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A look at the region

Laboratory of Geoarchaeology of Institute of Geology of the Czech Academy of Sciences

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ABSTRACT

Geoarchaeology is an established field of science in which geological principles are applied for the interpretation of archaeological situations. However, geoarchaeological laboratories are still not a self-evident part of archaeological institutions or archaeological companies. For this cooperation, specialized workplaces at universities, laboratories of the Geological Survey or institutes of the Czech Academy of Sciences usually serve. One such laboratory that specializes directly in geoarchaeology is the Laboratory of Geoarchaeology within the Department of Geological Processes of Institute of Geology of the Czech Academy of Sciences in Prague. The Geoarchaeological Laboratory participates in research both in the form of joint grant projects and on the basis of commercial cooperation. In the last ten years, several dozen studies published in impact publications, as well as several dozen projects published in the form of research reports, have been produced. The activities of the Geoarchaeological Laboratory are not limited to the territory of the Czech Republic, as cooperation on projects in the rest of Europe, Africa and Asia have also taken place.

1. Introduction

Geoarchaeology is, or at least should be, an integral part of modern archaeological research. However, the integration of geoarchaeology into archaeological research – in essence, the adoption of a multidisciplinary approach – depends on several aspects. Archaeological research usually takes place either as a so-called rescue excavation or as part of a pre-planned project. In the case of the latter, there should be no doubt about the inclusion of a multidisciplinary approach in the financial plans of the project, but in the case of rescue excavation, the financial possibilities always depend on the investor's options or the strategy of the archaeological institution (company).

A geoarchaeological approach means the application of geological methodological approaches for the interpretation of formation processes within archaeological situations. However, it is often understood on several levels and can include, for example: study of the provenance of building materials; the petroarchaeological study of ceramics (archaeometry); and also, the study of formation processes

that have played a role in the formation of a contemporary landscape. Another geoarchaeological approach is, for example, the study of anthropogenic sediments, both in terms of their geochemical signal and in terms of a sediment's structural elements. The sedimentary and related pedological record represents an environmental archive, which (with the appropriate methods) can provide invaluable information for the interpretation of the archaeological record in both a narrower and broader context.

At present, several institutions (and/or companies) specialize in geoarchaeological research in the Czech Republic, and most of these workplaces apply slightly different approaches. However, this paper does not aim to map in detail the Czech Republic's specialized geoarchaeological workplaces. But to give an idea of the variability of specialization of individual laboratories, it can be mentioned (taken at random) that: the Institute of Geological Sciences of the Faculty of Science of Masaryk University in Brno offers archaeometrical approaches (Přichystal, 2013), and approaches related to alluvial geoarchaeology (Petřík *et al.*, 2019); while Mendel University in Brno, for example, specializes in the study of pedological characteristics within archaeological sites (Rejšek *et al.*, 2019); and archaeometric

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Figure 1. The work of a geoarchaeologist begins with field reconnaissance. This might often be a challenge: for example, our work in the alluvial plain of the Morava River needed some detailed observation from boats. Tomáš Matys Grygar (left) and Lenka Lisá (right). Photo by Pavel Lisý.



Figure 2. In some cases, just walking is not sufficient during field reconnaissance. Sometimes, the researchers even have to go on horseback in the field, like in the case of the Ukok Plateau research. From the front: Aleš Bajer – geologist; Jan Novák – anthracology specialist; Petr Pokorný – palynologist; Pavel Lisý – photographer; Zdenka Šůvová – osteologist; and finally, the local guide. Photo by Lenka Lisá.



Figure 3. To get access to some sedimentary sections is sometimes a big challenge. The study of cave deposits in Kaptar Kamar (southern Uzbekistan) was very dusty and detailed work. From the left: Michaela Ryzá and Ladislav Nejman. Photo by Lenka Lisá.

Figure 4. It is not only up to the archaeologist to open the trenches; sometimes geologist also have to work with a shovel – as in the case of the Vršce site. From the left: Radek Novák and Aleš Bajer. Photo by L. Lisá.



Figure 5. Sediment sampling in a situation where two hands are not enough. Sampling by Lenka Lisá at the Palaeolithic site of Dolní Věstonice. Photo by P. Lisý.



Figure 6. Cautious micromorphological sampling conducted by Jan Horák (the Do Rybníčků site in Prague). Photo by Lenka Lisá.

studies are performed, for example, by the Institute of Archeology, Faculty of Philosophy, University of Hradec Králové (Thér *et al.*, 2019). In the case of the Laboratory of Geoarchaeology at the Institute of Geology of the Czech Academy of Sciences in Prague, geoarchaeology is dealt with on many levels. The text presented here outlines the structure of the work of this laboratory, the forms of its regional and foreign cooperation, and also its prospects for the future.

2. Establishment of the laboratory

Institute of Geology of the Czech Academy of Sciences (CAS) has been cooperating with archaeologists for many decades. The beginnings of this cooperation are connected mainly with the research of the Quaternary period, when Vojen Ložek worked at the institute. His work was followed by Václav Cílek, who still collaborates with archaeologists even today. Since 2003, Lenka Lisá has been working at the Institute of Geology of the Czech Academy of Sciences of the Czech Republic, specializing in the sedimentology of the Quaternary, with an overlap into geoarchaeology. Thanks to the cooperation with the archaeological company Archaia Brno, the first geoarchaeological projects started. These were focused on the provenance of the material and formation history of sediments associated with the morphology of quartz grains. During the reconstruction of the Institute of Geology, which took place in 2006–2009, a new laboratory established as a part of the Department of Geological Processes, specializing directly in the formation processes of sediments, in both a natural and archaeological context (Bajer *et al.*, 2014).

The basic motto of the laboratory in the comprehensive processing of an archaeological site is one of moving

from the macroscopic to the microscopic in scale. Thus, in complex studies, it processes both the overall morphology of the landscape, the relationship to historical sources, and the related sedimentary content that the terrain provides. Processing of the sediments themselves then takes place again: from basic macroscopic observations to more detailed, “more sophisticated”, methodological approaches. However, the selection of an approach is always based on the macroscopic processing, so that from an economic standpoint it is as efficient as possible. The output from the research is always a research report (either in Czech or in English), and, in most cases, also in the form of articles in peer-reviewed or high-impact journals, or in the form of monographs (either as a whole or as chapters).

3. The temporal and spatial focus of research

3.1 Palaeolithic geoarchaeology

The first studies of the current Geoarchaeological Laboratory of the Institute of Geology of the CAS were connected with a research project of the University of Cambridge, the “Moravian Gate project” and were focused on the natural environment of Palaeolithic hunters and gatherers in Moravia. Geoarchaeological research of the Palaeolithic in Moravia is linked to two different sedimentary phenomena: on the one hand, with research of the climatic record in loess, and on the other hand with the karst environment; this follows on from the decades of intensive work of Vojen Ložek in both Dolní Věstonice and the Moravian Karst. The area of the Moravian Valleys, which hides powerful snowdrifts of loess sediments burying cultural Palaeolithic layers, was in the past an important migration corridor for both large fauna and Palaeolithic cultures that moved here (Lisá *et al.*, 2013;

2014). The cave environment of the Moravian Karst provided occasional refuge for Palaeolithic hunters and gatherers (Lisá *et al.*, 2013a; 2013b; Lisá *et al.*, 2018; Nejman *et al.*, 2018). Localities that have been geographically surveyed in recent years are: the Kůlna cave in the northern part of the Moravian Karst; the Pod Hradem cave on the slopes of Pustý žlab valley; the Barová and Výpustek caves in the central part of the Moravian karst; and the Švédův stůl cave in the southern part of the Moravian karst (Nejman *et al.*, 2020).

3.2 Geoarchaeology of Post-Palaeolithic Prehistory and Protohistory

A number of studies carried out in recent years by the Geoarchaeological Laboratory of the Institute of Geology of the CAS come from rescue excavations, in which prehistoric situations were detected, mostly in the form of pits, ditches (Goláňová *et al.*, 2020; Lisá *et al.*, 2013a; 2015) or earthworks (Parma *et al.*, 2011). In these projects, emphasis was mostly placed on the formation processes of infill formation and the related intensity of soil development (Lisá *et al.*, 2019; Parma *et al.*, 2015; Vejrostová *et al.*, 2019). The laboratory is a part of the recently-completed project of the Czech Grant Agency “Oppidum as an Urban Landscape: Multidisciplinary Approach to the Exploration of Spatial Structure intra muros”.

3.3 Geoarchaeology of the Middle and Modern Ages

Geoarchaeological work focused on the research of medieval and modern situations has recently been linked to both rescue archaeological excavations and projects funded by the Grant Agency of the Czech Republic. In these situations, the formation processes of anthropogenic sediments associated with particular features, such as its fillings or a specific floor layers, are usually processed geoarchaeologically (Novák *et al.*, 2012). However, the work can also include an analysis of ceramics or the chemical composition of specific artefacts, which is studied in the Laboratory of Geoarchaeology of Institute of Geology of the Czech Academy of Sciences.

Anthropogenic sediments from floor horizons within medieval stables (Dejmal *et al.*, 2014), within the filling



Figure 7. The way how to conduct multiproxy sediment sampling in wet environmental conditions. The metal boxes contain material for pollen analyses, magnetic susceptibility, bulk material for chemical analyses, as well as material for sediment micromorphology analysis. Libor Petr at the Chrást site. Photo by Lenka Lisá.

of a grain pits (Lisá *et al.*, 2017), or the floor horizons of both modern (Lisá *et al.*, 2020a) and medieval houses (Lisá *et al.*, 2020b), have all been studied in the Laboratory of Geoarchaeology as part of the Czech grant Agency projects “Veselí nad Moravou – A medieval castle in an alluvial plain” and “Transformation of a town house in the 13th century (Brno-Prague-Wroclaw)”.

Figure 8. Sometimes even surgical masks are needed, for example, when you take sedimentary DNA samples. The Kaptar Kamar site in southern Uzbekistan. From the left: Michaela Ryzá and Miriam Nývtlová Fišáková. Photo by Lenka Lisá.





Figure 9. The inseparable part of all sample processing is the documentation. Sometimes it is the most important and the most responsible part of geoarchaeological research. From the left: Vít Záhorák, Michaela Ryzá. Photo by Lenka Lisá.

3.4 Research in Central Europe

Most of the research of the Laboratory of Geoarchaeology of Institute of Geology of the Czech Academy of Sciences is focused on research within the Czech Republic or central Europe. This is mainly due to the source of funding and projects in which the Laboratory of Geoarchaeology participates. Recent projects funded by the Czech Grant Agency have focused on research into Neolithic rondels (Lisá *et al.*, 2013a; 2015), or into medieval formation processes (Dejmal *et al.*, 2014; Lisá *et al.*, 2020a; 2020b); see details above. However, as part of rescue excavations, countless smaller projects have emerged, focusing primarily on research into prehistory (Parma *et al.*, 2011; Lisá *et al.*, 2019) or the Middle Ages (Lisá *et al.*, 2017; Novák *et al.*, 2012).

3.5 Research in Africa

The work of the Laboratory of Geoarchaeology in Africa was initially linked to cooperation with the Institute of Egyptology of Charles University in Prague (Čílek *et al.*, 2012), and later to a project of the Czech Academy of Sciences supporting international cooperation, which was implemented in Sudan, focused mainly on the environment of the Sixth Nile Cataract (Lisá *et al.*, 2012; 2017; Suková and Čílek, 2012), and resulted in long-term cooperation with the Institute of Egyptology of Charles University in Prague (Varadzinová Suková *et al.*, 2015; Kapustka *et al.*, 2019).

3.6 Research in Asia

Projects of the Laboratory of Geoarchaeology in Asia have been recently focused only in long-term project cooperation with the Faculty of Arts, Charles University in Prague, for the area of Southern Uzbekistan, and with the Faculty of Arts of the University of West Bohemia in Pilsen for the area of southern Kyrgyzstan.

4. Equipment background

The Laboratory of Geoarchaeology is structured as a basic sedimentological laboratory equipped with a fume hood, dryer, vacuum chamber and centrifuge. This equipment is mainly used for basic sedimentological analyses including detail descriptions, sieving with a set of sieves and pH measurements. Furthermore, the laboratory is involved with the preparation of micromorphological preparations, *i.e.* drying and impregnation. The sections themselves are then manufactured in a specimen preparation laboratory (thin-sectioning lab) and studied in an optical laboratory. The laboratory also owns an equipment for sample preparations for grain-size analysis. These are performed using a Cilas 2000 laser granulometer, which allows measurements in the range of 0.004–2500 micrometres.

5. Cooperation within the Geological Institute of the Czech Academy of Sciences

The various individual departments of Institute of Geology of the Czech Academy of Sciences have laboratories equipped with modern instrumentation and cooperation between the laboratories is closely linked. These laboratories suitably complement each other in a wide range of analyses, which in some cases can be effectively used in geoarchaeological interpretations. Production of sections is provided by the Thin Sectioning Laboratory, and then observation of these thin sections is carried out in the Laboratory of Optical Microscopy. The Laboratory of Mineral Separation handles the pre-preparation of samples, which may, for example, involve crushing, grain separation, or separation of heavy minerals. Other laboratories capable of measuring proxy

data suitable for specific case studies are, for example: The Laboratory of Paleomagnetism in Průhonice; the Laboratory for Determination of Physicochemical Parameters; the Laboratory for Determination of Elements; the Extra-clean Laboratory using ICP-MS and TIMS; the Electron Microscopy Laboratory; and the Raman Spectroscopy or X-ray Diffraction Laboratory. The research focus of the Institute of Geology of the CAS ensures that this cooperation is always conducted at the level of published scientific outputs in impact periodicals. More detailed information on the instrumentation of individual laboratories can be found at www.gli.cas.cz.

6. Perspectives for the future development of the laboratory

Due to the fact that cooperation between the Laboratory of Geoarchaeology and other laboratories operating within Institute of Geology of the Czech Academy of Sciences is very closely connected, there is little intention of expanding the laboratory too much in the future. One planned piece of equipment is a portable XRF analyser, for fast reconnaissance of a chemical signal in the field. Individual analyses can be used when cooperating in projects as a whole, or as specific analyses. A detailed price list for commercial analyses is available on the website of Institute of Geology of the Czech Academy of Sciences; www.gli.cas.cz

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