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Preface: Special Issue "Geoarchaeology and past human–environment interactions"

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1 Geoarchaeology: emerging fields and current challenges

Geoarchaeology incorporates various research areas at the interface between geosciences and archaeology. The discipline had already evolved during the 19th century when concepts of geology and stratigraphy were applied to archaeological contexts, but the use of the term geoarchaeology, and its recognition as an independent discipline, only started in the 1970s and 1980s (Cannell, 2012). However, several definitions of geoarchaeology have been proposed and discussed during the last years, depending on the scientific background of the authors (e.g., Butzer, 1982; Leach, 1992; Rapp and Hill, 1998; Benedetti et al., 2011; Engel and Brückner, 2014). Focusing on the equal role of both sciences, we follow the definition of Tinapp (2013) and define geoarchaeology as the application of geoscientific concepts in archaeology, and also of archaeological concepts in geosciences, to investigate the interactions between humans and geoecosystems during different periods. Geoarchaeology is an approach rather than a technique, so any technique or method can be included as it addresses the understanding of past human activities in a landscape and their environmental context (Cannell, 2012).

Given that humans always lived in landscapes and ecosystems and that those landscapes and ecosystems have been influenced by humans since the beginning of human activity, integrative investigations using a geoarchaeological approach are a mandatory precondition to obtain a comprehensive understanding of past human–environmental interactions. Furthermore, given its regional- to local-scale approach in documenting the often long and intricate history of human–environmental interactions, geoarchaeology is well suited for anthroposphere research that looks at regional landscape changes linked with human activity rather than at global phenomena (Kluiving and Hamel, 2016). The discipline strongly evolved during the last years, and different methods such as micromorphology, palynology, geochemistry, isotopic studies, geographical information systems and geophysics were integrated, leading to very multidisciplinary approaches in which the discontinuities and limitations of one proxy can be overcome by the evaluation of another (Ghilardi and Desruelles, 2009; Cannell, 2012; Engel and Brückner, 2014; Zielhofer et al., 2018; Schneider et al.,

2019). Furthermore, geoarchaeology was even established as a subject at different universities (Tinapp, 2013).

However, comprehensive and systematic multidisciplinary geoarchaeological research often remains limited to well-funded scientific research and larger commercial projects, although it contributes to a better understanding of complex human–environment interactions and could improve the sampling strategies (Cannell, 2012). In Germany, for example, most excavations are advance archaeological excavations in the context of construction works that are carried out by state departments of archaeology either on their own or by authorized private excavation companies in agreement with the authorities. The comprehensive and systematic application of geoarchaeological approaches is now slowly being realized at archaeological excavations, which also holds true for its use in the context of other applied archaeological questions such as creating databases for monument preservation (Gerlach et al., 2012; Tinapp, 2013; Beilharz and Krausse, 2015; Nadler, 2019). In addition to the development and integration of innovative methods and the further development of existing geoarchaeological concepts, the application of comprehensive and systematic geoarchaeological approaches in the daily practice of archaeological excavations and monument conservation is therefore a current challenge that must be addressed in the coming years in order to prevent further research gaps and an irreversible loss of potential knowledge.

2 The contributions of this volume

This Special Issue includes studies that were presented at the 15th annual meeting of the German Working Group for Geoarchaeology (Deutscher Arbeitskreis für Geoarchäologie) that was held during May 2018 at the main seat of the Bavarian State Department for Cultural Heritage in Munich. The working group was founded in 2004 and annually unites around 100 geoscientists and archaeologists from different German-speaking universities and research institutions as well as colleagues from state departments of archaeology, private excavation companies and geoarchaeological freelancers. Besides presenting and discussing current geoarchaeological research projects and the integration of new methods into geoarchaeological contexts, one goal of these meetings is to connect geoscientific and archaeological scientists from universities, research institutions and the daily archaeological practice in order to also distribute geoarchaeological approaches within the latter field. According to the broad-ranging interdisciplinary audience of the meeting, the seven articles in this Special Issue report about current geoarchaeological research projects, the application of innovative methods and approaches in geoarchaeological contexts, and issues related to the daily practice of monument management, mirroring the broad range of current developments and challenges in geoarchaeology.

The study of Hensel et al. (2019) was carried out by scientists at the University of Cologne in the framework of the DFG-funded CRC806 project "Our way to Europe". The authors investigated the recent relations between hydrological systems and the distribution of Palaeolithic sites and obsidian raw material outcrops in southwestern Ethiopia by combining geomorphological–hydrological analyses with field surveys and GIS mapping. Doing so, the authors aimed to transfer these recent interrelations into the past to better understand the factors that influenced prehistoric human settlement activity. Although – due to intensive current morphodynamics – a simple transfer of the recent situation into the past seems rather complicated, this study demonstrates an innovative way to deal with geoarchaeological questions such as former raw material availability at larger regional scales.

The study of Miera et al. (2019) was carried out by scientists at the University of Tübingen in the framework of the DFG-funded CRC1070 project "Resource Cultures" and aims to decipher the Neolithic settlement dynamics in several landscapes of southwestern Germany. The authors combined existing archaeological and new archaeopedological data from colluvial deposits. The latter were dated using radiocarbon and luminescence methods and are regarded as indicators of former settlement activity. This study presents an innovative geoarchaeological approach to complement generally incomplete archaeological datasets of former settlement activity, allowing researchers to derive better-based conclusions about the former settlement dynamics.

The study of Tolksdorf et al. (2019) reports about the results of the EU-funded bilateral German–Czech research project "ArchaeoMontan – Mittelalterlicher Bergbau in Sachsen und Böhmen" and was carried out under the leadership of the Archaeological Heritage Office in Saxony. The authors used palaeobotanical and geochemical methods as well as radiocarbon and potsherd dating to reconstruct the Medieval settlement and mining history as well as desertion processes in a small catchment in the Saxon Ore Mountains of eastern Germany. This study is a good example for how geoarchaeological investigations can complement patchy archaeological and historical datasets, leading to a better understanding of historical processes that are not documented elsewhere.

The study of Engel et al. (2020) reports the results of a joint German–Qatari study that was carried out in the southern Qatari peninsula and was led by scientists from the University of Cologne. The authors investigated the current geomorphic setting and palaeoenvironmental changes recorded in karstic depressions that were centers of prehistoric settlement activity at least since the Neolithic period, focusing on the former availability of water resources. By integrating geomorphic mapping, geophysical prospection, sediment coring, sediment analyses and luminescence dating and relating their results with the location of archaeological sites, the authors aim to contribute to building up a palaeoenvironmental framework of prehistoric settlement.

The study of Reichel et al. (2019) was carried out by scientists from the University of Applied Sciences Berlin. It addresses soil erosion at archaeological sites that on the one hand affects the site through destruction processes and on the other hand builds up a record of former agricultural activity in the form of colluvial layers. The authors investigated Late Holocene colluvia in combination with the position of an adjacent lake shoreline next to an archaeological site in eastern Germany by using sedimentological–pedological analyses, tachymetric mapping and archaeological dating of archaeological finds, photogrammetric methods and GIS. The study demonstrates that this combination of methods allows for a more precise stratigraphical classification of archaeological finds in geoarchaeological trenches, leading to a better chronological classification of colluvial layers.

The study of Teegen et al. (2019) is mostly based on field courses for students that were carried out under the supervision of scientists from the Ludwig Maximilian University in Munich. The authors report about archaeological prospections of a Celtic to Roman site in western Germany using a combination of field and geophysical surveys, lidar scans, aerial photographs, and GIS analyses that resulted in kernel density maps of bricks and ceramics. The authors demonstrate that such an integrated methodological approach leads to a significant gain in knowledge about the location of former houses, the way of their destruction and former waste management.

The study of Vogt and Kretschmer (2019) exemplifies the use of a geoarchaeological approach for cultural heritage management. It emerged from the archaeological practice of the Archaeological Heritage Office in Saxony and the State Office for Cultural Heritage Management Baden-Württemberg. The authors address the conflicts between archaeology and agriculture linked with soil erosion and the drainage of wetlands that endanger archaeological sites in intensively used agrarian landscapes. To locate archaeological sites that are affected by soil erosion, the authors use a geoarchaeological approach that includes aerial photographs, soil mapping and soil coring. The use of this knowledge, by incorporating the interests of landowners and farmers, allows researchers to develop individual conservation and protection strategies for endangered archaeological sites.

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