

SCIENTIAE  
GEOLOGICAE

ACTA  
MUSEI  
MORAVIAE

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109 ■ 2024 ■ 1

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Edited by Jakub Březina - Vladimír Hrazdil

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MORAVSKÉ ZEMSKÉ

MUZEUM BRNO 2024

## HYDROTHERMÁLNÍ SULFIDICKÁ MINERALIZACE ZE SKALKY V HAVLÍČKOBRODSKÉM RUDNÍM REVÍRU (ČESKÁ REPUBLIKA)

HYDROTHERMAL SULFIDE MINERALIZATION FROM SKALKA IN THE HAVLÍČKŮV BROD  
ORE DISTRICT (CZECH REPUBLIC)

PETR PAULIŠ, STANISLAV KOPECKÝ, ZDENĚK DOLNÍČEK, JIŘÍ SEJKORA

### Abstract

Pauliš, P., Kopecký, S., Dolníček, Z., Sejkora, J., 2024: Hydrotermální sulfidická mineralizace ze Skalky v havlíčkobrodském rudním revíru (Česká republika). – Acta Musei Moraviae, Scientiae geologicae, 109, 1, 3–35 (with English summary).

*Hydrothermal sulfide mineralization from Skalka in the Havlíčkův Brod ore district (Czech Republic)*

In the central part of the Havlíčkův Brod ore district, the remains of historical mining were discovered near the Skalka hill (463 m a.s.l.), 2.4 km SSE of the centre of Havlíčkův Brod, in connection with the construction of new roads in 2022. In the studied material from the rest of mine dumps, mainly common sulfide minerals with a composition characteristic for this ore district (pyrite, Fe-rich sphalerite, arsenopyrite, galena) were found, in association with more rare sulfides, chalcopyrite, pyrrhotite and ullmannite, which had not yet been found there. Tetrahedrite-group minerals were also found in the studied samples, which, based on the new nomenclature, can be classified as tetrahedrite-(Fe) with variable Ag contents and kenoargentotetrahedrite-(Fe). In addition to sulfides, muscovite, clinochlore, fluorapatite, rutile, monazite-(Ce), xenotime-(Y) and probable Y+REE and P+As rich coffinite were determined. In the rare supergene mineralization, scorodite, schultenite, cerussite, anglesite, smithsonite, and calcite were found.

*Key words:* sulfidic mineralization, chemical composition, Havlíčkův Brod ore district, Skalka, Czech Republic  
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### ÚVOD

Havlíčkobrodský polymetalický revír se nachází v sv. části Českomoravské vrchoviny a zahrnuje území o rozloze cca 200 km<sup>2</sup>. Jedná se o historickou oblast exploatace Ag-Pb-Zn-(Cu) ložisek. V celém revíru je řada lokalit, na kterých se v minulosti těžily polymetalické rudy, nebo na nich probíhal průzkum. Přestože první listinný doklad existence zdejších stříbrných dolů pochází až z roku 1257 (listina Smila z Lichtenburka), je pravděpodobné, že počátky dolování lze hledat již ve třicátých letech 13. století (HRUBÝ 2014).

Havlíčkobrodský rudní revír je složen téměř ze stovky rudních žil a žilných pásem, které se vyskytují zhruba mezi obcemi Počátky, Jitkov, Hosov, Šlapánov, Květnov, Koječín, Věž, Michalovice, Havlíčkův Brod a Krátká Ves. Žilné výskyty nejsou rozmístěny rovno-

## ASOCIACE SUPERGENNÍCH SULFÁTŮ Z LOMU KONSTANTIN U VELKÉHO VRBNA (MORAVA, ČESKÁ REPUBLIKA)

SUPERGENE SULFATE ASSOCIATION FROM THE KONSTANTIN QUARRY NEAR VELKÉ VRBNO  
(MORAVIA, CZECH REPUBLIC)

DALIBOR MATÝSEK, JAKUB JIRÁSEK, TOMÁŠ PEK

### Abstract

Matýsek, D., Jirásek, J., Pek, T., 2024: Asociace supergenních sulfátů z lomu Konstantin u Velkého Vrbna (Morava, Česká republika). - Acta Musei Moraviae, Scientiae geologicae, 109, 1, 37-50 (with English summary).

*Supergene sulfate association from the Konstantin Quarry near Velké Vrbno (Moravia, Czech Republic)*

Konstantin Quarry, extracting graphite from 1977 until 2009, is situated on the outcrop of the graphite seams of the Velké Vrbno Unit, with uncertain Devonian age. The rock series includes metapelites, metacarbonates (calcite and dolomite marbles), quartzites and metavolcanites. It underwent Variscan metamorphism with the peak at ca. 11 kbar and 660 °C, i.e., in the amphibolite facies. Two graphite seams were extracted in the Konstantin Quarry. Both contain significant amount of sulfur - up to 11.1%. Up to now, only jarosite was identified as a secondary phase. New sampling, field emission scanning electron microscopy and energy-dispersive X-ray microanalysis revealed varied association of secondary sulfates. Namely, abundant botryoidal aggregates and crusts of white fibroferrite and pale-yellow slavíkite, partly corroded gypsum aggregates, and coatings of powdery hydroniumjarosite accompanying schwertmannite. Rosettes are infrequent and crusts of magnesiocopiapite, rare microscopic alunogen, hexahydrate and epsomite. This association shows rather early stage of oxidation alteration with the predominant Fe<sup>3+</sup>-sulfates, but with lack of reaction products with the surrounding rocks (metacarbonates). In this very low-pH environment, most of the recognized products are not final stages of Fe<sup>3+</sup> hydrolysis and still have significant acidification potential. We expect that during the time, mineral association will shift towards pickeringite-halotrichite series minerals and epsomite.

*Key words:* sulfate, slavíkite, fibroferrite, graphite, acid mine drainage, Silesicum, Czech Republic

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### ÚVOD

Sulfidické minerály jsou v prostředí s přítomností kyslíku termodynamicky nestabilní, což nutně vede k jejich postupné destrukci za vzniku složité paragenese sekundárních sulfátů. Jak sulfidy, především pyrit a markazit, tak i jejich rozkladné produkty jsou v přírodě velmi hojné a vyskytují se prakticky ve všech typech hornin a geologických prostředích. Al-

## MINERALOGICKÁ CHARAKTERISTIKA Cu-MINERALIZACE Z LOMU PODHŮRA U LIPNÍKA NAD BEČVOU (MORAVSKOSLEZSKÝ KULM, ČESKÁ REPUBLIKA)

MINERALOGY OF THE Cu-MINERALIZATION FROM THE QUARRY PODHŮRA NEAR LIPNÍK  
NAD BEČVOU (MORAVO-SILESIAN CULM, CZECH REPUBLIC)

ZDENĚK DOLNÍČEK, MICHAELA KREJČÍ KOTLÁNOVÁ, ROSTISLAV KOUTŇÁK,  
JANA ULMANOVÁ

### *Abstract*

Dolníček, Z., Krejčí Kotlánová, M., Koutňák, R., Ulmanová, J., 2024: Mineralogická charakteristika Cu-mineralizace z lomu Podhůra u Lipníka nad Bečvou (moravskoslezský kulm, Česká republika). - *Acta Musei Moraviae, Scientiae geologicae*, 109, 1, 51-69 (with English summary).

*Mineralogy of the Cu-mineralization from the quarry Podhůra near Lipník nad Bečvou (Moravo-Silesian Culm, Czech Republic)*

A mineralogical study of newly collected samples of Cu-mineralization from the quarry Podhůra (Czech Republic) revealed an extraordinary rich mineral assemblage bound on steep NW-SE trending hydrothermal veins. The veins are hosted by folded Lower Carboniferous marine flysch sediments of the Hradec-Kyjovice Formation, belonging to the Moravo-Silesian Palaeozoic. The primary mineralization is very simple, being formed by chalcopyrite and minor pyrite, both disseminated in calcite gangue with numerous inclusions of dolomite to Fe-rich dolomite and rarely minute grains of xenotime-(Y) and quartz. The near-surface parts of the vein are strongly weathered. The completely weathered ore is formed by common powdery *limonite*, malachite, and rare cuprite and azurite. Gently weathered chalcopyrite is rimmed by common Cu-sulphides (including djurleite, digenite/roxybite, anilite, geerite, and spionkopite) and rare bornite. In addition, a piece of native copper was found among supergene products. Chemical compositions based on spot electron microprobe analyses are given for most mineral phases. Although the similar simple primary Cu-mineralization occurs at several localities in wider surroundings, the newly studied supergene assemblage belongs to the mineralogically richest one in the whole area of the Moravo-Silesian Culm.

*Key words:* Moravo-Silesian Culm, ore veins, Cu-mineralization, cuprite, supergene processes

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## ÚVOD

Činný kamenolom Podhůra, situovaný cca 2,5 km jižně od Lipníku nad Bečvou, je významnou geologickou lokalitou, ilustrující geologické poměry severní části tektonické kry Maleníku, karpatskou předhlubní oddělené od hlavního masivu nízkohesenického kulmu.

## MORDENIT Z HORNIN TĚŠÍNITOVÉ ASOCIACE V PODBESKYDÍ (MORAVA, ČESKÁ REPUBLIKA)

MORDENITE FROM TESCHENITE ASSOCIATION ROCKS IN BESKYDY PIEDMONT AREA  
(MORAVIA, CZECH REPUBLIC)

DALIBOR MATÝSEK, JAKUB JIRÁSEK, ONDŘEJ POUR

### Abstract

Matýsek, D., Jirásek, J., Pour, O., 2024: Mordenit z hornin těšinitové asociace v Podbeskydí (Morava, Česká republika). – Acta Musei Moraviae, Scientiae geologicae, 109, 1, 71–82 (with English summary).

*Mordenite from Teschenite Association Rocks in Beskydy Piedmont area (Moravia, Czech Republic)*

Teschenite Association Rocks, Early Cretaceous igneous rocks bound to the Silesian Unit of the flysch Outer Carpathians, are typical for the zeolites in the fissures, amygdaloid cavities, rock matrix, as well as in their contact metamorphic rocks. Previously described minerals of the zeolite group include analcime, natrolite, phillipsite, harmotome, heulandite-Ca, ferrierite-Ca, and thomsonite-Ca. Two occurrences of the mordenite were newly recognized in Straník (GPS N 49° 33.130' E 017° 59.330') and Fryčovice (GPS N 49° 40.810' E 018° 13.727' a N 49° 40.738' E 018° 13.710'). At both sites mordenite forms very thin acicular aggregates in the cavities of undoubtedly effusive rocks, filled by younger calcite. It is orthorhombic, space group  $Cmc2_1$ , with unit-cell parameters refined from powder X-ray diffraction:  $a = 18.121(1)$ ,  $b = 20.474(2)$ ,  $c = 7.5213(8)$  Å (Fryčovice) and  $a = 18.1265(3)$ ,  $b = 20.4527(3)$ ,  $c = 7.5185(2)$  Å (Straník). The quantitative chemical composition by EDS are given for both sites. However, their reliability is reduced by nature of very thin crystals (2.5 μm), where analyses from polished section probably overestimate calcium content due to enveloping calcite, whereas analyses from crystals etched by the 10% solution of the acetic acid show significant increase the content of Na<sup>+</sup> and K<sup>+</sup>. The zeolite framework is not affected by etching, with perfect reproducibility giving exactly the same  $T_{Si} = 0.83$  for both cases.

*Key words:* mordenite, zeolite, powder X-ray diffraction data, Teschenite Association Rock, Czech Republic

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### ÚVOD

Pro většinu hornin těšinitové asociace v Podbeskydí je podstatným znakem přítomnost minerálů zeolitové skupiny, zejména analcimu, v základní hmotě. Zeolity se vyskytují i na puklinách, v mandlovcových dutinách a také v kontaktně a hydrotermálně metamorfovaných či metasomatizovaných sedimentech v okolí těles vulkanitů. V případě základní hmoty hornin byly dosud popsány analcim a natrolit (Tschermak 1866; Rohrbach 1885). Tschermak také jako první zjistil, že horniny těšinitové asociace jsou převážně analcimické. Smulikowski (1929a, b) a po něm řada dalších autorů uvádí přítomnost natrolitových pseudo-

# CHLORITY AKO INDIKÁTORY METAMORFÓZY KARBONÁTOVÝCH A PELITICKÝCH HORNÍN PRÍKROVU BÔRKY NA LOKALITE SLAVOŠKA (SLOVENSKÁ REPUBLIKA)

CHLORITES AS METAMORPHIC INDICATORS OF CARBONATE AND PELITIC ROCKS  
OF THE BÔRKA NAPPE AT THE LOCALITY SLAVOŠKA (SLOVAK REPUBLIC)

PETER RUŽIČKA

## Abstract

Ružička, P., 2024: Chlority ako indikátory metamorfózy karbonátových a pelitických hornín príkrovu Bôrky na lokalite Slavoška (Slovenská republika). - Acta Musei Moraviae, Scientiae geologicae, 109, 1, 83-98 (with English summary).

*Chlorites as metamorphic indicators of carbonate and pelitic rocks of the Bôrka nappe at the locality Slavoška (Slovak Republic)*

Based on chemical composition of chlorites in marble and in phyllite from the locality Slavoška within the Bôrka Nappe, the temperature conditions of regional metamorphism were established. The identified mineral assemblage of marble consists of calcite, muscovite, Fe-chlorites, albite and fluorapatite. The mineral assemblage of phyllite consists of quartz, muscovite, Mg-chlorites, albite and fluorapatite. Fe-chlorites (chamosite) in marble reflect metamorphic temperature in the range  $T_1 = 344-392$  °C;  $T_2 = 333-381 \pm 15$  °C and Mg-chlorites (clinocllore) in phyllite formed at  $T_1 = 318-349$  °C;  $T_2 = 311-343 \pm 10$  °C. Mg-Fe chlorites formed by recrystallization of the original volcanic-sedimentary protolith, while the probable source for the formation of chlorites was admixture of basic pyroclastic material. Marbles and phyllites were metamorphosed under greenschist facies conditions during the Alpine metamorphic event within the lithostratigraphic sequence of the Dúbrava Formation of the Bôrka Nappe in the Western Carpathians.

*Key words:* chlorite, muscovite, chemical composition, metamorphic temperature, crystalline limestones, phyllites, Western Carpathians, Slavoška, Slovak Republic

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## ÚVOD

Článok je zameraný na stanovenie teplotných podmienok metamorfózy karbonátových a pelitických hornín na základe zloženia chloritov, ktoré tvoria spolu s muskovitom integrálnu súčasť ich minerálnej asociácie a majú genetický význam v rámci skúmanej lithostratigrafickej sekvencie príkrovu Bôrky Západných Karpát. Prezentované analytické údaje o chemickom zložení chloritov v skúmaných mramoroch a fylitoch predstavujú relevantný minerálny indikátor alpínskej regionálnej metamorfózy v oblasti Slavošky. V minulosti boli podobným spôsobom spracované lokality metakarbonátov v rámci gelnickej skupiny južného gemerika (MYŠLAN a RUŽIČKA 2022).

## LOKALIZÁCIA A GEOLOGICKÁ CHARAKTERISTIKA

Skúmaná lokalita Slavoška (obr. 1) sa nachádza v rámci katastra obce, v okrese Rožňava, v Košickom kraji. Podľa geomorfologického členenia Slovenskej republiky (KOČICKÝ

## TĚŽKÉ MINERÁLY Z VLTAVÍNONOSNÝCH SEDIMENTŮ V OKOLÍ VRÁBČE: IMPLIKACE PRO PALEOGEOGRAFIÍ

HEAVY MINERALS FROM MOLDAVITE-BEARING SEDIMENTS IN THE VICINITY OF VRÁBČE:  
PALEOGEOGRAPHIC IMPLICATIONS

DAVID BURIÁNEK, JAN KARMAZIN

### Abstract

Buriánek, D., Karmazin, J., 2024: Těžké minerály z vltavínonosných sedimentů v okolí Vrábče: implikace pro paleogeografii. – Acta Musei Moraviae, Scientiae geologicae, 109, 1, 99–124 (with English summary).

*Heavy minerals from moldavite-bearing sediments in the vicinity of Vrábče: paleogeographic implications*

The area of Southern Bohemia in vicinity of the Budějovice Basin is known for the occurrence of moldavites. This study provides sedimentological and mineralogical descriptions of the Miocene to Pleistocene moldavite-bearing sediments in the vicinity of Vrábče (Vrábče and Koroseky beds); heavy minerals from these sediments were investigated in order to reconstruct their source areas. Both sediment types (Vrábče and Koroseky beds) contain variable amounts of kyanite, tourmaline, garnet, staurolite, and rutile in their transparent heavy mineral assemblages. The heavy minerals were derived mainly from migmatites to paragneisses, and their minor part was sourced most likely from weathering of marbles, calc-silicate rocks, orthogneiss, muscovite granites and/or pegmatites. Eclogites, amphibolites, and ultrabasic rocks were identified as significant sources of material for forming the Vrábče and Koroseky beds based on the chemical composition of garnet and spinel. At least a part of the kyanite probably comes from the granulites. The Miocene Vrábče beds represent the product of alluvial/lacustrine-fan sedimentation. Based on their abrasion degree heavy minerals in these sediments were transported on short distances (max. several km), probably from rocks strongly affected by Cretaceous and Paleogene weathering (Prachatice Mountains). The assemblage and composition of heavy minerals from fluvial sediments of the Koroseky beds show excellent correlation with mineralogy of rocks in their close vicinity. Detrital opaque heavy minerals are significant constituents of Koroseky beds. The chemical composition of ilmenite clasts suggests a source in basic rocks (amphibolites, eclogites). The dominance of quartz and/or feldspars in the clastic material, together with the prevalence of zircon and Th-rich monazite in heavy minerals assemblage, indicate that a significant part of the clastic material was derived from the weathering of granitoids (mainly durbachites). The minor part of the heavy mineral assemblages (e.g., staurolite, cassiterite) either comes from more distant parts of the Moldanubian Unit or represents a recycled material from older sedimentary sequences (e.g., Neogene, Cretaceous sediments).

*Key words:* Moldavite-bearing sediments, Sedimentology, Heavy minerals, Mineralogy, South Bohemia

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### ÚVOD

Geneze vltavínů je všeobecně spojována s dopadem meteoritu ve středním miocénu do oblasti dnešního Bavorska (např. KRŠUL 2008, SCHWARZ a LIPPOLT 2014). Při průletu

## LOWER CRETACEOUS BELEMNITE ASSOCIATIONS FROM THE RYCHALTICE LOCALITY AND THE DISINTEGRATION OF THE BAŠKA RIDGE (THE SILESIA UNIT, OUTER WESTERN CARPATHIANS, CZECH REPUBLIC)

SPODNOKŘÍDOVÉ BELEMNITOVÉ ASOCIACE LOKALITY RYCHALTICE A ROZPAD BAŠSKÉHO  
HŘBETU (SLEZSKÁ JEDNOTKA, VNĚJŠÍ ZÁPADNÍ KARPATY, ČESKÁ REPUBLIKA)

ZDENĚK VAŠÍČEK

### *Abstract*

Vašíček, Z., 2024: Lower Cretaceous belemnite associations from the Rychaltice locality and the disintegration of the Baška Ridge (the Silesian Unit, Outer Western Carpathians, Czech Republic). - *Acta Musei Moraviae, Scientiae geologicae*, 109, 1, 125-140 (with Czech summary).

*Lower Cretaceous belemnite associations from the Rychaltice locality and the disintegration of the Baška Ridge (the Silesian Unit, Outer Western Carpathians, Czech Republic)*

An approximately 200 m long road-cut near the village of Rychaltice uncovered the exposure with Lower Cretaceous sedimentary sequence of the Baška Subunit of the Silesian Nappe at the contact with Paleogene deposits of the Subsilesian Nappe (Outer Western Carpathians). At the base of the Silesian Nappe tectonical melange with blocks, a lenticular olistostrome and pebbles of Štramberk-type limestones occur at the contact zone of both nappes. Weathered and partially reworked belemnite rostra come from the weathered dark grey unstratified mudrocks, in a section of only several meters thick. The collection of more than one hundred incomplete and small-sized rostra of belemnites is the subject of a taxonomic and stratigraphic evaluation. Despite the unfavourably preservation of the rostra, it was possible to identify at least 4 taxa, which indicate the stratigraphic range of almost the entire Lower and the base of Upper Cretaceous series. Among these, the oldest fragments are of *Pseudobelus* ex gr. *bipartitus*, which show a broad stratigraphic range from the late Berriasian to the early late Hauterivian. In addition, there is a small (probably juvenile) specimen of *Duvalia* ex gr. *binervia* of the late Valanginian – earliest Hauterivian age. The rare species mentioned above are accompanied by the occurrence of *Parahibolites tourtia* and the abundant occurrence of *Neohibolites* ex gr. *minimus - ultimus*. The latter association indicates a (late) middle Albian to the early Cenomanian age. Additionally, to the stratigraphic spectrum of belemnites (late Berriasian – early Cenomanian), the finding of a single valve of the aptychus *Punctaptychus* cf. *punctatus* gives the evidence for even older material present, i.e. Tithonian to Berriasian. Determined belemnites and aptychus, indicate the Berriasian to the early Cenomanian age of the conglomerate deposits of Chlebovice facies (Baška Development).

*Key words:* Outer Western Carpathians, Lower Cretaceous, Cenomanian, belemnite associations.

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### INTRODUCTION

This paper presents a collection of Lower Cretaceous belemnites at the Rychaltice locality in deposits of the Baška Development of the Silesian Unit (Flysch Western Carpathians), along a road cut in the vicinity of the village of Rychaltice near Příbor. Belemnites from the



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