Dark soil on sand dunes as a result of terrain levelling and tillage at the early medieval settlement of Mikulčice, Moravia

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Abstract
At the early medieval Great Moravian site of Mikulčice-Valy (8th–10th century AD), a metre-thick set of anthropogenic horizons of dark colour mixed with sand from the local dunes were found during rescue archaeological excavations. Archaeologists usually consider similar finds to be cultural layers because they are full of artifacts and ecofacts. It is the question if such general interpretation is sufficient. In order to reveal the formation processes of this humus-rich horizons in detail, the physico-chemical analyses, micromorphological analysis, together with archaeological interpretation were carried out. Based on micromorphological analysis, it is clear that this is not only a cultural layer, but rather a Dark Earth that is physico-chemically influenced by the formation and gradual anthropogenic mixing with sand dunes.

Study site
Mikulčice site belongs among several important centres of Great Moravia. It is located approximately 3 km southeast of the village of Mikulčice on the border with Slovakia (Figure 1). The area of the site is approximately 10 ha and is surrounded by ramparts. The importance of the centre is underscored by the discovery of the palace, 12 churches and a large burial ground. That is why the site was the centre of the nobility of the time. The sediments represent one of the environmental archives dated to the early medieval period (8–9th century AD). The area studied in this study has exceptional importance for the understanding of the background of the site and is represented by the set of dark and yellow sandy layers reaching thickness approximately of 1 meter.

Introduction
Dark soil horizons full of anthropogenic residues such as charcoal, bones, pottery fragments, coprolites are distributed all over the world. They are found in tropical Amazonia and Africa as well as in temperate Europe1,2,8,14. These soils can also be located as buried soils and are thus the subject of study by archaeologists5,7. The problem is that their classification is not stable in the scientific disciplines. In the case of soils sciences, we talk about anthropogenic soils, which are further classified, in the case of archaeology referred as cultural layers1. This is also the case in this study, where apparent cultural layers turned out to be buried anthropogenic soils.

The macroscopic observation of studied sections revealed a number of horizons differing by colour and grain size (Figure 2). Their micromorphological observation showed, that the lighter horizons are composed mainly of pure sand (B), while the dark horizons are composed of sandy loam, rich of anthropogenic residues (A). High bioturbation together with kitchen waste and excremental features are significant mainly for the dark horizons. These correspond to the organic infills of the houses and should represent former floors as obvious from the archaeological excavation plans. The light horizons represent the phase of surface levelling. These layers are usually very depleted. The lower parts of the sections represent former surfaces of wet environment of alluvial plain (C).

Discussion
Remnants of kitchen waste (e.g. fish bones, charcoal), building material (mortar), ceramics, but also herbivore excrements and oak wood (house structures) were observed in the micromorphological samples. This accumulation of residues associated with trampling led to the formation of anthropogenic dark layers.

Conclusions
This research contributes to the debate on anthropogenic soil formation in Europe6,7. A forthcoming study describes Dark Earth formation processes in order to understand settlement strategies.

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