

Echinoderms in the Bohemian Ordovician

Ostnokožci v českém ordoviku (Czech summary)

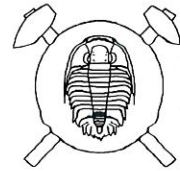
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An updated list of echinoderm and “carpoid” groups and species in the Bohemian Ordovician is presented in the form of a table with a brief introduction.

Key words: Echinodermata, “Carpoidea”, biostratigraphy, Ordovician, Bohemia



Echinoderm fauna represents a typical but quantitatively very variable component of the Bohemian Ordovician assemblages at all stratigraphical levels, from Tremadocian to Ashgillian. Its distribution clearly reflects a preference for relatively firm, sandy substrates.

In the transgressive clastics and pyroclastics of the Třenice Formation there are only very rare and poorly preserved (sometimes even problematical) remains of cystoids, with the exception of the special sedimentary iron ore deposits in the mine “V Ouzkém”, where we can meet a rich fossil fauna, including relatively abundant cystoids of both the groups Diploporita and Rhombifera, represented by fragments and even whole thecae of some stratigraphically significant genera as are *Palaeosphaerites*, *Echinosphaerites* and *Glyptosphaerites*.

In the Mílina Formation, the echinoderm assemblage does not differ markedly from the previous one. A representative of Rhombifera, *Macrocystella?* sp., appears for the first time but the findings of this and other fossils are generally scarce and fragmentary.

During the sedimentation of clayey shales of the Klavava Formation the environment did not produce suitable conditions for the existence of echinoderms but in some layers of the calcareous tuffs the first remains of tiny inadunate crinoids in the Bohemian Ordovician have been encountered, particularly their isolated subtle columnals. We suppose that the tuffs formed relatively firm enclaves in the prevalent soft muddy bottom, and thus enabled crinoids to anchor their stems.

A marked turnover of the echinoderm fauna comes with the onset of the Llanvirnian transgression followed by deepening of the sedimentary basin. The number of individuals, species as well as higher taxa dramatically increases. Almost all echinoderm classes known from all over the world at this time are present in the Šárka Formation. From cystoids there are important genera *Archegocystis* and *Pyrocystites* (Diploporita), from crinoids especially the readily discernible columnals of *Ramseyocrinus primus*, the oldest Bohemian asterozoans are represented by relatively well-preserved skeletons of the somasteroid *Archegonaster*, archaic types of ophiuroids *Palaeura* and *Eophiura*, and some not yet described true asteroids. All the mentioned taxa are biostratigraphically significant for the Mediterranean palaeoprovince.

“Carpoidea” are equally abundant, esp. the genera *Mitrocystites*, *Mitrocystella*, *Lagynocystites*, *Balanocystites* and *Reticulocarpos*. It ought to be stressed that here we are using only the old cumulative name “Carpoidea” because it is not the purpose of this article to discuss the problematical phylogenetic relationship of these strange creatures to true echinoderms or calcichordates.

Echinoderm assemblage of the Dobrotivá Formation differs from the previous one in the presence of some other species. While the genus *Mitrocystites* survives, three other “carpoid” genera are assigned to *Prokopicystis*, *Anomalocystites*, and *Bohemiaecystis*. Stem fragments of the crinoid *Ramseyocrinus* sp. have been discovered in both the shales and siliceous concretions, but members of other echinoderm groups are rare.

Although the echinoderm assemblage in the Libeň Formation is composed of only a few species, it points to the onset of a typically Caradocian fauna from cystoids have been found e.g. genera *Rhombifera* and *Echinosphaerites*, from eocrinoids *Ascocystites*, from edrioasteroids “*Hemicystites*”.

Echinoderm fauna of the Letná Formation shows a marked increase in animal diversity of the Barrandian basin. For example, crinoids are represented by the well-known species *Caleidocrinus multiramus*, eocrinoids by the genera *Ascocystites* and *Mimocystites*, coronate blastoids by the genus *Mespilocystites*, rhombiferan cystoids by *Echinosphaerites*, *Macrocystella* and *Rhombifera*, and edrioasteroids by several species of the cumulative “genera” *Agelacrinites* and *Hemicystites*. Skeletons of oegophiurids of the species *Bohemura jahni* are relatively frequent as well as mass occurrences of in-the-current-oriented thecae of the “carpoid” *Dendrocystites barrandei*. Sporadic but important are the findings of the rare paracrinoid *Letenocrinus longibrachialis* (as the members of the class Paracrinioidea have so far been known only from the regions of North America and Baltoscandia).

In the Vinice Formation, echinoderms are confined mostly to the sedimentary environment of oolitic iron ores, being represented by several palaeogeographically significant taxa, e.g. genera *Echinosphaerites* and *Orocystites* (Rhombifera), *Fungocystites* (Diploporita), *Mespilocystites* (Coronata), and a “carpoid” genus *Anomalocystites*. The prevalent muddy bottom of other parts of

Table 1. Table of echinoderm species in the Bohemian Ordovician

Particular Echinoderm Groups and Species	Stages and Formations of the Barrandian Ordovician											
	1		2	3	4	5					6	7
	Tn	MI	Kl	Šk	Db	Lb	Le	Vn	Zh	Bd	Kd	Ko
“Carpoidea”												
<i>Reticulocarpus hanusi</i> Jefferies et Prokop 1972				xx								
<i>Mitrocystites mitra</i> Barrande, 1887				xx	xx							
??? <i>Mitrocystites mitra</i> Barrande, 1887							xx					
<i>Mitrocystella barrandei</i> Jaekel, 1918				xx								
<i>Balanocystites lagenula</i> Barrande, 1887				xx								
<i>Lagynocystites pyramidalis</i> (Barrande, 1887)				xx								
<i>Anatiferocystis barrandei</i> Chauvel, 1941				xx								
<i>Anatiferocystis spinosa</i> Ubaghs, 1979							xx					
<i>Bohemiaecystis bouceki</i> Caster, 1967					xx							
<i>Prokopicystis mergli</i> Cripps, 1989					xx							
“ <i>Anomalocystites</i> ” <i>incipiens</i> Barrande, 1887					xx							
“ <i>Anomalocystites</i> ” <i>ensifer</i> Barrande, 1887								xx				
“ <i>Anomalocystites</i> ” <i>bohemicus</i> (Barrande, 1887)											xx	
<i>Aspidocarpus bohemicus</i> Ubaghs, 1979							xx					
<i>Barrandocarpus jaekeli</i> Ubaghs, 1979							xx					
<i>Dendrocystites barrandei</i> Bather, 1889							xx					
<i>Dendrocystites sedgwicki</i> Barrande, 1887									xx			
“ <i>Cystidea</i> ” <i>obscondita</i> Barrande, 1887									xx			
Diploporita												
<i>Palaeosphaeronites</i> sp.		xx										
<i>Palaeosphaeronites crateriformis</i> (Růžička, 1927)	xx											
<i>Pyrocystites?</i> sp.	xx											
<i>Pyrocystites pirum</i> Barrande, 1887				xx								
<i>Glyptosphaerites</i> sp.		xx										
<i>Arhegocystis desiderata</i> (Barrande, 1887)				xx								
<i>Calix purkynei</i> (Klouček, 1917)					xx							
<i>Calix</i> sp.									xx			
<i>Aristocystites bohemicus</i> Barrande, 1887									xx			
<i>Aristocystites</i> cf. <i>bohemicus</i> Barrande, 1887						xx	xx	xx				
<i>Aristocystites metroi</i> Parsley et Prokop, 1990									xx	xx		
<i>Fungocystites</i> sp.						xx						
<i>Fungocystites rarissimus</i> Barrande, 1887								xx				
<i>Fungocystites solitarius</i> Barrande, 1887								xx	xx			
<i>Hippocystis batheri</i> Chauvel, 1935									xx			
<i>Hippocystis sculptus</i> (Barrande, 1887)								xx				
<i>Codiacystis bohémica</i> (Barrande, 1887)									xx			
<i>Codiacystis moneta</i> (Barrande, 1887)									xx			
<i>Eucystis chlupaci</i> Prokop, 1964											xx	
Rhombifera												
<i>Echinospaerites ? concomitans</i> Barrande, 1887	xx											
<i>E. ? ferrigena</i> Barrande, 1887	xx											
<i>Echinospaerites infaustus</i> Barrande, 1887						xx	xx	xx	xx			
<i>Echinospaerites quaerendus</i> Barrande, 1887										xx	xx	
<i>Rhombifera bohémica</i> Barrande, 1867						xx	xx	xx	xx			
<i>Orocystites helmhackeri</i> Barrande, 1887								xx				
<i>Homocystites alter</i> (Barrande, 1887)									xx			
Eocrinoidea												
<i>Archaeocystites medusa</i> Barrande, 1887				xx								
<i>Ascocystites draboviensis</i> Barrande, 1887						xx	xx					
<i>Ascocystites micraster</i> Barrande, 1887							xx					
<i>Ascocystites</i> cf. <i>micraster</i> Barrande, 1887							xx					
<i>Mimocystites bohémicus</i> Barrande, 1887							xx					
<i>Macrocystella</i> sp.		xx										
<i>Cardiocystites bohémicus</i> Barrande, 1887									xx			

Table 1. (continued)

Particular Echinoderm Groups and Species	Stages and Formations of the Barrandian Ordovician											
	1		2	3	4	5					6	7
	Tn	Ml	Kl	Šk	Db	Lb	Le	Vn	Zh	Bd	Kd	Ko
Paracrinoidea												
<i>Letenocrinus longibrachialis</i> Prokop et Petr, 1990							xx					
Blastoidea – Coronata												
<i>Mespilocystites bohemicus</i> Barrande, 1887							xx	xx	xx			
<i>Mespilocystites</i> sp.												xx
Crinoidea												
unpubl. columnals			xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
? <i>Ramseyocrinus primus</i> (Waagen et Jahn, 1899)				xx								
<i>Ramseyocrinus</i> sp.					xx							
<i>Caleidocrinus multiramus</i> Waagen et Jahn, 1899							xx					
<i>Caleidocrinus</i> sp. ind.							xx					
“ <i>Caleidocrinus</i> ” <i>subpartitus</i> (Waagen et Jahn, 1899)										xx		
? <i>Caleidocrinus artifex</i> (Waagen et Jahn, 1899)										xx	xx	
<i>Polycrinus ramulatus</i> Jaekel, 1918									xx			
<i>Polycrinus kosoviensis</i> Jaekel, 1918											xx	
Somasteroidea												
<i>Archegonaster pentagonus</i> Spencer, 1951				xx								
Asteroidea												
unpubl. gen. et sp. indet.				xx			xx					
two distinct species, unpubl. gen. et sp. indet.										xx		
<i>Siluraster perfectus</i> Jaekel, 1903									xx			
Ophiuroidea												
<i>Palaeura neglecta</i> Schuchert, 1915				xx								
<i>Eophiura bohémica</i> Schuchert, 1915				xx								
<i>Hypophiura tentatrix</i> Jaekel, 1925					xx							
<i>Bohemura jahni</i> Jaekel, 1903							xx		xx			
<i>Taeniaster bohemicus</i> Petr, 1989										xx		
<i>Klarasterina klara</i> Petr, 1989										xx		
Edrioasteroidea												
<i>Argodiscus hornyi</i> Prokop, 1965							xx					
? <i>Argodiscus rarus</i> Plas et Prokop, 1979				xx								
“ <i>Hemicystites</i> ” <i>bohemicus</i> (Barrande, 1887)						xx	xx					
“ <i>Hemicystites</i> ” <i>velatus</i> (Barrande, 1887)							xx					
“ <i>Agelacrinites</i> ” <i>confertus</i> Barrande, 1887							xx					
“ <i>Agelacrinites</i> ” <i>bellulus</i> Barrande, 1887									xx			
“ <i>Agelacrinites</i> ” <i>bohemicus</i> Barrande, 1887							xx					
“ <i>Agelacrinites</i> ” <i>tener</i> Barrande, 1887							xx					
“ <i>Agelacrinites</i> ” <i>latiusculus</i> Barrande, 1887									xx			

Explanations to the table:

1. Tremadocian
2. Arenigian
3. Llanvirnian
4. Dobrotivian
5. Berounian
6. Králodvorian
7. Kosovian

- Tn – Třenice Formation
Ml – Mílina Formation
Kl – Klabava Formation
Šk – Šárka Formation
Db – Dobrotivá Formation
Lb – Libeň Formation

- Le – Letná Formation
Vn – Vinice Formation
Zh – Zahořany Formation
Bd – Bohdalec Formation
Kd – Králův Dvůr Formation
Ko – Kosov Formation

the Vinice Formation does not form a suitable environment for the life of echinoderms.

The echinoderm fauna of the Zahořany Formation constitutes a further abrupt increase in abundance and biostratigraphical importance, with components appearing also in other parts of Europe, Africa, Asia, eastern regions of Northern America, and eastern Australia. Especially frequent are cystoids of the genera *Echinospaerites* (Rhombifera), *Aristocystites* and *Codiacystis* (Diploporita), while the “carpoid” *Dendrocystites sedgwicki* may become a useful index species for European and Asian correlation. Unfortunately, numerous edrioasteroids as well as placocystitid and lagynocystitid “carpoids” are not yet revised. Relatively common are the crinoids of the genus *Polycrinus*, ophiuroid *Bohemura* and the asteroid *Siluraster*.

Bohdalec Formation, with its muddy sedimentation, is less suitable for the development of echinoderms. Portions of stems and columnals of the crinoid “*Encrinites*” (= *Caleidocrinus?*) *artifex* are stratigraphically significant, while oegophiurids of the genus *Taeniaster* are palaeogeographically widespread; the species *T. bohemicus* is typical for the localities in the so-called “Polyteichus facies” representing relatively firm calcareous-silty substrate of the sedimentary basin but also occurs in the clayey shale of the common facies of the Bohdalec Formation. Resting trails of the latter species and its “brittlestar beds” are also discovered here, possibly the oldest in the world, because the so far known oldest brittlestar beds have been reported from the Permian of U.S.A.

Echinoderms of the Králův Dvůr Formation are scarce but useful for the purpose of correlation, esp. with the Baltoscandian region. They are represented with the cystoid species *Echinospaerites querendus* and *Eucystis chlu paci*, crinoids *Caleidocrinus artifex* and *Polycrinus kosoviensis*, and the “carpoid” genus *Placocystites*.

At least, the sedimentary environment of the Kosov Formation does not seem to be very suitable for the life of echinoderms, and particularly very unhappy for their skeletal preservation itself. The majority of remains consist of fragments of the coronate blastoid *Mespilocystites* (similar to species from France and Iberian Peninsula) and resting trails of (?taeniasterid) ophiuroids originally described by Frič as *Spongaster fallax* (= *Asteriacites fallax*).

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Ostnokožci v českém ordoviku

V práci jsou charakterizovány jednotlivé stupně českého ordoviku z hlediska zastoupení ostnokožců a „karpoidů“ a je zde zpřesněn seznam dosud popsáných druhů včetně jejich stratigrafického rozpětí.