THE USE OF HISTORICAL CARTOGRAPHIC AND ICONOGRAPHIC SOURCES IN SEARCH OF ABANDONED OR FORGOTTEN STONE QUARRIES FOR CONSTRUCTION PURPOSES

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ABSTRACT
When repairing historic buildings with dressed stone masonry or stone cladding there is often the need for a thorough petrographic and mineralogical analysis of the rock material used, sometimes even including the locating of the quarries from where the rock was originally obtained in the past. However the vast majority of quarries used in the past as a source of building material were abandoned over time. Often they were only small stone pits located in the near surroundings of the construction site. If the stone was not taken from one of the major quarries, whose history is well known and has been described in related literature, there are two options remaining: direct terrain surveys of nearby areas and at times areas further afield or research of possible written and pictorial archival sources.

This paper focuses on where to obtain these documents, how they usually look, how to proceed in searching for them and finally how to interpret them. Also some examples of how stone quarries are depicted on old maps and pictures will be shown, including pointing out the historical and contemporary urban planning and landscaping context. Nowadays the situation of abandoned quarries in relation to a current settlement structure or a protected natural area can create serious obstacles in the pursuit of recovering stone for the repairs of historical monuments from their authentic sources.

Keywords: dressed stone, quarry, written sources, old maps, natural resources

INTRODUCTION
When searching for suitable replacement material for the repair of historic buildings of facing stone masonry, finding the location of the original quarries and verifying the current possibilities of obtaining stone of the same or similar composition and appearance are often among the most important tasks. Even if extraction from the original site is no longer possible, such findings are usually important for the understanding of the history of the object under investigation.

For the most important buildings, such as cathedrals, monasteries or old stone bridges, quarrying sites are usually documented in written sources. Often there existed bigger quarries, open and deliberately exploited for the needs of the specific construction site. The owner of a quarry, in such a case, was the investor in the works – a monastery, church chapter, etc. Less important urban, municipal and manor buildings, including
rural churches, are reported on to a lesser degree and for other common buildings the written documents are even rarer. The amount of surviving written sources, of course, depends on the completeness of archival records and the age of the monument. Detailed written sources from the medieval period are usually preserved only for the most important buildings [8]. In terms of information value and authenticity they are the most valuable sources of direct evidence, especially construction accounts. For facts recorded with a time delay (annals, chronicles, memories of witnesses) or subjective testimonies (biographies, personal correspondence) there is a higher need for critical analysis.

Work related to searching, transcribing, possibly translating and finally the proper interpretation of these written sources must be entrusted to an experienced specialist, ideally a historian who is experienced in archive research for the needs of historic construction studies. He should be able to go through all the archival material with potentially interesting content and interpret the findings correctly. In addition to written sources in archival collections there are also visual sources, which can include historical maps, building plans or contemporary drawings, sketches, prints and photographs. While the analysis of earlier written sources usually requires palaeographic training, the visual materials, or reproductions of such, can be studied even by a layman or a specialist from another related field, such as a geologist, historian, restorer or architect. A deeper knowledge of the topic of study is invariably an advantage and sometimes may even be crucial for the correct interpretation. Modern opportunities to work with digital copies of historical maps and plans in a GIS environment, often even in thematic layers, allows direct comparison and verification of the topographic position.

CHURCH OF OUR LADY IN KONOJEDY

An excellent example of the use of preserved written and pictorial documents for locating original sources of building stone is in those related to the late Baroque Monastery Church of the Assumption of the Virgin Mary in the former convent of the Servites in Konojedy (Litomerice district), from the years 1748 to 1752. The church is a relatively large vaulted nave building constructed mostly of dressed sandstone. Careful study of the church construction history revealed detailed construction accounts, which make it possible to follow the entire progress of construction including the role of all the involved crafts. Exceptionally, the specific locations are referred to by name where the building stone was quarried, both for the conventional stonework and for the production of more demanding architectural elements. [5]
During the five years of building, a total of 10 quarries are mentioned varying in distance from 1.5 to 30 km from the site. The closest to Konojedy is 2.5 km away in Brusov, where Mesozoic calcareous sandstone and claystone were extracted for use as rough masonry blocks for the common masonry and the foundations of the church. Ashlar masonry was combined with fragments of brick and hard basaltoid Tertiary pyroclastics, the latter acquired in a rock outcrop, 1.5 km away in the village of Bílí Kostelec. Carefully processed blocks forming the base of the church are of more durable Mesozoic quartz sandstone. Besides the already mentioned Brusov they were also imported from the 6 km distant Úštěk and Stranný 7 km away. A total of four different quarries provided the material for the cutting of profiled cornices. For that purpose they used better quality Mesozoic quartz sandstone from quarries in Blížvedly (6 km away), Stranný (7 km), Lovečkovice (9 km), or even from Loubí 20 km away. Mesozoic quartz sandstone from quarries on the outskirts of Úštěk (6 km) was used exclusively for the heads of high pilasters on both the external and interior walls and for the window jambs. It was probably most satisfactory in terms of its composition and workability for these architectural elements. Even more stringent requirements were imposed on the material for profiled door portals. Mesozoic quartz sandstone was brought from the approximately 30 km distant quarry near Seidelberg (today Plěšivec near Nedamov). Its quality, especially regarding hardness and abrasion resistance, is undoubtedly confirmed by its use for the paving of the church where it was combined with glauconitic calcareous Mesozoic sandstone from Hrušovany (16 km). Very interesting, but not unusual, is the opening of a new quarry of Mesozoic quartz sandstone in 1750 at Dubová Hora near Dubá (20 km). Unfortunately, however, the purpose for which this material was used is not recorded anywhere.
With the help of the detailed survey maps of 1843 (Fig. 2-5), it has been possible to accurately trace the remains of all the mentioned quarry sites. Their situation related to the location of the church building is shown in Figure 1. Although these maps are almost a hundred years later, they usually reflect the current status of older historical development such as these quarries which were exploited for very long periods. In some places mentioned a single quarry was discovered, while in others, such as at Dubová Hora, there are several possible sites. This probably indicates a long tradition in stone quarrying in this area, with small quarries dispersed at various sites. The quarry in Plešivec is no longer depicted on the map from 1843 as a pictogram, but east of the village there are two places with the local name Steinbruch (meaning Quarry in German).

Identified quarries used in the construction of the church in Konojedy also represent several different types of quarrying methods, which are typically found in the Bohemian Cretaceous Basin. The quarry in Brusov (Fig. 2) represents a widespread tradition of a small local source found at the edge of a minor village. It used horizontal excavating which is easiest where moderately protruding hillocks reveal solid sedimentary bedrock. Such quarries were used over a long period for the common local buildings and constructions and they are very often found in the North Bohemian region. Slightly different is the method of extraction or utilization of natural relief at the quarry in Loubí (Fig. 3), where there is a gradual excavation of the rock revealed by erosion processes in the form of terraces above the stream meandering in the valley. The centre of the village is located at the top, on a plateau with fertile farmland, while the quarry was opened in the valley at the base of the cliff wall, next to a long-distance communication route. A variant of this type are the quarries in the town of Ústěk (Fig. 4) where urban settlements spread in such a way that the quarries were left immediately behind residential houses lined up along the valley road in front of the rock walls. It is assumed that the houses built adjacent to the rock housed people employed in the quarries directly behind them. The last completely different type of quarrying is in Hrušovany (Fig. 5). In the surrounding fields quite far from the village, is a great quarry opened as a regular rectangular hole in the ground with the walls again showing terraced excavation. Finding good quality rock was undoubtedly a strong impetus for the removal of agricultural land and the establishment of a business for the production and sale of stone.

The example of Konojedy church shows how a combination of comprehensive written sources describing the emergence of an important historical building coupled with detailed historical maps allows for a very accurate assessment of the sources of the rock material used in the construction. The information obtained at the same time shows the use of stones of different origin from a relatively large variety of different quarries. The reasons for this can be seen as a combination of certain artistic intentions of the architect with attempts to match the durability of the stone to the climatic conditions and in relation to its placement within the entire structure. Perhaps another aspect could even have been logistical. The considered distribution of material support to more suppliers from nearby sources could have contributed to the fact that the church building was fully completed within the relatively short period of five years. [5]
Fig. 2 – Brusov (Litoměřice district), survey map, 1843. Smaller local quarry (plot no. 206) southwest of the village and detail (http://archivnimapy.cuzk.cz/)

Fig. 3 – Loubí (Česká Lípa district), survey map, 1843. Cliff wall quarry at the eastern end of the valley and detail (http://archivnimapy.cuzk.cz/)
Fig. 4 – Ústěk (Litoměřice district), survey map, 1843. Quarries and buildings at the edge of the valley in the southern outskirts and detail (http://archivnimapy.cuzk.cz/)

Fig. 5 – Hrušovany (Litoměřice district), survey map, 1843. Extensive recessed quarry southeast from the village and detail (http://archivnimapy.cuzk.cz/)
HISTORICAL MAPS AND PLANS

For older historical periods detailed survey maps are not available with which to accurately identify the place of extraction of the stone. Quarries, whose economic importance has always been unquestioned, appeared only on land and forest maps of manor estates. At other times, we find them depicted as part of a detailed landscape in the panoramas of cities which began to appear from the late Middle Ages following the development of the printing press. A good example is the view of the Swiss capital of Bern engraved by Matthäus Merian in 1638 (Fig. 6).

Detailed surveyed maps showing the entire territory of the Czech Republic, as with most other European countries, have only been available since the early 19th century. Among the most valuable materials in the collection of the Central Archives of Surveying, Mapping and Cadastre is a unique work of the early 19th century – the so-called Fixed Land Survey based on the Imperial Patent of December 1817. In its time it was the most objective and accurate work capturing both quantitative and qualitative status of land and economy in the Czech lands. It consists of hand-drawn and colored original survey maps of all areas at a scale of 1:2880. Between the years 1824-1843 49,700 map sheets of a total of 12 691 community territories were produced. A set of these hand-colored prints was designated as a control collection for the Vienna archives (called the Imperial Imprints). A complementary collection is the so-called Indicator Sketches, consisting of copies of map sheets with the names of the owners of the land or
with new information added. Today, all of these archival maps have been digitized and are freely accessible on the website archives and are among the most viewed by researchers. They provide valuable information on the history, cultural heritage, architecture and natural resources of the Czech Republic.

In the quest for the historical old quarries also useful are the maps of the the First, Second and Third Military Surveys, which took place between the second half of the 18th century and the late 19th century. In particular, the Third Military Survey maps are a valuable study material, eliminating the shortcomings of the previous editions and were in scale 1: 25 000 for the whole territory of the former Austro-Hungarian Empire. From these map sheets was later created the main map work for the general public – in a special map scale of 1: 75 000 and for general maps in scale 1 : 200 000. The maps of the Third Military Survey overcame demise of the Austro-Hungarian Empire and continued to be modified and updated up to the middle of the 20th century as the only medium-scale map series covering the entire territory of Czechoslovakia. These numerous repeated releases suggest significant opportunities not only for military purposes but also in many civilian fields. [2]

The location of the abandoned old quarries can be ascertained using the detailed aerial photographs of the entire surface area of today's Czech Republic which were produced from about 1938 to the present. These photographic and later photogrammetric maps show the gradual disappearance and urbanization of smaller quarries originally once situated in close proximity to settlements. They also show the gradual reclamation of quarries located in the open countryside with some of the flooded quarries now put to recreational use, others as local biocentres while some, especially the smallest ones, have disappeared almost without trace.

*Fig. 7 – Miletice (Kladno district), abandoned sandstone quarry near the village of Miletice, detail of map from Military Survey III, sheet no. 3852 (http://archivnimapy.cuzk.cz/*)
ABANDONED QUARRIES AROUND DOKSY AND KAMENNÉ ŽEHOVICE

The search for old mines may have a different reason other than investigating sites related to one specific building. Demand for building stone from local sources today often remains untapped because the number of quarries from which you can get quality stone for facing masonry is only a fraction of the original. It is similar in other European countries [4], [9]. For example, between the villages of Doksy and Kamenné Žehrovice and in their immediate vicinity, there are several dozen abandoned and often overgrown larger and smaller quarries. Popular and widely used medium to coarse-grained arkoses, arcotic sandstones and conglomerates of the young paleozoic age have been excavated there since the Middle Ages up until the 1950’s. Their colour is a white-gray, gray-yellow to rusty red. In the Middle Ages and just after this stone was still used for fine and coarse construction and stone work, masonry blocks, slabs, stairs, curbs and corbels and was one of the most important building blocks of Prague. In addition to this building use it was also used for millstones, a practice dating back to Neolithic times.

Fig. 8 – Kamenné Žehrovice and Doksy (Kladno district), an area with many abandoned quarries for arkoses and marked with the geological survey carried out for potential restarting of quarrying activities

The local quarries have been proven to have been in operation in the second half of the 14th century, when stone from here was used in the construction of St Vitus Cathedral in Prague. [8] The tombstones of the first architects of the cathedral, Matthias of Arras (died 1352) and Petr Parler (died 1399), were also made from this stone. It was favoured also in the Baroque period when it was the most widely used building block in Prague. It can be seen on stairs, portals, linings and other architectural and sculptural elements particularly at Prague Castle and many other religious and secular buildings and gardens. Among the most important buildings in Prague which used this stone are the
Charles Bridge, the National Theatre, the National Museum and the Vinohrady railway tunnel, an important transportation construction.

From a heritage point of view it is desirable in the maintenance and repair of historic buildings to use the same or at least a similar kind of stone. Previously it was not possible to obtain such stone in the Czech Republic. In 1986-87 a geological survey was conducted of the site near Doksy and Kamenné Žehrovice which verified the existence of about 27 000 m$^3$ of arkoses suitable for the repair of historic monuments [6]. In 1990 a local agricultural cooperative started trial production, but unresolved ownership rights to the land meant that after a short time production had to be stopped. We can only hope that after the settlement of property rights production will restart to provide high quality stone suitable for the renovation and restoration of historic buildings.

*Fig. 9 – Quarries in the territory between Kamenné Žehrovice and Doksy from a survey map from 1841 with marks showing stone quarries (http://archivnimapy.cuzk.cz/)*
Fig. 10 – Abandoned quarry near the village of Doksy, open until the end of 1950’s (photo S. Chamra)

Fig. 11 – Abandoned quarry near the village of Doksy, showing traces of tools (photo S. Chamra)
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REFERENCES


