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PREHISTORIC QUARRYING IN THE JIZERSKÉ HORY MOUNTAINS

GÓRNICTWO PREHISTORYCZNE W GÓRACH IZERSKICH

Abstract: In the 20 years since the important discovery of metabasite quarrying in the Jizerské hory Mountains (northern Bohemia, Czech Republic) a wealth of knowledge has been gathered on this raw material used to make Neolithic polished stone tools. A synthesis of these results now gives a more comprehensive view of how this raw material was employed in different periods and extracted directly at the source sites. The overview is at the same time a springing board for further research. Exploitation of metabasite and its widest spatial distribution was in the Linear Pottery culture (LBK; 5400–5000/4900 BC). In the post-LBK period of regionalisation, the sources of raw materials for the production of polished tools were diversified and the degree of utilisation of Jizera Mountains-type metabasite is demonstrably varied by region.

Keywords: Neolithic, Mesolithic, LBK, quarrying, Jizera Mountains-type (Jizerské hory) metabasite

Abstrakt: Odkrycie kamieniołomów metabazytu w Górach Izerskich (w północnych Czechach) stanowiło ważny moment w archeologii neolitu na przełomie tysiącleci. W ciągu ostatnich 20 lat zgromadzono wiele informacji na temat surowca używanego do wyrobu neolitycznych polerowanych narzędzi kamiennych. Dzięki tym danym można uzyskać pełniejszy obraz użycia tego surowca w różnych okresach oraz o sposobach jego wydobycia bezpośrednio w miejscach eksploatacji. Jednocześnie można wskazać punkty wyjścia do dalszych badań. Kultura ceramiki wstęgowej rytej (LBK; 5400-5000/4900 p.n.e.) może być uznana za okres kluczowy, ponieważ to w tym czasie oddziaływanie przestrzenne i jego wydobycie były największe. W okresie regionalizacji, następującym po LBK, źródła surowców do produkcji polerowanych narzędzi były zróżnicowane, a stopień wykorzystania metabazytu z Gór Izerskich różnił się znacznie w zależności od regionu.

Słowa kluczowe: neolit, mezolit, kultura ceramiki wstęgowej rytej, kamieniołom, metabazyt typu Góry Izerskie

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INTRODUCTION

The quarrying, processing and distribution of metabasite from the Jizerské hory Mountains (**Fig. 1**) is an important industry in the early Neolithic period of central Europe. The current idea is that this high-quality raw material is closely connected to the Neolithisation of central Europe, playing a crucial role in the development of wood processing and house construction. Its distribution range, based on the current set of data, extends over the whole of central Europe, even reaching regions several hundred kilometres away from the source. A more detailed knowledge of this extensive distribution network is important for a better understanding of the complexity of early Neolithic society in central Europe.

A number of crucial questions still need to be answered in order to gain a full understanding of the significance of this discovery. The overview of the current state of research presented in this article is designed to provide a platform for further progress in this area of studies. The purpose of this paper is to establish a clear terminology and set the geological identification standard for this material, to be used in cross-border research across Europe in the future.

Investigations of the quarrying area revealed several separate quarrying fields scattered along a line roughly 10 km long. These extraction places are all of early Neolithic date associated with the Linear Pottery culture (hereinafter: LBK), while the post-LBK sources remain unknown. Intensive exploitation of the resources was made possible by the proximity of stable Neolithic settlement. In the early Neolithic, metabasites were distributed over all of central Europe and probably even beyond the region. In the following period, the Jizera Mountains-type metabasite appears to have been of only regional importance.

DISTRIBUTION AND USE OF JIZERA MOUNTAINS-TYPE METABASITE IN CENTRAL EUROPE

Current knowledge of the distribution of Jizera Mountains-type metabasite largely reflects the uneven state of petroarchaeological research on the raw materials of polished stone tools in the individual countries within this range. Establishing raw material provenance requires sophisticated instrumentation, regional geological knowledge and, where appropriate, destructive analyses of polished stone artifacts.

In assemblages of the polished industry in the Czech Republic, this raw material has a 90% recorded presence for the duration of the early Neolithic (LBK), the result based on analyses from many sites (Lička *et al.* 2014; Burgert 2022). While this is not surprising in Bohemia, the region nearest to the sources, it is interesting to note that the situation in Moravia is similar even in areas most distant from the source (c. 250 km). An examination of metabasites from the burial site at Kleinhadersdorf in the adjacent part of Lower Austria (Götzinger 2015) revealed a dominance of Jizera Mountains-type metabasites, and it is generally accepted that this raw material was widely distributed throughout the Neolithic settlement area (also Lenneis, Götzinger 2017, p. 198).

In northwestern Hungary, several Neolithic polished artifacts made of Jizera Mountains-type metabasite have been recorded from the vicinity of Győr (Orsolya *et al.* 2008)

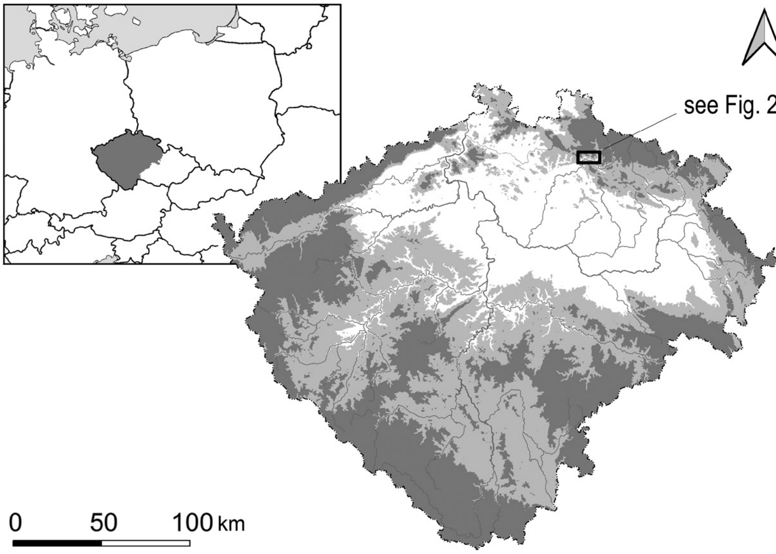


Fig. 1. Location of quarrying fields in the Jizerské hory Mountains. Prepared by P. Burgert.

Ryc. 1. Lokalizacja pól górniczych w Górach Izerskich. Oprac. P. Burgert.

and from the Baradla Cave in the north of the country (Kereskényi *et al.* 2023). Based on tool typology (no data on the find contexts is available), a chronological connection with the early Neolithic is unquestionable.

In Poland, assemblages of a polished stone industry with a distinct or dominant presence of the Jizera Mountains-type metabasite have been identified practically throughout the entire territory where linear pottery has been found, including remote areas around the Szczecin Lagoon and Lesser Poland (Krystek *et al.* 2011; Czekaj-Zastawny 2014). In most areas, tools were distributed as final products, but cursory references to tool blanks from the Lower Silesia area are an indication of possible secondary processing of metabasite in this region as well (Kufel-Diakowska *et al.* 2022, Fig. 4).

In Germany, petroarchaeological research in Saxony, which is the state nearest to the sources of metabasites in the Jizerské hory Mountains, has not been carried out to any great extent. However, the authors' current study leads to the tentative conclusion that the raw material, including tool blanks, was imported to the region in significant quantities. Tool production on the spot is attested by sandstone sharpeners for final tool finishing and a great deal of evidence for the cutting of the raw material. Jizera Mountains-type metabasite has also been recorded in significant quantities in the state of Hessen. Britta Ramminger (Ramminger 2007) and Nicole Kegler-Graiewski (Kegler-Graiewski 2007) have pointed out the dominant occurrence here of Jizera Mountains-type metabasite at the very beginning of the Neolithic, continuing in the early Neolithic albeit supplemented with local raw materials.

According to Ramminger (Ramminger 2007, pp. 248–249), the raw material labelled as amphibolite, which she identifies with Jizera Mountains-type metabasite, occurs in all parts of Germany and in the eastern half of Belgium. Whether it is indeed the metabasite in question (especially on the western fringes of the occurrence of these 'amphibolites') will have to be confirmed by detailed petroarchaeological research.

Although there are no radiocarbon dates associated with the post-LBK material from the quarries in the Jizerské hory Mountains, finds of artifacts in the Stroked Pottery culture (SBK) settlements indicate a continued intensive use of this metabasite in Bohemia. The Jizera Mountains-type metabasite has been recorded sporadically at SBK settlements in Moravia as well, for example, Popovice (Zelená 2007), and probably Olomouc-Slavonín (Zapletal 1999), where petroarchaeological research on polished stone tools preceded the discovery of the Jizera Mountains-type metabasite sources. This type of metabasites occurs in Saxony as well, also in relatively smaller quantities compared to the previous period. The massive axe-hammers from the Caput Adriae area (NE Italy), where Jizera Mountains-type metabasite artifacts have been found, can be identified with the post-LBK period based on tool typology (Bernardini *et al.* 2012; Bernardini 2018). Tools made of the Jizera Mountains-type metabasites are also relatively frequent in the early Lengyel settlements in south Moravia, but their occurrence is often linked to multicultural sites occupied since the early Neolithic. Typologically, they do not correspond to contemporary artifacts. The characteristic LBK adzes disappear and and are replaced by massive hammer axes made of local volcanic raw materials (amphibolic diorite, porphyritic microdiorite) or amphibolite from southwestern Moravia. Smaller tools, such as axes and flat wedges, are mostly made from local Želesice-type metabasite. This typological shift is probably connected to a change in woodworking techniques.

This overview specifically does not concern itself with any other areas outside central Europe that could have been within the distribution range of the Jizera Mountains-type metabasites, such as France, the Netherlands, Denmark, Moldova, and Ukraine.

THE DISCOVERY OF METABASITE SOURCES IN THE JIZERSKÉ HORY MOUNTAINS

The first overview of raw materials used for the production of Neolithic polished stone tools appeared in Bohemia already at the end of the 19th century (Matiegka 1894; Niederle 1894). The list included diorite, gabbro, serpentinite, amphibolite, diabase, eclogite, basalt, granite, archean schist, porphyry, and sandstone. In a later work, Lubor Niederle added lydite as the third most commonly used raw material (Buchtela, Niederle 1910, p. 11). Lydite is an unusual green-black colour when fresh and is very likely to have been confused with Jizera Mountains-type metabasite.

Geologist Karel Žebera addressed the issue of the raw materials of polished stone tools in Bohemia in his research into prehistoric marble quarrying at Bílý Kámen near Sázava (central Bohemia). In one of the quarrying pits, he discovered a collection of 2,000 fragments of polished tools (Žebera 1939; Burgert *et al.* 2020). He objectively noted the striking uniformity of the raw material used, but incorrectly sought their source in the surrounding amphibolite outcrops. He then generalised this idea to the whole of Bohemia (Žebera 1945, p. 241) and identified amphibolites from the Posázaví region in the south-eastern part of central Bohemia as the main raw material of Neolithic polished tools in Bohemia. His conclusions were adopted by most authors of monographs on the prehistory of Czechoslovakia at that time (Filip 1945, p. 14). Žebera based his findings only on field experience and macroscopic observations.

Modern results based on the study of petrographic thin sections under a polarizing microscope were published only in the early 1970s (Štelcl, Malina 1970). This was in connection with the emergence of the new scientific field of petroarchaeology. On the basis of results from the well-known Neolithic site at Bylany near Kutná Hora (Velímský 1969) and their own investigations of polished industry from several Moravian sites, the authors pointed out that the Neolithic was indeed dominated by one type of rock, which they termed actinolite-amphibolic or actinolite greenschists. Jindřich Štelcl assumed that the sources of these raw materials were situated in the vicinity of Sobotín in the Hrubý Jeseník Mountains or in the nearby Rychlebské hory Mountains, but he failed to find them.

Investigating hoards of polished stone industry in Bohemia Slavomil Vencl raised serious issues regarding the search for the source of the predominant raw material of Neolithic polished stone tools (Vencl 1975). He pointed to their striking concentration in the northeastern part of Bohemia. Excluding the more southerly geological units because of a higher or stronger metamorphosis, he was able to locate the source either in the Krkonoše-Jizera Crystalline Unit or the rather minor occurrence of the Zvičina Crystalline Unit. The latter was jointly investigated in this direction by Antonín Přichystal and Jiří Kalferst in 1987–1988, but they did not confirm the occurrence of the rocks they were looking for there.

It was not until the early 1990s that the presence of the key raw material was noticed (Bukovanská 1992). When comparing various potential sources in central and northern Bohemia, Marcela Bukovanská identified the most probable outcrops of actinolite schists, originated as contact hornfels on the southern exocontact of the Krkonoše-Jizera granite massif with specific localities of Černá studnice, Maršovice Hill, Zahájí, Zbytky and others. She also noted that the possible use of these 'nephritoid' rocks for the production of Neolithic tools had already been pointed out by German regional researchers in the interwar period (Granzer 1933). This line of investigations was interrupted in the post-war period, following the exodus of the German population. Bukovanská's suggestions went unheeded and it took the better part of ten years before prehistoric quarrying sites were actually found in places previously identified in her work.

The discovery of prehistoric metabasite quarries in the Jizerské hory Mountains was made independently by two researchers. Přichystal identified the quarrying site of Velké Hamry in 2002 (Přichystal 2002a). He was also the first to identify the rock in question in the Kamenice riverbed and followed it to the outcrops, discovering a large prehistoric quarrying field in the process. In the same year, a group of researchers led by geologist Vladimir Šrein (Šrein *et al.* 2002) concentrated on the area identified by Bukovanská, which lies about 8 km in a straight line to the west of Velké Hamry (**Fig. 2**).

For the sake of completeness, one should also mention a dead-end in research on the origin of the raw material in the 1980s. Prior to the establishment of the exact location of the resources in the Bohemian Massif some researchers searched for the origin of the raw material in southeastern Europe (Schwarz-Mackensen, Schneider 1983; Schwarz-Mackensen, Schneider 1987). This reasoning was based on the assumed direction of the spread of the Neolithic into central Europe.

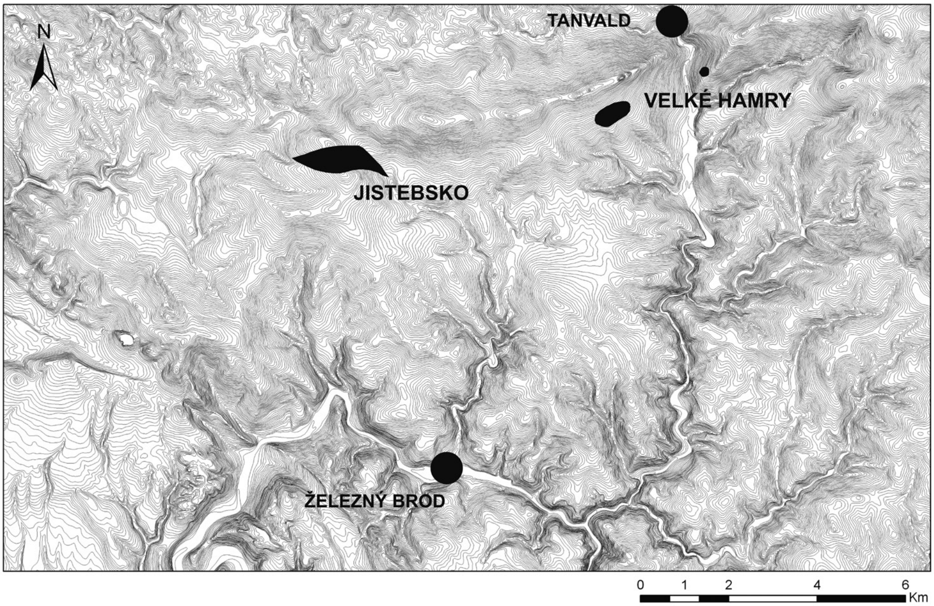


Fig. 2. Enlarged map of the localization of the two main sources: Jistebsko and Velké Hamry. Several smaller natural outcrops occur at the Velké Hamry locality. Prepared by P. Burgert, P. Šída.

Ryc. 2. Lokalizacji dwóch głównych źródeł – zbliżenie: Jistebsko i Velké Hamry. W rejonie Velké Hamry występuje kilka mniejszych, naturalnych wychodni. Oprac. P. Burgert, P. Šída.

RAW MATERIAL TERMINOLOGY AND DESCRIPTION

The petrographic and geochemical characteristics of the raw material quarried in the Jizerské hory Mountains have been studied to date by several authors (Klomínský *et al.* 2004; Šída, Kachlík 2009; Šída *et al.* 2014b). It is a metamorphosed alkaline volcanic rock (basalt or its volcaniclastics) characterized by a distinct planar parallel texture (metamorphic foliation) and a nematogranoblastic to nematoblastic structure, which is why it is mostly called Jizera Mountains-type metabasite or amphibole-rich metabasite in Czech-language topic literature (Přichystal 2013; Šída *et al.* 2014b). The terms actinolite-hornblende schist and amphibolitic schist (Christensen, Ramminger 2004; Christensen *et al.* 2006), recently directly amphibole-rich metabasite (Bernardini *et al.* 2012), are also used in studies from outside the Czech Republic. The authors consider Jizera Mountains-type (Jizerské hory) metabasite to be the most appropriate designation.

Plagioclase-hornblende hornfels (referred as Jizera Mountains-type metabasite; for terminology, see above) of basaltic composition is greenish-grey to dark greenish-black in colour, fine-grained, usually massive dense rock (3.05 g/cm^3 according to Milch 1902), which splits into flat fragments, 1-to-10 cm-thick, with typically sharp edges and conch shell fractures. Weathered pieces typically have a light grey or whitish weathering crust up to several mm thick or have undergone a strong limonitisation on the weathered surface. When struck with a hammer, it has a typical metallic sound, which is why it was German authors referred to it as "Eisenstein". It forms concordant layers (from 1 cm to 2 m thick) at a distance of several dozen to several hundred meters in host spotted muscovite-biotite phyllites (schists) to porphyroblastic andalusite-cordierite-biotite hornfelses in the southern exocontact of the Variscan 317± 2 Ma Tanvald granite (Žák *et al.* 2013; **Fig. 3**).

The characteristics of the material used for the production of stone tools have been determined based on samples from 38 localities in the exocontact zone of the Tanvald granite between Heřmanice in the west and Český Šumburk. At a total of five localities, metabasites were found in artificial outcrops (abandoned quarry, excavations for the construction of buildings, well). The remaining 33 documented localities are in slope debris, piles of material collected during medieval agricultural activity, and several localities uncovered during a spot linear excavation between Zadní Zbytky and Velké Hamry. Archaeological finds were documented at nine of the more than 30 described sites, in quaternary deluvial sediments and artificial depots. The archaeological sites of Jistebsko, Velké Hamry and Český Šumburk were studied in more detail.

Metabasite mineralogy was studied on six representative textural types of metabasite, 163 analyses of mineral phases were performed on a CamScan S4 microanalyzer. Twenty samples of metabasites covering the entire territory, including material from archaeological sites, were processed microscopically.

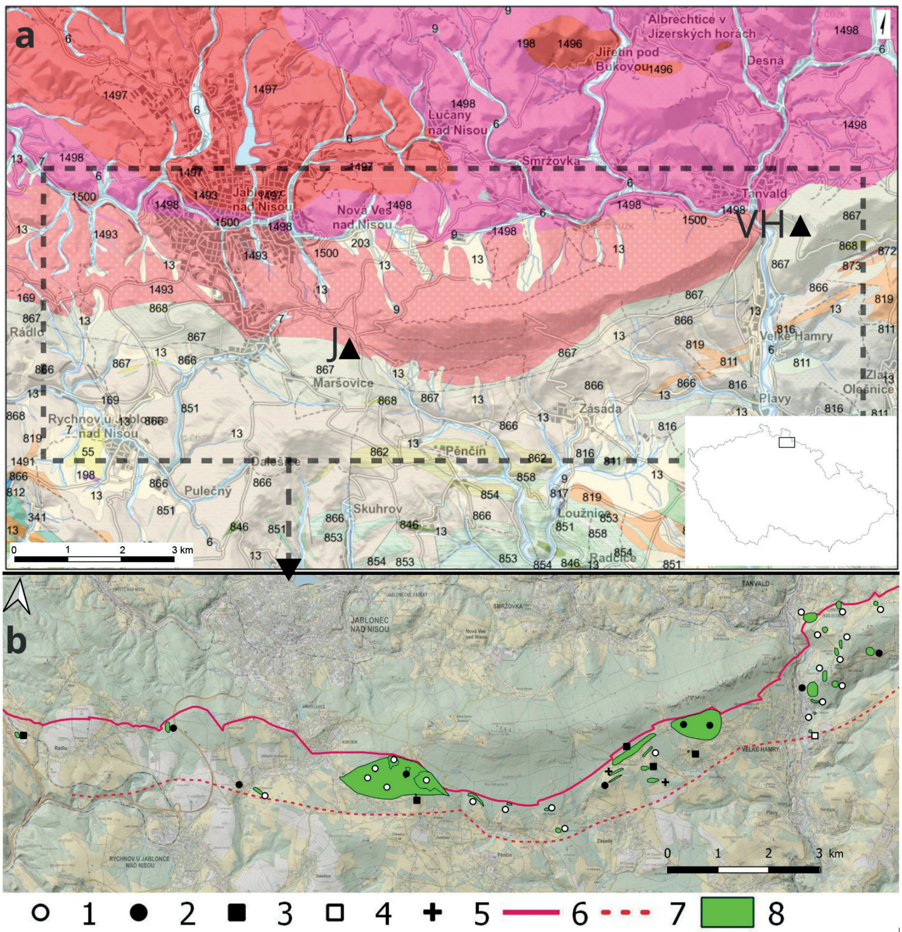
Sixteen representative samples of metabasites were studied geochemically, covering in full their petrographic variability. Four samples of the raw material were taken from the Jistebsko archaeological site (Christensen *et al.* 2006) and two others from the Rádlo excavation site (Klomínský *et al.* 2004). Five samples were picked out from artificial outcrops (excavation for buildings, wells) and the rest from mining sites and artificial depots. For location, detailed description of studied sites, petrographic, mineralogical and chemical characteristic of studied samples see Klomínský *et al.* 2004; Šída *et al.* 2014b; Šída, Kachlík 2009.

PETROLOGY OF METABASITES

Under an optical microscope, two textural end members of metabasites can be defined: a) fine grained amphibole-rich metabasites with whisker types of randomly arranged hornblendes; b) metabasites with relicts of former porphyritic texture, where both amphiboles or uralitized pyroxenes and plagioclases formed original phenocrysts, which were partly or completely replaced by newly formed aggregates of secondary hornblendes and basic plagioclases (**Fig. 4**).

Fine-grained metabasites are composed of Mg-or Fe hornblende, actinolite, cummingtonite, basic plagioclase and ilmenite. Mg-hornblende, actinolite and cummingtonite are intergrowing in textural equilibrium. Cummingtonite also often forms thin rims of the above mentioned hornblendes or crystallizes inside the amphibole aggregates. Hornblendes are often arranged radially to whisker or sheaf-like aggregates (**Fig. 5**). Plagioclases are mostly completely recrystallised into an equigranular mosaic of very fine grains of basic plagioclases. Quartz, apatite and pyrrhotite are the most common accessories; less frequent are magnetite and other sulphides as pyrite, arsenopyrite, chalcopyrite and sphalerite (Šrein *et al.* 2002). Coarser-grained quartz fills the crosscutting veinlets or lenses, especially in the inner part of the aureole.

Metabasites with relics of a primary porphyritic texture differ from the aforementioned, not only in their coarser-grained texture, but also in their mineral and chemical composition. The rock consists of up to 0.6 mm long prismatic pseudomorphs consisting of Mg-or Fe hornblende, less common actinolite and cummingtonite, replacing older amphibole or uralitised pyroxene. Plagioclases (up to 0.8 mm) are less common phenocrysts; they mostly fill the space between hornblende aggregates. Thin randomly-oriented needles of hornblendes are enclosed in recrystallised plagioclase. In contrast to the previous type, plagioclases may preserve acidic (andesine) patchy domains and more basic rims. They are not completely recrystallised into a newly grown equigranular mosaic compared to fine-grained metabasites. Apatite, epidote, biotite and titanite are more common accessories. Skeletal euhedral phenocrysts of primary ilmenite are often preserved. Relics of greenschist to blueschist facies minerals (epidote, barroisite, lawsonite, chlorite) common in host rocks outside of the contact zone are also rare, but described from the Jistebsko area by Šrein *et al.* (Šrein *et al.* 2002). They are preserved mostly in coarser-grained porphyritic metabasites, while the contact metamorphic assemblages prevail in fine-grained types.



Most samples of both types of metabasites show variably developed metamorphic foliation defined by a weak compositional banding (alternation of hornblende, and plagioclase rich domains with disseminated ilmenite) or by preferred orientation of recrystallized hornblendes and plagioclases, along which fine grained matrix minerals are wrapped. Grain size and texture of metabasites are influenced not only by primary features, but also by the distance from the granite body and by regional metamorphism and associated shearing preceding the onset of contact metamorphism.

MINERALOGY OF METABASITES

The mineral chemistry of the most important constituents of metabasites — hornblendes and plagioclases — is shown in **Fig. 6**. The dominant type of amphiboles is monoclinic calcic amphiboles, classified as ferrohornblende, magnesiohornblende, actinolite and cummingtonite. The Si in T site range between 6.8 and 7.79 pfu, they are very low in TiO_2 and MnO and alkalis. FeO rich (21.5–22.1 wt%) cummingtonite is present mostly in all samples as rim or newly formed euhedral grains or exsolution lamellae in other hornblendes.

The coexistence of the aforementioned amphiboles in textural equilibrium is caused by their immiscibility at the transition from greenschist to amphibolite facies (Dale *et al.* 2005). The composition of plagioclases ranges from andesine to anorthite (**Fig. 5**). Metabasites with a porphyritic texture (An-30-45) have a more acidic composition, while mostly completely

Fig. 3. Basic overview of the geological situation in the region: a – geological map of the vicinity of the Neolithic quarries in the Jizera Mountains; key: J – Jistebsko; VH – Velké Hamry; 6 – alluvial sediment; 9 – moor, peat, gyttja; 13 – stony to clayey-stony sediments; 198 – olivinic nephelinite; 341 – grey and greenish-grey siltstones, claystones, sandstones, beds of bituminous claystones, and clayey limestones; 811, 816, 853, 854 – phyllite; 812 – crystalline limestone to dolomite; 819, 868 – quartzite; 846 – serpentinite; 851 – metadolerite, green schist; 862 – quartzitic phyllite and quartzite; 866, 867 – phyllite and mica schist; 872 – pyroxene gneiss; 873 – mica schist; 1493 – quartz-hematite vein; 1497, 1500 – granite; 1498 – granite to granodiorite; b – overview map of all the sites with outcrops of the studied metabasites; key: 1 – undetermined type of metabasite; 2 – fine-grained metabasite; 3 – porphyritic metabasite; 4 – tuffitic phyllites; 5 – fine-grained and porphyritic metabasite; 6 – contact zone between the Tanvald and Liberec granites and the crystalline complex; 7 – edge of the contact aureole; 8 – areas with finds of metabasites, in most cases areas of dispersed fragments of metabasites in slope sediments; only a few sites represent exposures with preserved positions of bodies. Prepared by F. Trampota based on *Geological map 1:50 000 of the Czech Republic, Czech Geological Survey Prague* (www. geology.cz).

Ryc. 3. Podstawowa sytuacja geologiczna w regionie: a – mapa geologiczna okolic neolitycznych kamieniołomów w Górach Izerskich; legenda: J – Jistebsko; VH – Velké Hamry; 6 – osady aluwialne; 9 – torfowisko, torf, gytia; 13 – osady kamieniste do ilasto-kamienistych; 198 – nefelinit oliwinowy; 341 – szare i zielonkawo-szare iłowce, iłowce, piaskowce, pokłady iłowców bitumicznych i wapieni ilastych; 811, 816, 853, 854 – fyllit; 812 – wapień krystaliczny do dolomitu; 819, 868 – kwarcyt; 846 – serpentynit; 851 – metadoleryt, łupek zielony; 862 – fyllit kwarcytowy i kwarcyt; 866, 867 – fyllit i łupek mikowy; 872 – gnejs piroksenowy; 873 – łupek mikowy; 1493 – żyła kwarcowo-hematytowa; 1497, 1500 – granit; 1498 – granit do granodiorytu; b – mapa przeglądowa wszystkich stanowisk z wychodniami badanych metabazyt**ów**; legenda: 1 – nieokreślony typ metabazytu; 2 – metabazyt drobnoziarnisty; 3 – metabazyt porfirytowy; 4 – fyllity tufitowe; 5 – metabazyt drobnoziarnisty i porfirytowy; 6 – strefa kontaktu granitów tanvaldzkich i libereckich z kompleksem krystalicznym; 7 – krawędź aureoli kontaktowej; 8 – obszary ze znaleziskami metabazytowymi, w większości przypadków obszary rozproszonych fragmentów metabazytowych w osadach stokowych; tylko kilka miejsc reprezentuje odsłonięcia z zachowanymi pokładami. Oprac. F. Trampota na podstawie *Geological map 1:50 000 of the Czech Republic, Czech Geological Survey Prague* (www. geology.cz).

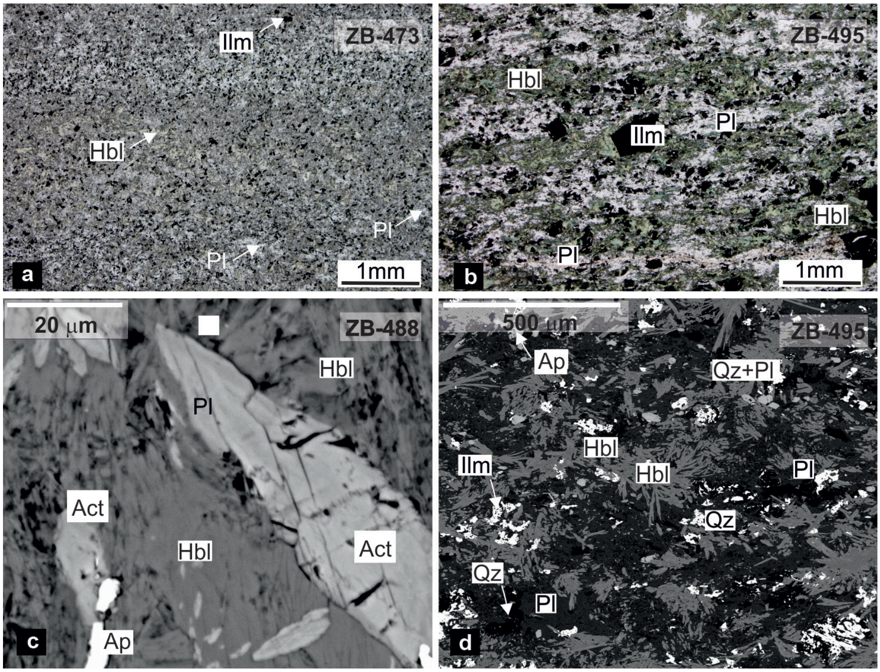


Fig. 4. Jizera Mountains-type metabasite, analysed samples: a – sample ZB-473. Fine-grained laminated metabasite from the quarrying pit at the Jistebsko III archaeological site. Note alternate hornblende- and plagioclase-rich laminae with fuzzy borders; WGS 84 coordinates: 50.702266078N, 15.20980226E; b – sample ZB-495. Metabasite with relic porphyritic texture. Older hornblendes are replaced by fibrous, randomly oriented aggregates of magnesio-hornblende, actinolite and cummingtonite. Primary magmatic ilmenites break down into fine-grained aggregates. Older plagioclases are recrystallized to fine-grained mosaic of equigranular grains of 0.0X – 0.1 mm diameter. The basicity ranges from andesine to anorthite, 50.71037588N, 15.27580848E; c – sample ZB-488. Back-scattered electron (BSE) image of porphyroblastic metabasite. Sharp contact between actinolite and actinolitic hornblende probably due to immiscibility of both phases during the rising temperature in the course of contact metamorphism; 50.71711796N, 15.29615948E; d – sample ZB-495. BSE image of whisker-like aggregates of Mg-to-Fe hornblende replacing older porphyroblastic hornblende. Recrystallized plagioclases show a weak preferred orientation and enclose hornblende fibers and broken crystals of ilmenites (mineral abbreviations according to: Whitney, Evans 2010); Hbl – hornblende, Ac – actinolite, Pl – plagioclase, Ilm –ilmenite, Qz – quartz, Ap – apatite. Prepared by V. Kachlík.

Ryc. 4. Metabazyt typu Góry Izerskie, analizowane próbki: a – próbka ZB-473. Drobnoziarnisty laminowany metabazyt z wyrobiska górniczego na stanowisku archeologicznym Jistebsko III. Widoczne naprzemianległe blaszki bogate w hornblendę i plagioklazy z rozmytymi granicami; współrzędne WGS 84: 50.702266078N, 15.20980226E; b – próbka ZB-495. Metabazyt z reliktową porfirową teksturą. Starsze hornblendy są zastępowane przez włókniste, losowo zorientowane agregaty magnezjo-hornblendy, aktynolitu i cummingtonitu. Pierwotne ilmenity magmowe rozpadają się na drobnoziarniste agregaty. Starsze plagioklazy są rekrystalizowane do drobnoziarnistej mozaiki ziaren równobocznych o średnicy 0,0X – 0,1 mm. Zasadowość waha się od andezyny do anortytu, 50.71037588N, 15.27580848E; c – próbka ZB-488. Obraz elektronów wstecznie rozproszonych (BSE) porfiroblastycznego metabazytu. Ostra płaszczyzna styku między aktynolitem i aktynolityczną hornblendą prawdopodobnie z powodu niemieszalności obu faz podczas wzrostu temperatury w trakcie metamorfizmu kontaktowego; 50.71711796N, 15.29615948E; d – próbka ZB-495. Obraz BSE przypominających wąsy agregatów hornblendy Mg do Fe zastępujących starszą porfiroblastyczną hornblendę. Rekrystalizowane plagioklazy wykazują słabą preferowaną orientację i otaczają włókna hornblendy i połamane kryształy ilmenitów (skróty minerałów wg: Whitney, Evans 2010); Hbl – hornblenda; Ac – aktynolit; Pl – plagioklaz; Ilm – ilmenit; Qz – kwarc; Ap – apatyt. Oprac. V. Kachlík.

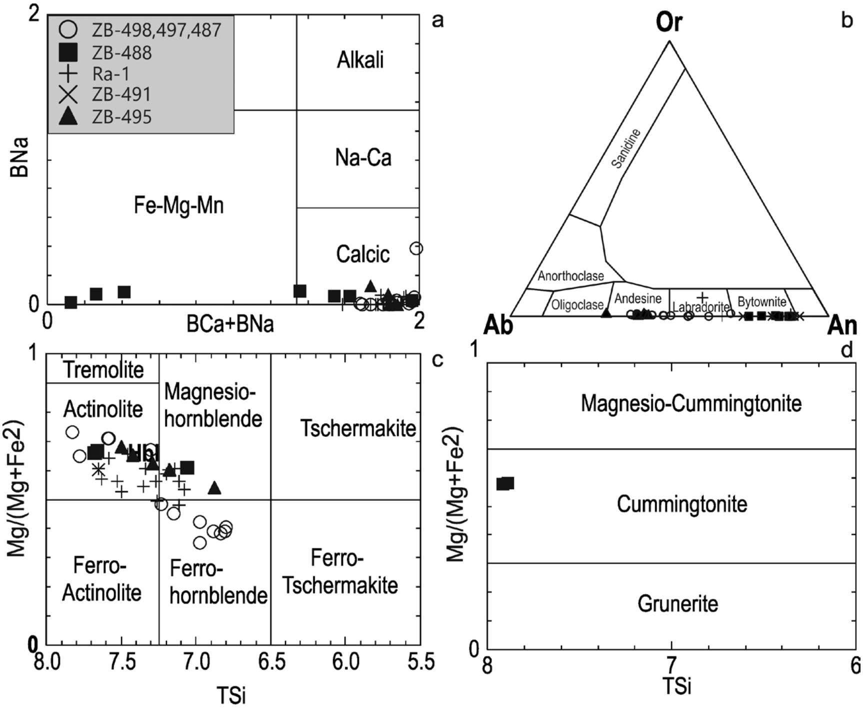


Fig. 5. Jizera Mountains-type metabasite: a – basic classification diagram (according to: Hawthorne 1981) for hornblendes; localities from the southern contact of Tanvald granite including the Jistebsko archaeological site; b – chemical composition of plagioclases from the Jizera Mountains-type metabasite (samples and localities as in c); c – classification diagram for calcic amphiboles (CAB < 1.50; (Na+K) A≤0.50, CaA≤0.50; according to: Leake *et al.* 1997); d – classification diagram for Fe-Mg cummingtonite series of amphiboles from the Jizera Mountains-type metabasite (according to: Leake *et al.* 1997). Sample ZB-498, locality 19, Zásada, Zbytky; sample ZB-497, locality 18, Zásada pod Vinicí; sample ZB-487, locality 33, Kokonín; sample ZB-491, locality 35, Rádlo – Dolní Háje; sample ZB-495, locality 17, Zásada, Zadní Zbytky, Vinice (in Šída *et al.* 2014b; Ra-1 in Klomínský *et al.* 2004). For a detailed petrographic and mineralogical description see Šída *et al.* 2014b. Prepared by V. Kachlík.

Ryc. 5. Metabazyt typu Góry Izerskie: a – podstawowy schemat klasyfikacyjny (wg Hawthorne 1981) dla hornblend; stanowiska z południowego styku kontaktu granitu Tanvald, w tym stanowisko archeologiczne Jistebsko; b – skład chemiczny plagioklazów z metabazytu typu Góry Izerskie (próbki i stanowiska jak w c); c – schemat klasyfikacyjny dla amfiboli kalcytowych (CAB < 1.50; (Na+K) A≤0.50, CaA≤0.50; wg Leake i in. 1997); d – diagram klasyfikacyjny dla serii kummingtonitów Fe-Mg amfiboli z metabazytu typu Góry Izerskie (wg Leake i in. 1997). Próbka ZB-498, stan. 19, Zásada, Zbytky; próbka ZB-497, stan. 18, Zásada pod Vinicí; próbka ZB-487, stan. 33, Kokonín; próbka ZB-491, stan. 35, Rádlo – Dolní Háje; próbka ZB-495, stan. 17, Zásada, Zadní Zbytky, Vinice (w Šída i in. 2014b; Ra-1 w Klomínský i in. 2004). Szczegółowy opis petrograficzny i mineralogiczny w Šída i in. 2014b. Oprac. V. Kachlík.

recrystallised plagioclases from fine grained metabasite have a more basic composition (An_{71-93}). Ilmenite as the third most important constituent has an important pyrophanite component (MnO 1.08–6.9 wt%) and a significant amount of Fe_2O_3 calculated from the stoichiometry; in contrast, MgO is very low (see Klomínský *et al.* 2004 for details). A more detailed description of major and accessory phases is given in Klomínský *et al.* 2004; Šída *et al.* 2014a; Šída, Kachlík 2009 (with references).

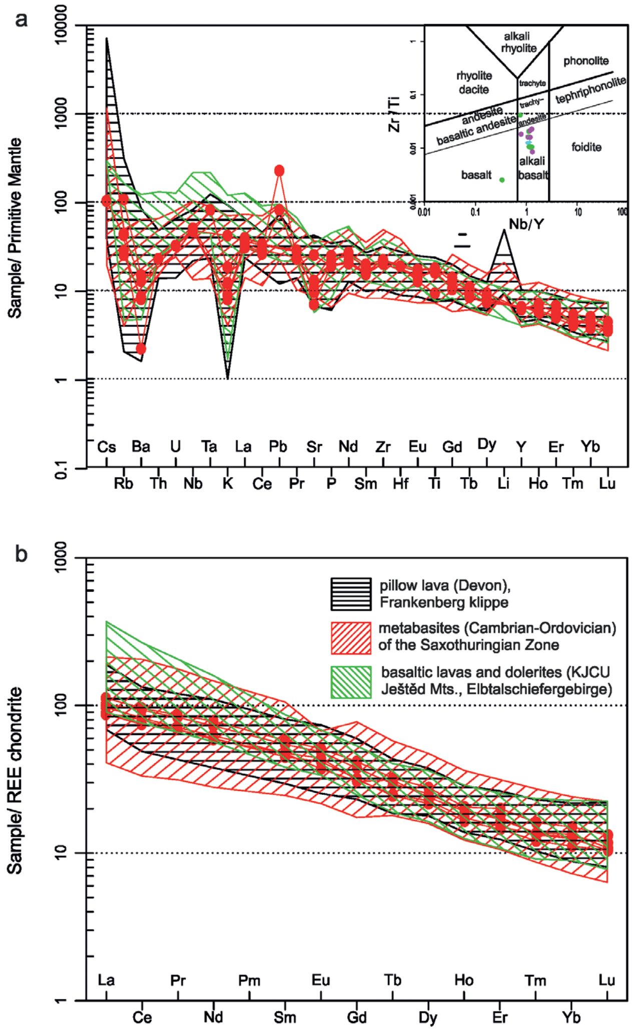


Fig. 6. Jizera Mountains-type metabasite from the Jistebsko archaeological site: a – primitive mantle (according to: Sun, Mc Donough 1989) normalized spider plots compared to metabasites from the abovementioned units (inset classification diagram of Pearce 1996) for metabasites from the contact aureole of the Tanvald granite; key: green dots – represent fine grained types; red dots – metabasites with relic porphyritic texture; b - chondrite (according to: Anders, Grevesse 1989) normalized spider plot (red dots) compared with the field pattern of Cambro-Ordovician (according to: Höhn *et al.* 2018; Patočka *et al.* 2000) and Devonian metabasites (according to: Nowak *et al.* 2011) of the Saxothuringian Zone, alkali metadolerites from the Elbtalschiefergebirge and Devonian pillow lavas from the Frankenberg klippe. Prepared by V. Kachlík.

Ryc. 6. Metabazyt typu Góry Izerskie ze stanowiska archeologicznego Jistebsko: a – prymitywny płaszcz (wg Sun, Mc Donough 1989), wykresy znormalizowane metabazytów w porównaniu do wyżej wymienionych jednostek (schemat klasyfikacji Pearce 1996) dla metabazytów z otoczki stycznej granitu Tanvald; legenda: zielone kropki – reprezentują typy drobnoziarniste; czerwone kropki – metabazyty z reliktową teksturą porfirową; b – znormalizowany wykres chondrytów (wg Anders, Grevesse 1989) (czerwone kropki) w porównaniu ze wzorem terenowym metabazytów kambrowo-ordowickich (wg Höhn i in. 2018; Patočka i in. 2000) i dewońskich (wg Nowak i in. 2011) ze strefy Saxothuringian, metadolerytów alkalicznych z Elbtalschiefergebirge i dewońskich law poduszkowych z Frankenberg klippe. Oprac. V. Kachlík.

Typical values of magnetic susceptibility are in the range of 0.5–0.8 x 10^{-3} SI units, but at some localities reach much higher values due to the presence of magnetite mineralisation (Bradák *et al.* 2009; Klomínský *et al.* 2004).

Metabasites from the contact aureole of the Tanvald granite exhibit a mostly basaltic to basaltoandesitic composition in the TAS diagram (Le Bas *et al.* 1986); (see **Fig. 6**). Fine-grained types (metatuffs) have a higher SiO_2 content (48–53 wt%), while porphyritic metabasites (dolerite sills) exhibit a lower SiO_2 content (45–50 wt%). Both groups are characterised by a high content of TiO_2, FeO and P_2O_5, a relatively low MgO value (40–65%) and relatively low alkali content. Na_2O prevail over K_2O up to six times in porphyritic types (originally dolerite sill), while fine grained amphibole rich samples have the lowest ratios up to 0.7. When we take into account discrimination diagrams using immobile transitional elements such as Nb/Y vs Zr/TiO_2 (Winchester, Floyd 1977), most samples fall into the field of alkali basalts. Trace elements are characterised by mostly variable depletion of highly mobile lithophile elements such as Rb, Sr, Ba, low content of Cr and Ni (with the exception of some porphyritic types, which are probably cumulates). In contrast, they exhibit positive anomalies in Nb, Ta, P, Ti, Li, Pb and mostly also Zr, normalised to chondrites according to Thompson (Thompson 1982).

Both types of metabasites show a highly fractionated pattern of REE (La_N/Yb_N) ranges from 11.3 to 6.07, without the Eu anomaly typical of the alkaline OIB type of basalts (**Fig. 6**). According to diagrams used for the discrimination of geotectonic environments (Hollocher *et al.* 2012; Pearce 1982; Wood 1980), metabasites fall mainly into the field of within-plate alkaline basalt (WPAB) or ocean island alkaline basalt (OIB), but mostly porphyritic types pass the boundary between WPAB and all evolved middle ocean ridge basalts (E-MORB) or within plate tholeiites (WPT). Metabasites from the contact aureole follow the MORB–OIB array. This is supported also by Pb and Sr isotopes (Christensen *et al.* 2006) and mildly positive $\varepsilon_{Nd\ 500}$ values.

They can be correlated with WPA basalt of the Železný Brod Crystalline Unit, Rýchory Mountains and Cambro-Ordovician WPAB basalts from the Thuringian and Bavarian facies realm surrounding the Münchberg klippe (Höhn *et al.* 2018). Less probable is their correlation with middle to upper Devonian alkaline metabasalts of the Ještěd Mountains, Elbtalschiefergebirge and Frankenberg klippe. They overlap heavily in their alkaline (WP geochemistry, but differ in texture and structure due to different metamorphic evolution (for a more comprehensive description of metabasites see Šída *et al.* 2014b).

PREVIOUS ARCHAEOLOGICAL EXCAVATIONS IN THE QUARRYING FIELDS

Archaeological excavations have thus far focused mainly on the Jistebsko site and only to a lesser extent on the Velké Hamry site (**Fig. 7**). The reason for this is that the Jistebsko site has well-preserved and visible terrain relics and is technically more accessible (**Fig. 8**). At the Velké Hamry site, the quarrying relics are located beneath modern deposits. A summary of the archaeological activity at all of the quarrying fields is given in **Table 1**.

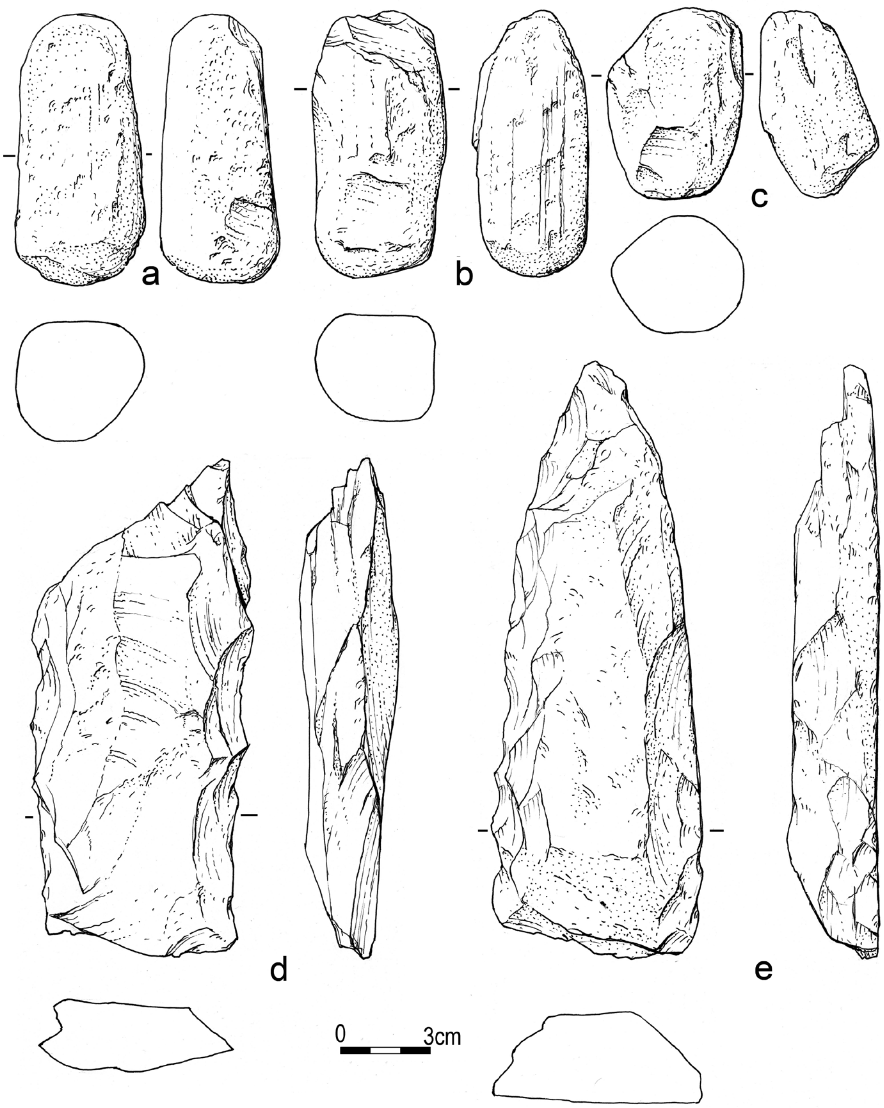


Fig. 7. Selected finds of artifacts from the quarrying fields of Velké Hamry, found in a 2014 surface survey: a–c – hammers; d–e – semi-products of axes. Drawing by M. Černý.

Ryc. 7. Wybrane znaleziska z pól górniczych Velké Hamry, pozyskane w 2014 r. podczas badań powierzchniowych: a–c – młotki krzemienne; d–e – półwytwory ostrzy siekier. Rys. M. Černý.

The small series of radiocarbon dates obtained during the excavations (**Table 2**) point to activity during the LBK period. No dates from the later Neolithic have so far been obtained directly from the quarrying fields, perhaps for a number of reasons. First, only a negligible part of the quarrying area has been investigated. Therefore, the post-LBK activity may be located in another part of the site that has yet to be investigated.

Fig. 8. Jitebsko III: surface evidence of Neolithic quarrying. Photo by P. Šída.

Ryc. 8. Jitebsko III: powierzchniowe pozostałości górnictwa neolitycznego. Fot. P. Šída.

Table 1. Basic chronological overview of field research at the quarrying fields in the Jizerské hory Mountains (prepared by P. Burgert, P. Šída).

Tabela 1. Przegląd badań terenowych pól wydobycia w Górach Izerskich (oprac. P. Burgert, P. Šída).

Year	Site	Research	References
2007	Velké Hamry II	Rescue excavation of a quarrying pit, discovered accidentally during house construction	Šída *et al.* 2013; Šída *et al.* 2014a, pp. 87–91
2004–2008	Velké Hamry I	Probing of Neolithic quarrying pits under modern overburden	Šída *et al.* 2012; Šída *et al.* 2014a
2002–2012	Jistebsko I	Probing of several quarrying pits (No. 1)	Šída *et al.* 2014a, p. 8
2009	Jistebsko, vicinity of site I, under the village	Documentation of the profiles of several quarrying pits during a rescue excavation necessitated by house construction, microprobe of a location of workshop waste	Šída *et al.* 2014a, pp. 17–21; Šída *et al.* 2014a
2010–2012	Jistebsko I	Extensive excavation of a quarrying pit (No. 2) in a square grid	Šída *et al.* 2014a, p. 8
2012–2013	Jistebsko III	Probing of a large quarrying pit No. 3	Ramminger, Šída 2012
2015	Jistebsko, vicinity of site I, under the village	Documentation of a quarrying pit during rescue excavation for the construction of a garage	Unpublished
2018–2019	Jistebsko, between sites I and III, under the village	Two concentrations of workshop waste and a quarrying pit, investigated with two microprobes	Unpublished
2022	Jistebsko, vicinity of location I, under the village	Concentration of workshop waste and a quarrying pit, investigated with two microprobes	Unpublished
2023	Jistebsko III	Continued exploration of quarrying pit 3, excavated in 2012–2013. Microprobes in the vicinity	Unpublished

Table 2. Radiocarbon data obtained from the quarrying fields (prepared by P. Šída).

Tabela 2. Dane radiowęglowe uzyskane z pól wydobycia (oprac. P. Šída).

Site	Material	Lab number	Age ^{14}C	σ	Age BC, 95% probability			Dating	Context	References
Jistebsko I	charcoal	Erl-15826	6574	60	5631	–	5386	Neolithic	Quarrying pit 2, hearth L1	Ramminger, Šída 2012
Jistebsko I	charcoal short life	UGAMS 10397	6510	30	5535	–	5379	Neolithic	Quarrying pit 2, hearth LM5 (24)	Unpublished
Jistebsko I	charcoal short life	UGAMS 10398	6500	30	5526	–	5376	Neolithic	Quarrying pit 2, hearth LM9 (15)	Unpublished
Jistebsko III	charcoal	Poz-90051	6400	40	5471	–	5317	Neolithic	Quarrying pit 3	Unpublished
Jistebsko I	charcoal short life	UGAMS 10396	6390	30	5469	–	5316	Neolithic	Quarrying pit 2, hearth LM4 (25)	Unpublished
Jistebsko I	charcoal short life	UGAMS 10394	6360	30	5468	–	5231	Neolithic	Quarrying pit 2, hearth L1/3 (31)	Unpublished
Jistebsko I	charcoal	Erl-15827	6334	59	5470	–	5214	Neolithic	Quarrying pit 2, hearth M1	Ramminger, Šída 2012
Jistebsko	charcoal	UGAMS 5279	6270	30	5316	–	5211	Neolithic	Lot 350/1, section quarrying pit 2	Prostředník, Šída 2010
Jistebsko I	charcoal short life	UGAMS 9513	6250	30	5311	–	5078	Neolithic	Quarrying pit 2, hearth L1	Unpublished
Jistebsko I	charcoal	Erl-15825	6234	58	5321	–	5036	Neolithic	Quarrying pit 2, hearth H1	Ramminger, Šída 2012

Jistebsko I	charcoal short life	UGAMS 9514	6230	30	5303	–	5070	Neolithic	Quarrying pit 2, hearth M1	Unpublished
Velké Hamry II	charcoal	GdA-1206	6220	40	5303	–	5057	Neolithic	Quarrying pit 1	Prostředník, Šída 2010
Jistebsko	charcoal	UGAMS 5277	6210	30	5295	–	5057	Neolithic	Lot 350/1, trench 1, hearth	Prostředník, Šída 2010
Jistebsko I	charcoal short life	UGAMS 10395	6210	30	5295	–	5057	Neolithic	Quarrying pit 2, L2 (6)	Unpublished
Jistebsko	charcoal	CRL 22_1980	6186	30	5281	–	5034	Neolithic	Excavation 2022, trench 1	Unpublished
Jistebsko I	charcoal	VERA-2981	6120	35	5209	–	4957	Neolithic	Quarrying pit 1, trench 1	Prostředník *et al.* 2005
Jistebsko	charcoal	UGAMS 5278	6100	30	5207	–	4935	Neolithic	Lot 350/1, section quarrying pit 2	Prostředník, Šída 2010
Jistebsko I	charcoal	GdA-533	6095	35	5207	–	4859	neolithic	Quarrying pit 1, trench 3	Prostředník, Šída 2010
Jistebsko	charcoal, Fraxinus	Poz-90053	6020	40	5011	–	4799	neolithic	Excavation 2015	Unpublished

The second possibility is that the area was not used for metabasite quarrying in the post-LBK period. The raw material may have been quarried at other outcrops in the area or extracted in the Kamenice river. Some polished tools from the context of the SBK retain part of the original river-cobble surface, thus proving that at least some of the raw material in the later period did not come directly from primary sources (Šída 2007, p. 101; Burgert 2019, p. 199, Fig. 250).

The archaeological material found in the quarrying pits consists mainly of waste from the production of tool blanks, of which several tons were found here. In addition, there are accumulations of charcoal in the form of remains of fireplaces.

LOCALISATION OF THE JIZERA MOUNTAINS-TYPE METABASITE SOURCE IN RELATION TO STABLE NEOLITHIC SETTLEMENT

To understand the relationship between the metabasite quarrying area in the Jizerské hory Mountains and the stable settlement area (**Fig. 9**), it is necessary to consider settlement structure based on a synthesis of the Neolithic in Bohemia (Pavlů, Zápotocká 2013, Figs 2–3). This spatial analysis is based on archaeological finds (including isolated ones) that can be chronologically assigned to particular archaeological cultures. The second option is to use the dataset at Neolithic settlement sites (Pajdla, Trampota 2021), which only applies to the post-LBK period and to the eastern half of Bohemia, i.e., east of the Jizera and Vltava rivers. It does not include casual finds, hence the difference from the first set described above. Two chronological phases of SBK pottery (Early/Late) can be distinguished and their development traced.

The broader settlement area in the surroundings of the Jizerské hory Mountains is practically identical taking the two successive archaeological cultures (LBK and SBK) into consideration. The closest stable settlement area to the metabasite sources in the Jizera Mountains is in the area around the town of Turnov, about 12 km in a straight line, where a cluster of settlement sites exists. Other settlement clusters are in the vicinity of the town of Jičín (about 30 km), already integrated with continuous settlement in Bohemia. To the north there is a smaller settlement cluster between the towns of Legnica and Jawor at a distance of about 80 km, while the main early Neolithic settlement area south of Wrocław is over 90 km away. To the west, the nearest settlement area is in the vicinity of Dresden at a distance of approximately 100 km.

An analysis of SBK settlement dynamics in the eastern half of Bohemia (Trampota, Pajdla 2022) revealed a greater concentration of sites in the Jičínská pahorkatina Hilly land in the early phase of the SBK when the population probably declined in number; in other periods this area was not as densely populated. In the later phase of the SBK, settlement shifted to the traditionally inhabited wider belt around the Elbe river. Whether this behaviour is related to the proximity of metabasite sources in the Jizerské hory Mountains and southern Silesia in the case of erratic flint is not demonstrable, but it is possible to work with such a hypothesis.

The Jizera Mountains metabasite type is found in all of the LBK and SBK settlements in Bohemia, the only change occurring over time in the typological spectrum, when

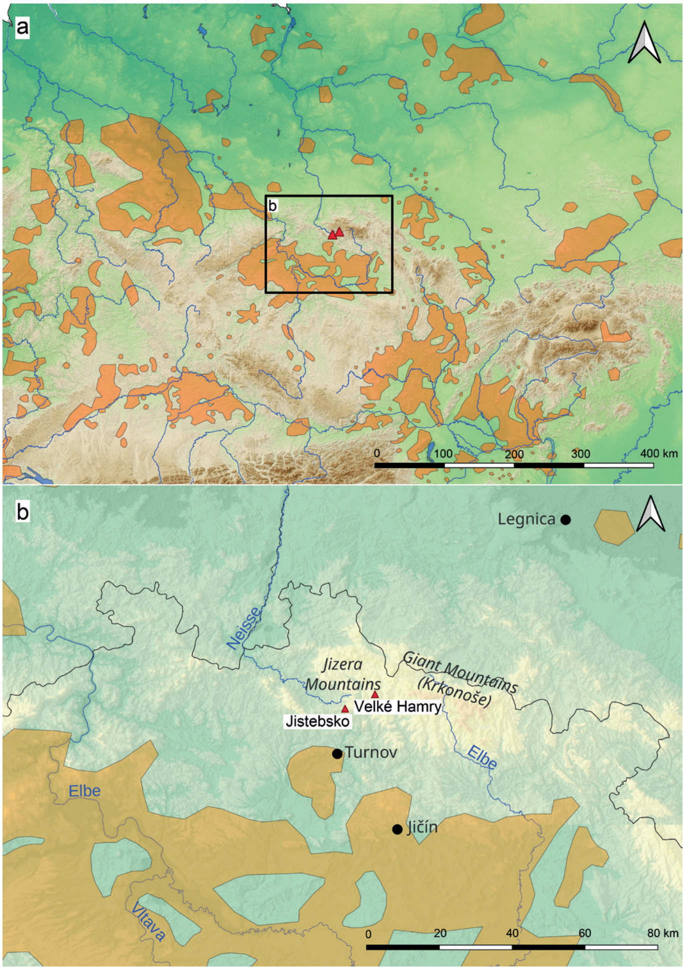


Fig. 9. LBK settlement in the vicinity of the Jistebsko and Velké Hamry quarrying fields: a – quarrying location (red triangles); b – detailed view. Visualisation by F. Trampota.

Ryc. 9. Osada LBK w pobliżu pól górniczych Jistebsko i Velké Hamry: a – lokalizacja miejsc wydobycia (czerwone trójkąty); b – zbliżenie. Oprac. F. Trampota.

the characteristic LBK adzes are replaced by axe hammers typical of the late SBK. However, the original "flat" adzes continue unchanged throughout the Neolithic.

PROCESSING THE RAW MATERIAL

At present, the quarrying and processing of the raw material is attested only in an LBK chronological context. No demonstrable activity seems to have taken place directly in the quarrying field in a later period. However, secondary workshops from an SBK context are known from sites in the East Bohemia region.

During the LBK, tool flakes were chipped into shape directly at the sites where the raw material was extracted. Numerous deposits of flakes and various raw material waste have been preserved from this process, exceptionally also semi-finished products and working tools, namely, hammers (**Fig. 7**).

Subsequently, the artifact flakes were transported mainly to eastern Bohemia (respectively to the area south-east of the source), where they were finished by grinding in common settlements. This is evidenced by the discovery of sandstone grinders of various forms, which were used for the final finishing of the tools. A relatively large concentration of hoards of semi-finished or finished tools, or combinations of these, is recorded from approximately the same region (Vencl 1975). Outside of Bohemia, semi-finished tools were sporadically found in Lower Silesia (Kufel-Diakowska *et al.* 2022) and more frequently in Saxony, for example, in Eythra (Bock 2016, Fig. 10.1:7). Repeated evidence of raw material cutting, most likely with a sandstone saw, has been recorded from several sites in Saxony whereas this type of processing is documented quite sporadically in Bohemia (Stolz 2016). With regard to the cutting of semi-finished products, Saxony thus has a specific position in metabasite processing. In other parts of central Europe settled in the early Neolithic, there is no evidence of metabasite processing and the tools were imported here as finished artifacts.

DISCUSSION

The identification of Jizera Mountains-type metabasite sources used during the Neolithic for producing polished stone tools, along with the discovery of prehistoric quarry remains at some of these sites, represents the culmination of a century of research by three generations of archaeologists and geologists. Yet, in many respects the study of this phenomenon has only just begun.

At the moment, the Jizera Mountain metabasite can be said to have predominated the raw material market only in the LBK period. Based on findings from several regions far from the source (e.g., Hessen, Ramminger 2007; western Slovakia, Farkaš *et al.* 2008), the raw material base began to be diversified already during the late LBK and especially in the post-LBK period (Burgert, Přichystal, Gadas 2023). It is likely that more metabasite resources were exploited in the later period because this raw material was available in more regions.

Evidence of the processing of semi-finished materials into final polished stone tools at the settlements is known from the earliest LBK (Burgert 2022). The production of polished tools at settlements is also known in the post-LBK age in eastern Bohemia and Saxony. Chipped flakes are known directly from the quarrying fields. Distribution away from the sources was therefore primarily directed to the nearest settlement regions and took the form of semi-finished products prepared by chipping. The presence of natural sources of sandstones in the vicinity of the workshops also seems to be an important aspect. Sandstone polisher were used for finishing work.

In the broader context of the LBK, it is likely that the distribution network of metabasite of the Jizerské hory type was the most extensive, but not the only one. In addition, there were distribution networks of radiolarites from the Bákony, silicites of the Kraków-Częstochowa Jurassic, as well as spondylus and other sea shell jewelry. This reflects the character of early

Neolithic society, which was probably very well connected socially, permitting a long-distance distribution of artifacts.

In this context, it is also worth noting that the resources are located in the middle of the later LBK expansion in central Europe. The fact that settlement is spatially related to this resource may not be a coincidence, especially given the dominance of the resource in the LBK. Its presence may have actually been a centripetal force for settlement.

From a diachronic perspective, the quarrying of raw material from the Jizera Mountains already in the Mesolithic is best evidenced by an axe discovered in a grave in Bad Dürrenberg, Saxony (Šída 2013, p. 24). At the same time, fragments of polished tools are known from finds under rock overhangs in the adjacent region of the foothills of the Jizera Mountains. These situations are also attributed to the Mesolithic, but reliable dating is problematic due to the origins of the layers under the rock overhangs. No Mesolithic date has yet been obtained from the quarrying fields themselves (**Table 2**).

CONCLUSION

The present comprehensive overview of issues related to the quarrying and distribution of Jizera Mountains-type metabasite is based mainly on published data, to which some new data has been added.

The resource was evidently in use already in the Mesolithic, but its fundamental importance for the Neolithization process of central Europe is closely related to the LBK. With the end of this period, exploitation of this metabasite becomes limited to a regional context. Without the woodworking tools that were produced for the construction of Neolithic longhouses and other structures, the Neolithization of central Europe would probably have looked very different. The later use of this resource in the Eneolithic/late Neolithic is only sporadic.

With emerging research on the polished stone industry in the early Neolithic, and this metabasite in particular, the current idea of the Neolithization process will probably be reformulated in the future, and the metabasite from the Jizera Mountains will play a major role in it.

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Proof-read by Iwona Zych

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STRESZCZENIE

Wydobywanie, przetwarzanie i dystrybucja metabazytu z regionu Gór Izerskich stanowi ważne zjawisko we wczesnym neolicie Europy Środkowej. Starania o znalezienie głównego źródła surowca dla środkowoeuropejskich neolitycznych narzędzi kamiennych trwały ponad sto lat. Obecnie, przeszło 20 lat po odkryciu wymienionych pól górniczych, fakt ten został zaakceptowany przez badaczy i wszedł do obiegu naukowego. Mimo to, pod wieloma względami jesteśmy dopiero na początku poznania tego złożonego zjawiska.

Naszym zdaniem, główne pytania dotyczące przyszłych badań można sformułować następująco:

1. Czy Góry Izerskie są jedynym obszarem źródłowym metabazytów używanych w neolicie?
2. Jaką formę przybrała sieć dystrybucji?
3. Czy działalność wydobywcza w Górach Izerskich podążała za działalnością mezolitycznych społeczności łowiecko-zbierackich, i/lub czy są one zbieżne chronologicznie?

W niniejszym artykule staramy się przedstawić kompleksowy przegląd zagadnień związanych z wydobyciem i dystrybucją metabazytu z Gór Izerskich, głównie na podstawie istniejącej już wiedzy, ale także nowych, prezentowanych przez nas danych. Stanowią one punkt wyjścia do nakreślenia możliwych kierunków dalszych studiów nad tym tematem.

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