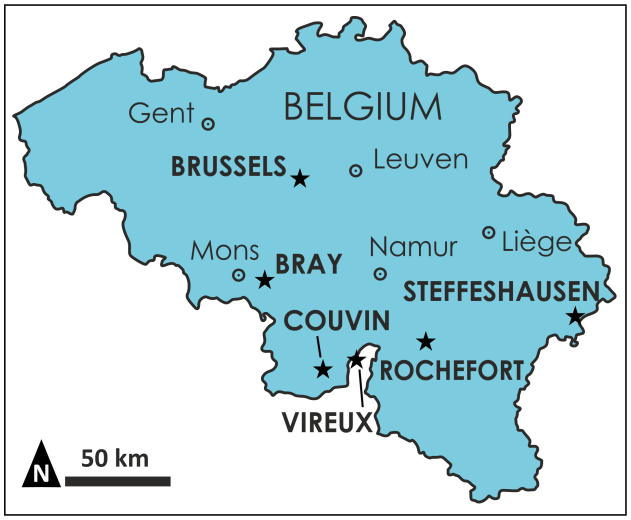

Figure 1. Location of Belgian and French localities mentioned in the text. **Couvin:** Trou Bodet, 400 m southeast of Couvin railway station, where ammonoid *Subanarcestes macrocephalus* Schindewolf, 1933 (specimen IRSNB a13851; Figs 3–4) was found in the upper Eifelian, Chavées Member, Jemelle Formation; **Steffeshausen:** Auf Schleid Quarry, wherefrom the lower Emsian ammonoid *Ivoites schindewolfi* De Baets et al., 2013a is reported by De Baets et al. (2013b); **Rochefort:** Fond des Vallennes, where Maillieux's (1924, 1933, 1938) ammonoid *Agoniatites transitorius* Phillips, 1841 was found in the Eifelian Jemelle Formation; **Vireux:** Mur des douaniers, at the Franco-Belgian border, wherefrom ammonoid *Pinacites jugleri* (Roemer, 1843) is reported by Becker in Schraut (2000) in the Eifelian Jemelle Formation; **Bray:** Bray colliery, where Demanet's (1943) nautilid *Solenocheilus latiseptatus* (De Koninck, 1878), refigured here in Fig. 5, was found in the lower Moscovian Meeuwen Member, Flénu Formation, Belgian Coal Measures Group; **Brussels:** where the Royal Belgian Institute of Natural Sciences (RBINS), the repository of all figured specimens in this paper, locates.

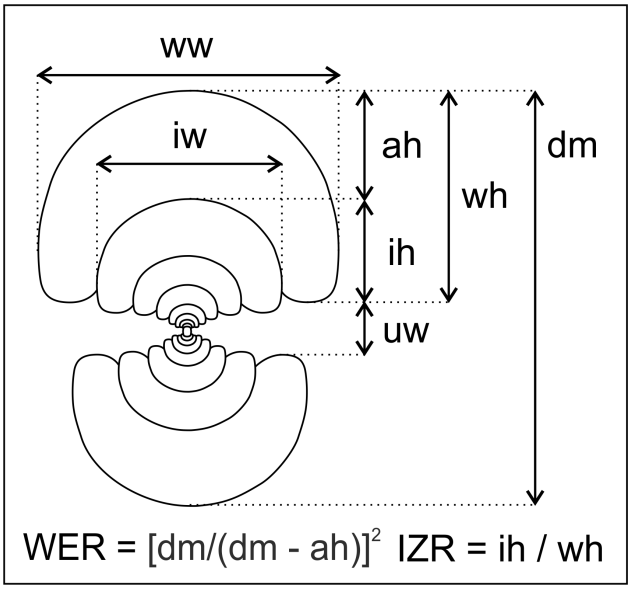

Figure 2. Parameters and ratios of the ammonoid conch used in the text. Abbreviations: ah: apertural height, dm: conch diameter, ih: imprint height, iw: imprint width, uw: umbilical width, ww: whorl width, wh: whorl height, WER: Whorl Expansion Rate (WER) (= $[dm/(dm - ah)]^2$), IZR: Imprint Zone Rate (= ih/wh). After Korn (2010) and Klug et al. (2015).

4350 fossils belonging to 956 species from Belgium plus another 4400 specimens and 812 species from abroad.

The descriptive conch terminology used here (Fig. 2 and Table 1) follows that of Korn (2010) and Klug et al. (2015).

IRSNB a13851 has been analyzed using the RBINS X-ray micro-focus computed tomography (micro-CT) machine RXEasyTom 150 (from RX Solutions, France) at 150 kV and 200 µA with copper filter with a spatial resolution (voxel size) of 23.6408 µm. After scanning, the extraction into 16-bit tiffs and the generation of a 3D mesh of the outer surface have been performed with X-Act software. For further rendering and segmentation (Fig. 3F–I), Dragonfly ORS was used. Additional metadata, photographs and a link to the 3D surface mesh are made accessible through the RBINS Virtual Collections platform.

Author citation is only given for taxa that are taxonomically discussed. For those only mentioned discussing age dating, author citations can be found in the referenced papers from which the data are cited from. For the authorship of taxonomic ranks above the Family level in the Systematic Paleontology chapter, Korn & Klug (2002) is followed, but modified to Hoffmann et al. (2022) for Class and Subclass levels.

3. Systematic paleontology

Phylum Mollusca Linnaeus, 1758
Class Cephalopoda Cuvier, 1795
Subclass Ammonoidea Haeckel, 1866
Order Agoniatitida Ruzhencev, 1957
Suborder Anarcestina Miller & Furnish, 1954
Superfamily Anarcestoidea Steinmann, 1890
Family Anarcestidae Steinmann, 1890
Genus *Subanarcestes* Schindewolf, 1933

Type species. *Subanarcestes macrocephalus* Schindewolf, 1933, by original designation, from Olkenbach, Rheinland-Pfalz, Rhenish Mountains, Germany, from an equivalent of the Wissenbach Formation, undifferentiated middle to late Eifelian (see Ebbighausen et al., 2011 for more details).

Remarks. The family-level classification of the genus *Subanarcestes* is debated, and a consensus is lacking (see e.g., Becker & House, 2000; Ebbighausen et al., 2011 and Nikolaeva et al., 2017 for overview and discussions). Korn & Klug (2002) placed it together with *Sobolewia* Wedekind 1918 and *Holzapfeloceras* Miller 1932 in the Family Sobolewiidae House, 1989. Ebbighausen et al. (2011) placed it with *Werneroceras* Wedekind, 1918 in the Subfamily Werneroceratinae Erben, 1964 (Family Werneroceratidae Erben, 1964). Here, awaiting further studies, we follow Nikolaeva et al. (2017), the most recent paper discussing it, in leaving it in the Family Anarcestidae Steinmann, 1890.

Subanarcestes macrocephalus Schindewolf, 1933
(Figs 3A–I, 4)

1908 *Nautilus* Breyn, Maillieux, p. 175.
1933 *Subanarcestes macrocephalus* Schindewolf, p. 95, pl. 4, fig. 14, text-fig. 27.
2002 *Subanarcestes macrocephalus* Schindewolf 1933, Klug, p. 60, pl. 12, figs 1–3, 5, figs 39A–H, 42B, G, 43, 44 (with full synonymy prior to 2002).
2017 *Subanarcestes macrocephalus* Schindewolf, 1933, Nikolaeva et al., p. 241, pl. 1, fig. 1 (with additional synonymy).

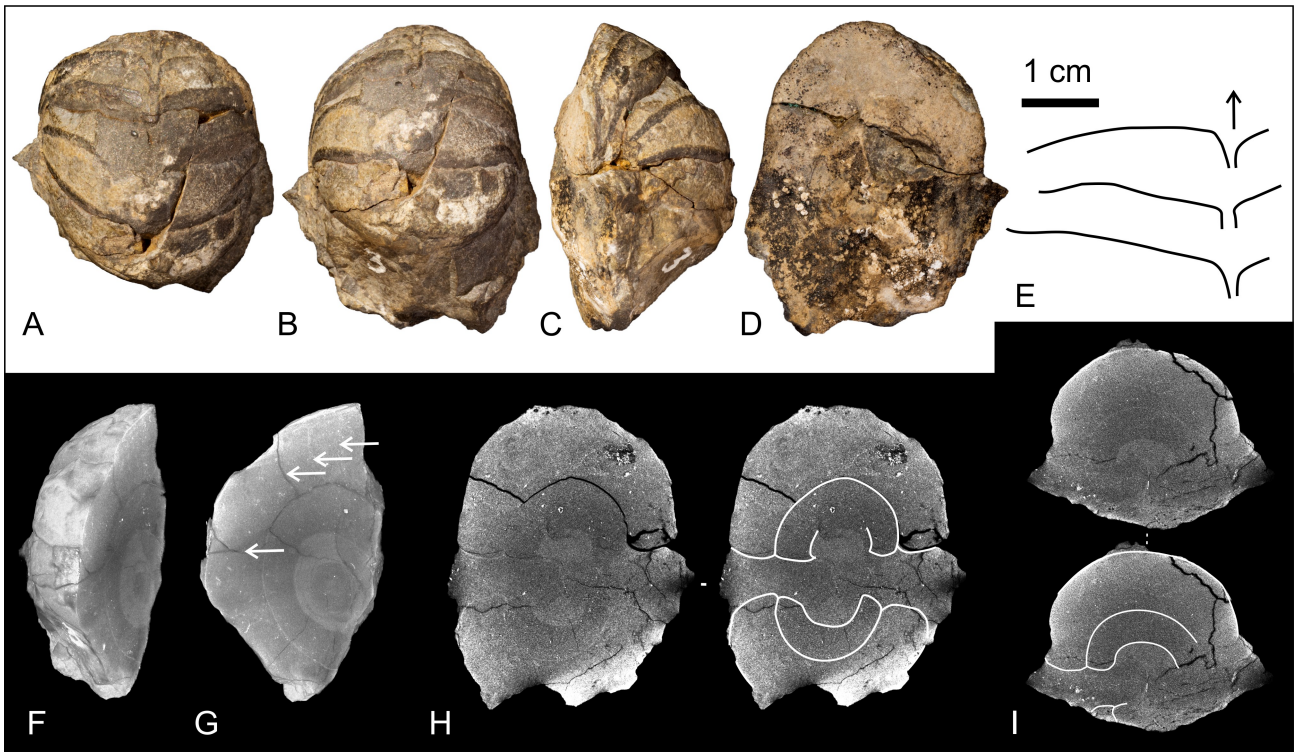

Figure 3. Anarcestoid ammonoid cephalopod *Subanarcestes macrocephalus* Schindewolf, 1933 from the Chavées Member, Jemelle Formation, of Trou Bodet, Couvin, specimen IRSNB a13851. **A**–**D.** Ventral (A, B, D) and lateral (C) views. **E.** Drawing of sutures. **F**–**G.** 3D-rendering of the specimen, virtually cut, with narrower spaced septa (arrows) near the apertural end of the specimen. **H**–**I.** Virtual cuts of the specimen.

Types. Holotype is the specimen figured by Schindewolf (1933, pl. 4, fig. 14).

Material. Specimen IRSNB a13851, previously Invert-08254-0078, from the 'Co2c' of Trou Bodet, Couvin.

Description. A fragmentary phragmocone of a specimen that would have had a conch diameter larger than 40 mm when it would have been complete. The largest whorl width is 29 mm. On the external side, the remains of five or six chambers are recognizable over about one-third of a whorl. The suture line shows a relatively deep external lobe on the venter, to then slope upwards towards the flank where it extends almost straight without clearly definable lobes or saddles (Fig. 3A–C, E). One side of the specimen is partly overgrown with lichen (Fig. 3D), evidencing that the specimen must have been exposed in a natural outcrop for some time. Micro-CT imaging allows adding much more details to the description (Fig. 3F–I). First, the specimen is much more complete than can be observed externally. The innermost whorls are crushed. Measurements of conch parameters obtained from virtual cross-sectioning of the specimen are given in Table 1. Based on these measurements, following definitions by Korn (2010) and Klug et al. (2015), the conch has very strongly embracing whorls (IZR = 0.39–0.57), a moderate to low expansion rate (WER = 1.64–1.77), and a narrow umbilicus (subinvolute conch) (uw/dm evolving from 0.34 at dm 17.73 mm to 0.17 at dm 38.18 mm). The septal spacing is narrower in the last two chambers. The septal neck projecting adaperturally was seen just below the venter in one of the two last chambers.

Discussion. The specimen is said to come from Trou Bodet, a fossiliferous locality 400 m SW of the Couvin railway station (Fig. 1) exposing beds of the 'Co2c', that is registered as site 'Pl. Couvin n°3' in the archives of the paleontology collections of the RBINS. In the archives of the Belgian Geological Survey, it is registered as 191E0303. Given the impressive list of identified species of fossils, including corals, brachiopods, trilobites, cephalopods, and various other fossils, Maillieux must have visited this locality repeatedly. (Note that the list in the

Table 1. Conch parameters of IRSNB a13851. In mm for dm, ww, wh, ah, ih and uw. See Fig. 2 for full names and definitions of these parameters.

dm	ww	wh	ah	ih	uw	wb/ww	uw/dm	WER	IZR	ww/dm
38.18	28.31	19.61	8.39	11.18	6.35	1.44	0.17	1.64	0.57	0.74
29.93					6.18		0.21			
>23.25	26.53	15.18	7.47	7.71		1.75			0.51	
>15.68	14.56	7.72	4.23	3.50	4.90	1.89			0.45	
24.18	16.13	10.56	6.44	4.48	5.94	1.53	0.25	1.86	0.39	0.67
17.73	13.41	8.16	4.42	3.64	6.10	1.64	0.34	1.77	0.46	0.76
13.26	6.90	4.06				1.70				0.52

paleontology collection does not include 'goniatites' like the list of 191E0303). Several of Maillieux's specimens from Trou Bodet became type or figured specimens, e.g., the lectotype of brachiopod *Cyrtinopsis brachyptera brachyptera* (Maillieux, 1914) (specimen IRSNB a10295, see Mottequin, 2019 and references therein) and figured specimens of brachiopods *Intermedites supraspeciosus* and *Intermedites intermedius* (specimens IRSNB a2012 (listed as A.V. 5487) and IRSNB a2028 (listed as A.V. 5507), see Vandercammen & Vandercammen-Goffinet, 1970 and references therein). Fossils collected at Trou Bodet by other people were illustrated or included in works by e.g., Tsien (1970, corals), Bultynck (1970, conodonts and macrofauna), and Fournier (1897, trilobite *Harpes macrocephalus*, recently refigured by Mottequin, 2021).

In the revised stratigraphy of the Belgian Eifelian rocks by Denayer (2019), the 'Co2c' in the Couvin area corresponds to the Chavées Member of the Jemelle Formation. Conodonts date these beds to the *costatus* (upper part), *kockelianus* and *eiflius* (lower part) zones (Bultynck, 1970; Gouwy & Bultynck, 2003; Denayer, 2019). According to Becker et al. (2020), this correlates to a late Eifelian age roughly between 389 and 387 Ma. At Trou Bodet, but possibly not exactly at the same spot as where Maillieux collected his material, Bultynck (1970) described two sections from trenches at Trou Bodet dug under supervision of M. Lecompte of the RBINS, in which he identified the outcropping strata as 'Co2c II' and 'Co2c III', which would narrow the age of the specimen to the *kockelianus* Zone (Bultynck, 1970; Denayer, 2019).

The fairly globular shape of the conch, the low whorl expansion rate, the prominent external lobe and the simple suture on the flanks readily refer specimen IRSNB a13851 to as a representative of the Superfamily Anarcestoidea. The size of the umbilicus in combination with the shape of the ventral lobe and the absence of a broad lateral lobe on the midflank refers this specimen to the genus *Subanarcestes* Schindewolf, 1933.

Klug (2002) gave an overview of the nowadays recognized species of *Subanarcestes* and also plotted several of their conch parameters, like the evolution of the size of the umbilicus (uw/dm plot, see Klug's 2002 fig. 44) and the rate of imprint (IZR plot, see Klug's 2002 fig. 43) throughout ontogeny. These plots are very informative. In particular, the uw/dm and IZR plots allow to easily separate type species *Subanarcestes macrocephalus* from all other species of the genus. Since, only *Subanarcestes aristanensis* Nikolaeva in Nikolaeva et al., 2017 was added, which both for size of the umbilicus (uw/dm plot, Klug's 2002 fig. 44) and as the rate of imprint (IZR plot, Klug's 2002 fig. 43) plots well away from the beforementioned genotype.

When we plot our (limited number of) measurements of conch parameters obtained from IRSNB a13851 (Table 1) onto Klug's (2002) uw/dm and IZR plots, they fall perfectly within the range of the genotype, both for the size of the umbilicus as well as for the imprint zone rate. All other parameters fall also within the observed range of the species. And when compared to other subinvolute to involute ammonoids dating to the Eifelian, like *Sobolowia globulare* Petter, 1959 and *Sobolewia nuciformis* (Whidborne, 1890), IRSNB a13851 has a larger umbilical diameter (see e.g., Korn & Klug 2002 figs 128C, D, G).

Stratigraphically, *Subanarcestes macrocephalus* has a range spanning most of the Eifelian, from the middle *costatus* to the *ensensis* conodont Zone (Klug, 2002). The age of our specimen thus fits well within this range. However, it is worthy of note that our specimen postdates the *Subanarcestes macrocephalus* ammonoid zone (Becker & House, 2000 for overview and definition), a zone defining a time in the early Eifelian.

Geographically, it is known from Germany (Rhenish Mountains), France (Armorican Massif), Spain (Cantabrian Mountains and Pyrenees), Morocco (Tafilalt, northern Maider, eastern Zagora Graben, and Dra Valley), Algeria (Ougartha and Saoura Valley), Russia (Northern Urals) and Uzbekistan (Aristantau Mountains) (Klug, 2002, Ebbighausen et al., 2011 and Nikolaeva et al., 2017 for discussion and references), and now also Belgium.

4. Discussion – importance of the find

Specimen IRSNB a13851 was first identified by Eugène Maillieux as *Cryptoceras* (Fig. 4), an assignment that he later changed into *Nautilus* Breyn (Maillieux, 1908, p. 175) and, in 1928, into "*Nautilus*" sp. indeterminate to genus and species level. It was also listed as *Nautilus* sp. in his unpublished inventory of the RBINS paleontology collection, as well as on his unpublished list of species for the Trou Bodet locality in the minutes of the inventory of fossiliferous localities, and in the Belgian Geological Survey minutes of locality 191E0303, and on his published list of fossils occurring in the '*Cobn*^{2}' in the explanatory notes of the geological map of Couvin (Maillieux, 1912, p. 53).

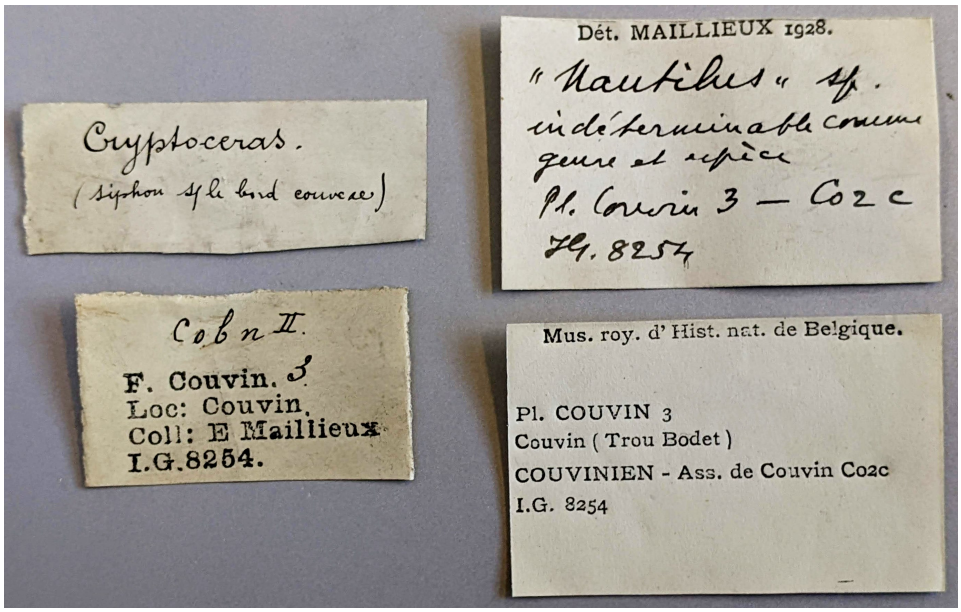

Figure 4. Anarcestoid ammonoid cephalopod *Subanarcestes macrocephalus* Schindewolf, 1933 from the Chavées Member, Jemelle Formation, of Trou Bodet, Couvin, specimen IRSNB a13851, labels. The oldest label (top left, by Eugène Maillieux) transcripts as follows '*Cryptoceras* sp. - siphon sur le bord convexe', which translates to '*Cryptoceras* sp. - siphuncle along the convex side'. Maillieux's revision in 1928 assigned the specimen as '"*Nautilus*" sp., indéterminable comme genre et espèce' which translates to '"*Nautilus*" sp., indeterminable to genus and species'.

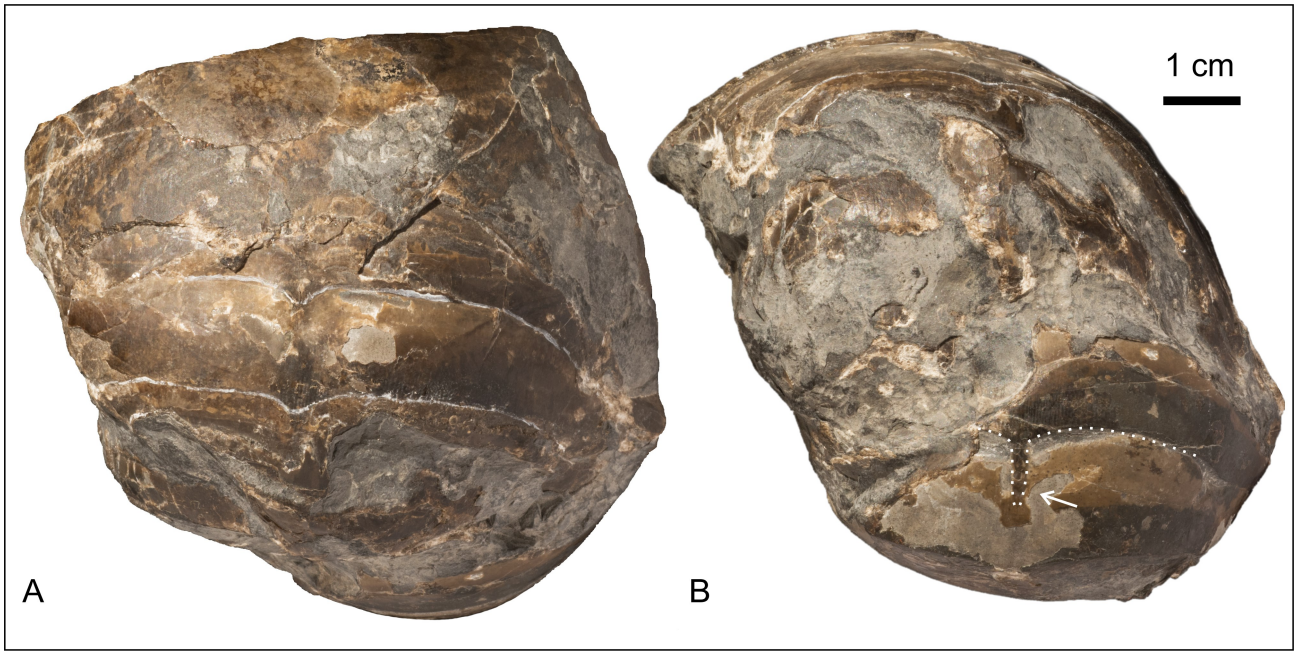

Figure 5. A–B. Example of a false narrow and deep ventral lobe in the suture of Nautilida, a phenomenon resulting from the siphuncle being present just below the venter. Ventral views of specimen IRSNB a06741, Demanet & Van Straelen's (1938, p. 170, pl. 129, fig.11) *Solenochilus latiseptatus* (De Koninck, 1878), which was also figured by Demanet (1943, p. 125, pl. 5, fig. 21) (misspelled as *Solenocheilus* by the authors). From the 'Charbonnages de Bray' (Bray colliery), ~12 km E of Mons (Fig. 1), from the roof of the Petit-Buisson marine horizon with *Anthracoceras aegiranum*, Meeuwen Member, Flénu Formation, Belgian Coal Measures Group, lower Moscovian (base of Westphalian C according to the traditional subdivision), upper Carboniferous. (Naming of lithostratigraphic units as in Delmer et al., 2002).

Cryptoceras is an old and invalidated name, both the one introduced by Barrande (1846) as the one by d'Orbigny (1850). Barrande's *Cryptoceras* was quickly replaced by *Ascoceras* Barrande by von Hauer, 1847; this genus is still valid today and groups Silurian nautiloid cephalopods with a very particular conch. It is clearly *Cryptoceras* d'Orbigny 1850 that Maillieux meant. This name was replaced by *Solenochilus* Meek & Worthen, 1870 (sometimes misspelled as *Solenocheilus*, see also Fig. 5) (Family Solenochilidae Hyatt, 1893; see Meek & Worthen, 1870; Mikesh & Glenister, 1966 and Teichert et al., 1964, p. K441 for discussions and overview), a true representative of the Order Nautilida. The genus *Solenochilus* ranges from the Carboniferous to the Permian. It has a conch characterized by touching whorls, a depressed whorl section, a ventrally positioned siphuncle, and, when it comes into the adult stage, large dorsolateral spines are developed (Teichert et al., 1964). On internal molds of specimens having lost all carbonate from the shell and siphuncle, one may get a false impression that the suture has a narrow and deep external lobe. This phenomenon is made well visible in Teichert et al.'s (1964) figure 318.2a. It is also present in Demanet & Van Straelen's (1938, p. 170, pl. 129, fig.11) specimen of *Solenochilus latiseptatus* (De Koninck, 1878) from the late Carboniferous of Bray, Belgium (Fig. 1), refigured here on Figure 5, as well as in one of De Koninck's (1878, pl. XXII fig.2b) drawings of *Nautilus latiseptatus* from the early Carboniferous (Tournaisian) of Belgium. It must be this phenomenon that Maillieux had in mind when he assigned IRSNB a13851 to *Cryptoceras*. His old label (Fig. 4) states 'siphon sur le bord convexe' (siphuncle along the convex side). This is clearly erroneous, although, with *Subanarcestes* being an ammonoid, the siphuncle is still situated close to the venter. The absence of a large nautilid-type siphuncle is also evidenced by the micro-CT imaging of the specimen (Fig. 3F–I).

Not unimportantly, if the assignation to *Solenochilus* would have been correct, or that the specimen would truly be a representative of the Order Nautilida, it would make it the oldest 'nautilus' fossil of Belgium and supplemented important information on the early evolution of the order. Fossils of basal Nautilida are rare, which is part of the reason why the origin and subordinal and superfamilial classification within the Nautilida has had a complex history and still requires further analysis (e.g., Dzik & Korn, 1992; Manda & Turek, 2009, 2011, 2019; King & Evans, 2019). Significantly different systematic schemes and approaches were adopted in the past, and a satisfying consensus is lacking. Major recent modifications to the classification of the Nautilida are the exclusion of the Rutoceratidea and the establishment of the new Suborder Lechritrochoceratina as basal nautilids (Manda & Turek, 2011, 2019).

No other Nautilida are currently known from the Belgian Devonian at all. One possible exception is that of *Nautilus aborigenum*, a yet to be revised species introduced by Dupont (1872, p. 159) when describing fossils found during excavations at the Trou de Chaleux cave (Hulsonniaux, Houyet, Namur Province) in human context (Magdalenian). Dupont's naming referred to the ancient people who collected the specimen. According to the description, the species is based on a single chamber of a large, chambered shell originating from Devonian *Psammites du Condroz* rocks (Famennian, Mourlon, 1881, p. 21), which make up the beds underlying the Carboniferous limestones into which the caves are formed. The absence of Nautilida from Belgian Devonian strata makes their presence in the early Carboniferous, both with large numbers as with great diversity, even more remarkable (e.g., De Koninck, 1842–1844, 1878, 1880).

Belgian Eifelian, Givetian, Frasnian and Famennian strata, however, preserve quite a diversity of the subclass Nautiloidea (in the old tripartite division of the Class Cephalopoda, alternative classifications of the Nautiloidea have recently been

proposed in the light on the ongoing revision of Teichert et al.'s (1964) Nautiloidea Treatise, see King & Evans, 2019 and Pohle et al., 2022 for overviews). However, nearly the entire Devonian cephalopod fauna from Belgium is in urgent need of revision. Most of the fauna is formally undescribed and only referred to in stratigraphic works without describing and figuring specimens. For the same stratigraphic interval of our *Subanarcestes* specimen, the 'Co2c', Maillieux (1938) lists: *Orthoceras crebrum* Saemann, *Spyroceras nodulosum* (Schlotheim), *Meloceras belgicum* Foord, *Phragmoceras orthogaster* Sandberg, *Gomphoceras inflatum* (Goldfuss), *Gyroceras alveiferum* Maillieux, *Gyroceras eifelense* (d'Archiac & de Verneuil), *Gyroceras nodosum* (Goldfuss & Bronn) and *Agoniatites transitorius* (Phillips) (taxonomy as in Maillieux, 1938). While the taxonomy of all these records needs an in-depth revision, one can still deduce that this level delivers a diverse cephalopod fauna, both in the number of species, evolutionary lineages, and conch shapes. The same holds true for Germany, where more studies were undertaken in the past. Afhüppe & Becker (2022) recently listed all species described (formally and in open nomenclature) for the Givetian of the Rhenish Mountains, a list that includes at least 45 taxa including orthocones (Orthoceratida and Pseudorthoceratida), breviconic Oncoceratoidea, and cyrto- to gyroconic, depressed Rutoceratoidea.

5. Conclusions

The ammonoid cephalopod *Subanarcestes* is described for the first time from Eifelian rocks in Belgium, based on a single incomplete specimen referred to as *Subanarcestes macrocephalus* Schindewolf, 1933 from the Chavées Member, Jemelle Formation, of Trou Bodet, Couvin (Dinant Synclinorium). This occurrence is situated within the interval spanning the *costatus* (upper part), *kockelianus* and *eiflius* (lower part) conodont zones, which correlates to a late Eifelian age roughly between 389 and 387 Ma. This interval may possibly be further restricted to the *kockelianus* Zone only.

The discovery enlarges the sparse knowledge of ammonoid occurrences in Belgian Eifelian deposits, and in the Belgian Lower and Middle Devonian as a whole. Ammonoids are very rare in these beds, and only a few specimens and occurrences have yet been properly described from them.

The specimen is not a representative of the Nautilida, as suggested by Maillieux, nor from the Nautiloidea s.l., but from the Ammonoidea.

The power of the application of micro-CT imaging in the study of fossilized remains of cephalopods is yet again evidenced. It allowed us to obtain a much larger set of measurements and observations from the specimen, on conch shape and septa, for which without them, a species and even genus level assignation within the Anarcestoidae would have been almost impossible to obtain, and certainly not without damaging a historical and unique specimen.

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Author contribution

The author recognized the ammonoid character of specimen IRSNB a13851, executed its micro-CT imaging, drew its suture, identified its genus and species, made the figures, and wrote the text.

Data availability

The figured specimens are housed in the RBINS repository, guaranteeing their long-term safekeeping and availability to other researchers for future studies. The micro-CT imaging dataset can be obtained upon request from the RBINS paleontology collection manager.

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