

STATE OF THE ART OF “AMPHIBIAN” LOCALITIES OF THE LETOVICE SUBBASIN (BOSKOVICE BASIN, CZECH REPUBLIC)

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Abstract: *This paper provides a summary of localization of Permian historical sites in the Boskovice Basin, which yielded amphibians of the family Discosauriscidae. Most of these sites have not been previously precisely localized. Our investigation is focused mainly on so-called “Špinar's localities” named after Prof. Z. Špinar and described in his work. Several sites were also described by A. Stehlík, J. Zajíc & S. Štamberg and J. Augusta. The reason for the localization of these locations is that more than 3,000 samples from these sites are stored at the Chlupáč's Museum of Earth History of the Charles University in Prague. Most localities are situated around the village of Bačov, where carbonization is the dominant type of preservation of Palaeozoic amphibian skeletons.*

Key words: Palaeozoic, Permian, Carboniferous, Boskovice Basin, Letovice Subbasin, amphibian

INTRODUCTION

The Boskovice Basin and its sub-unit, the Letovice Subbasin, are important areas where large numbers of fossil remains of the Late Palaeozoic amphibians have been recorded in the past. These findings are dispersed in many collections of various institutions in the Czech Republic. A large number of amphibian fossil records from a part of the collections of Chlupáč's Museum of Earth History (CHMHZ) of the Charles University in Prague. The fossils came mostly from field works conducted during the 1950's and 1960's (Krejčí 2016, tab. 2). However, field research connected with fossil collecting has a history of about 150 years. The gradual decline in collecting activities, closing of some localities, the discovery of new sites and the use of different local names by various researchers have consequently led to inconsistent and erroneous labelling of the findings. This article focuses on cataloging and sorting of the localities of Letovice Subbasin area and simultaneously gives an overview of the current status of the localities. Hereby, we summarize locality data concerning fossil amphibian records.

Earliest studies on the geology of Boskovice Basin were published in the first half of the 19th century and they were related to the mining indus-

try of Carboniferous coal. Except information obtained from coal mine reports, other data were obtained from profiles, including parts along the river Oslava near the village of Oslavany. These profiles are of the late Gzhelian and early Asselian ages (Jaroš 1962, Šimůnek & Martínek 2009). However, the earliest historical mentions of the Boskovice Basin are those of Zippe (1835, 1842) and Rittler (1853), who correlated sediments of the Rosice-Oslavany region with the Rotliengend strata in Germany.

The Boskovice Basin is famous for providing rich fossil fauna and flora (Štamberg & Zajíc 2008). Vertebrates are represented by fishes, amphibians and rare reptiles. Invertebrates are mainly represented mainly insects. The first mention of these faunas dates back to the end of the 19th century (Makowsky 1876). Systematic research, however, began only in the early the 20th century and has continued to this day. More intense research was initiated Augusta (1926a, 1926b, 1933b, 1931), Stehlík (1924) and later built on by Špinar (1951a, 1951b, 1952a, 1952b, 1959), Kukulová (1955, 1963, 1964a, 1964b, 1965), Schneider (1980, 1984), Klembara & Bartík (1999), Klembara & Meszáros (1992), Zajíc (2000),

Schneider & Werneburg (2012) and Klembara (1997). Detailed reports are given in the works of Augusta (1933a, 1937a, 1937b), Havlena (1955) and most recently in a summary by Šimůnek & Martínek (2009), and partly also by Pešek (2004).

BIOSTRATIGRAPHY OF THE BOSKOVICE BASIN

The Boskovice Basin is located between the Mol-danubicum and Moravosilesicum zones. In fact, the Boskovice Basin lies on the suture of these two regional structures (Pešek 2004). The Boskovice Basin was formed along the Main Boskovice fault which delineates the eastern edge of the Basin (Fig. 1). The Basin is divided into two subbasins, Rosice-Oslavany and Letovice.

The Boskovice Basin is composed of four formations: Rosice-Oslavany, Padochov, Veverská-Bítýška and Letovice. The amphibian-bearing localities belong to the Letovice Formation.

The main Carboniferous fossiliferous part of the Boskovice Basin is concentrated into grey layers of Rosice-Oslavany coal seams, especially to the black shales and some intercalated embedded clastic sediments. In the Permian deposits, the main fossiliferous layers are grey in colour and they are several meters to several tens of meters thick lacustrine deposits of Padochov, Veverská Bítýška and Letovice formations (Šimůnek & Martínek 2009). Fossiliferous are also hundreds of meters thick red beds which contain poorly preserved plant remains referred to genera *Walchia* and *Cordaites* (Rieger 1965). Fossiliferous horizons, however, thin and infrequently distributed within the red beds strata, ranging from the Late Carboniferous to the Early Permian in age. The upper part of the Letovice Formation provided valuable information about plant and animal assemblages and changes in the composition of communities from the Late Gzhelian to the Cisuralian. Key information for the stratigraphically older part of the Basin are provided by macroflora, whose character allows its assignment to existing plant zones (Wagner 1984, Wagner & Álvarez-Vázquez 2010). On the other hand, in the Permian succession of the Basin, plant zones are less reliable and faunal associations are thus more important for biostratigraphy (Zajíc 2000, Schneider & Werneburg 2012, Štamberg 2013, 2014; see Tab. 1 herein).

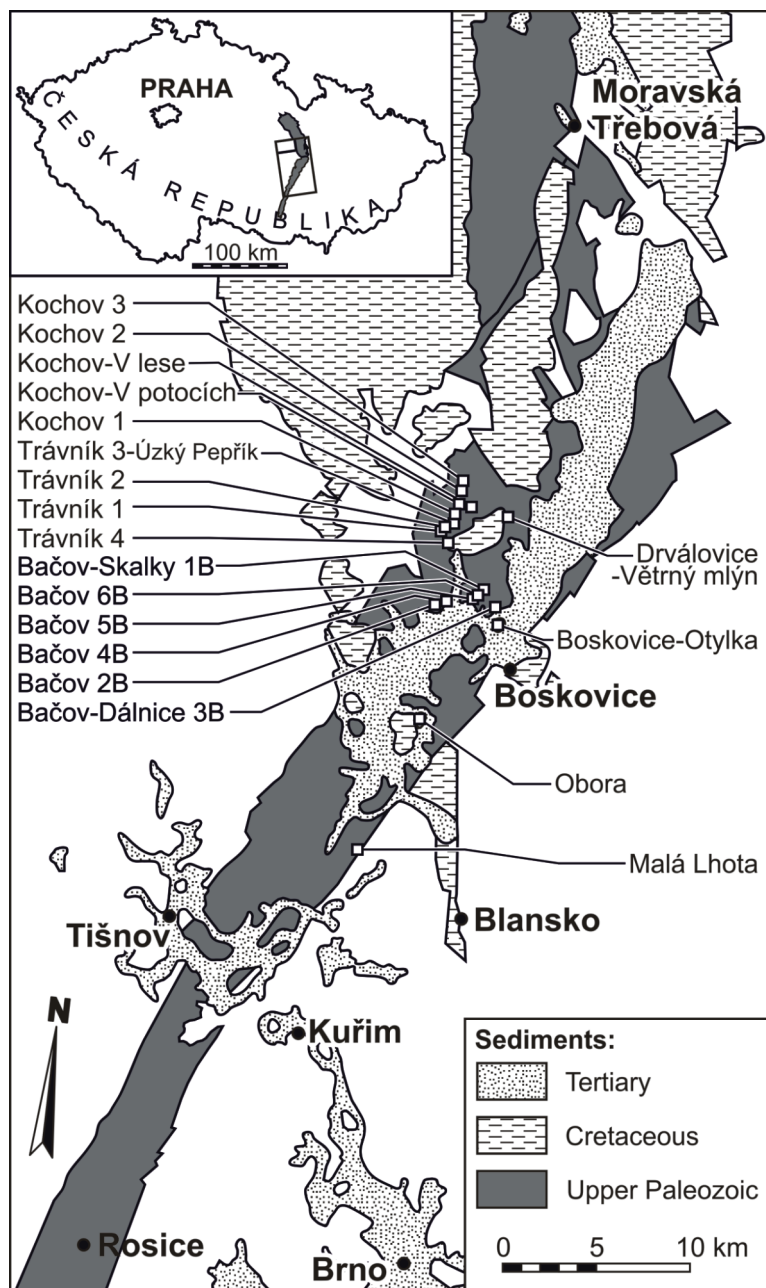


Figure 1. Simplified geological map and geographical distribution of fossil sites in the Letovice Subbasin.

Table 1. Stratigraphic chart of the Boskovice Basin/Letovice Subbasin (after Štamberg & Zajíc 2008).

Global units			Regional stages		Boskovice Basin			Biozone
System	Series/ Subsystem	Stage	Stage	Substage	Formation	Member	Horizon	
Permian	Cisuralian	Artinskian	Upper Rotliengend		Letovice	Upper		<i>Xenacanthus decheni</i>
		Sakmarian	Lower Rotliengend			Middle	Bačov Míchov Kochov	
		Asselian				Lower	Lubě Zboněk-Svitávka Zbraslavec	
						Veverská Bítýška		
		Padochov				Říčany Zbýšov		
Carboniferous	Pennsylvanian	Gzhelian	Stephanian	C	Rosice-Oslavany		Rosice-Oslavany Helmhacker	<i>Sphaerolepis - Elonichtys</i>

LOCALITIES

In the following section we list the localities where the Late Palaeozoic amphibian fauna was found in the Boskovice Basin (Fig. 2). The summary includes information about historical localities described in the past, as well as those discovered recently.

Localities are listed in an alphabetical order and their description is structured as follows: brief geographical location, lithology, general remarks, references and list of recorded fossil species. The references are ordered chronologically. The original locality name or names used in a publication follows respective authors. Translations into English are placed in square brackets. For localities described by Špinar (1952a, 1952b), abbreviated names used by the author are given in brackets. All coordinates are read from map.

LIST OF LOCALITIES

Bačov – Na Skalkách or Skalky (B1)

Geography: Třetí lom [The Third Quarry] is located to the south of the dirt road from Vísky to Sudice, in the forested slope above the Bačov Creek, 500 m west of the centre of the Bačov village (Plate I, Fig. 3) (coordinates: N 49° 31' 37.8", E 16° 38' 09.6" refer to central part of the locality). This

locality is nowadays called "the Nature Monument Bačov" and the Bačov Hill is a local and historical name for this hill.

Lithology: Heavily bituminous limestone with spots of grey clay (Plate II, Fig. 1).

Remark: Palaeontological type of locality. One of the earliest studied fossiliferous localities in the studied region.

References: Augusta (1926b, 1936, 1948), Daňková (1950), Špinar (1950, 1951a, 1951b, 1952a), Havlena & Špinar (1956a, 1956b), Zajíc & Štamberg (1986), Roček (1988), Klembera & Meszároš (1992), Ivanov (2003), Zajíc & Štamberg (2004), Štamberg (2007), Šimůnek & Martínek (2009).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus pulcherrimus Fritsch, 1879

Discosauriscus sp.

Bačov (B2)

Geography: In a valley of a nearby road from Chručichromy to Bačov, about 1,200 m to the south-south-west of Bačov (coordinates: N 49° 30' 56.0", E 16° 38' 14.6" refer to upper part of the valley).

Lithology: Heavily bituminous limestone with spots of grey clay.

Remark: The locality used as a technical site for the deposition of material at planned highway construction; exact localization is currently unknown.

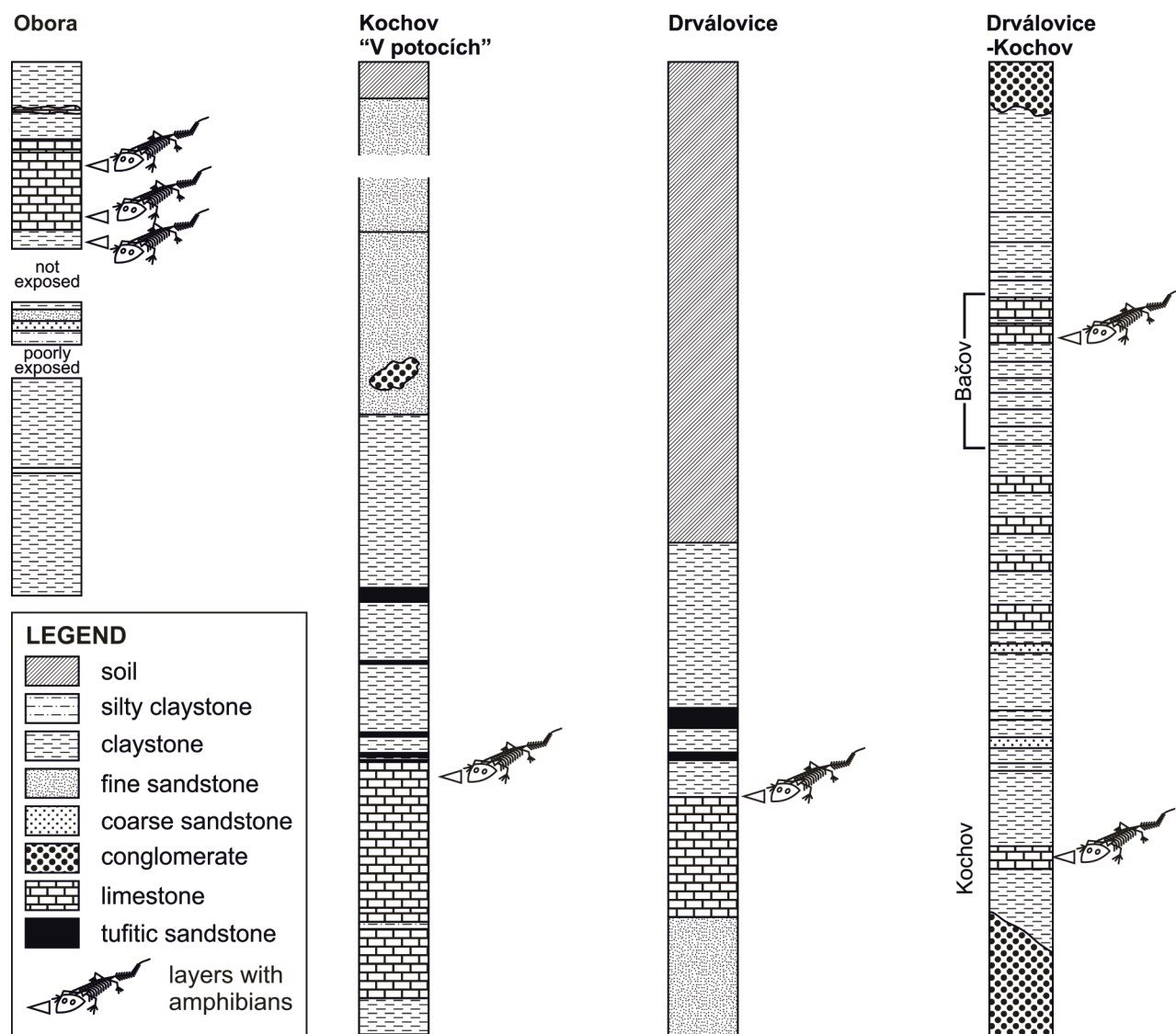


Figure 2. Recorded profiles of some locations with marked layers of preserved amphibian fossils. Modified after Dostál (2003a, 2003b) and Štamberg (2007).

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Bačov – Dálnice (B3)

Geography: Field near ramp to a bridge of an unfinished highway across the Semíč Creek about 800 m to the south-south-east of the village of Bačov (Plate I, Fig. 1) (approx. coordinates: N 49° 31' 08.5", E 16° 38' 47.6").

Lithology: Heavily bituminous limestone with spots of grey clay (Plate II, Fig. 2).

Remark: Located where there were roadworks on the highway.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Bačov (B4)

Geography: Valley of the Semíč Creek 600 m to the south-south-west of the center of the village of Míchov (coordinates: N 49° 31' 08.9", E 16° 36' 33.9").

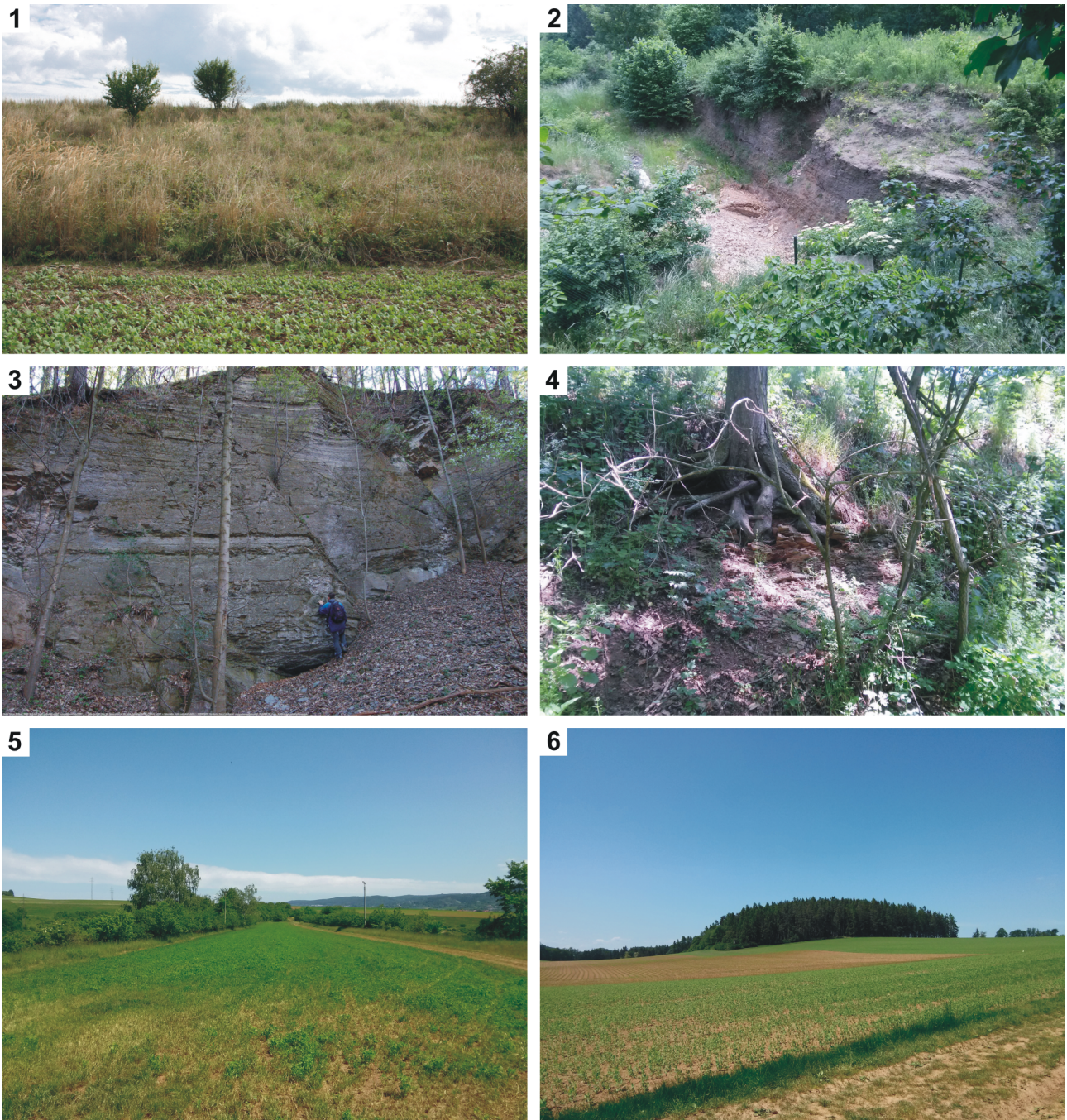


Plate I Recent preservation of localities of the Letovice Subbasin. 1 – Bačov-Dálnice (B3); 2 – Obora; 3 – Bačov – Na Skalkách (B1); 4 – Bačov (B6); 5 – View of surrounding of Boskovice-Otylka; 6 – Kočov (K3). (Photos 1–2 and 4–6 by M. Krejčí, 3 after Gilíková, 2007.)

Lithology: Heavily bituminous limestone with spots of grey clay.

Remark: Paleontological site on the eastern hill slope discovered in 1952.

Reference: Špínar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

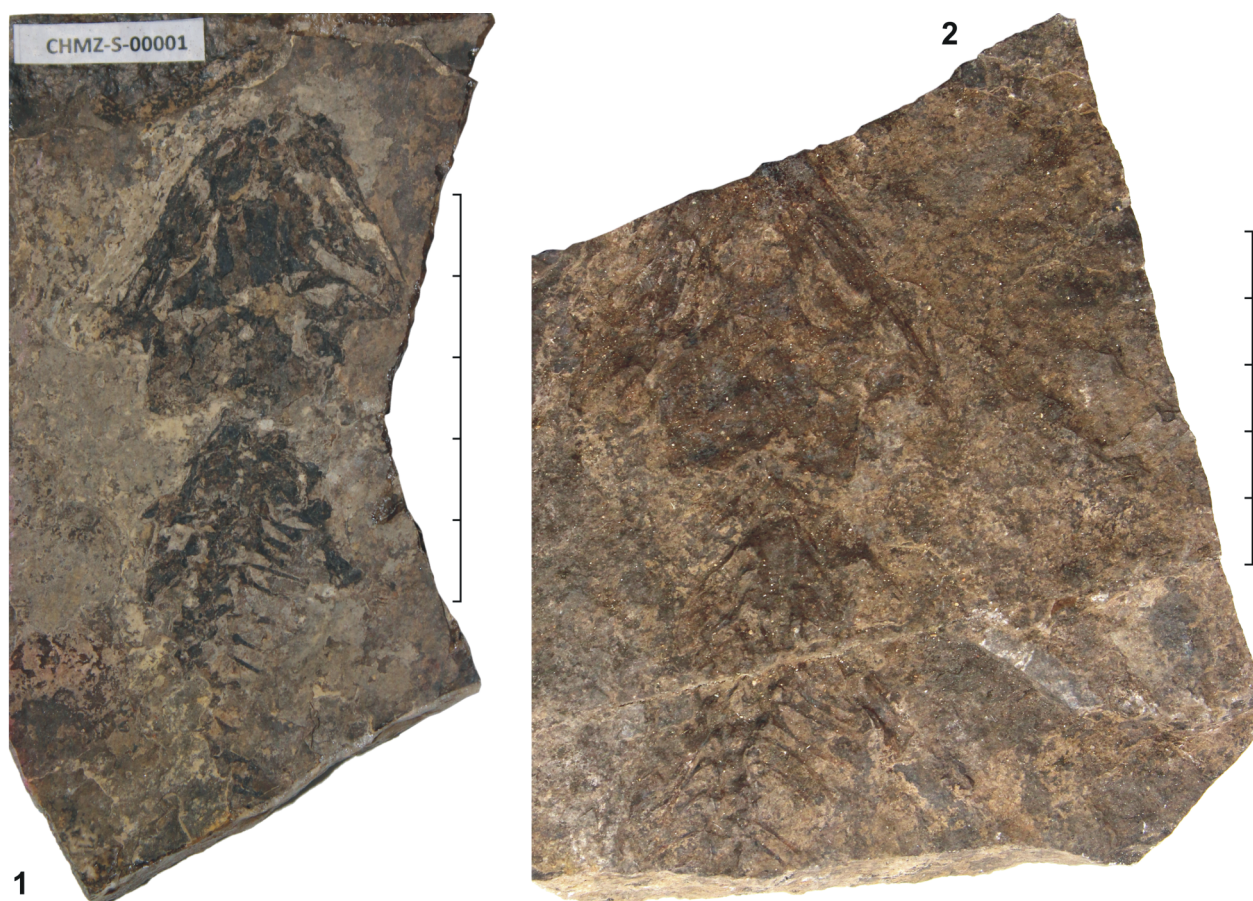


Plate II Examples of amphibians from the Letovice Subbasin. 1 – Specimen from Bačov – Na Skalkách (B1); 2 – Specimen from Bačov – Dálnice (B3). Scale bars equal 5 cm. (All photos by M. Krejčí.)

Bačov (B5)

Geography: Excavations situated 1,100 m to the west-south-west of the centre of the village of Bačov, 150 m to the north of the settlement Pod Bačovem, on the west side at dirt road from Míchov to Bačov.

Lithology: Heavily bituminous limestone with spots of grey clay.

Remark: The locality comprises two outcrops about 25 m apart. The first outcrop is a small trench and the second is an outcrop in the slope. Špinar (1952a) addressed them as 5Ba and 5Bb. (Coordinates: N 49° 31' 21.1", E 16° 37' 40.5" E and N 49° 31' 21.8", E 16° 37' 41.1".)

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Bačov (B6)

Geography: 200 m long shallow gorge (axis of the gorge is approximately SSE-NNW) on the northern side on a dirt road from Míchov to Bačov, approximately 800 m to the west-south-west of the village centre of the Bačov (Plate I, Fig. 4). (Coordinates: N 49° 31' 26.1", E 16° 37' 55.3" refer to southernmost margin of the gorge.)

Lithology: Bituminous shale.

Remark: The fossiliferous located 25 cm below the surface and appears in a series of small outcrops along the length of the gorge.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Boskovice – U Otylky

Geography: Temporary outcrop "U Otylky" is named after "St. Otyllia Chapel" (coordinates: N 49° 30' 37.9", E 16° 39' 02.2") between Bačov and Boskovice, 2,500 m north-north-west of the centre of Boskovice and 1,800 m to the south-south-east of the centre of Bačov (Plate I, Fig. 5).

Lithology: Limestone with a insignificant admixture of dispersed clay.

Remark: Collected specimens were discovered during a field excavation around the outcrop.

Reference: Havlena & Špinar (1956a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Drválovice

Geography: Surroundings of a dirt road 500 m to the west-west-south of the centre of Drválovice; situated near an old windmill which has not been preserved (approx. coordinates: N 49° 33' 49.4", E 16° 38' 33.7").

Lithology: 26 cm thick layer of limestone, claystone.

Remark: The fossiliferous horizon contains a fossil association similar to that known from Kochov – V Potocích.

References: Augusta (1936), Zajíc & Štamberg (2004), Štamberg (2007), Štamberg & Zajíc (2008).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Kochov (K1)

Geography: Field 400 m to the south-west of "Church of St. George" in the village of Kochov (coordinates: N 49° 33' 45.4", E 16° 36' 27.4").

Lithology: Limestone with a insignificant admixture of dispersed clay.

Remark: Phosphatization is a dominant mode of preservation of amphibians.

References: Augusta & Pokorný (1951), Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Kochov (K2)

Geography: Road in the forest to the north of Kochov (coordinates: N 49° 34' 27.5", E 16° 36' 35.5"),

approximately 1,100 m to the north of the Kochov cemetery.

Lithology: Limestone with a small admixture of dispersed clay.

Remark: Phosphatization is the dominant type of preservation of the vertebrate material.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Kochov (K3)

Geography: In the field under hump about 1,000 m to the east-south-east of the belfry of the village of Novičí (accidental finding in the field during agricultural work) (coordinates: N 49° 34' 46.9", E 16° 36' 36.7" refer to center of the field).

Lithology: Limestone with a insignificant admixture of dispersed clay (Plate I, Fig. 6).

Remark: Phosphatization is a dominant mode of preservation of amphibians.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Kochov – V lese

Geography: Excavated pit in the forest dating back to the beginning of the 21st century, which back-filled today; 1,000 m north of Kochov church (coordinates: N 49° 34' 25.1", E 16° 36' 53.2").

Lithology: Limestone with a insignificant admixture of dispersed clay.

Remark: Phosphatization is the dominant type of preservation of vertebrates at fifth layer, in other layers, only carbonization occurs.

References: Zajíc & Štamberg (2004), Klembara (2005, 2009), Štamberg & Zajíc (2008).

List of amphibian species:

Makowskia laticephalo (Klembara, 2005); one specimen, holotype kept at the Slovak National Museum in Bratislava (Slovakia)

Spinarerpeton brevicephalum (Klembara, 2009); one specimen, holotype kept at the Slovak National Museum in Bratislava (Slovakia)

Kochov – V potocích

Geography: Excavated pit in the forest dating back to the beginning of the 21st century, which back-filled today. At the margin at field, on the slope of

a valley of the Třebětínka stream; 1,000 m to the north-north-west of the Kočov church (coordinates: N 49° 34' 24.7", E 16° 36' 16.8").

Lithology: Limestone with a insignificant admixture of dispersed clay.

Remark: Phosphatization is the dominant type of preservation (in the fifth layer), in other layers, only carbonization occur; artificial outcrop Zajíc & Štamberg (2004).

References: Zajíc & Štamberg (2004), Štamberg & Zajíc (2008).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Malá Lhota

Geography: Exact location is unknown. Probably a field near villages of Černá hora and Malá Lhota.

Lithology: Grey, bituminous, clayey limestone.

Remark: This is one of the localities from which amphibian finds were collected already in the 19th century but the locality itself was not described and its exact location are not known today.

References: Makowsky (1876), Augusta (1936).

List of amphibian species:

Discosauriscus pulcherrimus (Fritsch, 1879)

Obora (in some literature called Jabloňany)

Geography: Field and outcrop 1,000 m to the south-west of the village of Jabloňany and 1,000 m north-east of the village of Obora (Plate I, Fig. 2). (Coordinates: N 49° 27' 34.2", E 16° 36' 8.3" refer to outcrop.)

Lithology: Limestone with a insignificant admixture of dispersed clay.

Remark: Carbonization is a typical mode of preservation of amphibian. The material is labeled only as Obora or Jabloňany but the names do not appear simultaneously on the same sample. The fossiliferous layer with amphibians is located just below the topsoil.

References: Kukulová (1960, 1963, 1964a, 1964b, 1965, 1969), Havlena & Špinar (1961), Zídek (1966), Kukulová-Peck (1972, 1974), Schneider (1980, 1984), Holub & Kozur (1981a, 1981b), Zajíc & Štamberg (1986), Dostál (2003a, 2003b), Ivanov (2003), Zajíc & Štamberg (2004), Šimůnek & Martínek (2009).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

The following is a list of localities referred to as Trávník which is today a part of the village Kladoruby. Trávník was a separated village until the early 1950s. All samples of fossil amphibians were collected in the fields, and thus the approach to these localities is problematic.

Trávník (T1)

Geography: Field 700 m west-south-west of Chapel in Kladoruby (accidental finding in the field during agricultural work) (coordinates: N 49° 33' 11.1", E 16° 35' 54.2" refer to approximate center of the field).

Lithology: Spotted clayey limestone.

Remark: The locality is known as a field belonging to the farmer Mr. Širůček in old literature.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Trávník (T2)

Geography: Field near the above mentioned field; about 500 m north of the village of Kladoruby (coordinates: N 49° 33' 20.1", E 16° 36' 01.3" refer to approximate center of the field).

Lithology: Spotted clayey limestone.

Remark: Only a few amphibian fossils were found there.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Trávník (T3) – “Úzký pepřík”

Geography: Probably a field to the south-west of the centre of the village of Trávník on the slope of the valley of the Kladorubka Creek. Exact distance from village is unknown, approximately 800 m to the south-west from the chapel in Kladoruby (approx. coordinates: N 49° 33' 04.5", E 16° 35' 53.7" refer to centre of the field).

Lithology: Bačov fossiliferous horizon, spotted clayey limestones.

Remark: Fossils poorly preserved.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

Trávník (T4)

Geography: Field 950 m to the south of the the chapel in Kladoruby. Local name for this field is Vísecko. (Approx. coordinates: N 49° 32' 47.6", E 16° 36' 29.7" refer to south part of the field.)

Lithology: Bačov fossiliferous horizon, spotted clayey limestone.

Remark: The fossiliferous layer is located just below the topsoil.

Reference: Špinar (1952a).

List of amphibian species:

Discosauriscus austriacus Makowsky, 1876

Discosauriscus sp.

CONCLUSION

This research deals with over 3,000 amphibian remains (Table 2) deposited at the CHMHZ of the Faculty of Science, Charles University Prague. The major aim is to localize these records as precisely as possible to existing localities. This study also shows that most samples do not have precise localization, as former collectors described the position of localities only very generally. Therefore, a lot of samples have only the localization reflecting the area of the nearest village/town, e.g. Bačov, etc. This problem concerns the majority of samples stored at the CHMHZ.

Table 2. Number of fossils of amphibians in the area of individual villages (adopted and modified after Krejčí, 2016).

Area	Number of samples
Bačov	2969
Obora	219
Drválovice	12
Trávník	47
Kochov	5
Malá Lhota	1

We have confirmed a relatively poor state of the art of paleontological localities in the Boskovice Basin (from which the amphibian material deposited at the CHMHZ originated). Only two localities are protected as a natural heritage. One of them, Bačov – Na Skalkách or Skalky (B1) is protected by the law on environmental protection. The second locality – Obora, is protected by the Masaryk University in Brno. However, the conditions at these sites are not optimal. Most of them are situated in

fields which are used for agricultural purposes during the whole year. Thus, large excavations are impossible. Few localities, e.g. 6B or Kochov – V lese, are open and fossiliferous layers are located near the topsoil but the localities are situated in forests or temporary creeks.

Most of the historical localities are probably lost and/or their location is unknown because earlier researchers did not use detailed localization in their publications. In younger literature, paleontological sites are better localized and described. Another problem related to the data in earlier literature comes from confusing use of different units of measurement. For example, Makowsky (1876) used miles instead of kilometres when referring to his localities. At the present, one mile corresponds to 1,609 metres but the Austrian mile at the end of the 19th century had 7,586 metres (Hosch 1877). Thus, it is also necessary to search for specific systems of measurements from the past.

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