Original article

Eurytholia plates (Problematica) from the late Silurian of the Austrian Carnic Alps

Plaques d'*Eurytholia* (Problematica) du Silurien terminal des Alpes Carniques autrichiennes

Annalisa Ferretti*, Enrico Serpagli

Dipartimento del Museo di Paleobiologia e dell'Orto Botanico, Università degli Studi di Modena e Reggio Emilia,
Via Università 4, 41100 Modena, Italy

Abstract

A small fauna of phosphatic plates of the enigmatic organism *Eurytholia bohémica* [Ferretti A., Serpagli E., Štorch P., 2006. Problematic phosphatic plates from the Silurian-Early Devonian of Bohemia, Czech Republic. *Journal of Paleontology* 80 1026–1031.], is described for the first time from upper Silurian beds of Austria. Other known Silurian occurrences of this taxon were restricted to Bohemian localities even if the genus had been previously reported from several Ordovician outcrops. The extension of *E. bohémica* from the microcontinent of Perunica to that of Carnica suggests that *Eurytholia* was not an uncommon constituent of Silurian fauna, at least at intermediate latitudes in the southern hemisphere. © 2006 Elsevier Masson SAS. All rights reserved.

Résumé

Une faune restreinte de plaques phosphatiques de l'organisme énigmatique *Eurytholia bohémica* [Ferretti A., Serpagli E., Štorch P., 2006. Problematic phosphatic plates from the Silurian-Early Devonian of Bohemia, Czech Republic. *Journal of Paleontology* 80 1026–1031.] est décrite pour la première fois dans des niveaux du Silurien supérieur d'Autriche. Bien que ce genre ait été décrit dans divers affleurements ordoviciens, ses occurrences siluriennes étaient jusqu'à présent restreintes aux localités de Bohême. L'extension de la répartition de *E. bohémica* du microcontinent Perunica au microcontinent Carnica suggère que *Eurytholia* n'était pas un élément rare des faunes siluriennes, tout du moins aux latitudes intermédiaires de l'hémisphère sud.

© 2006 Elsevier Masson SAS. All rights reserved.

Keywords: *Eurytholia*; Problematica; Phosphatic plates; Silurian; Carnica microcontinent

Mots clés : *Eurytholia* ; Problematica ; Plaques phosphatiques ; Silurien ; Microcontinent Carnica

1. Introduction

Eurytholia is an enigmatic organism recovered from lab-processed samples for phosphatic microfossil investigation (brachiopods and/or conodonts). The first study on this subject is by Sutton et al. (2001), who reported sporadic occurrences (24 elements) from the Middle-Late Ordovician (*Pygodus serra* and *P. anserinus* conodont zones) of several sites of the Iapetus Ocean (United Kingdom, Sweden, Estonia and Alabama).

The authors attributed the plates of the two species *E. prattensis* and *E. elibata* to a problematic scleritome, ovoid in outline, having plates inserted in soft tissue and arranged in sublongitudinal rows for protection. An abundant well-preserved fauna of *E. bohémica* (416 elements) was recently reported by Ferretti et al. (2006) from the late Silurian and Early Devonian of the Czech Republic, extending therefore both the geographic distribution of this problematic organism and its stratigraphic range. No definite interpretation was proposed, but the exploration of a possible linkage with early vertebrates was suggested.

A recent conodont analysis of some Silurian sections in the Austrian Carnic Alps led to the discovery of a new small association of these Problematica.

* Corresponding author. Fax: +39 059 2056535.
E-mail address: ferretti@unimore.it (A. Ferretti).

Fig. 1. Map of the study area (modified after Ferretti, 2005).

Fig. 1. Carte géographique de la zone d'étude (modifiée d'après Ferretti, 2005).

2. Geological setting

Paleozoic rocks of the Carnic and Karawanken Alps make up an almost continuous sequence (Middle Ordovician to Late Permian) geographically distributed in a west-east alignment (Fig. 1). The Silurian is irregularly exposed within this framework with sequences, which are often condensed, having a maximum thickness of about 60 m. Numerous sedimentary gaps affect the calcareous sequences at the base of the Silurian and also at the Llandovery/Wenlock boundary and in latest Wenlock times (Schönlaub, 1998 and references herein).

The Rauchkofel Boden Section (Fig. 2), located on the southwestern slope of Mount Rauchkofel in the Austrian Carnic Alps, exposes a 28 m-thick calcareous succession documenting the Late Ordovician (Ashgillian)-Early Devonian (Pragian), but with a significant early Silurian gap. Detailed description of the section is given in Ferretti et al. (1999). Limestones (shallow-water bioclastic limestones and cephalopod-bearing beds), shales (locally rich in graptolites) and cherts are the main rock types of the Silurian (Schönlaub, 1998). For some time now, the rich faunal content of these rocks has allowed detailed taxonomic and biostratigraphic study of all major groups.

Faunal and sedimentological data would locate the Carnic Alps in the Silurian in a paleolatitudinal position between 30 and 40°S (Schönlaub, 1998). Proximity between Carnica (Brett et al., 2004) and Laurentia and Avalonia is suggested by similarities of sequence stratigraphy in the Carnic Alps, England and eastern North America as well as by related global eustatic changes affecting the Gondwana derived terranes to the east and Laurentia to the west (Brett et al., 2004).

3. Material

The assemblage from the Carnic Alps is composed of 28 phosphatic plates, recovered from a single sample (level 326 of Fig. 2) at the base of the Alticola Limestone (Ludlow-Pridoli). Other samples from the same section or even other horizons of the same bed were barren of these enigmatic elements. The associated conodont fauna is mostly composed of "distacodiform" elements with no age diagnostic species. A horizon immediately above this bed produced elements documenting the *Pedavis latialata* Zone (Ludfordian, Ludlow). In Bohemia, *E. bohémica* was reported from five distinct conodont zones of Ludlow age (*K. crassa*, *Pol. siluricus*, *Pe. latialata*, *Oz. snajdri* and *Oz. crista*

Plate 1. Scanning electron micrographs of *Eurytholia bohémica* Ferretti et al. (2006). Rauchkofel Boden Section, sample 326, Silurian (Alticola Limestone) of the Carnic Alps, Austria. Fig. 1a,b. Upper and lateral views of IPUM 27871, $\times 100$. Fig. 2a,b. Upper and lateral views of IPUM 27872, $\times 95$. Fig. 3. Upper-lateral view of IPUM 27873, $\times 105$. Fig. 4a,b. Upper and lateral views of IPUM 27874, $\times 125$. Fig. 5a,b. Upper and lateral views of IPUM 27875, $\times 95$. Fig. 6a,c. Lower-lateral and lower views of IPUM 27876, $\times 85$. Fig. 6b. Lower-lateral view of the plate cavity showing a regular net-like pattern, $\times 720$. Fig. 7. Upper view of IPUM 27877, $\times 100$. Fig. 8a. Lower-lateral view of IPUM 27878, $\times 120$. Fig. 8b. Detail of the net pattern exposed in lower view, $\times 580$.

Planche 1. Photographies au MEB de *Eurytholia bohémica* Ferretti et al. (2006). Coupe de Rauchkofel Boden, échantillon 326, Silurien (Alticola Limestone) des Alpes Carniques, Autriche. Fig. 1a,b. Vues supérieures et latérales du spécimen IPUM 27871, $\times 100$. Fig. 2a,b. Vues supérieures et latérales du spécimen IPUM 27872, $\times 95$. Fig. 3. Vue supérieure-latérale du spécimen IPUM 27873, $\times 105$. Fig. 4a,b. Vues supérieures et latérales du spécimen IPUM 27874, $\times 125$. Fig. 5a,b. Vues supérieures et latérales du spécimen IPUM 27875, $\times 95$. Fig. 6a,c. Vues inférieures et latérales du spécimen IPUM 27876, $\times 85$. Fig. 6b. Vue inférieure-latérale de la cavité de la plaque montrant un treillis homogène, $\times 720$. Fig. 7. Vue supérieure du spécimen IPUM 27877, $\times 100$. Fig. 8a. Vue inférieure-latérale du spécimen IPUM 27878, $\times 120$. Fig. 8b. Détail du treillis à l'intérieur de la cavité de la plaque, en vue inférieure, $\times 580$.

Fig. 2. Generalized stratigraphy of the Silurian in the Rauchkofel Boden Section (modified after Ferretti, 2005). Asterisk marks the position of the productive bed. Sample numbers refer to Schönlaub (1980).

Fig. 2. Stratigraphie généralisée du Silurien de la coupe de Rauchkofel Boden (modifié d'après Ferretti, 2005). L'astérisque indique la position du niveau livrant les fossiles. Les numéros d'échantillons font référence à la numération proposée par Schönlaub (1980).

zones) and one biozone of Early Devonian age (*Pe. pesavis* Zone) (Fig. 3).

All the Austrian specimens described in this paper are in the collections of the Paleontological Museum of the "Dipartimento del Museo di Paleobiologia e dell'Orto Botanico", University of Modena and Reggio Emilia (IPUM).

4. Discussion

The Carnic material is poorly preserved, the dorsal surface of the plates being often strongly corroded (Plate 1, Fig. 5a,b). In addition, the fauna is mostly composed of broken specimens, black to light grey in colour. Conodonts, on the contrary, keep apparently the same black colour (corresponding to a Colour Alteration Index 5). Complete elements, subrectangular to elliptical in shape, range in size from 0.3 to 0.5 mm, but incomplete plates may be up to 1 mm. The Austrian elements have therefore comparable dimensions to those of the Bohemian fauna (0.3–2 mm; Ferretti et al., 2006). The plate ridge varies in posi-

Fig. 3. Stratigraphic range of *Eurytholia*.

Fig. 3. Extension stratigraphique d'*Eurytholia*.

tion, width and height. The ridge may in fact be central to eccentric, large or narrow, rounded or sharp, perpendicular or oblique to the plate longer margins. The peculiar girdle of *E. bohemia*, a sort of furrow bordered by two well-defined thickened margins at a fairly constant distance, runs all along the plate margins (Plate 1, Figs. 6a, 8a). No ornamentation or growth lines were observed on the dorsal surface. A wide basal cavity extends to the apex of the ridge (Plate 1, Fig. 6c).

Because of poor preservation, SEM investigation could not confirm the bilayered structure of the plate wall already indicated by previous reports (Sutton et al., 2001; Ferretti et al., 2006). Nevertheless, the ventral surface exposes in some specimens a regular geometric pattern all along the plate surface (Plate 1, Figs. 6b, 8b) with an average 2 µm net diameter. The same pattern and net size has been observed in the Bohemian material (Ferretti et al., 2006).

E. bohemia was reported in Bohemia from several biozones of Ludlow and Lochkovian age in different localities of the Prague Basin. No sampling was done there from other Silurian levels, but the constant presence in most of the investigated samples and their extraordinary local abundance suggest that remains of *E. bohemia* were common in the Silurian seas of Bohemia and of the microplate of Perunica, located between the Gondwana and North European (Baltic) cratons and involving major part of the Bohemian Massif (Havlíček et al., 1994).

On the contrary, the assemblage described here appears to represent a sporadic occurrence in the Carnic Alps. The numerous conodont investigations conducted so far did not report any of these problematic elements elsewhere.

The plate productive layer reveals an unusual dominance of Muellerisphaerida, a group of globular spherical spinose phosphatic microfossils, recently interpreted as postmortem phosphatized acanthomorphic acritarchs (Kremer, 2005).

After recent reports, *Eurytholia* phosphatic plates are now known in strata ranging from the Middle Ordovician to the Early Devonian (Fig. 3) from several paleogeographic settings.

Increased attention in residue-picking technique is now desirable in order to produce other pieces of evidence and so add information on spatial and temporal distribution of these Problematica and to understand their real nature.

Acknowledgments

Constructive comments by Stefan Bengtson (Stockholm) and Sebastien Clausen (Lille) greatly improved the final paper. C. Gentilini (Modena) provided SEM assistance and is deeply thanked. This paper is a contribution to the project 23/ES1 “Fossils as time indicators: integrated conodont-graptolite biostratigraphy of selected Lower Palaeozoic sections of the Czech Republic (Barrandian area) and Italy (Carnic Alps and Sardinia)” and PRIN 2004 “The end and the beginning: loss and recoveries from the end-Ordovician mass extinction in North Gondwana”.

References

- Brett, C., Ferretti, A., Histon, K., Schönlaub, H.P., 2004. Eustasy and basin dynamics of the Silurian of the Carnic Alps (Austria). 32nd IGC-Florence, 2004, abstract.
- Ferretti, A., 2005. Ooidal ironstones and laminated ferruginous deposits from the Silurian of the Carnic Alps, Austria. *Bollettino della Società Paleontologica Italiana* 44, 263–278.
- Ferretti, A., Histon, K., Schönlaub, H.P., 1999. The Silurian and Early Devonian of the Rauchkofel Boden Section, Southern Carnic Alps, Austria. In: Histon, K. (Ed.), 5th International Symposium: Cephalopods—Present and Past. Carnic Alps Excursion Guidebook, *Berichte der Geologischen Bundesanstalt* 47, Wien, pp. 55–62.
- Ferretti, A., Serpagli, E., Štorch, P., 2006. Problematic phosphatic plates from the Silurian–Early Devonian of Bohemia, Czech Republic. *Journal of Paleontology* 80, 1026–1031.
- Havlíček, V., Vanek, J., Fatka, O., 1994. Perunica microcontinent in the Ordovician (its position within the Mediterranean Province, series division, benthic and pelagic associations). *Sborník geologických věd Geologie* 46, 23–56.
- Kremer, B., 2005. Mazuelloids: product of post-mortem phosphatization of acanthomorphic acritarchs. *Palaaios* 20, 27–36.
- Schönlaub, H.P., 1980. Field Trip A: Carnic Alps. In: Schönlaub, H.P. (Ed.), Second European Conodont Symposium-ECOS II, Guidebook, Abstracts. *Abhandlungen der Geologischen Bundesanstalt* 35, pp. 5–57.
- Schönlaub, H.P., 1998. Review of the Paleozoic Paleogeography of the Southern Alps – The Perspective from the Austrian Side. *Giornale di Geologia* 60 (Special Issue), 59–68.
- Sutton, M.D., Holmer, L.E., Cherns, L., 2001. Small problematic phosphatic sclerites from the Ordovician of Iapetus. *Journal of Paleontology* 75, 1–8.