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RETIOLITES ANGUSTIDENS ELLES & WOOD, 1908 (GRAPTOLITHINA) FROM THE SILURIAN OF MT. COCCO (CARNIC ALPS, ITALY)

RETIOLITES ANGUSTIDENS ELLES & WOOD, 1908 (GRAPTOLITHINA) DAL SILURIANO DI M. COCCO (ALPI CARNICHE, ITALIA)

Riassunto breve - *Retiolites angustidens*, trovato in un blocco isolato di calcare a Orthoceras nell'area di Monte Cocco in associazione con *Monograptus* cf. *priodon*, viene qui descritto e figurato per la prima volta nelle Alpi Carniche: in precedenza la sua presenza, infatti, era stata segnalata, ma mai documentata. Dato che tutti i graptoliti rinvenuti hanno un limitato valore stratigrafico, l'età precisa dell'associazione studiata è attribuita alla Biozona a *Pterospathodus am. amorphognathoides* (Llandovery sup.) in base ai conodonti.
Parole chiave: Graptoliti, Sistematica, Siluriano, Alpi Carniche.

Abstract - Retiolites angustidens *is described and figured for the first time from the Carnic Alps, from a loose block collected from Mt. Cocco area. The association includes also* Monograptus *cf.* priodon*: this species, in fact, was previously reported, but never documented, from this area. Since all the graptolites found have a limited stratigraphic value, the precise age of the studied association is determined by conodonts as belonging to the latest Llandovery (*Pterospathodus am. amorphognathoides *conodont Zone)*.
Key words: *Graptolites, Systematics, Silurian, Carnic Alps.*

Introduction

Monte Cocco is located in the Eastern part of the Carnic Alps, north of Ugovizza (Udine), just south of the state border between Italy and Austria. The area has been known for a long time to geologists thanks to either the abundance of fossils (Stache 1878, 1879, 1884; Frech 1888, 1894) or the important mining activity, digging out iron and manganese (Feruglio 1970; Zucchini 1998).

The Silurian rocks of Monte Cocco are highly fossiliferous, and many papers deal with the taxonomy of selected groups, especially to nautiloid cephalopods (i.e.: Stache 1879; Frech 1888, 1894; Heritsch 1929; Serventi 2001; Serventi et al. 2007 and references therein). A few bivalves have been listed by Kříž (1999) in his monograph about Silurian bivalves from the Carnic Alps. Conodonts have been studied mainly in stratigraphic investigations (Manzoni 1965; Herzog 1988; Corradini et al. 2003; Corriga & Corradini 2009). To have a summary of the Silurian geology and palaeontology of Monte Cocco and a complete reference list refer to Corradini et al. (2010).

The presence of graptolites in the Monte Cocco area has been reported by several authors (Stache 1881, 1884, 1890; Frech 1888, 1894; Gortani 1923; Heritsch 1929), who referred on the occurrence of genera *Monograptus* and *Retiolites*. However, illustrations are very rare, since only a couple of specimens of *Monograptus priodon* has been figured by Gortani (1923, pl. 3, fig. 1) and Heritsch (1929, pl. 8, fig. 880).

Retiolitids seem to be quite rare also in other areas of the Carnic Alps. Beside the occurrence in Monte Cocco area, their presence have been reported, but never illustrated, only by Jaeger (1975) from Cellon section, by Jaeger & Schönlaub (1980) at Gunderscheimer Alm, and by Loydell et al. (2003) from Rauchkofel Bodentörl section.

Geological settings

Sediments of Late Ordovician to Late Devonian age are exposed in the Monte Cocco area. The basal part of the sequence consists of dark grey and greenish pelites and siltstones grading to light grey sandstones (Uqua

Fig. 1 - Location map of the Monte Cocco area, with detail of the Rio Tamer/Rio Uqua confluence, close to "Osteria al Camoscio". The circle indicate the described site.
- *Inquadramento geografico dell'area di Monte Cocco. A destra dettaglio dell'area della confluenza del Rio Tamer nel Rio Uqua, presso l'Osteria al Camoscio. Il cerchio indica l'area descritta.*

Fm), Katian-Hirnantian in age. Locally a massive level, about 10 m thick of crinoidal limestones, possibly Hirnantian in age, is documented.

Silurian rocks are relatively widespread and mainly represented by a cephalopod limestone in Wolayer facies (Corradini et al. 2003, 2010), which disconformably overlies the Ordovician sediments. The lower part of the Silurian sequences, up to the uppermost Gorstian, is represented by dark brown to black wackestone to packstone (Kok Fm), cropping out mainly on the western slope of Monte Cocco, but widely present as loose blocks in the creeks on the eastern side. The upper part of the sequence consists of about twenty meters of wackestones and packstones ("*Alticola* Lms"), well stratified in beds 10-50 cm thick. The brownish-reddish colour frequently turns to dark red by weathering, due to the abundance of iron minerals, and progressively grades to light grey across the Silurian/Devonian boundary. Fossils are quite common, mainly nautiloid cephalopods, trilobites and bivalves (Corradini et al. 2003, 2010).

The "*Orthoceras* limestones" are conformably followed by about 10 m of well bedded grey Lochkovian cephalopod wackestones and packstones (Rauchkofel Fm and La Valute Fm). The stratigraphy of these rocks has been studied by means of conodonts by Corradini et al. (2003) and Corriga & Corradini (2009).

The sequence continues with dark red nodular limestones (Findenig Fm) of Pragian to Givetian age and bioclastic grainstones and rudstones (Eifelian-Givetian). The youngest pre-Variscan sediments in the Monte Cocco area are represented by pelagic limestones ("Clymeniae Lms") of Upper Devonian age and by Carboniferous pelites of the Hochwipfel Fm.

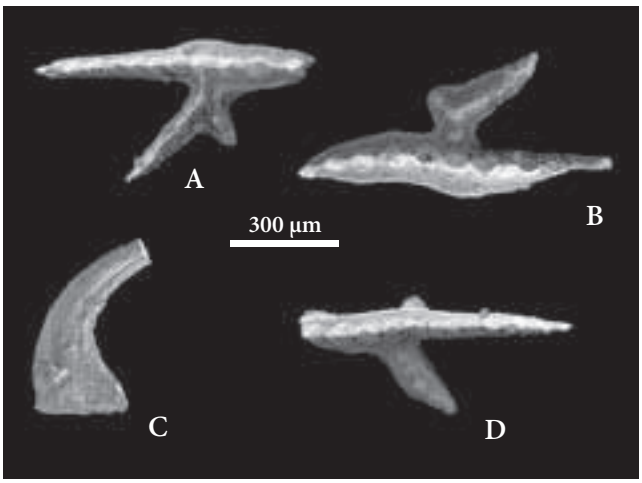


Fig. 2 - Conodonts from the retiolitid-bearing block. A-B: *Pterospathodus amorphognathoides amorphognathoides* Walliser, upper views of P1 elements MDLCA 33221-33222; C: *Dapsilodus obliquicostatus* (Branson & Mehl), lateral view of specimen MDLCA 33224; D: *Pterospathodus pennatus procerus* Walliser, upper view of P1 element MDLCA 33223.
- *Conodonti dal blocco contenente i retiolitidi. A-B:* Pterospathodus amorphognathoides amorphognathoides *Walliser, veduta superiore degli elementi P1 MDLCA 33221-33222, C:* Dapsilodus obliquicostatus *(Branson & Mehl), veduta laterale dell'esemplare MDLCA 33224; D:* Pterospathodus pennatus procerus *Walliser, veduta superiore dell'elemento P1 MDLCA 33223.*

Studied material

The studied material has been collected from a loose block along Rio Tamer, on the eastern slope of Monte Cocco (Fig. 1). The block consists of a dark grey *Orthoceras* limestone, belonging to the Kok Formation. Graptolites are very abundant, with an almost monospecific assemblage of *Retiolites angustidens* and a single specimen of *Monograptus* cf. *priodon*.

Other fossils are very abundant, too, but poorly preserved, being mainly represented by fragments of orthocone nautiloids, encrinurid and aulacopleurid trilobites, small brachiopods, cardiolid and other small bivalves, crinoid stems and a small plate of machaeridian anellid.

Epoch	Stage	Graptolite zones
WENLOCK	HOMERIAN	*Colonograptus ludensis*
		Colonograptus praedeubeli - Colonograptus deubeli
		Gothograptus nassa - Pristiograptus dubius
		Cyrtograptus lundgreni
	426	
	SHEIN	*Cyrtograptus rigidus - Cyrtograptus perneri*
		Monograptus riccartonensis - Monograptus belophorus
		Cyrtograptus centrifugus - Cyrtograptus murchisoni
Ma	428	
LLANDOVERY	TELYCHIAN	*Cyrtograptus lapworthi - Cyrtograptus insectus*
		Oktavites spiralis
		Monoclimacis griestoniensis - Monoclimacis crenulata
		Spirograptus turriculatus Streptograptus crispus
		Spirograptus guerichi
	436	
	AERONIAN	*Stimulograptus sedgwicki*
		Lituigraptus convolutus
		Pernerograptus argenteus
		Demirastrites triangulatus - Demirastrites pectinatus
	439	
	RD	*Coronograptus cyphus*

Fig. 3 - Range of the genus *Retiolites*.
- *Distribuzione del genere* Retiolites.

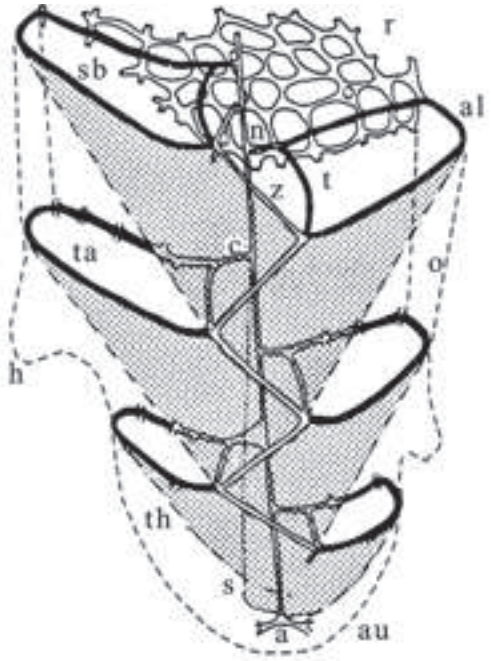


Fig. 4 - Diagrammatic representation of a *Retiolites* rhabdosome in a reverse view, with the ancora sleeve largely stripped away so that the thecal framework is visible. Abbreviations: a, ancora; al, thecal apertural lip; au, ancora umbrella; c, connecting rod; h hoods over proximal orifices; n, nema; o, orifices; r, reticulum; s, sicula; sb, septal bar; t, tranverse rod; ta, thecal aperture; th, theca; z, zigzag list (after Loydell et al. 1997, modified).
- *Rappresentazione schematica di un rabdosoma di* Retiolites *in vista inversa, con parte della membrana che lo ricopre rimossa, in modo che la struttura interna sia visibile. Abbreviazioni: a, ancora; al, margine dell'apertura della teca; au, ancora umbrella; c, aste di connessione; h coperture sopra le aperture\orifizi prossimali; n, nema; o, orifizi\aperture; r, reticolo; s, sicula; sb, barra dei setti; t, asta trasversale; ta, apertura delle teche; th, teca; z, struttura a zigzag (da Loydell et al. 1997, modificato).*

Conodont data

About 180 grams of rocks have been processed with conventional formic acid technique, in order to recover conodonts for a precise dating. The conodont association is very rich, even if not very well preserved, is composed of *Pterospathodus amorphognathoides amorphognathoides*, *Pt. pennatus procerus*, *Panderodus recurvatus*, *Dapsilodus obliquicostatus* and *Belodella* sp. (Fig. 2).

On the basis of conodonts, the studied block can be referred to the latest Llandovery *Pt. am. amorphognathoides* conodont zone.

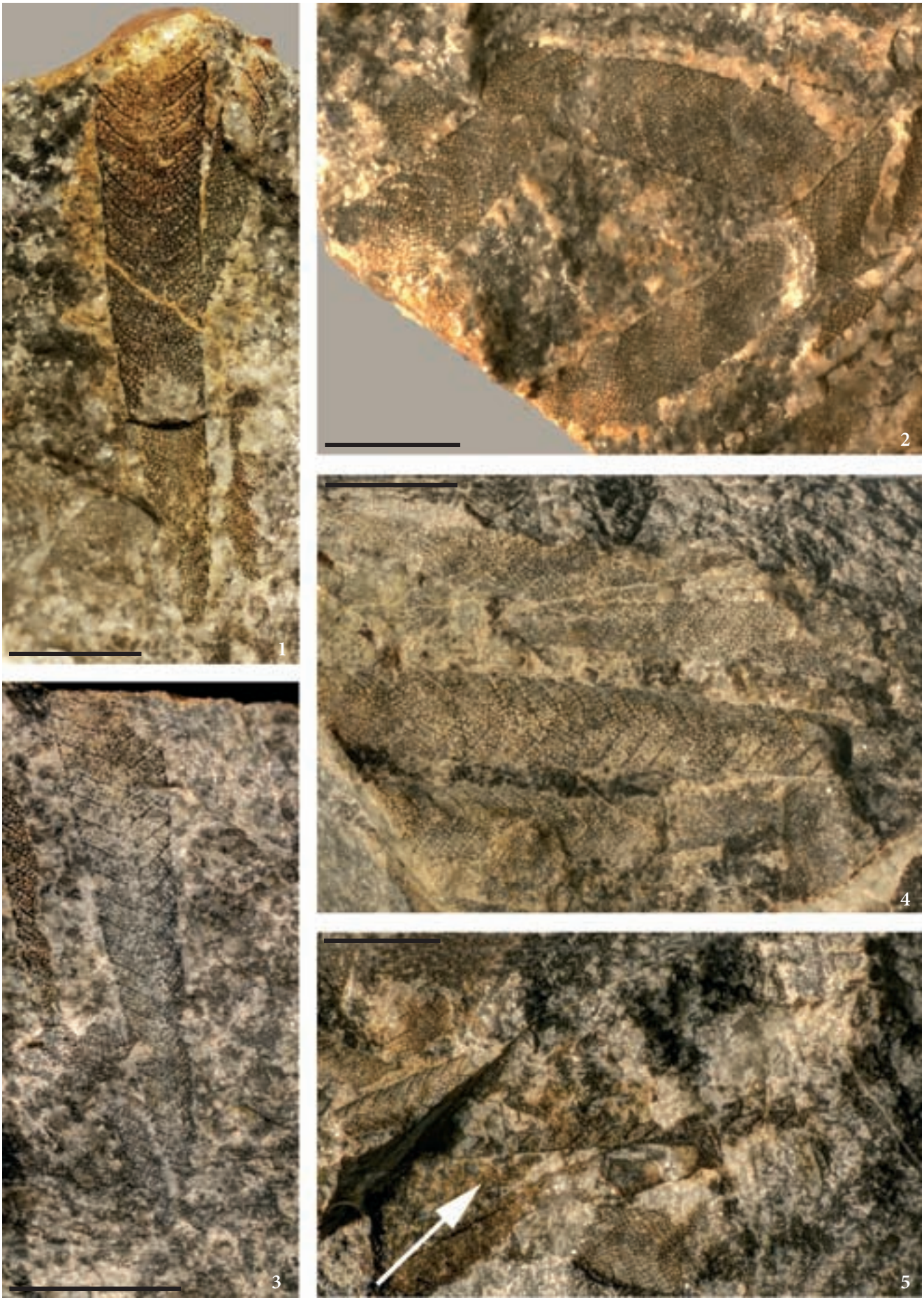
Graptolite data

The studied loose block yelded an aboundant graptolite assemblage, almost monospecific, being *Retiolites angustidens* the dominant species. A single specimen of *Monograptus* cf. *priodon* was also recovered.

Retiolites angustidens and *Monograptus priodon* are very long ranging species and, therefore, they have a very limited stratigraphic value. *Retiolites angustidens*, as all the retiolitids, span from the base of Telychian (Llandovery) to the lowermost part of the Sheinwoodian (Wenlock) (Fig. 3); *Monograptus priodon* ranges from the base of Telychian (Llandovery) to the middle Homerian (Wenlock).

Systematic Palaeontology

The studied graptolites are stored at the Museo Friulano di Storia Naturale (Udine) under catalog number MFSNgp 40459a-h. Synonymies are limited to main quotations and previous occurrences in the Carnic Alps.


1
2
3
4
5

Terminology

The terminology used here to describe the retiolitids was proposed by Loydell et al. (1997) and is illustrated in Fig. 4.

Measurement

Measurement of the dorso-ventral width, and the rate of the expansion proximally, is the easiest way to distinguish the *Retiolites* species, for this reason the most important datum is the rhabdosome dorso-ventral width measured respect to the distance from the proximal end.

Some other characters like inclination of the septal bar or the density of the reticulum vary considerably intraspecifically, or in function of the maturity of the samples: therefore they are not useful for the identification of the species of Retiolitids.

Class Graptolithina Bronn, 1846
Order Graptoloidea Lapworth, 1873
Suborder Diplograpthina Lapworth, 1873
Family Retiolitidae Lapworth, 1873
Subfamily Retiolitinae Lapworth, 1873

Genus *Retiolites* Lapworth, 1873

Retiolites angustidens Elles & Wood, 1908
(Fig. 5.1 - 5.4)

1908 *Retiolites* (*Gladiograptus*) *geinitzianus* var. *angustidens* - Elles & Wood, p. 338, pl. 34, fig. 9a-c.
1975 *Retiolites geinitzianus angustidens* Elles & Wood - Berry & Murphy, pl. 14, fig. 2.
1997 *Retiolites angustidens* Elles & Wood - Loydell, Storch & Bates, p. 757, pl. 1, fig. 1-2, 5, text-figs 2c, 3b.6.
2003 *Retiolites angustidens* Elles & Wood - Loydell, Mannik & Nestor, p. 214, fig. 9a.

Material: 10 rhabdosomes, MFSNgp 40459a-h.

Description: *Retiolites* with dorso-ventral width increasing gradually. The width is 1.8 mm to 2.5 mm at about 5 mm to the proximal end; 2.4 mm to 3 mm at 10 mm from the proximal end; distally, the width measure is at maximum 4.1 mm.

Observations: The specimens from Mt. Cocco are similar to the holotype by Elles & Wood (1908) from England and fit well with the material described by Loydell et al. (1997) from England, Bohemia, Wales and Scotland. The specimens described by Berry & Murphy (1975) from Nevada (USA), are also very similar to those from Mt. Cocco as well as to specimen figured by Loydell et al. (2003) from Latvia.

Family Monograptidae Lapworth, 1873

Genus *Monograptus* Geinitz, 1852

Monograptus cf. *priodon* (Bronn), 1835
(Fig. 5.5)

1835 *Lomatoceras priodon* - Bronn, p. 55, pl. 1, fig. 13.
1850 *Graptolite priodon* (Bronn) - Barrande, pl. 1, figs 1-14, p. 75.
1980 *Monograptus priodon* (Bronn) - Jaeger & Schönlaub, tab 3, fig. 7, p. 428.
1993 *Monograptus priodon* (Bronn) - Storch & Serpagli, pl. 9, figs 3-5, p. 40, text-fig. 12A, H.
2003 *Monograptus priodo*n (Bronn) - Loydell, Mannik & Nestor, text-fig. 1, fig. 18-19, p. 58.

Material: 1 rhabdosome not well preserved MFSNgp 40459b.

Description: The rhabdosome is slender and straight. The thecae are curved with the aperture direct downward. The sample is incomplete and the length is 14 mm. The sicula is small and straight 1 mm long, with a small aperture of about 0.25 mm, the apex achieves to the level of the first theca.

The width of the rhabdosome is at the level of the first theca 0.6 mm, at the level of the third theca is 1.2 mm, with a maximum width of 2 mm in the distal part of the rhabdosome. The thecal overlapping between thecae is about 1/3 of their length, and the thecae form an angle of 35°-40° with the axis of the rhabdosome; the 2TRD2 is 1.8 mm, 2TRD in the distal part of the rhabdosome is 2.5 mm; the thecal count is 6 measured in the distal five millimetres of the rhabdosome.

Observations: The state of preservation of the specimen is poor, however it is very similar with those figured by Barrande (1850) from Bohemia. Therefore we chose to name it *Monograptus* cf. *priodon*. It shows

Fig. 5 - 1. *Retiolites angustidens* Elles & Wood, MFSNgp 40459e (1.6). 2. *Retiolites angustidens* Elles & Wood, MFSNgp 40459a (1.8). 3. *Retiolites angustidens* Elles & Wood, MFSNgp 40459e (1.5). 4. *Retiolites angustidens* Elles & Wood, MFSNgp 40459h (1.7) 5. *Monograptus* cf. *priodon* Bronn, MFSNgp 40459b (2.1).
All the photos are taken under a thin level of water to increase the contrast. Scale bar = 5 mm.
- *1.* Retiolites angustidens *Elles & Wood, MFSNgp 40459e (1.6). 2.* Retiolites angustidens *Elles & Wood, MFSNgp 40459h (1.8). 3.* Retiolites angustidens *Elles & Wood, MFSNgp 40459e (1.5). 4.* Retiolites angustidens *Elles & Wood, MFSNgp 40459h (1.7) 5.* Monograptus *cf.* priodon *Bronn, MFSNgp 40459b (2.1).*
Le immagini sono state riprese sotto un sottile velo d'acqua per incrementare il contrasto. La scala di riferimento è di 5 mm.

also similarities with specimens illustrated by Jaeger & Schönlaub (1980) and Loydell et al. (2003) from different outcrops of the Austrian Carnic Alps and to *Monograptus priodon* described by Storch & Serpagli (1993) from Sardinia.

Conclusions

The main results of this paper can be summarized as follows:

1. *Retiolites angustidens* is described and figured for the first time from the Carnic Alps. His occurrence was in fact previously reported, but not illustrated, by Jaeger (1975) from Cellon section, by Jaeger & Schönlaub (1980) at Gunderscheimer Alm and by Loydell et al. (2003) from Rauchkofel Bodentörl.
2. A latest Llandovery age of the studied loose block, being all the graptolites long ranging taxa, has been stated by means of conodonts of the *Pterospathodus am. amorphognathoides* conodont Zone.

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