



Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

GIS analysis of the spatial distribution of Middle Palaeolithic artefacts in Kůlna Cave (Czech Republic)

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ARTICLE INFO

Article history:
Available online xxx

Keywords:
GIS analysis
Spatial distribution of artefacts
Kůlna Cave
Middle Palaeolithic
Micoquian
Taubachian

ABSTRACT

The archaeological materials from Kůlna Cave have undergone various types of analyses as part of many different studies. Some of these have indicated the need to carry out a reconstruction of the spatial distribution of finds in order to focus on the ways in which the cave was divided. Having such knowledge, we could also explain more precisely the function of individual settlement horizons. The system of documentation, employed during the excavation of the cave, has made it difficult to analyse the spatial distributions using conventional methods. It is proposed using of GIS software spatial analysis simulations brought relevant and evident visualization. The results show that the utilisation of the cave changed with time. Along with simple structures attributed to the Taubachian, we also describe evidence of complex use of the interior of Kůlna Cave during the Micoquian phase of settlement (around 50 ka calBP). Results of spatial distribution analyses indicate that the same functional division of the cave was maintained over time (e.g. layer 7a or 6a) and it consequently assumes a transmission of social knowledge within the organisation of the Kůlna Cave space.

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1. Introduction

A basic feature of human behaviour is territoriality, manifested e.g. in the construction of dwellings or in the use of natural shelters for different purposes. In all cases this is not only a simple need for protection against the harsh effects of the environment, but also serves as a definition of “private” space within the inhabited ambient.

Ethnographical studies show various spatial settlement structures or zones existed within inhabited sites (Binford, 1996; Galanidou, 2000). Many factors played a role in the complexity of these settlement structures (Bailey and Galanidou, 2009) and sometimes it is difficult to categorize these factors individually given the scarcity of evidence recovered at the site (for overview see e.g. Machado et al., 2015). A detailed analysis of spatial relations among artefacts can help to filter, at a certain level, biological and post depositional factors and to reconstruct the ways in which a site was utilised, as well as the basic principles of human behaviour which influenced the formation processes (cf. e.g. Butzer, 1982; Schiffer, 1983; Shott, 1998; McPherron, 2005; Bertran et al., 2012; Henry, 2012). If we apply the appropriate methods of analysis, we are capable of defining human behaviour in space and time with a

certain probability. One of the proven methods for assessing archaeological sites and finds is their spatial analysis (Clark, 1977). Using geographical information systems (GIS) makes analysis, evaluation and visualisation of the data much easier (for an overview of methods see Fotheringham and Rogerson, 1994; Stillwell and Clarke, 2004; Kemp, 2008). The application of GIS methods in archaeological research has become highly developed today (e.g. Wheatley and Gillings, 2002; Conolly and Lake, 2006; García et al., 2014).

The accuracy of analysis and interpretation is directly dependent on the quality of the documentation of archaeological situations and finds. Modern research places a strong emphasis on georeferenced data that can be easily analysed by computer (McPherron and Dibble, 2002; McPherron, 2005; McPherron et al., 2009; Gallotti et al., 2012), nevertheless modern excavations of sites are often spatially very limited and a picture of human behaviour within the site is incomplete and results can change according to the extent of the excavated area (compare e.g. Riel-Salvatore et al., 2013; Machado et al., 2015, Tab. 1). Caves represent unique sites because areas of the human activities are strictly defined by cave walls. Moreover, there are often preserved sequences of archaeological layers and therefore we can investigate both the synchronic and diachronic aspect of the human behaviour within the individual site.

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<http://dx.doi.org/10.1016/j.quaint.2015.10.028>

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In that respect, Kůlna Cave could be a unique site because of the preservation of many archaeological layers and the extent of the excavation (Valoch, 1988a, 2002). Unfortunately, the data were collected in the 1960s and 1970s and do not fulfil the required quality regarding spatial position.

The following contribution is a first attempt to reveal the spatial distribution of artefacts in Middle Palaeolithic layers of Kůlna Cave using the Geographic Information System (GIS). The main objective

of the analysis was to examine if we are able to reconstruct the human behaviour within the cave based on a data archive that does not contain three coordinates and which therefore cannot be simply displayed in the plan of the cave. A methodology for georeferencing finds is proposed and the applicability of the method is demonstrated by the diachronic comparison of cave division in 5 Middle Palaeolithic layers – Taubachuan layers 11c and 11, and Micoquian layers 7c, 7a and 6a.

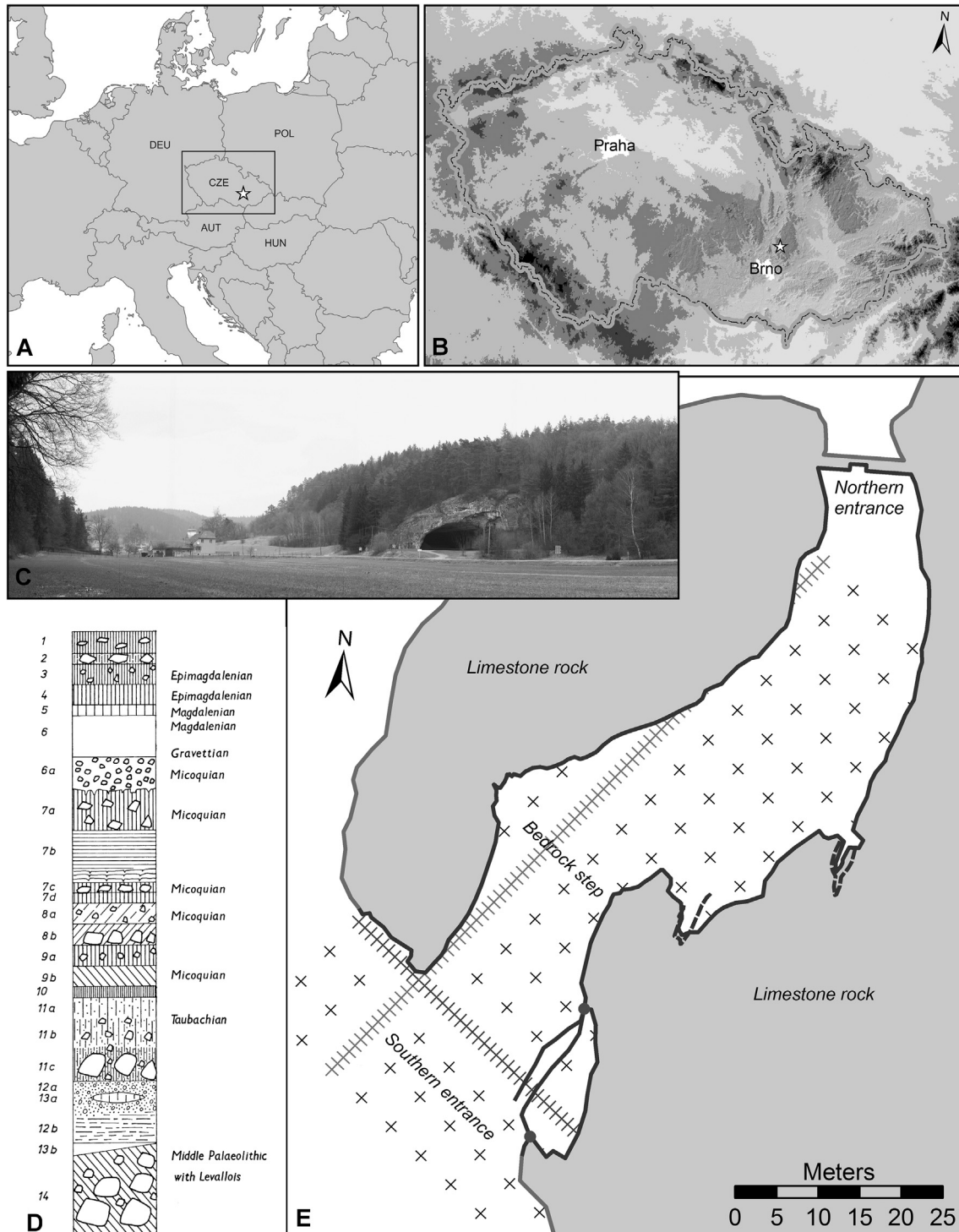


Fig. 1. Location of Kůlna Cave in Europe (A) and Czech Republic (B), view on the southern entrance of the cave (C); (D) stratigraphic sequence (modified from Valoch, 1989, Fig. 1); (E) ground plan of the cave.

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