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CHARAKTERISTIKA TURMALÍNŮ Z ALBITOVÉ JEDNOTKY GRANITICKÝCH PEGMATITŮ ŽIL Č. 5 A Č. 8 V DOLNÍCH BORECH - HATÍCH

CHARACTERIZATION OF TOURMALINES FROM ALBITE UNIT OF PEGMATITE DIKES
NO. 5 AND NO. 8 AT DOLNÍ BORY - HATĚ

EVA MRKUSOVÁ, RADEK ŠKODA, JAKUB HAIFLER, JAN FILIP, MARKÉTA HOLÁ

Abstract

Mrkusová, E., Škoda, R., Haifler, J., Filip, J., Holá, M., 2023: Charakteristika turmalínů z albitové jednotky granitických pegmatitů žil č. 5 a č. 8 v Dolních Borech - Hatích. - Acta Musei Moraviae, Scientiae geologicae, 108, 1, 3-16 (with English summary).

Characterization of tourmalines from albite unit of pegmatite dikes No. 5 and No. 8 at Dolní Bory - Hatě

Tourmaline crystals from albite units of pegmatite dikes No. 5 and No. 8 at Dolní Bory - Hatě were investigated by electron microprobe, LA-ICP-MS, and Mössbauer spectroscopy in order to get complete chemical characterization including Fe^{3+}/Fe_{tot} , light, and trace elements contents. In transmitted light, tourmaline shows quite distinct core with a slight sector zoning which is overgrown by darker parts with oscillatory zoning and delta features. In some section of crystals, the core was not observed. The empirical formulae are characterized by 0.044-0.065 Fe^{3+}/Fe_{tot} , high X-site vacancy (0.37-0.61 *pfu*), 1.57-1.64 *apfu* Fe_{tot} , low Mg (0.16-0.29 *apfu*) and elevated Al at the Y-site (0.69-1.01 *apfu*). Oxygen or the OH group dominates at W-site (0.44-0.69 and 0.20-0.42 *apfu*, respectively), whereas F is low (0.03-0.25 *apfu*). Based on these ionic ratios, the oxy-foitite>foitite>oxy-schorl are dominant endmembers in the tourmaline cores, whereas the oscillatory and delta features parts correspond to oxy-schorl to very rare schorl.

Key words: tourmaline, oxy-foitite, foitite, oxy-schorl, EPMA, Mössbauer spectroscopy, LA-ICP-MS, pegmatite, Dolní Bory - Hatě, Czech Republic

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1. ÚVOD

Minerály superskupiny turmalínu, dále jen turmalíny, mají zpravidla trigonální symetrii s acentrickou prostorovou grupou $R3m$. Obecný vzorec superskupiny turmalínu je uváděn jako $XY_3Z_6[T_6O_{18}][B_3O_3]_3V_3W$, s následným obsazením jednotlivých strukturálních pozic prvky uvedenými podle relativní četnosti: X-pozice = Na^{1+} , Ca^{2+} ; □ (vakance) > K^+ ; Y-pozice = $Fe^{2+} \sim Mg^{2+}$, Al^{3+} , Li^+ , Fe^{3+} , Ti^{4+} , Mn^{2+} , Cr^{3+} > Zn^{2+} , Ni^{2+} , Cu^{2+} , V^{3+} ; Z-pozice = Al^{3+} > Mg^{2+} , Fe^{3+} ,

ZLATO A DOPROVODNÉ MINERÁLY ZE ŠTOLY MÍR A ZE ŠTOLY NA BARYTĚ U ŠTĚPÁNOVA NAD SVRATKOU (ŠTĚPÁNOVSKÝ RUDNÍ REVÍR, ČESKÁ REPUBLIKA)

GOLD AND ASSOCIATED MINERALS FROM THE MÍR AND NA BARYTĚ ADITS NEAR
ŠTĚPÁNOV NAD SVRATKOU (ŠTĚPÁNOV ORE DISTRICT, CZECH REPUBLIC)

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

Abstract

Dolníček, Z., Krejčí Kotlánová, M., Koutňák, R., Ulmanová, J., Malý, K., 2023: Zlato a doprovodné minerály ze štoly Mír a ze štoly Na barytě u Štěpánova nad Svratkou (štěpánovský rudní revír, Česká republika). - Acta Musei Moraviae, Scientiae geologicae, 108, 1, 17–28 (with Czech summary).

Gold and associated minerals from the Mír and Na barytě adits near Štěpánov nad Svratkou (Štěpánov Ore District, Czech Republic)

A mineralogical study of newly collected samples of Cu-Pb(-Zn) ore mineralization from the Mír and Na barytě adits in the Štěpánov Ore District (Czech Republic) clarified of elevated contents of Au, which were encountered in previous chemical analyses of the bulk ore. Small inclusions of Au-Ag alloys were found to be enclosed in early quartz and associated chalcopyrite. Some gold grains are zoned. The cores are formed by gold (50.1–74.2 at. % Au), whereas the rarely found rims have composition of Au-rich silver (47.9–22.8 at. % Au). In addition, pyrite, galena and sphalerite are minor ore minerals in the studied samples. The supergene phases are represented by *stilpnosiderite*, *limonite*, malachite, brochantite, and Cu-sulphides (chalcocite, djurleite, digenite/roxbite, anilite, geerite). The origin of Ag,Sb-rich rims of gold grains could be related to activity Ag,Sb-bearing fluids, which operated during crystallization of late mineral assemblage of the same vein containing calcite, baryte, galena and tetrahedrite-group minerals. The new compositional data collected from accompanying minerals are partly different from published data and point out that a detailed revision of mineralogy of hypogene mineralization of this ore vein is necessary.

Key words: Štěpánov Ore District, Mír adit, ore veins, gold, silver, hydrothermal alteration.

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1. ÚVOD

Štěpánovský rudní revír, ležící na západní Moravě sz. od Tišnova, je znám výskytem dvou hlavních typů sulfidického zrudnění – Pb-Zn(-Sb) a Cu-Pb(-Zn) (MALÝ 2000; HOUZAR a MALÝ 2002). Mineralizace jsou vázány zejména na pravé či ložní rudní žíly, vzácně-

SEKUNDÁRNÍ BASTNÄSIT-(Ce), BASTNÄSIT-(La) A PARISIT-(Ce) Z LOŽISKA CÍNOVEC - PRODUKTY INTERAKCE PRIMÁRNÍCH REE MINERÁLŮ S POZDNÍMI NÍZKOTEPLTNÍMI FLUIDY

SECONDARY BASTNÄSITE-(Ce), BASTNÄSITE-(La) AND PARISITE-(Ce) FROM THE CÍNOVEC
DEPOSIT - PRODUCTS OF INTERACTION OF PRIMARY REE MINERALS WITH LATE
LOW-TEMPERATURE FLUIDS

SEBASTIÁN HREUS, JAN CEMPÍREK, KAREL BREITER, JAKUB VÝRAVSKÝ

Abstract

Hreus, S., Cempírek, J., Breiter, K., Výravský, J., 2023: Sekundární bastnäsit-(Ce), bastnäsit-(La) a parisit-(Ce) z ložiska Cínovec - produkty interakce primárních REE minerálů s pozdními nízkoteplotními fluidy. - *Acta Musei Moraviae, Scientiae geologicae*, 108, 1, 29–40 (with English summary).

Secondary bastnäsite-(Ce), bastnäsite-(La) and parisite-(Ce) from the Cínovec deposit - products of interaction of primary REE minerals with late low-temperature fluids

The Cínovec/Zinnwald is a world-class greisen-type Li-Sn-W-Nb-Ta deposit. The REE minerals as common accessories are present there. Primary REE-bearing phases are represented by zircon, thorite, monazite, xenotime group minerals and fluorite. Secondary REE minerals include bastnäsite and synchysite group minerals, REE oxyfluorides, REE fluorides as well as dussertite group minerals. Magmatic monazite-(Ce) is a ubiquitous mineral with a distinct negative Eu anomaly. High contents of Th in monazite are characteristic for upper part of the granitic cupola (5.0–11.4 wt.% ThO₂). Within the deposit, replacement of monazite-(Ce) by bastnäsite-(Ce) was observed. Bastnäsite structure type is stable in mineral associations with elevated LREE concentrations which were formed by the reaction of primary monazite with relatively low temperature fluids rich in carbonate and fluoride ions. Different type of bastnäsite was formed by alteration of REE rich fluorite. However, the fluids responsible for both bastnäsite types formation were the most probably identical.

Key words: Cínovec, greisen deposit, CO₂-rich fluids, monazite group minerals, bastnäsite group minerals, Saxothuringicum, Bohemian Massif

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1. ÚVOD

Krušné hory patří mezi klasické oblasti s výskytem greisenových ložisek v rámci variského orogenu. Procesy spojené s migrací REE byly pozorovány v rámci několika různých ložisek a výskytů granitů A-typu v Krušných horách. V A-typovém granitu Markersbach, který

MOTTRAMIT ZE ŠTOLY ALŽBĚTA V ČERNÉM DOLE V KRKONOŠÍCH (ČESKÁ REPUBLIKA)

MOTTRAMITE FROM THE GALLERY ELIZABETH IN ČERNÝ DŮL
IN KRKONOŠE MOUNTAINS (CZECH REPUBLIC)

PETR PAULIŠ, JIŘÍ SEJKORA, PETR JANÁK, ZDENĚK DOLNÍČEK,
RADKO TÁSLER, ONDŘEJ POUR

Abstract

Pauliš, P., Sejkora, J., Janák, P., Dolníček, Z., Tásler, R., Pour, O., 2023: Mottramit ze štoly Alžběta v Černém Dole v Krkonoších (Česká republika). - Acta Musei Moraviae, Scientiae geologicae, 108, 1, 41–56 (with English summary).

Mottramite from the gallery Elizabeth in Černý Důl in Krkonoše Mountains (Czech Republic)

Rare Pb-Cu vanadate, mottramite, was found at samples from the gallery Elizabeth in Černý Důl, Krkonoše Mountains (Czech Republic). It forms yellow to yellow-orange coatings and thin crusts formed by hemispherical aggregates with size up to 0.05–0.1 mm with vitreous lustre. Mottramite is orthorhombic, space group *Pnma*, the unit-cell parameters refined from X-ray powder diffraction data are: *a* 7.627(2), *b* 5.971(2), *c* 9.466(3) Å and *V* 431.1(1) Å³. Three chemically different types of mottramite were distinguished on the base of occupation of *B*- and *T*-sites of ideal formula AB(XO₄)(OH). The first is As-poor mottramite with empirical formula (Pb_{0.93}Ca_{0.05})_{Σ0.98}(Cu_{0.62}Fe_{0.16}Zn_{0.09})_{Σ0.87}(VO₄)_{0.80}(PO₄)_{0.09}(SiO₄)_{0.08}(AsO₄)_{0.02}(OH)_{0.63}. The other two types are As-rich mottramite with different range of Fe and Zn substitution at *B*-site and empirical formulae (Pb_{0.75}Ca_{0.11}Bi_{0.03})_{Σ0.89}(Cu_{0.78}Fe_{0.05}Zn_{0.04})_{Σ0.87}(VO₄)_{0.51}(AsO₄)_{0.32}(SiO₄)_{0.12}(PO₄)_{0.05}(OH)_{0.44} and (Pb_{0.82}Ca_{0.12})_{Σ0.94}(Cu_{0.34}Zn_{0.27}Fe_{0.18})_{Σ0.79}(VO₄)_{0.56}(AsO₄)_{0.40}(SiO₄)_{0.03}(PO₄)_{0.01}(OH)_{0.42}, respectively.

Key words: mottramite, powder X-ray diffraction data, unit-cell parameters, chemical composition, Černý Důl, Krkonoše Mts., Czech Republic

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1. ÚVOD

Starý důlní revír u obce Černý Důl v Krkonoších je místo s dlouhou báňskou historií. Největší soustředění starých důlních děl se nachází cca 3 km s. od Černého Dolu v Černém (či Stříbrném) dole v údolí Čisté. Podle někdejší horské boudy bývá tato důl-

MINERALOGIE MASIVNÍHO SERPENTINU A KLINOCHLORU Z DOLOMITICKÝCH MRAMORŮ MOLDANUBIKA NA ZÁPADNÍ MORAVĚ (ČESKÝ MASIV)

MINERALOGY OF MASSIVE SERPENTINE AND CLINOCHLORE FROM THE DOLOMITIC
MARBLE OF MOLDANUBICUM IN WEST MORAVIA (BOHEMIAN MASSIF)

STANISLAV HOUZAR, JIŘÍ SEJKORA, RADANA MALÍKOVÁ

Abstract

Houzar, S., Sejkora, J., Malíková, R., 2023: Mineralogie masivního serpentinu a klinochloru z dolomitických mramorů moldanubika na západní Moravě (Český masiv). - Acta Musei Moraviae, Scientiae geologicae, 108, 1, 57-78 (with English summary).

Mineralogy of massive serpentinite and clinochlore from the dolomitic marble of Moldanubicum in West Moravia (Bohemian Massif)

Massive aggregates of yellow-green, grey-green and brown Mg-rich phyllosilicates occur in dolomite marbles enclosed in Moldanubian gneisses and especially migmatites (Bohemian Massif). Serpentine subgroup minerals and Mg-chlorites were distinguished on the basis of X-ray and chemical studies. The serpentinite is represented by Al- and Fe-poor lizardite (~ 0.01 apfu Al; $0.01-0.05$ apfu Fe). The Mg-chlorite belongs to the clinochlore (so-called *pseudophite*), which, in addition to the significant content of Al ($1.54-2.32$ apfu), has variable content of Fe ($0.03-1.07$ apfu) and relatively low contents of Mn and Ca. Trace contents of Zn (~ 0.02 apfu) in both lizardite and clinochlore from the localities where the marbles have elevated Zn > 500 ppm are notable. Only microscopic phlogopite, fluorapatite, muscovite, titanite and tremolite were identified in the studied massive Mg-phyllosilicates. Serpentine (lizardite) was formed as part of metasomatic reaction veins (calcite-forsterite-diopside skarn), where it forms a separate monomineral zone. Clinochlore was formed by the complete replacement of plagioclase and K-feldspar along the contact of granitoid veins (metatect) intruding to the dolomite marbles, and the veins simultaneously underwent desilification. In both cases, they are products of reactions of dolomite marbles with external fluids and/or melts rich in $\text{SiO}_2 \pm \text{Al}_2\text{O}_3$ at high H_2O activities ($X_{\text{CO}_2} < 0.10-0.05$) and at $T < 300^\circ\text{C}$.

Key words: serpentinite, lizardite, clinochlore, dolomite marble, Moldanubicum, Bohemian Massif, Czech Republic

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1. ÚVOD

Dolomitické mramory východní části moldanubika obsahují různé minerální asociace, které v nich vznikly metamorfními reakcemi zejména v období variské orogeneze.

PETROGRAFIE A MINERALOGIE SKARNU OD MALEŠOVA (KUTNOHORSKÉ KRYSTALINIKUM, ČESKÁ REPUBLIKA)

PETROGRAPHY AND MINERALOGY OF THE SKARN FROM MALEŠOV
(KUTNÁ HORA CRYSTALLINE COMPLEX, CZECH REPUBLIC)

JAN BUBAL, DAVID DOLEJŠ

Abstract

Bubal, J., Dolejš, D., 2023: Petrografie a mineralogie skarnu od Malešova (kutnohorské krystalinikum, Česká republika). – Acta Musei Moraviae, Scientiae geologicae, 108, 1, 79–93 (with English summary).

Petrography and mineralogy of the skarn body near Malešov (Kutná Hora Crystalline Complex, Czech Republic)

The skarn body near Malešov belongs to calcium-iron skarns with a typical Ca-Fe-Al mineral association. The Malešov skarn body is located in the structurally highest part of the Kutná Hora Crystalline Complex, the Malin Unit, which in this part is mainly formed by gneisses and migmatites. The deposit body is dominated by garnet-pyroxene skarn, less frequently by garnet and magnetite skarn. Replacement of primary minerals by amphibole or epidote also occurs. Fine-grained garnet skarn is formed by isotropic dark red garnet ($\text{Adr}_{78-88}\text{Grs}_{9-19}\text{Alm}_{2-4}\text{Pyr}_{0-0.3}$), while massive garnet skarn consists of garnet grains with different core ($\text{Adr}_{13-38}\text{Grs}_{31-50}\text{Alm}_{29-36}\text{Pyr}_{0-2.5}$) and rim ($\text{Adr}_{28-66}\text{Grs}_{21-37}\text{Alm}_{12-33}\text{Pyr}_{0-1.6}$) chemistry. In association with garnet is often pyroxene ($\text{Hd}_{60-90}\text{Di}_{10-40}$) which can be replaced by amphibole (hastingsite composition). Other minerals are magnetite, Fe-epidote, calcite and albite. Magnetite is characterized by high content of Al_2O_3 (0.54 wt. %) a SiO_2 (0.1 wt. %), while siderophile (V, Cr) and chalcophile elements (Ni, Cu, Zn) are below the detection limit. From the observed petrographic relationships, garnet, pyroxene, and magnetite skarns appear to be primary, while the formation of amphibole reaction zones, epidote, carbonate veins, or weak silicification caused by the emplacement of granitic pegmatites, are probably products of late alteration.

Key words: garnet, pyroxene, magnetite, skarn, Kutná Hora Crystalline Complex, Bohemian Massif

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1. ÚVOD

Vápenato-železnaté skarny jsou poměrně častými horninami regionálně metamorfovaných komplexů v Českém masivu. Bývají vyvinuté na kontaktech s karbonáty chudými na Mg a tvoří je Ca-Fe-Al bohatá minerální asociace zastoupená především granátem (almandin-grosulár-andradit), klinopyroxenem řady diopsid-hedenbergit, případně amfibolem a epidotem. Skarnová tělesa vystupují především v severní a východní části moldanubika a dále v přilehlém kutnohorském a svrateckém krystaliniku. Další významné skarnové lokality se nachází v centrální části krušnohorského a také v oblasti krkonošského krystalinika (BERNARD a POUBA 1986; NĚMEC 1991; BERNARD 2000; PERTOLDOVÁ *et al.* 2009).

MINERALOGICKÁ CHARAKTERISTIKA FOSFORITŮ Z KARBONÁTOVÝCH BREKCIÍ Z LÍŠEŇSKÉHO SOUVRSTVÍ U OBCE BŘEZINA (STŘEDNÍ ČÁST MORAVSKÉHO KRASU)

MINERALOGICAL CHARACTERISTICS OF PHOSPHORITES FROM CARBONATE BRECCIAS,
LÍŠEŇ FORMATION NEAR THE VILLAGE OF BŘEZINA
(THE CENTRAL PART OF THE MORAVIAN KARST)

DAVID BURIÁNEK, VÍT BALDÍK, DALIBOR VŠIANSKÝ, KAREL DIVIŠ,
TOMÁŠ VIKTORÍN

Abstract

Buriánek, D., Baldík, V., Všianský, D., Diviš, K., Viktorín, T., 2023: Mineralogická charakteristika fosforitů z karbonátových brekcií z líšeňského souvrství u obce Březina (střední část Moravského krasu). – *Acta Musei Moraviae, Scientiae geologicae*, 108, 1, 95–105 (with English summary).

Mineralogical characteristics of phosphorites from carbonate breccias, Líšeň Formation near the village of Březina (the central part of the Moravian Karst)

The concretions and angular clasts of phosphorites are hosted in the limestone breccia of the Tournaisian to Viséan age (Hostěnice development, Líšeň Formation of the Moravian Karst). We interpreted angular clasts as fragments of concretions. Black-coloured concretions are ellipsoidal, up to 5 cm in diameter. Both textural types of phosphorites consist of crystalline and cryptocrystalline fluorapatite, pyrite crystals and framoids often replaced by goethite, clay minerals (kaolinite), quartz and calcite. Locally are visible allochems (peloids), fragments of macrofossils (e.g. Brachiopods and/or Bivalves) and microfossils (Foraminifera). We use an optical microscope, X-ray diffraction analysis and electron microprobe to study these phosphorites. Fine-grained needle-like subhedral to anhedral fluorapatite crystals with 0.10–0.22 wt. % FeO and up to 0.01 wt. % MnO are a dominant mineral component. The phosphorite concretions were probably formed in a shallow, Famennian carbonate ramp environment (Upper part Macocha Fm.). Apatite recrystallization (colomorphic or banded) textures and precipitation together with pyrite demonstrate formation concretions during early diagenetic anoxic events in unconsolidated host sediments. The period of phosphogenesis was followed by Tournaisian erosion, reworking, and condensation during the tectonic modification sedimentary basin. These processes were responsible for depositing limestone breccia consisting of angular to subangular clasts of the Devonian limestones (Macocha Fm.), black silicates and phosphorites.

Key words: mineralogy, X-ray diffraction analysis, phosphates, limestones, Moravian Karst, Bohemian Massif

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EARLY CRETACEOUS AMMONITE ASSOCIATIONS IN THE WESTERN CARPATHIANS (THE MORAVIAN-SILESIA AREA AND WESTERN SLOVAKIA)

SPODNOKŘÍDOVÉ AMONITOVÉ ASOCIACE V ZÁPADNÍCH KARPATECH
(MORAVSKOSLEZSKÁ OBLAST A ZÁPADNÍ SLOVENSKO)

ZDENĚK VAŠIČEK

Abstract

Vašíček, Z., 2023: Early Cretaceous ammonite associations in the Western Carpathians (the Moravian-Silesian area and Western Slovakia). – *Acta Musei Moraviae, Scientiae geologicae*, 108, 1, 107-125 (with Czech summary).

Early Cretaceous ammonite associations in the Western Carpathians (the Moravian-Silesian area and Western Slovakia)

From the geological point of view, the north-eastern part of the Czech Republic and the greater part of the neighbouring Slovakia are built by the Western Carpathian Mountains system. They mainly consist of two basic geological units – i.e. the Outer Western Carpathians and the Central Western Carpathians. The Silesian Unit of the Godula development in the Outer Carpathians, and the Pieniny Klippen Belt together with the Central Carpathians in Slovakia, which is generally spread from the northwest to the southeast, are the most important units in this system, discussed in the first part of the paper submitted. Occurrence of Valanginian to Aptian stratigraphic indexes comprised in ammonite associations in the units described above, are reviewed. On the other hand, the representatives of long living forms of suborders Phylloceratina and Lytoceratina are of minor stratigraphic value. The follow-up discussion is based on information presented in Table, showing only the stratigraphic positions of zonal ammonite indexes, in all three studied units of the Western Carpathians. The findings are parallelized and compared with the current Early Cretaceous ammonite standard zonation of REBOULET *et al.* (2018). Warm-water Mediterranean ammonite association predominates in all three units studied. Some genera, originated from the Mediterranean bioprovince, extended from west to east across Danish-Polish depression into Boreal zone. The genus *Platylenticeras* passed from the Boreal zone towards the Silesian Unit for a short time in the early Valanginian; the genera *Dichotomites* and *Neocomites cf. peregrinus* passed towards the Central Carpathians in the late Valanginian. In some periods (Barremian and early Aptian), the ammonite association of the Silesian Unit differs somewhat from the association of the Pieniny Klippen Zone and the Central Carpathians, probably due to the palaeogeographic position of the Silesian Unit with a different facial development. The conclusion is focused on palaeogeographic findings which have influenced the composition of ammonite associations in sedimentary areas located southeast-wards from the former North-European platform. The main aim of this paper is to inform about the occurrence of Lower Cretaceous ammonites of current zonal importance in the Mediterranean faunal province of the Western Carpathian units.

Key words: Outer and Central Western Carpathians, Valanginian up to Aptian, ammonite indexes.

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1. INTRODUCTION

The contribution presented addresses the development of Early Cretaceous ammonite associations in neighbouring tectonic units in the Western Carpathians, and their compa-

PETROGRAPHIC INVESTIGATIONS OF THE SANDSTONE OF THE DHOK PATHAN FORMATION, SOUTH EASTERN HAZARA, NORTH PAKISTAN, IMPLICATIONS FOR THE PROVENANCE

PETROGRAFICKÝ VÝZKUM PÍSKOVCE SOUVRSTVÍ DHOK PATHAN, JIHOVÝCHODNÍ HAZARA,
SEVERNÍ PÁKISTÁN, PŮVOD KLASTICKÉHO MATERIÁLU

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Abstract

Alam, I., Nazir-ur-Rehman, Afrasiab, Ullah, S., Azeem, M. W., Iqbal, S., Rehan, M. S., Khan, K. 2023: Petrographic investigations of the sandstone of the Dhok Pathan Formation, South Eastern Hazara, North Pakistan, Implications for the Provenance. – *Acta Musei Moraviae, Scientiae geologicae*, 108, 1, 127-140 (with Czech summary).

Petrographic investigations of the sandstone of the Dhok Pathan Formation, South Eastern Hazara, North Pakistan, Implications for the Provenance

In this study, the sandstone of the middle part of the Dhok Pathan Formation was studied in detail for the petrographic-based provenance at the South Eastern Hazara. The outcropping clastic sequence of the area reveals complex braided fluvial depositional conditions dominated during Pliocene period. The interbedded channel facies (sandstones) and floodplain facies (shales and some specific sandstone units), in varying proportions, differentiate individual formation in the Siwalik Group. The watercourse sediments are the product of aggrading fluvial sedimentation and are distinguished by a succession of upward-fining sandstones overlain by mudstones. Most of the sandstone units in the study area have been observed as multistoried and comprised of composite sand bodies reflecting a mixed fluvial depositional mechanism. The petrographic analyses of different samples collected from the study area of the middle sandstone horizon of the Dhok Pathan Formation reveals abundant quartz, feldspar, rock fragments along with variable amounts of several accessory minerals such as epidote, garnet, jarosite and clay minerals. The feldspar grains show alteration to chlorite, kaolinite and other secondary minerals. Calcite, clay minerals, silicious and iron oxide are present as cementing material and their grains show poor to moderate sorting. Rock designated on the basis is lithic arkose to Feldspathic litharenite considering the Folk's classification of sandstone. Rock fragments observed in the petrographic analysis provide indications about provenance. These assemblages of rock fragments also suggest that the source rocks were rich in igneous to metamorphic ensemble in addition to sedimentary assimilation. By plotting the provenance diagram of Dickenson, showing that the source rocks fit in the zone of recycled orogen.

Key words: Southeastern Acronym of the Azad Jammu Kashmir, Middle Dhok Pathan Formation, Lithic Arkose, sedimentological, petrographic, provenance analysis, Recycled orogen, Pakistan

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