Ore Mining of Kutnohorsko and its Economic Importance for Construction and Development

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Abstract. Kutná Hora became one of the most important cities in the Middle Ages thanks to its rich deposits of silver ores. The city still contains its rich mining past in its name today. The importance of this deposit led to the city developing very intensively, especially thanks to King Václav II. This sovereign contributed to the creation of a major mining law Ius regale montanorum and also moved the central mint to this city. New coins - Prague groschen - were minted there. The profits from silver mining and coinage have been significantly reflected in the still admired and valuable architecture of this mining town. The beauty of these preserved monuments greatly exceeds national significance and the town also offers original examples of mining works, which belongs to a sought after tourist destinations. Therefore, some of these monuments were inscribed in the UNESCO World Heritage List in 1995.

1. Introduction
Today's town of Kutná Hora represents a historically significant locality, which has all the prerequisites to be an important centre for geoscience and montane activities. Nowadays, geo-tourism tourism is a very popular form of tourism, as evidenced by the many scientific works devoted to this form of tourism. [1-5]. This city, with its historical significance, is one of the world best examples, where the building process of medieval mining towns can be seen. Mining activity, which is also included in the name of the town itself, had in the past great importance for the economy of the then state of the time. Other important milestones for the city's development were the facts that the central mint was moved here, and the mining law named of Ius regale montanorum was issued. The city experienced rapid growth at the beginning of its city construction. Not only people who participated in the mining and worked ore, but also those who supplemented inhabitant structure of the then mining towns, contributed to this growth. The city was very fast becoming the second most important city in Bohemia, right after Prague, and its further development was still dependent on silver mining revenues. Ore mining in this area was terminated in 1992 at the “Turkaňik” mine, where copper ores were mined at that time.

2. Geological structure and deposit conditions of kutná hora district
The Kutná Hora ore district was one of the most important deposit areas. From a geological point of view, the area is built with intricately folded rocks that belong to the Kutná Hora crystalline complex. Younger Cretaceous rocks (various sandstones, conglomerates, clays, limestone, marlstones, powdery marl), tertiary rocks (gravel, sand) and quaternary rocks (gravel, loess, clay) settled on the varied series
of metamorphic rocks. Focal mineralization is bound to a complex of metamorphic rocks. This complex consists of two petrographically distinct groups:

- The northern part of the district is built with rocks of the so-called Malín group. This top-down complex is made up of two-mica to biotit gneisses with erlan lenses, then migmatites, and migmatitized two-mica orthogneisses at the bottom.
- The southern part of the district is called „Šternberk-Čáslavská“. The rocks creating this complex are various types of dicotyledonous gneisses, biotite gneisses, schist gneisses and schist. Smaller bodies of orthogneiss and migmatites also belong to them there. In contrast to the previous group, varied inserts, such as amphibolites and erlans to a greater measure are occurs there. The lenses of carbonate rocks, eclogites, serpentinites and skarns are present to a lesser degree.

The deposit is classified as the Mladovari venous-sulfid-polymetallic type closely related to dislocations in the mountain massif. This complex of metamorphic rocks is disrupted by many dislocations predominantly of N-S and NNE-SSW direction. These dislocations often served as feed channels, in addition to focal mineralization, also for veins of lamprophytes, pegmatites, to a lesser extent aplites and granite porphyrs. Ore veins reach great thickness and their lengths are close to 3 kilometers. Overall, however, the structure of this deposit is very complicated because mineralization not only filled the cracks, but also replaced the surrounding rocks that were geologically damaged. The effect of hydrotherms with different mineral contents resulted in 20 zones, of which only 7 were important for the mining itself. The classification of zones is based among other things primarily on mineralogical content of ore and belongs to the litostratigraphic unit of ore district. [6-8]

3. History of mining in Kutná Hora region

More precise determination of the time when mining started in the Kutná Hora ore district is still a problematic issue not only for historians and geologists, but also for scientists from other fields of science. Researches [9-13] in addition to others rely primarily on the study of mining history and coinage in this area. The opinion that mining began in the second half of the 13th century is still prevailing. Newer research results suggesting that mining began as early as the 10th century, are still hypothetic ones. The coin material of the Slavník denars, minted in neighboring Malín, is different from the material used in the minting of the Přemyslid coins. These differences may be due to differences between ore quality from the surface of the deposit and the quality of ores mined at higher depths. Differences are also apparent in the mineralization of individual zones, where mining could be initiated in the surface areas of the Rejzian zone. Metallurgical technology that improved over the centuries may also have some impact on quality of the ore. The importance of this deposit probably led to the establishment of the first Cistercian monastery in the Czech lands in 1142. Monasteries of this type were also very intensively active in the mining of ores in another regions. The second half of the 13th century was characterized by extensive prospector activities. Thanks these activities, rich parts of Kutná Hora deposit were discovered. This fact is an important milestone in the beginning of city building process of Kutná Hora. The top production of silver and copper, which were mined by-products, lasted in the individual zones during the 13th and 14th centuries. Although silver at that time also was mined at other domestic deposits, Kutná Hora mines produced around 90% of silver. The mining depth reached up to 500 m (donkey zone) at the beginning of the 15th century and at that time it was the largest in the world. The stagnation of mining began at the same time. The stagnation was originally due to both the high mining costs and the reduction in silver production. The Hussite wars also had an impact on the crisis and deepened the problem. A new rapid expansion of mining came at the end of the 15th century. The reign of King George of Poděbrady realised the coin reform and the economic situation also stabilized. Silver production reached new peaks and was around 6000 kg at the beginning of the 17th century. However,
the richest parts were already being exhausted and only the ore of little metal content is steel being mined and the losses were growing at the time. Material and food prices are also rising at this time. Silver prices are falling due to increased production of this metal in Germany and America as well. At the turn of the 17th and 18th centuries the mining of the deposit started to be restored. Mining in the 18th century was fluctuating and often did not meet expectations on some zones. Mining was disrupted in the middle of the 19th century and later attention was paid to mining waste (metal sulfids) as an additive for compacting ores from Příbram. The initiative also soon ended in the early 20th century. Due to the lack of strategic metals for the armaments industry at the turn of the 1930s and 1940s, mining works were restored. After World War II, these works helped to further develop the mining industry, which ended in 1992.

4. Creation, construction and development of the city

The origins of the city are closely related to the occurrence of silver ores in this area. As early as the 10th century, the Malín hillfort was founded, a fortified settlement built on the territory where the Celts and other ethnic groups lived before. The administration was entrusted to the noble family of Slavnikovci and the local mint already minted the first coins of the Czech rulers of silver denarii there at this time. Another milestone that preceded the founding of this city was the founding of the Cistercian monastery in Sedlec in 1142. This monastery has also its own primacy. It is the first monastery of this order, founded in the country. The rapid development of mining in the first half of the 13th century also underlined the discovery of new rich deposits of silver ores. King Václav II (1278-1305) had also been aware of the importance of silver for financing the state since the beginning of his rule. The rich deposit soon attracted miners from distant areas where these deposits were already poorly mined. At the beginning of development of Kutná Hora, there was a "Silver Fever" that brought thousands of people here. At this prosperous mining settlement in 1289, we find the name Mons Cuthna (Kutná Hora). An important milestone in the history of this city was the year 1300. In this year King Václav II gave this city a new document Ius regale montanorum (Royal Mining Law). It constituted the Mine Code and the Coin Reform. Italian lawyers, especially prominent lawyer Gozzius of Orvieto, also participated in the preparation of this document. The law consisted of four books, written in Latin. His preparation was based on previous legal documents, mainly from Jihlava mining law. This document was translated into many languages and was used in many parts of the world for a long time. The document also introduced a new coin - the Prague’s Groschen. This act was also related to the relocation of the central mint to this town shortly after 1300. The royal castle named Italian Court (Vlašský dvůr) was designed for this purpose. The urbanisation of the city was rather chaotic at the beginning, where the mining colonies were built next to single mines. Construction of burgher houses began at the beginning of the 14th century, as evidenced by archaeological research. The irregular plan for the construction of the town has still preserved today. The city was protected from the beginning by wooden walls, which were replaced by brick ones later. However, the rapid development of the city soon forced the construction of a new city fortification. The research suggests that the entire centre of the city was built in the early 14th century. These were mostly two-storey houses. Only the cellar parts of these buildings preserved. They often entered the mine. The city also began the construction of ostentatious church buildings later some which, have not been preserved up to now and which replaced the former wooden buildings. Church had a major influence on the overall development of the city at that time. The significant achievement of the independence of Kutná Hora from the Sedlec monastery as a result of the disputes that the city had with him since its beginning was also the construction of the Cathedral of St. Barbara (chrám sv. Barbory) on the grounds of the Prague Chapterhouse, behind the city walls. A rich social background has also been built in the city. Shops, a hospital, a spa and a town school grew up here. King Václav IV. resided in the Italian Court (vlašském dvore), which he also enlarged. The town was affected by the Hussite wars in the 15th century. The Sedlec Monastery was plundered, and the town burned down. The
second half of the 15th century is favourable for the city. Thanks to high yields from mining, the construction of the town was restored. The city was comparable with Prague once again. Considerable decreased of mining began in the first half of the 16th century was also reflected in the decline of the city and its construction. The city lost some of its royal freedoms, and Prague groschen are no longer minted here. In the 17th century, the monarch donated part of the city's property to Jesuits who set up a Latin school here and built a college. In the first half of this century, the number of people due to plague and religious problems decreased by a quarter. Two large fires hit the city in the following centuries and seriously damaged the city. Restoration of important monuments took place at the end of the 19th century. Unfortunately, at that time the city removed many medieval buildings, and also the city walls with gates. However, despite the unfavourable period events and various reconstructions, the city has preserved its historical and artistic character, dominated by Gothic until today. For this reason, Kutná Hora was declared an urban conservation area in 1961. The historic center of Kutná Hora together with the Church of St. Barbara and the Church of Our Lady (chrám Nanebevzetí Panny Marie) in Sedlec were added to the UNESCO World Heritage List in 1995 [11], [12], [14].

5. Significant surface and subsurface building objects

Very soon after its foundation, Kutná Hora became an important city and the economic importance of the local deposit was reflected in the long-term development of this city. Although the Hussite wars significantly damaged the city, thanks to mining it soon recovered and developed. The decline in mining also meant that the importance of this city also declined. The city was a big competitor of Prague in the past, now it is not. For comparison, Kutná Hora has less than 20 000 inhabitants today and the number of inhabitants is declining year-on-year, while Prague has around 1 309 000 inhabitants and this number is still. Both of these cities are on the UNESCO list. The fact that the city got into this list is due to the monuments that were built when the mining activity was very advanced. Originally Gothic buildings that were damaged by wars and fires in the past and were later restored, have retained their original character up to now. There are many monuments in the city [11], [15-17] which are mainly numerous churches, monasteries or chapels (Church of St. James (Kostel sv. Jakuba), Church of St. John of Nepomuk (Kostel sv. Jana Nepomuckého), Church of the Holy Trinity (kostel Nejsvětější Trojice), Church of Our Lady on the Square (kostel Matky Boží Na Náměstí), Monastery of St. Voršila (Klášter řádu sv. Voršily) and church Sacred Heart of Lord (kostel Nejsvětějšího srdece páně), Chapel of Corpus Christi (Kpale Božího těla)). Other buildings also belong to the historical objects e.g. houses (Sankturińskовský, Tylův, Kamenný, Dačický), the late Gothic Stone Fountain, the Baroque Plague Column. The 20th century architecture is represented by the buildings of theater, cinema and industrial school. For the purposes of geomontaneous tourism, some of these objects are described in more detail here and can be included in thematic itineraries. The church had a great influence in the times of the city's development, and also therefore the church buildings are the most beautiful and numerous buildings in the city.

5.1 Church of St. Barbara (Chrám Svaté Barbory)

This cathedral, dedicated to the patroness of miners, is a World Heritage site. The cathedral is one of the most beautiful examples of late Gothic found in Bohemia. This five-nave cathedral was supposed to be twice the length of its original plans. At the same time, it was supposed to be a competitor of St. Vitus Cathedral (chrám sv. Vita) in Prague. The beginnings of the construction dated back to 1388, when it began outside the walls of Kutná Hora, on the grounds of the Prague Chapter. This choice was to achieve the city's independence from Sedlec Monastery. The construction of the cathedral took place in stages and several architects participated in the projects. The cathedral was built by Jan Parler and sandstone from the surrounding quarries was used during the construction. Matěj Rejsek, who was replaced by Benedict Rejt after his death, continued in construction. Rejt's project was also used after his death. The
financial problems associated with the decline in mining in 1558 eventually ended construction. The incomplete and interrupted construction resulted in the western side of the temple being terminated by a temporary wall. Great damage was later caused by the Hussite wars, during which the interior of the church was destroyed, and the valuables stolen. In 1626 King Ferdinand II gave the temple to the Jesuits, who soon built a dormitory beside him. The later Baroque restoration of the roof truss, which took place after the fire, is only documented by Andreas Groll's photographs today, which date back to the mid-19th century. The purist restoration, which took place in 1884-1905, returned to the original Gothic elements, the temple was completed in the neo-Gothic style and the western part of the temple was enriched. There are interesting late Gothic frescoes in the interior. We can see in some chapels, such as the Hašplířská Chapel (Hašplířská kaple) or the Coin Chapel (Mincovní kaple), frescoes with mining motifs that are unique in the medieval church decorations.

5.2 Cathedral of the Assumption of the Virgin Mary and St. John the Baptist (katedrála Nanebevzetí Panny Marie a svatého Jana Křtitele)
This building, situated in the local part of Sedlec, is a former church of the Cistercian Sedlec monastery. The originally Romanesque church was built in this place in 1142 but it was eventually destroyed. Soon, in 1280, the construction of the Gothic Basilica began, which was completed in 1320. The name of the builder is unknown, but you can see that he used elements of Western European architecture in the project. This building, together with the monastery, was also burned down and abandoned during the Hussite Wars. His restoration began at the turn of the 17th and 18th centuries, first under the leadership of Pavel Ignác Bayer and later the novice Jan Blažej Santini-Aichel. The rebuilding was accomplished in the Baroque Gothic style and also deleted the insensitive traces of the reconstruction carried out by Pavel Ignác Bayer. In 1708 the cathedral was consecrated again. The convent building was also built, and the monastery was reconstructed. In 1783, as a result of Joseph's reforms, the temple was deconsecrated and closed. Shortly after 1806, it served as a parish church for the neighbourhood, and in the next six years, a tobacco factory was established there. Since the 19th century, the cathedral has undergone several renovations. Although the building has a Gothic character, most of the interior is Baroque. The cathedral has been open to the public since 2009.

5.3 Church of All Saints (Kostel všech svatých)
It is another building with two towers, situated in Sedlec. Construction of this cemetery chapel began in the early 14th century. The building had two floors. There was a chapel in one and a charnel house beneath it. This object was also burned during the Hussite Wars. At the beginning of the 16th century, the previously exhumed bones of the abolished cemetery were composed into a pyramid by a half-blind monk. In the beginning of the 18th century, the building was reconstructed under the leadership of Jan Blažej Santini-Aichel. After 1784, the church got into hands of the Schwarzenbergs of Orlík, which gave it its present appearance. Bones in the ossuary were arranged by František Rint, a carver from Česká Skalice.

5.4 Former Cistercian monastery in Sedlec
Founded in 1142, this monastery was the oldest Cistercian monastery in the Czech kingdom. To this monastery belonged extensive lands, which included the area of Kutná Hora. After discovering the rich deposits of silver, the monastery gained great profits from mining. The conquest of the monastery by the Hussites meant that this building was burned down and severely damaged. In the second half of the 15th century, a gradual restoration began, and several monks moved there. At the beginning of the 18th century Baroque-Gothic alterations were held here under the direction of Jan Blažej Santini-Aichel, later František Ignác Prée and Antonín Haffenecker. The new convent building was also built between 1753 and 1759. The finishing work continued until 1763. In 1783, the monastery was abolished and since 1812 a tobacco factory has started activity, which today belongs to Philip Morris ČR a.s.
5.5 Italian Court (Vlašský dvůr)
The original fortified seat was rebuilt in 1300 by King Václav II. A central mint was placed in this originally Gothic royal palace, where silver Prague groschen began to be minted. This castle was later adapted to the needs of King Václav IV. as a royal residence, when the royal palace and the chapel of St. Václav was built. Many important historical events have taken place at this site. In 1409 the Decree of Kutná Hora was signed here and in 1471 Vladislav Jagellonský was elected Czech king. With the dying mining, this mansion was no longer important. Throughout the centuries, the castle has undergone many reconstructions and therefore, for example, there are also Renaissance elements. The last major neo-Gothic reconstruction took place under the direction of architect Ludvík Lábler in the late 19th century. Today, this national cultural monument offers two guided tours: the Royal mint (královská mincovna) and the Royal palace (královský palác).

5.6 Hrádek - Czech Museum of Silver and Medieval Mine
Originally a wooden fortress was built here at the turn of the 13th and 14th centuries. Its purpose was to protect the city at its west side. Between 1400 and 1420, this fortress was rebuilt into a Gothic mansion. The owner of this residence was the royal reeve Vaclav of Donin at that time. Jan Smíšek of Vrchoviště was the most important of the owners of this property. Thanks to him the damaged Hrádek was rebuilt into a patrician palace after Hussites riots. This reconstruction took place in the style of Vladislav Gothic as well as the Renaissance, where decoration containing mining motifs was also used. In the years 1686-1773 there was a Jesuit seminary and later a Jesuit school. Between the years 1686 and 1773 there was a Jesuit seminary and later a Jesuit school. Other schools lived there later. Since the beginning of the 20th century, when the city bought Hrádek from the Teaching Institute in 1910, there were efforts to reconstruct the object and to establish a museum there. However, the reconstruction was realised finally in the 1950s. The Mining Museum was only opened here for a short time, because of the planned reconstruction, which was realised finally in 1990s. The new exhibition of the Czech Museum of Silver was opened in 1996. The exposition is very valuable from a geomontane point of view. It offers mainly exhibits from the fields of geology, mining, coinage, but also art, craft, ethnographic. A large Library is also one part of the museum. It is also interesting to visit the St. George adit (Štola sv. Jiří), which is situated between Hrádek and Church of St. Barbara. This perfectly preserved adit was built between the 14th century and the early 16th century. This drainage adit was excavated in gneisses, which are in close contact with the Cretaceous conglomerates, which can also be observed here. Overlying limestone is the source of sinter decoration in old corridors and reminds of karst decoration. The walls and ceilings of the work bear numerous traces of the use of old tools, hammer and pick. Only 250 m of work is open to visitors. This adit was accidentally discovered in 1967 when a hydrogeological survey of the city took place.

6. Conclusion
Kutná Hora is an illustrative example of how mining towns were built in the past. Mining activities, in the past not only in this city, but also elsewhere in the world significantly contributed to their construction and grandeur. Today's form of the city offers many tourist attractions that will appeal to a wide range of visitors. In addition to Gothic, Renaissance or Baroque buildings, visitors can also see a part of the city's underground. Today's city is the result of how the city has changed as a result of declining metal mining and the needs of the state and the people living there. Of the many original buildings, a representative part has been preserved, especially church buildings, which have preserved with little changes thanks to the renewal after the disasters that afflicted the town. Some efforts to restore
the city, for example, in the 19th century caused insensitive interventions in its historical integrity. Kutná Hora is one of the cities that take the first places in the list of geomontaneous meanings.

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