

Pokroky v paleontologickém a stratigrafickém výzkumu staršího paleozoika Českého krasu za posledních padesát let

Petr Budil, Česká geologická služba



Prof. RNDr. Ivo Chlupáč, DrSc.

6. 12. 1931 – 7. 11. 2002

„Dospěl-li jsem tak daleko, tedy jen díky tomu, že jsem stál na ramenou obrů.“ — Isaac Newton



Radvan Horný



Jiří Kříž



Ivo Chlupáč



Rudolf Prokop



Vladimír Havlíček



Josef Svoboda



Ferdinand Prantl



Jaroslav Kraft



Alois Přibyl

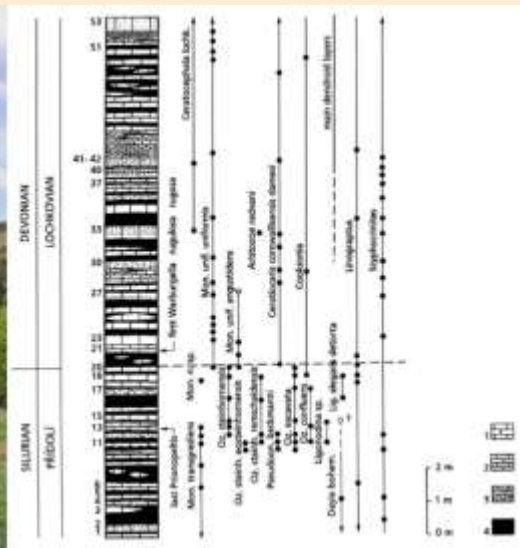


Milan Šnajdr



Bedřich Bouček

Tři mezinárodní stratotypy, dva parastratotypy



silur/devon: Klonk u Suchomast (1972)

přídolí: Požáry u Řeporyj (1982)



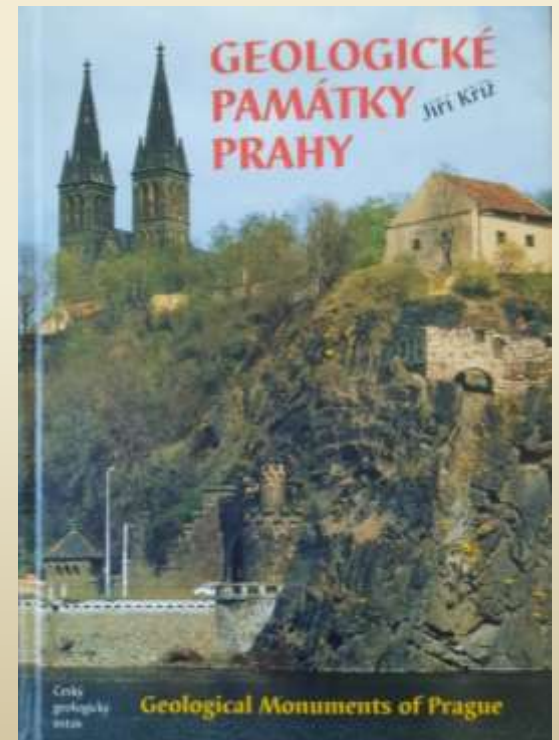
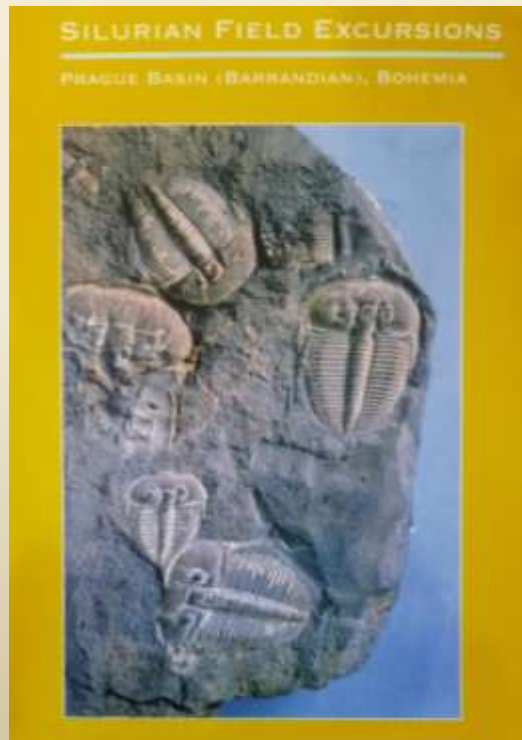
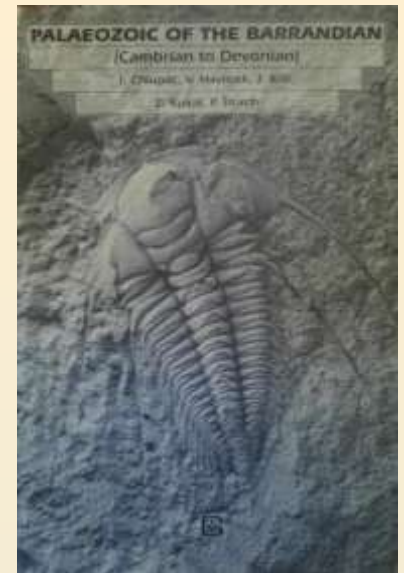
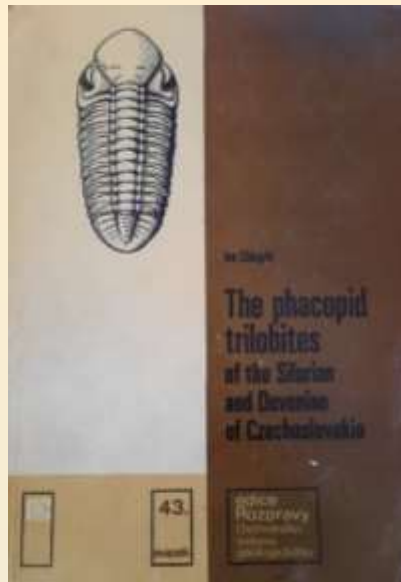
silur/devon: Budňanská skála u Karlštejna (1972)

lochkov/prag: Homolka ve Velké Chuchli (1989)

spodní/střední devon
Lom Prastav u Holyně (1999)

Generace našich předchůdců odvedla fantastickou práci

- Stovky článků, desítky monografií, **kteří stále mají co říci** a koncepty z nich často stále platí
- Moderní revize většiny skupin a jejich srovnání se zahraničními zástupci (navzdory „železné oponě“)
- **Velmi jemné stratigrafické členění zejména siluru, ale i devonu a dalších útvarů pražské pánve**
- Modely struktury pánví, dosud ne zcela překonané (zastarávající)





Ivo Chlupáč – štola Na Rešnách (1977)



Odchod ředitele ÚÚG Dr. J. Svobody z funkce (1970)

Nesporně vynikající odborné kvality badatelů „zlatých let“

Relativně dobré existenční, **vynikající organizační podmínky, nic nerozptylovalo** (nebyly mobily ani PC),



Navzdory nedobрым politickým podmínkám **byl relativní dostatek peněz, prostředků a lidí***

*Tedy pokud nebyli z místa „odejiti“ – potkalo to nakrátko i Prof. I. Chlupáče

Moderní doba

Realita: ideální podmínky skončily

Nedostávají se peníze

řádově nižší podpora ze strany společnosti (úspory)

Grantový systém – byrokracie, honba za body → → →
publikace množství drobníček (v prestižních časopisech)

Chybí podmínky pro časově náročné studie

Nechybí entusiasmus, ale ubývá síl

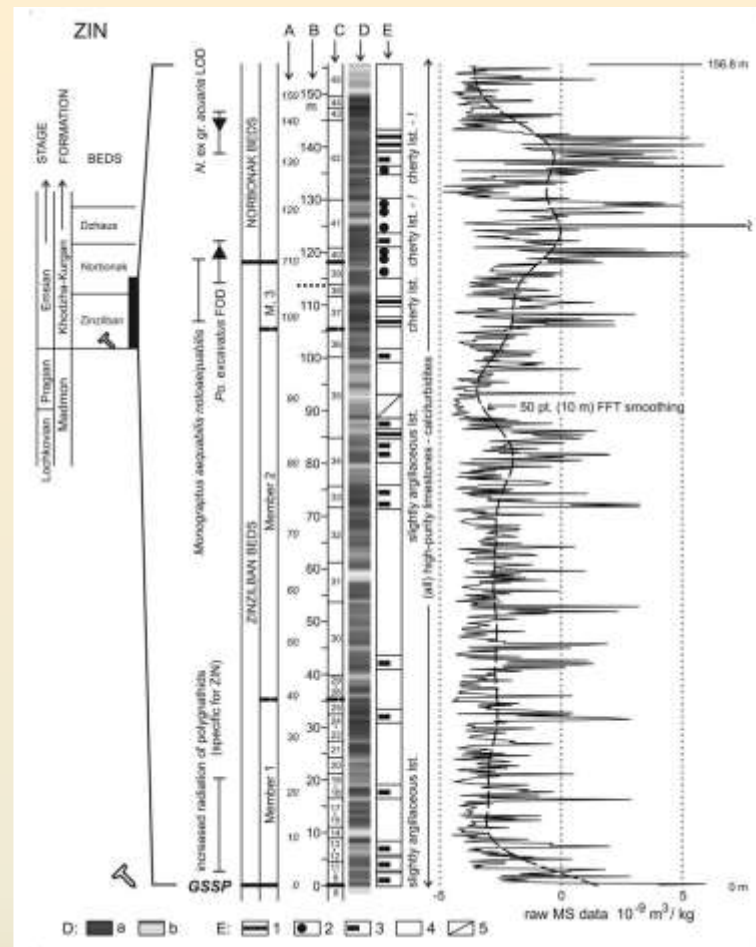
Děláme, co můžeme (???)

Budil (2012)



Jakékoli hodnocení
současného stavu
nemůže být věcně
správné, schází
odstup

Vždy je tu nebezpečí,
že práce některého z
kolegů nedoceníte,
či jednoduše
opomenete...



Přesto se o **shrnutí** pokusím

Bude nutně
zkreslené, neúplné a subjektivní

Pokroky ve výzkumu jednotlivých skupin (taxonomie, paleoekologie, tafonomie): specialisté (= za kým dnes jít pro určení zkameněliny)

- trilobiti a další členovci – M. Šnajdr, J. Vaněk, P. Budil, M. Mergl, J. Bruthansová, V. Vokáč, F. Hartl, F. Hörbinger, M. Šilinger, + J. Collette, E. Tetlie
- skolekodonti – P. Tonarová + O. Hints, M.R. Eriksson, T. Suttner
- mlži – J. Kříž, M. Polechová
- plži – R. Horný, J. Frýda + R.B. Blodget, P.R. Racheboeuf
- hlavonožci – V. Turek a Š. Manda
- brachiopodi – V. Havlíček, M. Mergl
- Mechovky – J. Kříž + A.L. Ferretti, K. Zágöršek
- Graptoliti; dendroidi – B. Bouček, A. Příbyl, P. Štorch + M. J. Melchin; J. Kraft
- dacryoconaridní tentakuliti – P. Lukeš, L. Ferrová, S. Vodrážková
- konodonti – L. Slavík, S. Vodrážková + O. Lehnert
- ostnokožci – R.J. Prokop, V. Petr, M. Nohejlová
- korálnatci a stromatoporoidi – A. Galle, J. Hladil
- konulárie – J. Bruthansová (M. Mergl)
- hyoliti – L. Marek, M. Valent
- Chitinozoa, Acritarcha, Prasinophyta, Foraminifera, Radiolaria – O. Fatka, R. Morávek, P. Dufka, J. Vodička, J. Bek, S. Vodrážková, K. Holcová, P. Čejchan + F. Paris, R. Brocke
- obratlovci – V. Vaškaninová + P. Ahlberg
- ichnofosílie – R. Mikuláš
- rostliny – J. Obrhel, M. Libertín, J. Kvaček, P. Kraft

Pracuje se tvrdě, intenzivně až hekticky (vysoké stovky článků). Velké množství velmi zajímavých prací (na hranici sledovatelnosti)

Kombinace klasických přístupů s moderními laboratorními metodami (CT, synchrotron)

Častější užití statistických metod, kombinace paleontologických, sedimentologických, geochemických výzkumů vedoucí k mnohem komplexnějšímu pohledu, nežli dříve

Pracuje se v často rozsáhlých týmech, ve spolupráci se zahraničními kolegy

Návrhy nových stratotypů

- **Aeron (silur)** – tým vedený Dr. Petrem Štorchem (Hlásná Třebaň)
- **Rozdělení oddělení přídolí (silur) na stupně** – tým vedený Dr. Štěpánem Mandou
- **Spodní/svrchní ems (spodní devon)** – příprava kandidátského stratotypu – tým vedený Prof. Jiřím Frýdou (Čeřinka u Bubovic)
- + Snaha o redefinici stratotypů stávajících (prag/ems) – tým vedený dr. L. Slavíkem
- **Detailní konodontová stratigrafie stupně lochkov (spodní devon)** – tým vedený Dr. L. Slavíkem

Lethaea

A proposed new global stratotype for Aeronian Stage of the Silurian System: Hlásná Třebaň section, Czech Republic

Petr Štorch, Jiří Fiala, Marek Záruba, Zuzana Tomyšková, Petr Štorch, Zuzana Tomyšková, Petr Štorch, Zuzana Tomyšková

LETHAEA

Abstract: The Aeronian Stage is the last stage of the Silurian System. It is defined by the first appearance of graptolites in the fossil record. The Aeronian Stage is the last stage of the Silurian System. It is defined by the first appearance of graptolites in the fossil record. The Aeronian Stage is the last stage of the Silurian System. It is defined by the first appearance of graptolites in the fossil record.

Division of Přídolí Series in Central Bohemia: graptolite and conodont biostratigraphy, faunal changes, and geochemical record

Stepán Mandou¹, Ladislav Ševčík², Petr Štorch³, Zuzana Tomyšková⁴ and Pavel Čop⁵

Abstract: The Aeronian Stage is the last stage of the Silurian System. It is defined by the first appearance of graptolites in the fossil record. The Aeronian Stage is the last stage of the Silurian System. It is defined by the first appearance of graptolites in the fossil record.

Subdivision of the Lochkovian Stage based on conodont faunas from the stratotype area (Prague Syncline, Czech Republic)

LEOŠKA SLAVÍK¹, PETR ČARLÍK², JIŘÍ FIALA³ and ZUZANA TOMYŠKOVÁ⁴

Abstract: The Aeronian Stage is the last stage of the Silurian System. It is defined by the first appearance of graptolites in the fossil record. The Aeronian Stage is the last stage of the Silurian System. It is defined by the first appearance of graptolites in the fossil record.

High-resolution tentaculite biostratigraphy and facies development across the Early Devonian Daleje Event in the Barrandian (Bohemia): implications for global Emsian stratigraphy

LENKA FIEDOROVÁ, JIŘÍ FIALA & PAVEL LUKÁČEK

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Sedimentary Geology
Ferruginous coated grains of microbial origin from the Lower Devonian (Fragnas) of the Prague Basin (Czech Republic) - Petrological and geochemical perspective
Stanislav Vlček et al.

Stratigraphic correlation of the Fragnas (Lower Devonian) of the Prague Basin (Czech Republic) with the Krasnoyarsk area (SW part of the Russian Federation)
Miroslav Mlýnský et al.

Lingulete brachiopods across the Kačák Event and Eifelian-Givetian boundary in the Barrandian area, Czech Republic
Miroslav Mlýnský et al.

Image showing various fossil specimens, likely brachiopods, arranged in a grid format.

Lethavia
A proposed new global stratotype for Aeronian Stage of the Silurian System: Hlánská Třebaň section, Czech Republic
Petr Pávek et al.

Diagram showing various fossil specimens, likely graptolites, arranged in a grid format.

Silurian-Devonian boundary events and their influence on cephalopod evolution: evolutionary significance of cephalopod egg size during mass extinctions
Štěpán Masopust et al.

A long-lasting steady period of isotopically heavy carbon in the late Silurian ocean: evolution of the δ13C record and its significance for an integrated δ13C, graptolite and conodont stratigraphy
Petr Pávek et al.

Příklady syntetizujících publikací

High-resolution tentaculite biostratigraphy and facies development across the Early Devonian Daleje Event in the Barrandian (Bohemia): implications for global Emsian stratigraphy

LINDA POKORÁ, ŠARITA POKORÁ & PAULI LUTZ

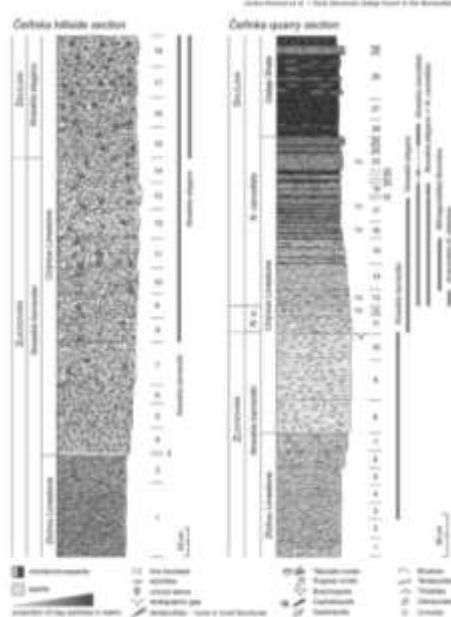
The long-term evolution of the Barrandian Carboniferous in Bohemia (Central Europe) has been studied in detail through the study of the Early Devonian tentaculite biostratigraphy. The different tentaculite biostratigraphies have been compared with the biostratigraphy of the Barrandian Carboniferous. The tentaculite biostratigraphy is the most reliable stratigraphic tool in the Barrandian Carboniferous, and the most important tool for the study of the Early Devonian tentaculite biostratigraphy. The tentaculite biostratigraphy is the most reliable stratigraphic tool in the Barrandian Carboniferous, and the most important tool for the study of the Early Devonian tentaculite biostratigraphy. The tentaculite biostratigraphy is the most reliable stratigraphic tool in the Barrandian Carboniferous, and the most important tool for the study of the Early Devonian tentaculite biostratigraphy.

Pokorá, L., Pokorá, Š. & Lutz, P. (2015) High-resolution tentaculite biostratigraphy and facies development across the Early Devonian Daleje Event in the Barrandian (Bohemia): implications for global Emsian stratigraphy. *Journal of Paleontology*, 89, 1454–1470. doi:10.1017/jpa.2015.111

Linda Pokorá, Šarita Pokorá & Pauli Lutz. 2015. High-resolution tentaculite biostratigraphy and facies development across the Early Devonian Daleje Event in the Barrandian (Bohemia): implications for global Emsian stratigraphy. *Journal of Paleontology*, 89, 1454–1470. doi:10.1017/jpa.2015.111

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DOI: 10.1017/jpa.2015.111



DOI: 10.1017/jpa.2015.111

Armoured test of Early Devonian *Mesoconularia* (Conulariida) from the Prague Basin (Czech Republic): probable adaptation to increased predation pressure

MICHA ŠMÍDL, LINDA POKORÁ & ŠARITA POKORÁ

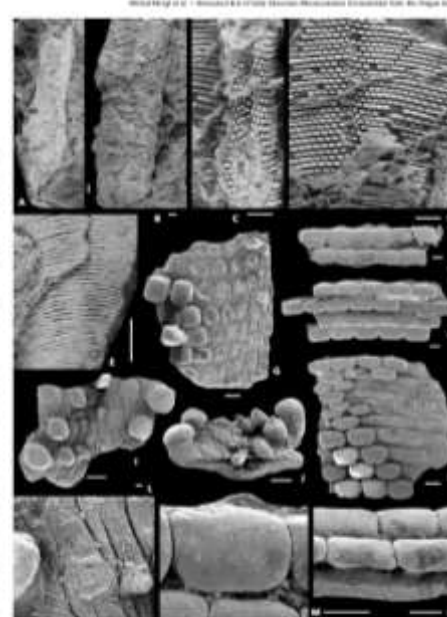
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Šmídl, M., Pokorá, L. & Pokorá, Š. (2015) Armoured test of Early Devonian *Mesoconularia* (Conulariida) from the Prague Basin (Czech Republic): probable adaptation to increased predation pressure. *Journal of Paleontology*, 89, 1471–1480. doi:10.1017/jpa.2015.112

Micha Šmídl, Linda Pokorá & Šarita Pokorá. 2015. Armoured test of Early Devonian *Mesoconularia* (Conulariida) from the Prague Basin (Czech Republic): probable adaptation to increased predation pressure. *Journal of Paleontology*, 89, 1471–1480. doi:10.1017/jpa.2015.112

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DOI: 10.1017/jpa.2015.112



DOI: 10.1017/jpa.2015.112

Paleogeography, Paleoclimatology, Paleoenvironment

The mid-Devonian (Silurian) biotic crisis in shallow settings of the Prague Syncline, Czech Republic: Integration of the graptolite fossil record with conodonts, shelly fauna and carbon isotope data

Nikola Šmíd¹, Jan Šmíd², Jitka Šmídová³, Ladislav Šmíd⁴, Zdeněk Šmíd⁵

The mid-Devonian (Silurian) biotic crisis in shallow settings of the Prague Syncline, Czech Republic: Integration of the graptolite fossil record with conodonts, shelly fauna and carbon isotope data. This study integrates graptolite, conodont, and shelly fossil records with carbon isotope data to understand the biotic crisis in shallow settings of the Prague Syncline, Czech Republic. The study shows that the biotic crisis was a result of increased predation pressure and a link to global changes in ocean chemistry and ecosystem overturn.

Šmíd, N., Šmíd, J., Šmídová, J., Šmíd, L., & Šmíd, Z. (2015) The mid-Devonian (Silurian) biotic crisis in shallow settings of the Prague Syncline, Czech Republic: Integration of the graptolite fossil record with conodonts, shelly fauna and carbon isotope data. *Journal of Paleontology*, 89, 1481–1495. doi:10.1017/jpa.2015.113

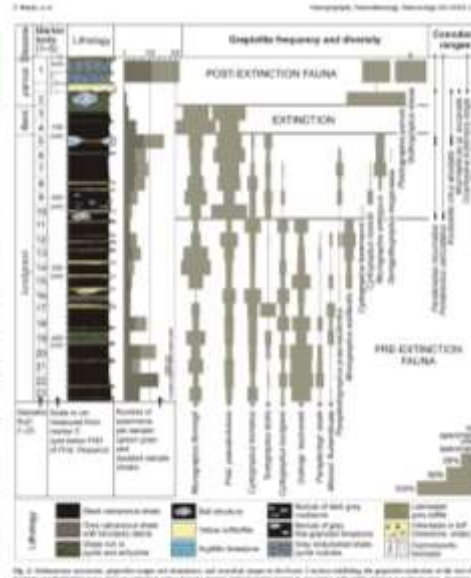


Fig. 1. Extinction frequency, graptolite range and diversity and survival of graptolite taxa in the Prague Syncline during the Daleje Event. The figure shows the impact of the Daleje Event on the Prague Syncline, Czech Republic, and its link to global changes in ocean chemistry and ecosystem overturn.

DOI: 10.1017/jpa.2015.113

Earth-System Reviews

The Mid-Devonian (late Silurian) Glaciation: A link with global changes in ocean chemistry and ecosystem overturn

Jill Trexler¹, Oliver Lehner², Michael St. John³, Peep Mook⁴, Miroslav Holoubek⁵, Michael St. John⁶, Jan Šmíd⁷, Barbara Pálfalvi⁸

The Mid-Devonian (late Silurian) Glaciation: A link with global changes in ocean chemistry and ecosystem overturn. This review discusses the Mid-Devonian (late Silurian) Glaciation and its link to global changes in ocean chemistry and ecosystem overturn. The study shows that the glaciation was a result of increased predation pressure and a link to global changes in ocean chemistry and ecosystem overturn.

Trexler, J., Lehner, O., St. John, M., Mook, P., Holoubek, M., St. John, M., Šmíd, J., & Pálfalvi, B. (2015) The Mid-Devonian (late Silurian) Glaciation: A link with global changes in ocean chemistry and ecosystem overturn. *Journal of Paleontology*, 89, 1496–1510. doi:10.1017/jpa.2015.114

DOI: 10.1017/jpa.2015.114

ARTICLE IN PRESS

Abstract

The Mid-Devonian (late Silurian) Glaciation: A link with global changes in ocean chemistry and ecosystem overturn. This abstract summarizes the key findings of the review, including the link between the glaciation and global changes in ocean chemistry and ecosystem overturn.

The Mid-Devonian (late Silurian) Glaciation: A link with global changes in ocean chemistry and ecosystem overturn. This abstract summarizes the key findings of the review, including the link between the glaciation and global changes in ocean chemistry and ecosystem overturn.

DOI: 10.1017/jpa.2015.114

Příklady publikací regionálně významných (s přesahem)

Nález devonských vápenců u asociací s hvězdicovým křemenem u Chýžavy v severním okolí pražské synformy

A find of Devonian limestones associated with star quartz near Chýžava in the northern surroundings of the Prague Synform

Karel Zák, Radkoš Radkoš, Petr Šaňl, Pavel Černý

Abstract
Abstract of the paper describing the Devonian limestone associated with star quartz near Chýžava in the northern surroundings of the Prague Synform. The paper is published in the journal of the Czech Geological Society, 2014, 118, 1-10. The paper describes the limestone associated with star quartz near Chýžava in the northern surroundings of the Prague Synform. The paper is published in the journal of the Czech Geological Society, 2014, 118, 1-10. The paper describes the limestone associated with star quartz near Chýžava in the northern surroundings of the Prague Synform. The paper is published in the journal of the Czech Geological Society, 2014, 118, 1-10.

1. Úvod
Úvodní text článku, který uvádí význam nálezů hvězdicového křemenem u Chýžavy v severním okolí pražské synformy. Text popisuje geologický kontext a význam nálezů pro poznání devonské geologie v této oblasti.

Text popisující geologický kontext nálezů a význam nálezů hvězdicového křemenem u Chýžavy v severním okolí pražské synformy. Text popisuje geologický kontext a význam nálezů pro poznání devonské geologie v této oblasti.

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24. ČASOPIS GEOLOGICKÝ VE SVĚTĚ - DEVONSKÉ PŘEMĚNY A KRYSTALIZACE

A.3. Příklady regionálních nálezů u Chýžavy
Text popisující regionální nález u Chýžavy v severním okolí pražské synformy. Text popisuje geologický kontext a význam nálezů pro poznání devonské geologie v této oblasti.



Fig. 3. Photomicrographs of mineral specimens showing characteristic star patterns.



Fig. 4. Photomicrographs of mineral specimens showing characteristic star patterns.



Fig. 5. Photomicrographs of mineral specimens showing characteristic star patterns.



Fig. 6. Photomicrographs of mineral specimens showing characteristic star patterns.

TRILOBITI BARRANDIENU

Díl 1
Trilobiti v lomu Kasov u Berouna

Václav Váňek, Petr Šaňl a Miroslav Pavlíček

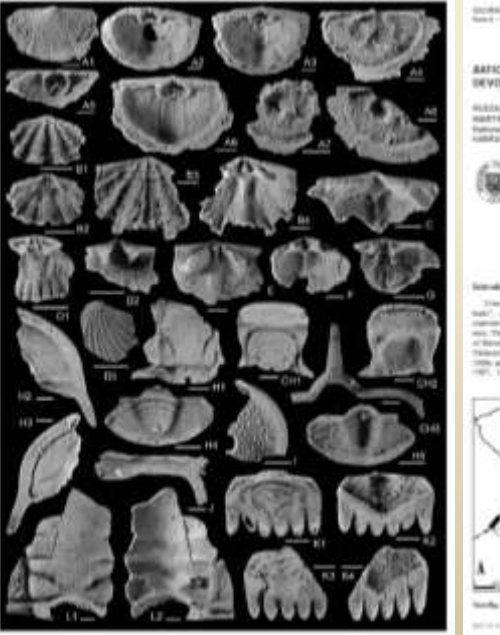
Pyritizovaná fosilní fauna v motolském souvrství (werlock) z lomu Kasov u Berouna

Pyritized fossil fauna in the Motol Formation (Werlock) in the Kasov Quarry near Beroun

Miroslav Pavlíček, Petr Šaňl, Václav Váňek

Abstract
Abstract of the paper describing the pyritized fossil fauna in the Motol Formation (Werlock) in the Kasov Quarry near Beroun. The paper is published in the journal of the Czech Geological Society, 2014, 118, 1-10. The paper describes the pyritized fossil fauna in the Motol Formation (Werlock) in the Kasov Quarry near Beroun. The paper is published in the journal of the Czech Geological Society, 2014, 118, 1-10.

Text popisující geologický kontext nálezů a význam nálezů pyritizované fosilní fauny v motolském souvrství (werlock) z lomu Kasov u Berouna. Text popisuje geologický kontext a význam nálezů pro poznání devonské geologie v této oblasti.



BAFCRWIS GEN. NOV. (CREBRIDIA, MADURATA) FROM THE BOHEMIAN EARLY DEVONIAN (THE CZECH REPUBLIC)

BAFCRWIS GEN. NOV. (CREBRIDIA, MADURATA) FROM THE BOHEMIAN EARLY DEVONIAN (THE CZECH REPUBLIC)

Miroslav Pavlíček, Petr Šaňl, Václav Váňek

Abstract
Abstract of the paper describing the new genus Bafcrwis from the Bohemian Early Devonian. The paper is published in the journal of the Czech Geological Society, 2014, 118, 1-10. The paper describes the new genus Bafcrwis from the Bohemian Early Devonian. The paper is published in the journal of the Czech Geological Society, 2014, 118, 1-10.

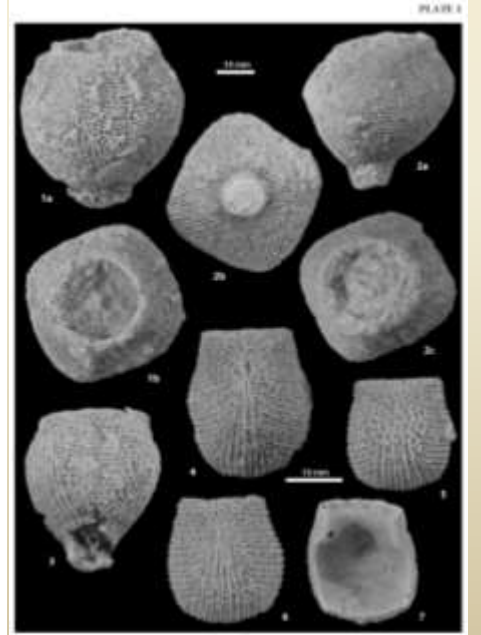
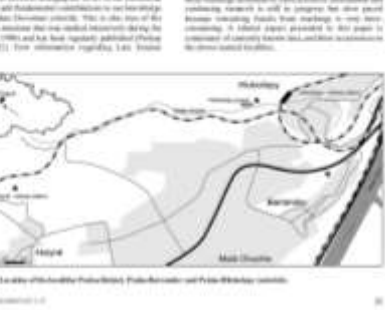


PLATE 1

Text describing the fossil specimens shown in Plate 1, including their identification and significance.

Jiný příklad - výjimečná zachování

Sporophytes of polysporangiate land plants from the early Silurian period may have been photosynthetically autonomous

Milan Libertin¹, Jiří Kvaček^{1*}, Jiří Bek¹, Viktor Žárský^{2*} and Petr Štorch²

The colonization of land by vascular plants is an extremely important phase in Earth's life history. This key evolutionary process is thought to have begun during the Middle Cambrian period and culminated in the Silurian/Early Devonian period (interval about 509–393 million years ago (Ma)), and is documented primarily by microfossils (that is, by dispersed spores, phytoliteis including fragments of algae, tissues, sporangia and cuticles), tubes and rare megafossils¹. A newly recognized fossil cooksoniid plant with in situ spores from the Barrandian area, Czech Republic, is of the highest importance because it represents extremely ancient megafossil evidence of land plant diploid generation: sporophytes (~432 Ma). The robust size of this plant places it among the largest known early polysporangiate land plants and it is probable that it attained adequate size for both aeration and effective photosynthetic competence. This would mean not only

were analysed comparatively and linked by cladistic analyses to several early land plant lineages. The most important character in these considerations was the presence or absence of conducting tissues. Specimens described as *Cooksonia porteri* Lang from the Lochkovian of England² have conducting tissues, whereas in *Cooksonia henryflaxiana* Lang from the Lochkovian of England³, conducting tissues were not found. *Aberonia calademai* (Eduard) Genco and Gorrivona (formerly *Cooksonia calademai*) from the Devonian of Aberystwyth in Scotland⁴, may even represent a sister to *Lyopodium*⁵. Thus, it was concluded: "...cooksonioids are presently understood representing a highly artificial group of plants ... that may include forms that are ancestral to either bryophytes or vascular plants, or possibly both⁶". This concept is coming under greater consideration with recent advances in our understanding of basal land plant phylogeny (that is, the basal position of bryophytes, their possible sister position to vascular

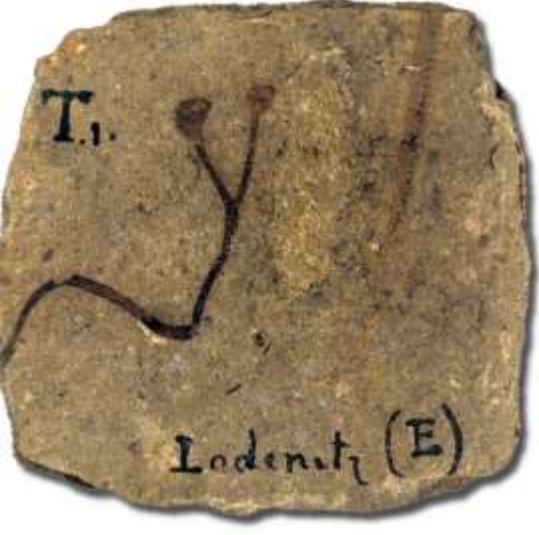
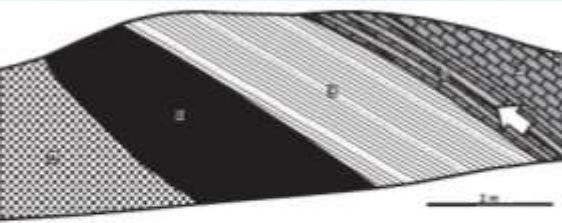
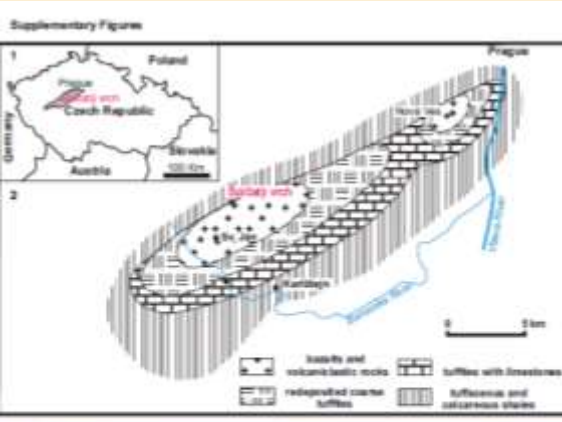


Fig. 1. Map of the Czech Republic, indicating location of the Prácheň Basin (Barrandian) with the Ludlow, Sudety, and basins.
 Fig. 2. Macrofacies distribution of the early Silurian paleogeography of Barrandian (modified according to KSG '70).
 Fig. 3. Road cut (Sudety) with Barrandian along near Loděnice (photo: Mikuláš, K.).
 A, Laminated tuffaceous shales with limestone intercalations.
 B, Aquatic level lens.
 C, Tuffaceous and tuffaceous shales.
 D, Basal part of layer (5–7 m), laminated calcareous and tuffaceous shales with limestone intercalations (stratigraphic bedrock).
 E, The place where sterile, asexual plant remains were found.
 F, Occurrence of higher graptolite *Metagraptus delphicus* co-occurring with visible *Melograptus* mine.
 G, Middle and upper part of layer where laminated calcareous and tuffaceous shales gradually pass into highly micaceous with interbedded tuffaceous shales (*Metagraptus delphicus* biozone containing, besides graptolites, diversified trilete and tricolpate bryozoans).
 H, Foliage impressions of *Ceratopteris rigida* biozone with highly developed trilete and tricolpate bryozoans (*Melograptus* mine, *Chetonia* margini, *Trichota* species, *Ovalopora* didactyla, *Wolffera* nodes, *Cyrtosira* minor, etc.).
 Fig. 4. Associated fauna.
 A, Single graptolite *Metagraptus delphicus* from the reverse side of *Cooksonia* specimen D 002, (scale bar 5 mm).
 B, Trilete *Melograptus* mine, along with plant fragments of *Cooksonia* specimen D 002, (scale bar 5 mm).

Supplementary Table
 Stratigraphic positions of the earliest records of *Cooksonia* within graptolite zones of Barrandian (A) and Ireland (B).

Series	Stage / Age (Myr)	Czech Republic (Štorch, 1994)	Graptolite ranges	Great Britain (Zatsewicz et al. 2009)
WENLOCK	427.4 HOMERIAN	<i>Austerus</i>	<i>M. henryi</i>	<i>Austerus</i>
		<i>dolomiti-praeobolus</i>		
		<i>Strepus</i>		<i>Strepus</i>
		<i>parvus-nassa</i>		<i>nassa</i>
	430.5	<i>Acata</i>		<i>Acata</i>
		<i>Andryni</i>		<i>Andryni</i>
SHEINWOODIAN	433.4	<i>radiata</i>		<i>radiata</i>
		<i>pennini-ramosus</i>		<i>pennini-ramosus</i>
		<i>rigidus</i>	<i>M. delphicus</i> , <i>M. arborescens</i> , <i>P. trilete</i> , <i>P. tricolpate</i>	<i>rigidus</i>
	433.4	<i>delphicus</i>		<i>delphicus</i>
		<i>dubius</i>		<i>dubius</i>
		<i>noveboracensis</i>		<i>noveboracensis</i>
433.4	<i>murchisoni</i>		<i>murchisoni</i>	

Early Silurian (mid-Sheinwoodian) palynomorphs from the Loděnice-Špičatý vrch, Prague Basin, Czech Republic

Jiří BEK, Petr ŠTORCH, Petra TONAROVÁ & Milan LIBERTÍN



Dispersed spores, cryptospores, scolecodonts, acritarchs, prasinophytes and chitinozoans, dated by graptolites as being middle Sheinwoodian (early Wenlock, ca 432 Ma), are described from the Loděnice-Špičatý vrch locality, Prague Basin, Czech Republic. Palynomorphs were macerated from a specimen (stored in the National Museum, Prague), with fragments of *Cooksonia* sp. and the zonal index graptolite *Monograptus belophorus* giving precise stratigraphic position within *Monograptus belophorus* Biozone. Important is the oldest occurrence of monolete spores. The number of spore taxa indicate that minimally six types of early vascular plants and probably two to three types of cryptosporophytes grew on the Svätý Jan Volcanic Island in the Prague Basin. The ecology of the first cryptospore and trilete spore producers within Sheinwoodian-Přidolí interval is discussed with special focus on first two globally important key events (after Homerian glaciation and during Přidolí) for earliest vascular land plants. The combination of palynological and palaeobotanical records confirms important role of volcanic islands of the Prague Basin for the evolution of early land plants. • Key words: palynology, earliest plants, spores and cryptospores, plant events.

Bek, J., Štorch, P., Tonarová, P. & Libertín, M. 2022. Early Silurian (mid-Sheinwoodian) palynomorphs from the Loděnice-Špičatý vrch, Prague Basin, Czech Republic. *Bulletin of Geosciences* 97(3), 385–396 (6 figures). Czech Geological Survey, Prague. ISSN 1214-1119. Manuscript received March 23, 2021; accepted in revised form August 3, 2022; published online September 3, 2022; issued September 3, 2022.

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The origin of land plants is one of the most important events in the Earth's history, having influenced continental and marine ecology as well as the global climate system (Berner *et al.* 2007, Wellman 2010). Many authors have hypothesized that land plants, *i.e.* embryophytes, originated from charophycean green algae and that the earliest land plants were "bryophyte-like" (e.g. Steemans *et al.* 2009). Most plants naturally shed their sterile and fertile organs during their lives. Upon death, plants become disarticulated and only rarely it is possible to find large fragments, which provide direct evidence of their existence. Indirect evidence includes phytodebris (or palynodebris or nematoclasts) like tubes, tissues, cuticles and sporangia together with both dispersed or *in situ* spores and/or cryptospores. Spores are much more abundant than plant fossils because they are smaller and consist of resistant material (sporopollenin). It is generally considered that the spore record is several times greater than that of plant macrofossils (Beck & Strother 2001). Another advantage is the often enormous production of spores by their plant producers.

The oldest palynological evidence for the first land plants are cryptospores (either as monads, obligate trilete marks. Cryptospore of spores with cell walls are distinct from trilete but resemble land plant oldest cryptospores are Cambrian strata (Strother Middle Devonian rocks & Steemans 2013, Well phytes (cryptospore sidered to represent the e 1999, Steemans *et al.* 20 considered to represent va ancestors (Wellman & C Edwards *et al.* 2014), v described from the Ordov The Ordovician-Silt sidered to be the crucial earliest vascular land plant

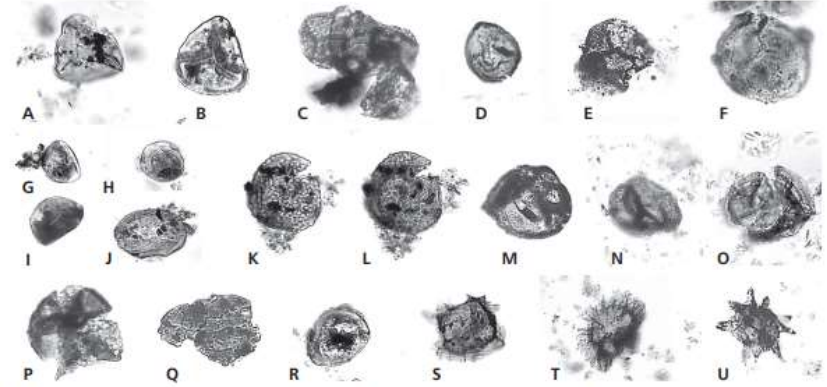


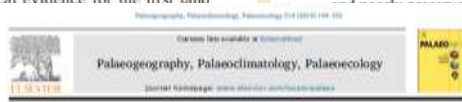
Figure 5. Spores, cryptospores, algae and acritarchs. All ×1500. • A – *Ambitisporites parvus* Burgess & Richardson 1995. • B – *Ambitisporites* spp. • C – tetrad of trilete sculptured spores of the *Aneurospora* type. • D – probably trilete spore of the *Ambitisporites* type. • E – poorly preserved and partly damaged probably trilete spore. • F – circular microspore to microgranulate palynomorph resembles trilete spore. Note possible trilete mark in the centre. • G – oval laevigate monolete spore. Note monolete laesurae along right margin. • H – probably laevigate monolete spore. Possible monolete laesurae is close to left margin. • I – oval laevigate monolete spore. Note short monolete laesurae in the centre. • J – oval sculptured palynomorph roughly resembles some monolete spore(?). • K, L – reticulate undetermined algae. • M, N – undetermined algae. • O – tetrad of undetermined algae. • P – tetrad of cryptospores of the *Aconthotetrax* type(?). • Q – sculptured trilete, possibly cryptospore. • R – cryptospores of the *Gneudinaispora cf. divellomedia* type. • S – acritarch of the *Cymatosphaera* type. • T – acritarch of the *Fimbrioglomerella* type. • U – acritarch of the *Cordubesia* type(?).

Some palynomorphs closely resembling trilete spores are poorly preserved and their precise classification is questionable or even not possible (Fig. 5D–F). Sometimes only the rays of the trilete mark, the most important characteristic, are visible with the surface being damaged (Fig. 5E). d into trilete and monolete forms. *bitisporites* (Fig. 5A, B) and *Am-Fig. 5D*). Another form is tetrad *ispora* type (Fig. 5C) which are g macerated from a sporangium *i* from the same stratigraphical ertin *et al.* 2018a). evigate monolete (Fig. 5G–I) and igate (Fig. 5J) monolete spores is

Morávek 2009; Vodička & Manda 2019), and scolecodonts (Šnajdr 1951). A detailed summary on previous research of organic walled microfossils from the Prague Basin was published by Morávek (2004). The present sampling has revealed that preservation of organic walled microfossils is poor. The original organic matter is corroded, and specimens are flattened and deformed probably due to marine origin of sediments. The state of preservation influenced the determination/classification of chitinozoans and scolecodonts, with the majority being indeterminate. Prasinophytes (Fig. 6U–X) were not studied in detail, though they may be the subject of future research. The chitinozoan assemblage is not diverse, with two determined taxa and two questionable genera present. Approximately a half of specimens were assigned to *Conochitina* spp. (Fig. 6A–D) and remaining specimens to *Ancyrochytina* spp. (Fig. 6E–N). Approximately forty specimens were found in sample D 550. Šnajdr (1951) determined that scolecodonts from the Motol Formation were paulinitids, belonging to the genus *Kettmerites* Žebera, 1935. He studied only poorly preserved

nomorphs. – There are several heinwoodian microfossils from uing acritarchs (Dufka 1992), ns (e.g. Dufka 1990, 1992, 1995b);

N), scolecodonts (O–T) and prasinophytes (U–X). All scale bars are 100 µm, except for V where it is 200 µm. • specimen collection number (SCN) PT101.22; B – SCN PT101.26; C – SCN PT101.28; D – SCN PT101.1. • E–N – PT98.3; F – SCN PT101.4; G – SCN PT101.23; H – SCN PT101.9; I – SCN PT99.6; J – SCN PT101.14; K – SCN M – SCN PT98.8; N – SCN PT101.16. • O, P – Polychaetaspidae, *Oenonites* sp.; O – first left maxilla, lateral view,



Initial plant diversification and dispersal event in upper Silurian of the Prague Basin
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ABSTRACT
A relatively rich assemblage of five species of radiolipidic plants is known from the upper Silurian of the Prague Basin, including *Ambitisporites*, *Aneurospora*, *Gneudinaispora*, *Cymatosphaera* and *Fimbrioglomerella*. The *Ambitisporites* species are characterized by a circular microspore to microgranulate palynomorph resembling trilete spore. Note possible trilete mark in the centre. The *Aneurospora* type is represented by a tetrad of four spores. The *Gneudinaispora* type is represented by a pair of spores. The *Cymatosphaera* and *Fimbrioglomerella* types are represented by single spores. The *Ambitisporites* type is characterized by a circular microspore to microgranulate palynomorph resembling trilete spore. Note possible trilete mark in the centre. The *Aneurospora* type is represented by a tetrad of four spores. The *Gneudinaispora* type is represented by a pair of spores. The *Cymatosphaera* and *Fimbrioglomerella* types are represented by single spores.

INTRODUCTION
The origin of land plants is one of the most important events in the Earth's history, having influenced continental and marine ecology as well as the global climate system (Berner *et al.* 2007, Wellman 2010). Many authors have hypothesized that land plants, *i.e.* embryophytes, originated from charophycean green algae and that the earliest land plants were "bryophyte-like" (e.g. Steemans *et al.* 2009). Most plants naturally shed their sterile and fertile organs during their lives. Upon death, plants become disarticulated and only rarely it is possible to find large fragments, which provide direct evidence of their existence. Indirect evidence includes phytodebris (or palynodebris or nematoclasts) like tubes, tissues, cuticles and sporangia together with both dispersed or *in situ* spores and/or cryptospores. Spores are much more abundant than plant fossils because they are smaller and consist of resistant material (sporopollenin). It is generally considered that the spore record is several times greater than that of plant macrofossils (Beck & Strother 2001). Another advantage is the often enormous production of spores by their plant producers.

RESEARCH ARTICLE

Unique diversity of acanthothoracid placoderms (Basal jawed vertebrates) in the Early Devonian of the Prague Basin, Czech Republic: A new look at *Rosolovo* and *Molopteleichthys*

Verica Vaškaninová^{1,2,3}, Petr B. Žilka^{4,5}

Abstract

The diversity of Early Devonian placoderms (before the Lochmoeon and Pragian of the Prague Basin, generally attributed to the genera *Rosolovo* and *Molopteleichthys*, or *rosolovi*) in the Prague basin, Bohemia (ca. 360–350 Ma) shows unique combination with the origin of the Lochmoeon. *Rosolovo* and *Molopteleichthys* were the only type of the genus, this assignment of both species to *Rosolovo* is supported. However, the Lochmoeon members previously identified as *Rosolovo* specimens also contain new genera, *rosolovi*, distinguished from *Rosolovo* by their general form: these are found around Špirovice and Budečkov. The shared genus *Molopteleichthys*, synonymized with *Rosolovo* by some previous authors, as shown to be valid. Furthermore, whereas *Rosolovo*, *Trompsko* and *Rosolovo* can be assigned to the group Acanthothoracina, on the basis of several features including presence of a projecting posterior region of the antorbital, *Molopteleichthys* belongs to a separate and probably new acanthothoracid. Skull roof pattern and other aspects of morphology vary greatly between these taxa. *Rosolovo* has a posteriorly broadened skull roof, whereas the skull-roofs of *Trompsko* and *Molopteleichthys* occur in both anterior oblique. *Trompsko* has an anteriorly elongated lower jaw and appears to lack a posterior pit. *Rosolovo* has a long posterior region, in contrast *Trompsko* the posterior region is not elongated. Fossil localities of the Bohemian of *Rosolovo* and the skull-roofs of *Rosolovo* and *Molopteleichthys* discovered since last century are being going into question (re-evaluation including an apparently extreme degree of skull roof variability). These conclusions should be investigated.

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Acantothoracodermi z období Early Devonian

Fig 1. Rosolovo and Molopteleichthys. A: *Rosolovo*, dorsal view. B: *Rosolovo*, lateral view. C: *Molopteleichthys*, dorsal view. D: *Molopteleichthys*, lateral view. Scale bars are provided for each view.

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Acantothoracodermi z období Early Devonian

Fig 2. Molopteleichthys. A: *Molopteleichthys*, dorsal view. B: *Molopteleichthys*, lateral view. C: *Molopteleichthys*, skull roof. D: *Molopteleichthys*, skull roof. Scale bars are provided for each view.

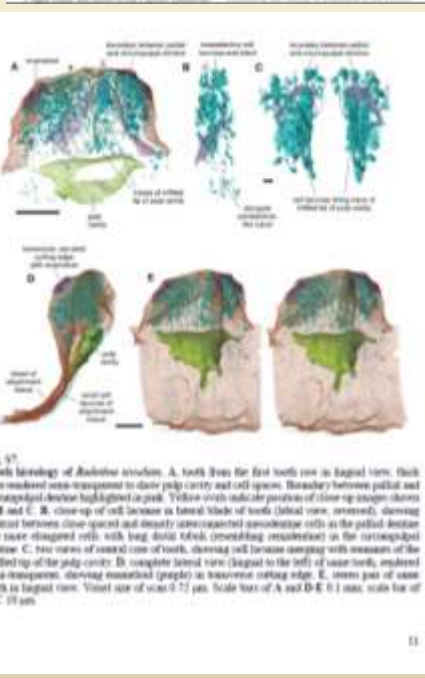
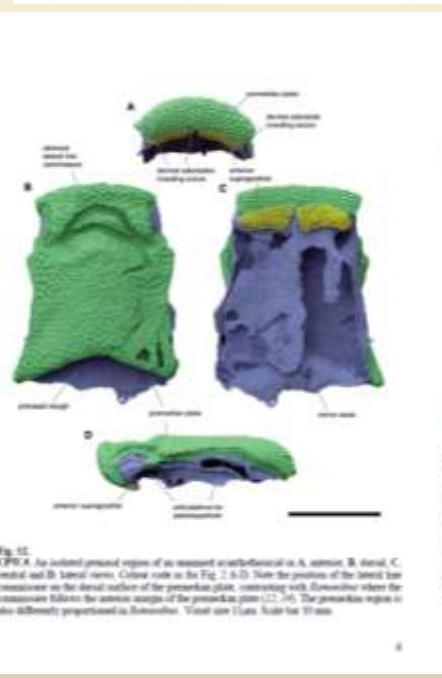
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Vertebrate microfossils from the Pragian, Emsian and Eifelian of the Prague Basin (Czech Republic)

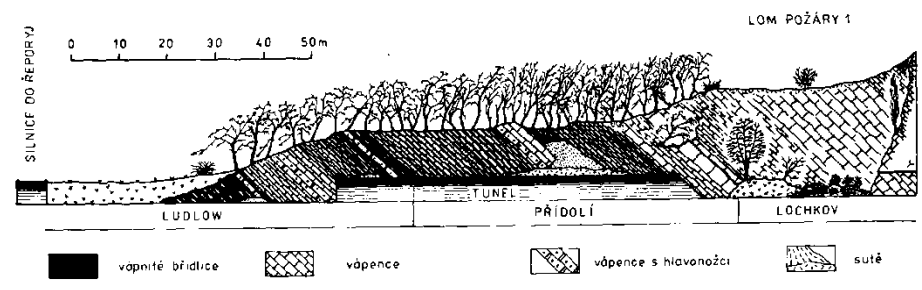
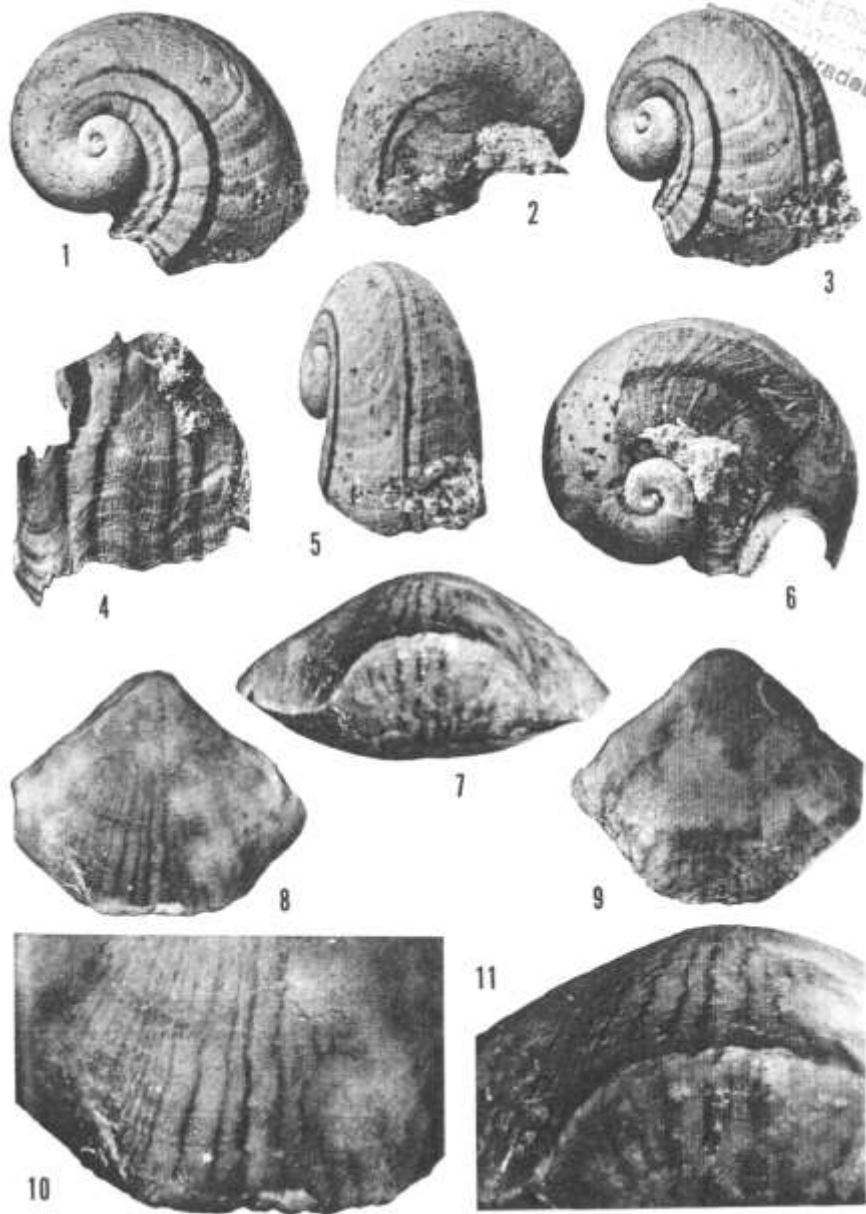
Michal Mergl¹, Verica Vaškaninová², Dalibor Pátek³

Abstract

The vertebrate microfossils from the Pragian and Emsian stages of the Prague Basin (Czech Republic) are reviewed. The microfossils are divided into three groups: acanthothoracids, placoderms, and vertebrates. The microfossils are described and their stratigraphic distribution is discussed. The microfossils are compared with those from the Emsian and Eifelian stages of the Prague Basin (Germany).



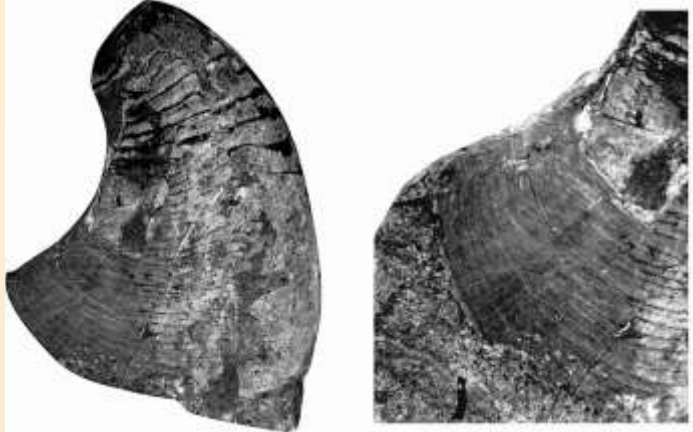
Moderní výzkum obratlovců siluru a devonu pražské pánve – Vaškaninová (2020), Vaškaninová a P. Ahlberg (2017), Vaškaninová et al. (2020), Vaškaninová a Kraft (2014a,b), Mergl et al. (2014) a další publikace



Defilé stratotypu požárského (přídolského) souvrství na Požárech u Řeporyj. Hranice ludlow—přídolí je v tomto profilu definována mezinárodním hraničním stratotypem přídolí [vrstva č. 96, ležící 196 cm nad bází požárského (přídolského) souvrství]



Barvy na schránkách: *Platyceras deceptivum* (Kříž a Lukeš 1974), Požáry



Phragmoceras imbricatum Barrande, 1865; ludlow, gorst, zóna *C. colonus*;
Butovice, Na Břekvici, kopaninské souvrství



Oonoceratidní hlavonožec
Richardsonoceras forbesi
(Barrande, 1866). Kopaninské s.,
ludlow, ludford, Kosov



Peismoceras pulchrum (Barrande, 1865),
Ludlow, raný gorst, Butovice - Na Břekvici, kopaninské
souvrství



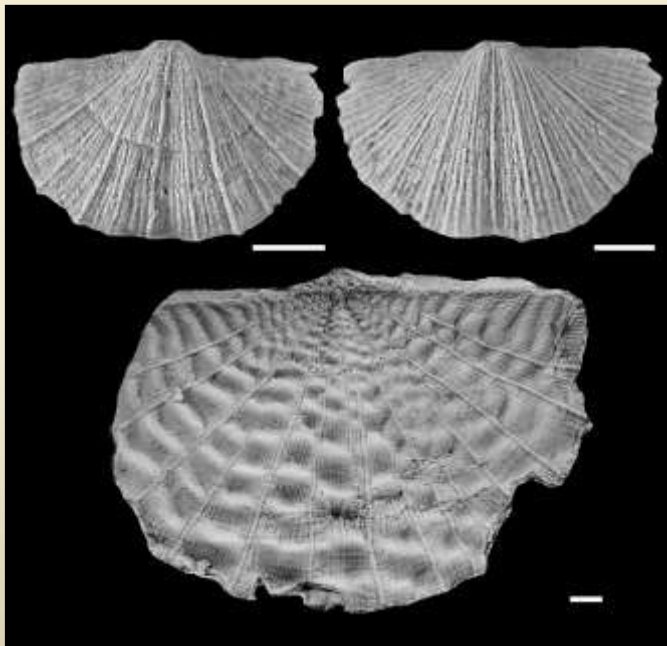
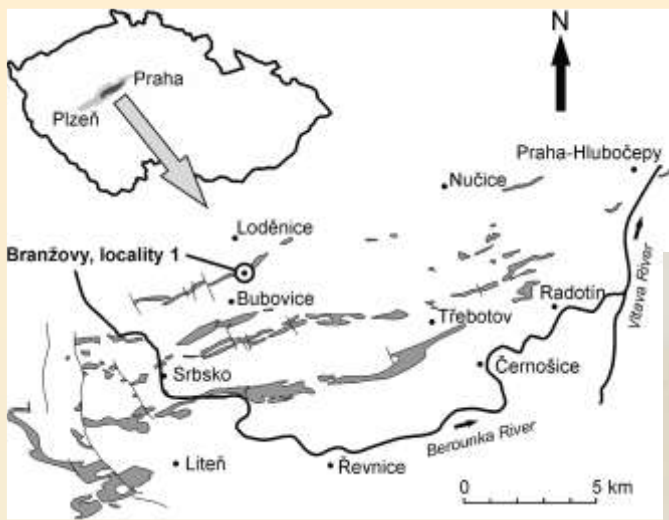
Oonoceras sp. Kopaninské
souvrství, ludlow, ludford, Beroun –
Dlouhá hora



Hexameroceras panderi (Barrande, 1865),
Ludlow, nejvyšší ludford,
Praha - Velká Chuchle

Manda a Turek (2009a,b), 2015
Turek a Manda (2011, 2020)
aj.

Barvy na schránkách: cephalopoda



Mergl a Nolčová (2016) – Kotýské vápence, Branžovy

Response of organophosphatic brachiopods to the mid-Ludfordian (late Silurian) carbon isotope excursion and associated extinction events in the Prague Basin (Czech Republic)

MICHAL MERGL, JIŘÍ FRÝDA & MICHAL KUBAJKO



The present paper represents the first results of an on-going multidisciplinary study focused on the response of marine faunas to the mid-Ludfordian (late Silurian) carbon isotope excursion and associated extinction events (Ludfordian, late Silurian). The paper describes the stratigraphical distribution of organophosphatic brachiopods from the uppermost part of the *Neocucullograptus inexpectatus* to lower part of *Monograptus parulitimus* graptolite biozones (i.e. early Ludfordian to earliest Pridoli). Numerical analysis of the stratigraphical distribution, based on more than 1300 determinable valves of 15 organophosphatic brachiopod species, revealed three groups being significantly supported. They are here formalized as new organophosphatic brachiopod communities: the oldest *Opiconidion ephemerus* Community, the *Kosoidea fissurella* Community, and the youngest *Opiconidion paraphermerus-Kocagittella clara* Community. The *Opiconidion ephemerus* Community and the *Opiconidion paraphermerus-Kocagittella clara* Community have distinct similarities in their taxonomic composition, moderate species diversity and low dominance indices. The communities are separated by the monospecific *Kosoidea fissurella* Community present just after the Lau and Kozłowski bioevents during the period of high $\delta^{13}\text{C}$ values which is interpreted as an opportunistic community. Re-occurrence of some brachiopod taxa after the bioevents and the mid-Ludfordian carbon isotope excursion raises the question, at least for organophosphatic brachiopods, as to the extent to which the Lau and Kozłowski bioevents represent true global extinction events and whether their significance has not been overestimated. Two new species are erected: *Opiconidion bouceki* and *Opiconidion paraphermerus*. • Key words: mid-Ludfordian carbon isotope excursion, Lau and Kozłowski bioevents, Silurian, organophosphatic brachiopods, Barrandian, new taxa.

MERGL, M., FRÝDA, J. & KUBAJKO, M. 2018. Response of organophosphatic brachiopods to the mid-Ludfordian (late Silurian) carbon isotope excursion and associated extinction events in the Prague Basin (Czech Republic). *Bulletin of Geosciences* 93(3), 369–400 (11 figures, 2 tables). Czech Geological Survey, Prague. ISSN 1214-1119. Manuscript received April 15, 2018; accepted in revised form July 3, 2018; published online August 6, 2018; issued August 20, 2018.

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The Silurian Period represents a rather unusual period in Earth history. During the last two decades several distinct and rapid changes in the Silurian global carbon cycle have been recognized. These geochemical events were closely linked to major crises in marine ecosystems as well as to palaeoclimatic changes (see Munnecke *et al.* 2003, Loydell 2007, Calner 2008, for reviews). The largest magnitude perturbation in the Silurian global carbon cycle, named the mid-Ludfordian carbon isotope excursion (CIE) by Kaljo *et al.* (1997), has been considered also to represent the largest carbon isotope excursion throughout the whole Phanerozoic and the second largest in Earth history

(Munnecke *et al.* 2003). On the other hand, the mid-Ludfordian CIE was preceded only by moderate faunal crises referred to as the Lau conodont Bioevent (Jeppsson 1987), Kozłowski graptolite Bioevent (Urbanek 1993), and Pentamerid Bioevent (Talent *et al.* 1993). The mid-Ludfordian CIE and the associated faunal turnover have been documented from many palaeocontinents, in particular from different areas of Baltica (see Kaljo *et al.* 1996, 1997, 2007, 2014; Calner 2008; Eriksson *et al.* 2009; Jeppsson *et al.* 2012; Kozłowski & Munnecke 2010; Kozłowski & Sobień 2012; Younes *et al.* 2016; Spirodonov *et al.* 2017), Australia (Talent *et al.* 1993;

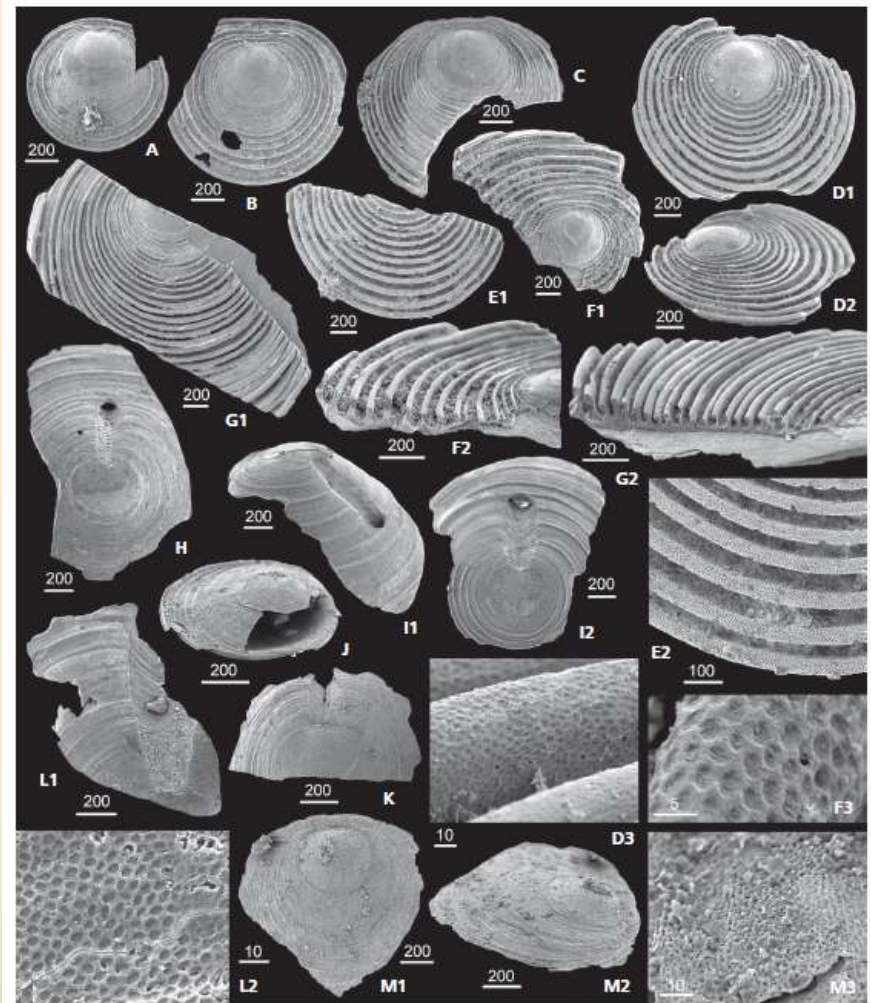
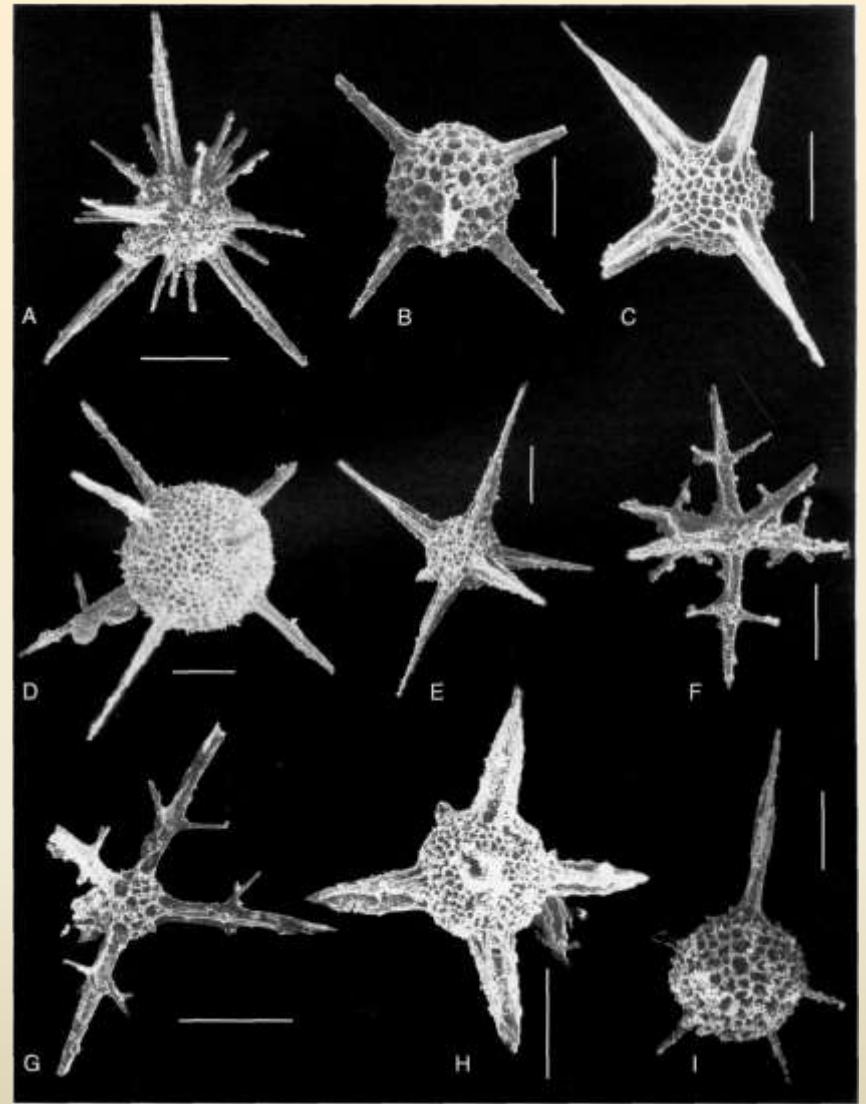
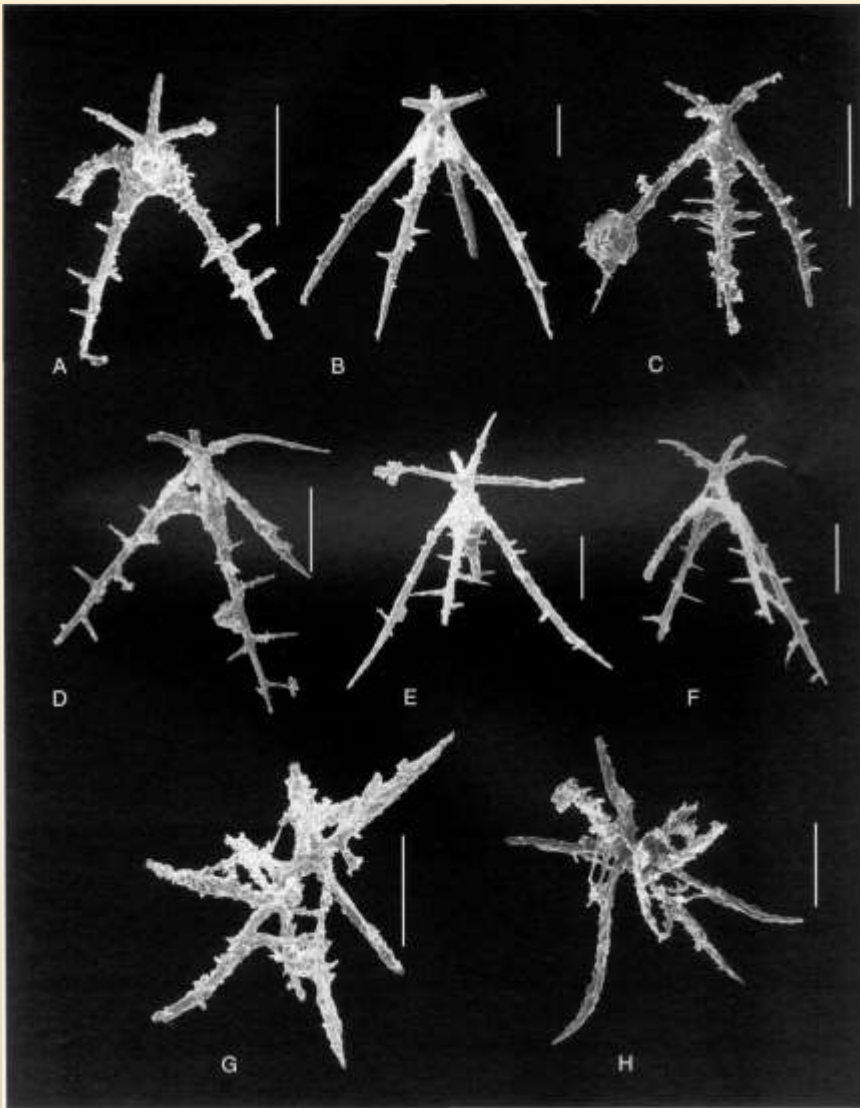


Figure 5. A–K – *Clymithole vexata* (Barrande, 1879), Kosov Quarry, samples K2 (A, B), K8 (D, F, H, I, J), K10 (C, E, G, K). A – exterior of small dorsal valve, JF195_30; B – exterior of dorsal valve, JF195_31; C – exterior of dorsal valve, JF195_5; D – exterior of dorsal valve (1), its anterodorsal view (2) and detail of its microornament (3), JF195_79; E – exterior of large incomplete dorsal valve (1), and its microornament (2), JF195_6; F – exterior of large incomplete dorsal valve (1), detail of ornament (2), and its microornament (3), JF195_81; G – exterior of incomplete dorsal valve (1), detail of ornament (2), JF195_7; H – exterior of incomplete ventral valve, JF195_82; I – exterior of incomplete ventral valve (2), and its posterolateral view (1), JF195_83; J – complete small shell, JF195_86; K – exterior of incomplete ventral valve, JF195_8. • L – *Acrosaccus* sp. A, Kosov Quarry, sample K10. Exterior of incomplete ventral valve (1) and its microornament (2), JF195_9. • M – *Acrosaccus* sp. B, Kosov Quarry, sample K3. Exterior of incomplete ventral valve (1), its laterodorsal view (2) and its microornament (3), JF195_84. Length of bars in μm .



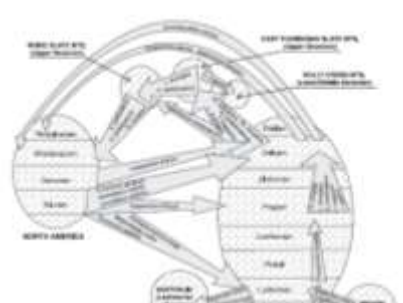
Radiolárie: P. Čejchan (MS); Budil (1995), Braun & Budil (1999)

Journal of Paleontology 2013, 87(1), 1-12

SILURIAN AND DEVONIAN FORAMINIFERS AND OTHER ACID-RESISTANT MICROFOSSILS FROM THE BARRANDIAN AREA

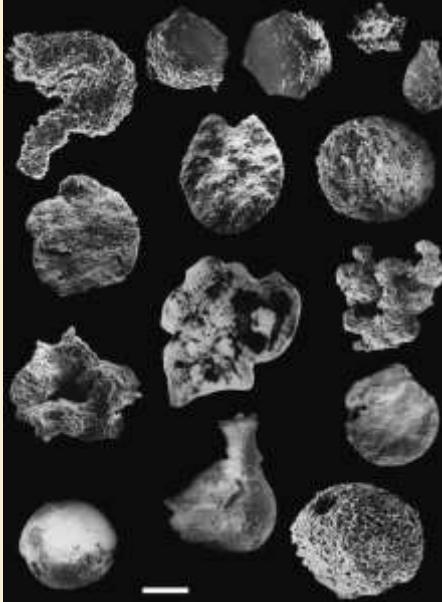
ADRIANA HOLCOVÁ
 Institute of Geology and Palaeontology, Charles University, Albertov 6, CZ-128 00 Prague 2, Czech Republic

Abstract: The Barrandian area is one of the most important paleontological regions in Central Europe. It is characterized by a rich fossil record, including silurian and devonian foraminifera and other acid-resistant microfossils. This paper presents a comprehensive overview of the fossil record in this region, including a detailed stratigraphic correlation chart. The study is based on a thorough examination of the literature and new field and laboratory work. The results show that the Barrandian area is a key region for understanding the evolution and distribution of foraminifera and other microfossils during the silurian and devonian periods.



Key to the stratigraphic correlation chart: 1. Silurian, 2. Devonian, 3. Carboniferous, 4. Permian, 5. Triassic, 6. Jurassic, 7. Cretaceous, 8. Tertiary, 9. Quaternary.

Abbreviations: Sil. = Silurian, Dev. = Devonian, Carb. = Carboniferous, Perm. = Permian, Trias. = Triassic, Jur. = Jurassic, Cret. = Cretaceous, Terc. = Tertiary, Quat. = Quaternary.



Journal of Paleontology 2013, 87(1), 1-12

The morphology of small agglutinated foraminifera from the Devonian carbonate complex of the Prager Syrtites, (Barrandian area, Czech Republic)

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²Department of Geology, Faculty of Science, Masaryk University, Brno, CZ-602 00 Brno, Czech Republic

Abstract: This study describes the morphology of small agglutinated foraminifera from the Devonian carbonate complex of the Prager Syrtites. The specimens are characterized by their agglutinated structure and small size. The study includes detailed descriptions of the morphology and a correlation chart. The results show that these foraminifera are distinct from other groups and provide important information about the paleoenvironment and paleogeography of the Barrandian area during the Devonian period.

Výzkum foraminifer – K. Holcová

Výzkum chitinozoi – F. Paris, P. Dufka; J. Vodička

Journal of Paleontology 2013, 87(1), 1-12

Marine Micropaleontology

Research paper

A monometal and statistical study of chitinozoan distributions across the lastglacial Eem (Weslůck, Silesian) from the Prague Basin, Czech Republic: A specific pattern driven by ecological changes

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Abstract: This study presents a monometal and statistical analysis of chitinozoan distributions in the lastglacial Eem (Weslůck, Silesian) from the Prague Basin. The results show a specific pattern of distribution driven by ecological changes. The study includes detailed descriptions of the chitinozoan morphology and a correlation chart. The results provide important information about the paleoenvironment and paleogeography of the Prague Basin during the lastglacial period.

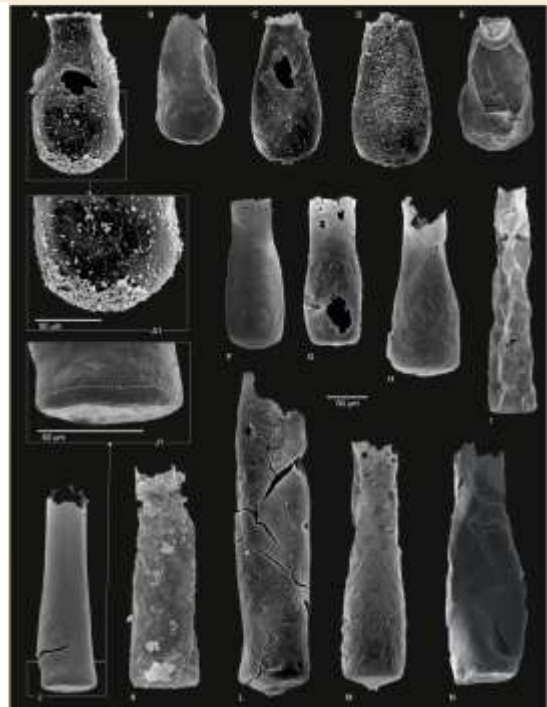
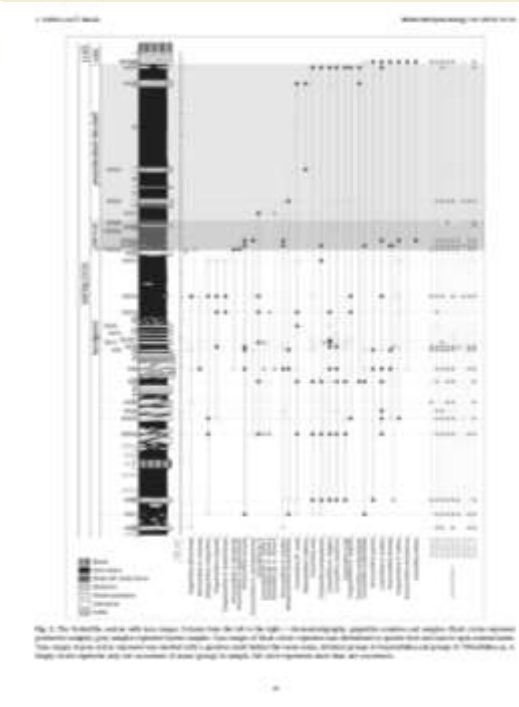


Fig. 1. The chitinozoan assemblage from the lastglacial Eem (Weslůck, Silesian) from the Prague Basin. The figure shows a stratigraphic correlation chart and microscopic images of chitinozoan specimens. The chart shows the distribution of chitinozoans across the lastglacial period, and the images show the morphology of the specimens. The results show a specific pattern of distribution driven by ecological changes.

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Received 10 September 2012, Accepted 10 October 2012, Available online 11 September 2012

Available online 11 September 2012

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Silurian carcinosomatid eurypterids from the Prague Basin (Czech Republic)

PETR BUDIL, ŠTĚPÁN MANDA & ODD ERIK TETLIE



The eurypterid record from the Prague Basin includes occasional Ludlow faunas, but in the uppermost Silurian (Přídolí) eurypterids suddenly become common in relatively deep water facies. Pterygotids clearly dominate these late Silurian faunas, whereas carcinosomatids are represented by the single species *Eurypterus acrocephala*, known from only a few specimens. This species is revised and its validity is discussed herein. A new eurypterid fauna found in deep water shale facies is described from the lower and middle part of the Mnouk Formation, Wenlock. *Sphenocrinus*-Homotrid, *Coryngonius murchisoni* to *C. longyvevi* graptolite biosomes, at Praha-Ločkovice. It consists of common fragments of the carcinosomatid eurypterid described here as *Eurypterus*? sp. A and rare possible pterygotid fragments. This is the earliest evidence of carcinosomatids outside Laurentia and one of the earliest records of the group worldwide. This early occurrence outside a hypothetical Laurentian evolutionary cradle is discussed with respect to the paleogeography of other faunas colonizing peri-Gondwanan basins after the decline of widespread early Silurian anoxia. A previous suggestion that carcinosomatids (presumed basal members of the Carcinomasomatoidea) had similar distribution patterns to pterygotids is discussed. Eurypterids migrated into the peri-Gondwanan realm from the tropical zone, but the dispersion potential of carcinosomatids into the temperate and cool water realm was probably lower than that of pterygotids. In the Prague Basin, the carcinosomatid-dominated fauna of the Wenlock age was replaced in the late Silurian by a pterygotid-dominated fauna. • Key words: Eurypteroidea, Carcinomasomatoidea, Prague Basin, Wenlock, Přídolí.

BUDIL, P., MANDA, Š. & TETLIE, O.E. 2014. Silurian carcinosomatid eurypterids from the Prague Basin (Czech Republic). *Bulletin of Geosciences* 89(2): 257–267 (7 figures). Czech Geological Survey, Prague. ISSN 1214-1110. Manuscript received April 19, 2013; accepted in revised form January 6, 2014; published online March 11, 2014; issued May 19, 2014.

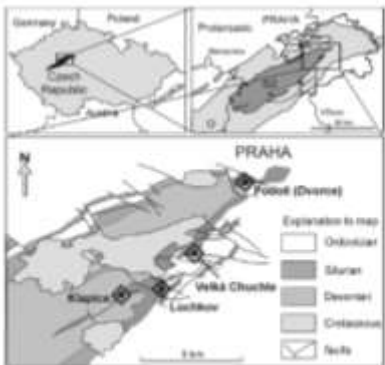


Figure 1. Maps showing the location of the Prague Basin in the Czech Republic, the distribution of Paleozoic rocks in Central Bohemia, and detail of the NE part of the Prague Basin with localities yielding carcinosomatids. O - Ordovician, Sil - Silurian and Devonian.

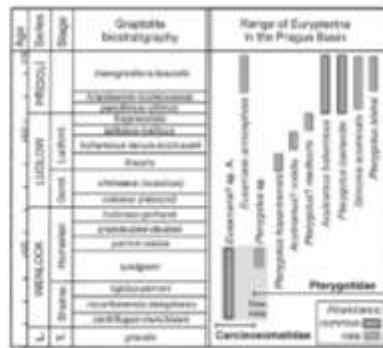
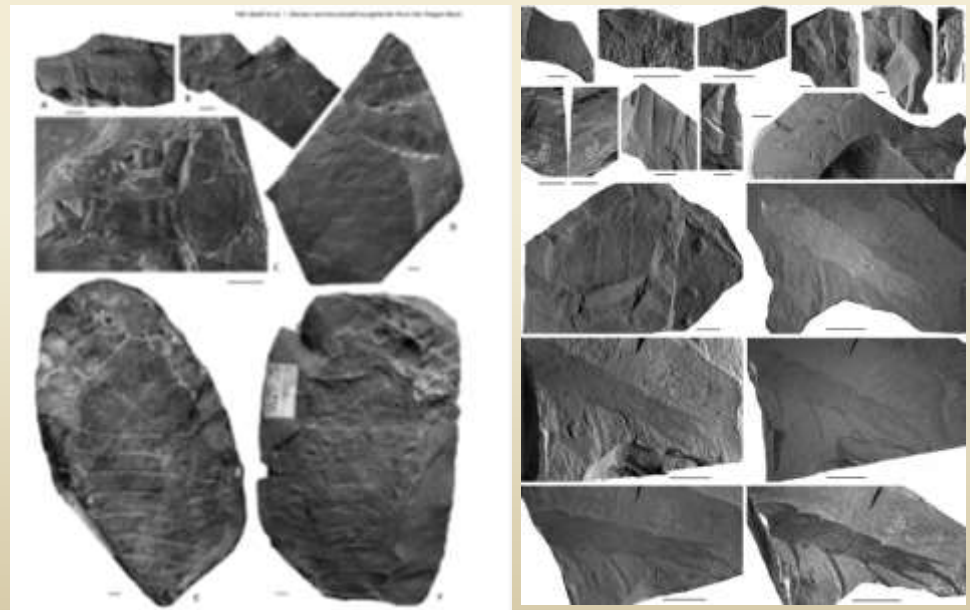
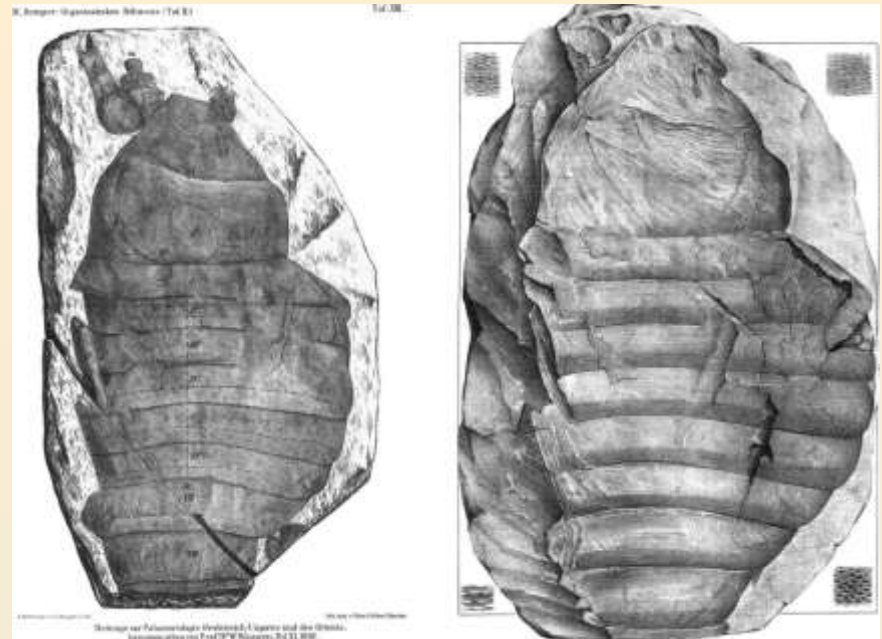
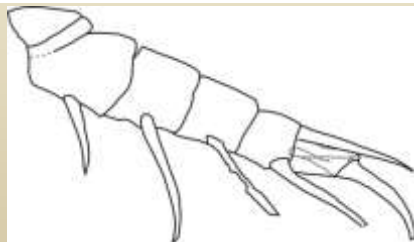


Figure 2. Stratigraphic distribution of eurypterids in the Silurian of the Prague Basin. Ranges of late Silurian eurypterids after Chlupáč et al. (1994) and Chlupáč (1994). Geotectonic zones after Štorch (1994, 1995), Manda & Kříž (2000) and Manda et al. (2012).



Výskyt eurypteridů již v motolském souvrství (Budil et al. 2010)



Ceratiocaris papilio (Salter *in* Murchison, 1859) v pražské pánvi
Mandibuly a trupové končetiny zachované *in-situ* (Budil et al. 2010)

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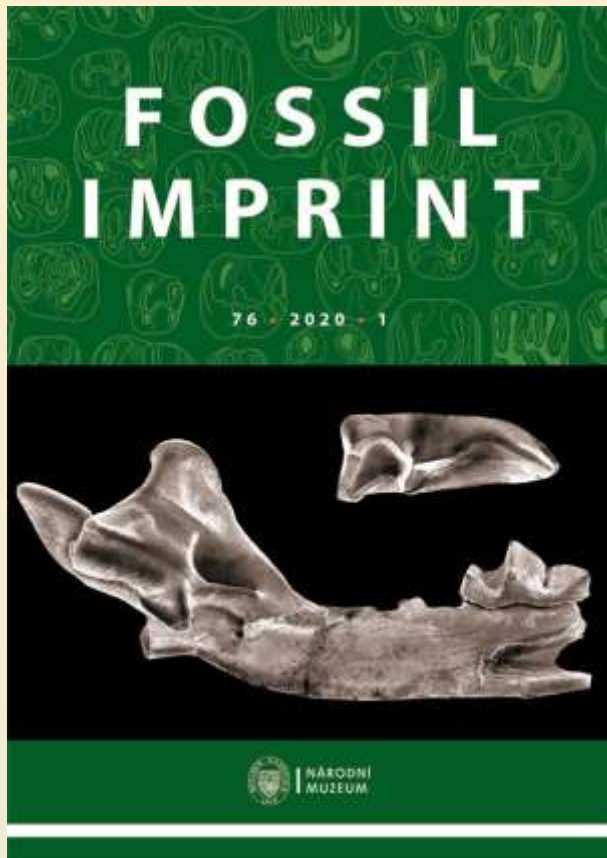
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The type of *Peltocarpus cretaceus* Miq., 1863 described from the Cretaceous of the Bro-Petersberg, The Netherlands, is an *Excelsa mya burtini* (Brongn.) Sittlerich, 1876, most likely from the Brussels area, Belgium

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Zprávy o geologických výzkumech, 55, 1, 2022

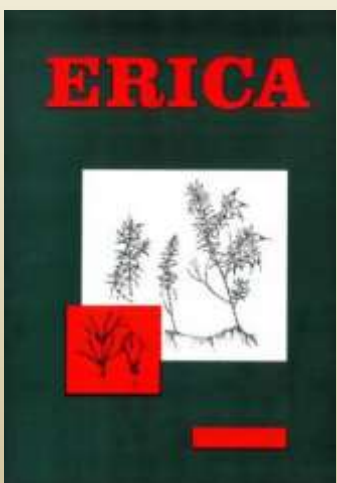
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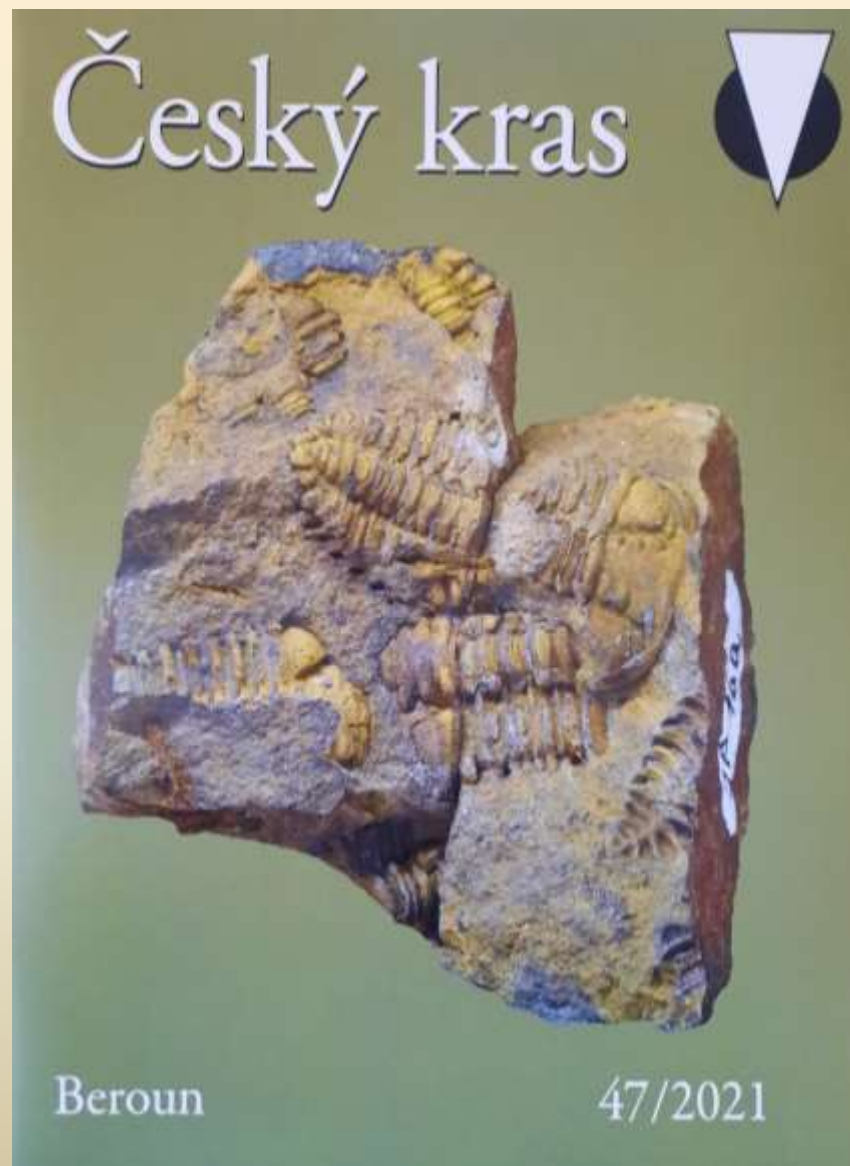
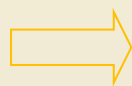
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Proměny významného regionálního časopisu Český kras v čase



Vydáván od roku 1976



Přejme CHKO Český kras vše nejlepší do dalších let!



Děkuji Vám za pozornost



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