

## The Arenig/Llanvirn boundary (Ordovician) in the Prague Basin (Bohemia)

### Hranice arenig-llanvirn (ordovik) v pražské pánvi (Čechy) (Czech summary)

(2 text-figs.)

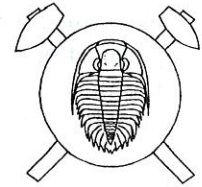
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Relations within the Klabava/Šárka Formations boundary interval at the Drahouš locality near Rokycany are described. In the lower part of the Šárka Formation, there is one biozone (*Corymbograptus retroflexus* Biozone) and Bouček's (1973) horizons are of a local character. The Arenig/Llanvirn boundary is situated above the Klabava/Šárka Formations boundary, because the first appearance of *Didymograptus spinulosus* Perner is within the *Corymbograptus retroflexus* Biozone.



### Introduction

During the construction of a highway west of Rokycany, the Klabava/Šárka Formations boundary of the Prague Basin Ordovician was uncovered in the area of the classical locality Drahouš (Holub, 1908; Iserle 1903; J.Kraft, 1974; J.Kraft et P.Kraft, 1992). The whole section was macropaleontologically investigated in detail. In addition, samples for supplemental study (micropaleontology, lithology, paleomagnetism, determination of the diagenetic degree, absolute age) were collected.

An intensive research of the Lower Ordovician, and especially of the boundaries between particular stages, is in progress. Therefore, we summarize the most important preliminary results of macropaleontological research of the outcrop in a simple qualitative form in the present paper.

In the Prague Basin, the Klabava/Šárka Formations boundary is exposed at the Ejpovice (Frýda, 1988; Mergl, 1983, 1991; Dzik, 1983) and Strašice (Frýda, 1988; Mergl 1983, 1991) localities. The tuffites and tuffitic shales of the Klabava Formation are overlain there by oolitic iron ores that belong to the Šárka Formation. Graptolites have not been found in these rocks; an exception is several undetermined stipe fragments from Ejpovice.

The boundary between both formations was also described by Horný et Chlupáč (1952) from the quarry near a sporting airport (Rokycany – Straň quarry). Deeply weathered yellow clayey shales of the Klabava Formation with relatively common fragments of graptolites, inarticulate brachiopods, trilobites and other fossils contain in their uppermost part (two meters thick) several thin layers of tuffitic shales

with different assemblages composed mostly by inarticulate brachiopods. The index fossil of the upper biozone of the Klabava Formation – *Tetragraptus reclinatus abbreviatus* Bouček – was found as high as three meters below the boundary of the Klabava/Šárka Formations. The shales of the Klabava Formation are followed by an about 1.2 m thick layer of oolitic iron ore belonging to the Šárka Formation. In its overlay occur disintegrated shales with siliceous concretions containing fauna typical of the Šárka Formation. At present, this sequence is in the filled part of the quarry and is not accessible.

### Locality Drahouš near Rokycany

The locality consists of several outcrops (both natural and artificial) exposed during the construction of the highway) in the low slope above the alluvial plane of the Klabava river, about two kilometers WSW of Rokycany, near the Klabava dam.

The westernmost outcrop has been only roughly investigated (Kraft, 1974 – outcrop marked C). At present, the exposures in the eastern part of the locality are obscured by the embankment of the highway.

The sequence exposed includes the uppermost part of the Klabava Formation and the lower part of the Šárka Formation including their boundary. The continuity of the sequence of the Šárka Formation is interrupted by a fault.

The Klabava Formation is formed by grayish-green, grayish-yellow to brownish-yellow clayey shales, which are followed by a 1.9 m



thick layer of tuffites and tuffitic shales in the uppermost part. The Formation is relatively rich in fauna. In the clayey shales, fossils occur individually or more often in clusters (transported fragmentary material), occupying relatively large sections of the surface of the bedding planes. Among graptolites, *Tetragraptus reclinator abbreviatus* Bouček and *Azygograptus suecicus* Moberg are common. Contrariwise, *Holograptus membranaceus* (Bouček) and *Acrograptus strangulatus* (Bouček) are very rare. Dendroids markedly predominate in graptolite assemblage of the Klabava Formation, and *Desmograptus stephanicus* P.Kraft is most com-

mon (sofar, this species has been known in four specimens only). *Dictyonema krafti* Bouček, *Callograptus horaki* (Bouček), *C. rokycanensis* Bouček, *C. holubi* Bouček, *C. undosus* J.Kraft, *Dendrograptus bouceki* J.Kraft, *Acanthograptus* sp. are rarer. Inarticulate brachiopods *Paldiskites sulcatus* (Barr.), *Rafanoglossa platyglossa* Havlíček and *Conotreta* sp. are common. Locally also chitinozoans (visible to the naked eye) as well as spicules of sponges cover densely large portions of bedding planes. Fragments of conularids and cephalopods (*Bathmoceras* sp.) are uncommon. In the lower part of the measured section ichnofossils (mostly *Planolites*-like) are locally extremely abundant.

In the overlying tuffitic shales only phosphatic remains (inarticulate brachiopods, rarely conodonts) are found. One bed contains sparsely distributed specimens of *Bergaueria* ichnosp.

The Šárka Formation. The uppermost part of the Klabava Formation, i.e. tuffitic shales and tuffites, is overlain by a 1.1 m thick layer of oolitic iron ore. As the boundary of both formations we consider the base of the iron ore, analogously to other localities (see above).

The remaining section of the Šárka Formation is composed of monotonous gray, grayish-brown to blackish-brown clayey, locally micaceous shales. The fauna of the Šárka Formation is relatively rich and occurs scattered or in small clusters. In the species composition one important change was recorded in the framework of the measured section:

Graptolites (*Corymbograptus retroflexus* (Perner), *Aulograptus cucullus* (Bulman), *Aulograptus feistmanteli* Bouček, *Expansograptus stanislavi* Bouček, *Expansograptus* sp.), members of the genus *Caryocaris* Salter and inarticulate brachiopods occur in the lower part of shales. *Boiophyton pragense* Obrhel is common. Trilobites, mollusks and articulate brachiopods are rare.

Within the interval of 6.5 – 8.0 m above the fault there is a change, characterized by a reduction of the number of graptolite species (*Aulograptus* and *Expansograptus* do not continue upwards) and by a decrease in abundance of inarticulate brachiopods. On the contrary, the other fauna begins to occur commonly (articulate brachiopods, mollusks, gastropods, ostracods, trilobites, hyolithids and others) and the number of species increases.

Among taxa which run throughout the measured section, members of the genus *Caryocaris* Salter and graptolite *Corymbograptus retroflexus* (Perner) should be mentioned.

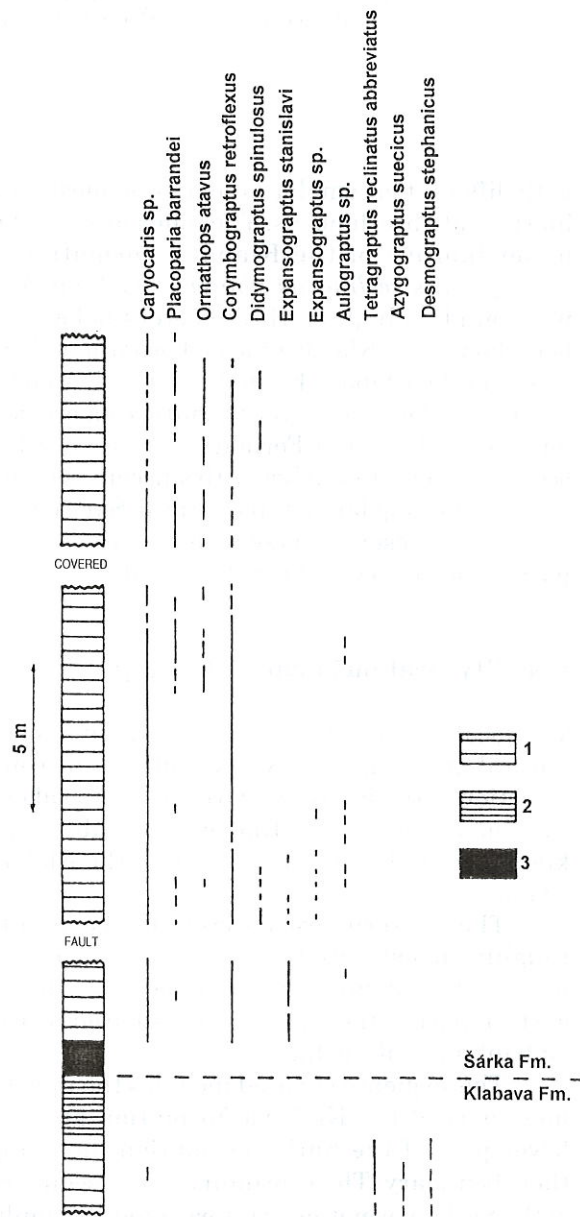


Fig. 1. Measured section at Drahouš with stratigraphical ranges of selected taxa. 1-clayey shales, 2-volcanodetritic rocks, 3-oolitic iron ores.



		Bouček (1973)		J. Kraft et P. Kraft (1992)		
Stage	Formation	Biozone		Biozone	Formation	Stage
Llanvirn	Šárka	Didymograptus clavulus		Didymograptus clavulus	Šárka	Llanvirn
		Didymograptus pseudogeminus		Didymograptus spinulosus		
		Corymbograptus retroflexus	C. retroflexus retroflexus Subzone	Corymbograptus retroflexus		
			C. retroflexus maximus Subzone			
		Pseudoclimacograptus paradoxus Horizon		Corymbograptus retroflexus		
Expansograptus ferrugineus Horizon						
Arenig	Klabava	Tetragraptus reclinatus abbreviatus		Tetragraptus - Azygograptus	Klabava	Arenig
		Schizograptus tardibrachiatus		Holograptus tardibrachiatus		
		Corymbograptus v-similis		Corymbograptus v-similis		
				horizon with Clonograptus (C.) sp.		

Fig. 2. Biostratigraphical division of the Klabava and Šárka Formations according to J.Kraft et P.Kraft (1992) correlated with Bouček's scheme (1973).

### Biostratigraphical notes

The section investigated belongs biostratigraphically to the upper part of the Tetragraptus-Azygograptus Biozone (Klabava Formation) and to the lower part of the Corymbograptus retroflexus Biozone (Šárka Formation) – see fig. 2.

The distribution of some graptolite species at Drahouš throws new light upon the biostratigraphy of the lower part of the Šárka Formation.

In the biostratigraphical scheme of the Šárka Formation proposed by Bouček (1973) two horizons were established on its base, as recognized in the iron ore deposit at Krušná hora (fig. 2).

From graptolites limited to the horizons mentioned, only *Aulograptus feistmanteli* Bouček was found at Drahouš. *Corymbograptus retroflexus* (Perner) occurs throughout the section exposed starting with the upper part of the iron ore layer. In addition, *Expansograptus stanislavi* Bouček was found there in association with the graptolite species mentioned (fig.1). *E. stanislavi* does not occur at Krušná hora, while in the lower part of the Šárka Formation at the Stanislav mine it is abundant. Besides, at Drahouš occurs *Expansograptus* sp. (?sp.n.). This species is not known from any other locality.

It appears that the distribution of particular graptolite species was primarily influenced by different conditions, so that coeval graptolite associations differed in different locations within the basin.

Because of these facts we suppose that both horizons established by Bouček (1973) in the

lowermost part of the Šárka Formation are of local character, and can be considered as parts of the *Corymbograptus retroflexus* Biozone that have no wider regional value. This conclusion, together with results of J.Kraft's (1974) investigations, confirm the correctness of the existence of only one biozone in the lower part of the Šárka Formation, i.e. the *Corymbograptus retroflexus* Biozone.

### The Arenig/Llanvirn boundary

As noted by Rushton et Molyneaux (1989), the Arenig/Llanvirn boundary in the Bohemian Ordovician is not identical with the Klabava/Šárka Formations boundary, because *Didymograptus spinulosus* Perner and *Didymograptus artus* Elles et Wood occur within the *Corymbograptus retroflexus* Biozone. The relations at Drahouš support this concept because in a continuous section 3.3 m above the iron ore layer no pendent didymograptids were found. However, the boundary between both stages most likely falls into that part of the section which is not preserved at Drahouš owing to the fault. The first finding of *D. spinulosus* was recorded directly above this fault.

It must be stressed that the marked interruption of *D. spinulosus* distribution (text-fig.1) most probably indicates its lower tolerance to environmental changes. Therefore, the establishment of the Arenig/Llanvirn boundary (fig.2) on the basis of the first occurrence of *D. spinulosus* appears to be problematic.

Translated by the authors

## References

- Bouček, B. (1973): Lower Ordovician Graptolites of Bohemia. – Academia. 1–185. Praha.
- Dzik, J. (1983): Early Ordovician conodonts from the Barrandian and Bohemian–Baltic faunal relationships. – Acta palaeont. pol., 28, 327–368. Warszawa.
- Fryda, J. (1988): A new species of *Modestospira* (Gastropoda) from the Ordovician of Bohemia. – Věst. Ústř. Úst. geol., 63, 227–232. Praha.
- Holub, K. (1908): Příspěvek ku poznání fauny Dd. γ. – Rozpr. Čes. Akad. Vědy Slovesn. Umění, Tř. II, 17, 10, 1–19. Praha.
- Horný, R. – Chlupáč, I. (1952): Biostratigrafický průzkum klabavských břidlic v Rokycan. – Věst. Ústř. Úst. geol., 27, 141–144. Praha.
- Iserle, J. (1903): Zpráva o novém nalezišti fauny v břidlici pásma D–d<sub>1</sub>γ u Rokycan. – Věst. Král. Čes. Společ. Nauk, Tř. mat.–přirodověd., 29, 1–7. Praha.
- Kraft, J. (1974): Graptolites from the “Drahouš” locality near Rokycany (Šárka Formation – Llanvirnian of the Ordovician of the Barrandian). – Folia Mus. Rer. natur. Bohem. occident., Geol. 3, 1–15. Plzeň.
- Kraft, J. – Kraft, P. (1992): Biostratigraphy of the Klabava and Šárka Formations (Bohemia, Lower Ordovician) – a brief overview of new investigations. – Acta Univ. Carol., Geol., 3/4. Praha (in print).
- Mergl, M. (1983): Faciální vývoj a faunistická společenstva klabavského souvrství (ordovik) v západní části pražské pánve (barrandienská oblast). – MS, undergraduate thesis, Geological library of the Faculty of Sci., Charles Univ. Prague.
- (1991): New Lower Ordovician (Arenig) trilobite assemblages in Bohemia. – Čas. Mineral. Geol., 36, 193–203. Praha.
- Rushton, A. W. A. – Molyneux, S. G. (1989): The biostratigraphic age of the Ordovician Skiddaw Group in the Black Combe Inlier, English Lake District. – Proceedings (Yorkshire geol. Soc.), 47, 267–276. Leeds.

## Hranice arenig–llanvirn (ordovik) v pražské pánvi (Čechy)

Při stavbě dálnice Praha–Plzeň byl na území klasické lokality Drahouš (asi 2 km zsz. od Rokycan) odkryt vrstevní sled nejvyšších poloh klabavského a spodních partií šáreckého souvrství, včetně jejich hranice.

Klabavské souvrství tvoří jemné jílovité břidlice, které v nejvyšších polohách přecházejí do 1,9 m mocné sekvence tuftických břidlic a tuftů. V jílovitých břidlicích převládají inartikulární brachiopodi a graptoliti. Stratigraficky významné jsou druhy *Tetragraptus reclinatus abbreviatus* Bouček a *Azygograptus suecicus* Moberg. V poloze tuftických břidlic se vyskytují pouze fosfatické zbytky (především inartikulární brachiopodi).

Na bázi šáreckého souvrství je vyvinuta 1,1 m mocná poloha oolitické železné rudy, která ostře přechází do jílovitých, místy slídnatých břidlic, jejichž sled je po 3,3 m porušen výraznou dislokací. Ve spodních partiích šáreckého souvrství se vyskytují především graptoliti [*Corymbograptus retroflexus* (Perner), *Aulograptus cucullus* (Bulman), *A. feistmanteli* Bouček, *Expansograptus stanislavi* Bouček, *Expansograptus* sp.], zástupci rodu *Caryocaris* Salter a inartikulární brachiopodi. Běžný je *Boiophyton pragense* Obrhel. Ostatní fauna je vzácná.

V intervalu 6.5–8 m nad dislokací dochází ke změně, která je charakteristická redukcí počtu druhů graptolitů a snížením počtu jedinců inartikulárních brachiopodů. Naopak se začíná běžně vyskytovat ostatní fauna (artikulární brachiopodi, mlži, břichonožci, ostrakodi, trilobiti, hyoliti aj.) a roste počet jejich druhů.

Biostratigraficky náleží zkoumaný sled svrchním polohám biozóny *Tetragraptus–Azygograptus* (klabavské souvrství) a spodním partiím biozóny *Corymbograptus retroflexus* (šárecké souvrství).

Z biostratigrafického hlediska je pozoruhodné, že na lokalitě Drahouš nebyl na bázi šáreckého souvrství zjištěn ani jeden z horizontů stanovených Boučkem (1973). Tyto horizonty mají zřejmě lokální charakter a lze je považovat za součást biozóny *Corymbograptus retroflexus*.

Rushton et Molyneux (1989) upozornili, že hranice arenig–llanvirn není totožná s hranicí klabavského a šáreckého souvrství. Tato skutečnost byla potvrzena i poměry zjištěnými na lokalitě Drahouš. Pendentní druh *Didymograptus spinulosus* Perner, jehož první výskyt zde indikuje hranici arenig–llanvirn, se objevuje uvnitř biozóny *Corymbograptus retroflexus*.