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GEO-PEDOLOGICAL OBSERVATIONS AT THE VANYARC SITE

Introduction

Requested by A. Markó, archaeologist-in-charge of the excavations a complex geo-pedological field work was undertaken at the Middle Palaeolithic site Vanyarc. The horizons the soil structure and the calcareous character of the studied profile were described and the colours recorded by using MUNSELL SOIL COLOR CHARTS (1990). Samples were collected in order to study particle size distribution, micromorphology and clay mineralogy.

Geological backgrounds

The oldest formation exposed along the margins of the NNE facing hillslope, right above the village of Vanyarc are Late Miocene (*Sarmatian*) terrestrial gravels, sands and Late Pleistocene loess and brown earth.

Clays and siltstones ('Schlier') of Early Miocene (*Karpatian*) age crop out to the NNW, various Middle Miocene (*Badenian*) andesite and sand (with *Pectunculus*), sandstone and clay of Late Oligocene age are exposed to the NNE of the research area.

Description of the studied formations

Based on field observations supported by laboratory analyses the following three main formations could be disinguished at the esxcavated site.

Formation N° I. (0–22 cm) is a loose, brown (10YR 5/3), humiferous silty sand with scarce, 2 mm to 1 cm size, quartzite pebbles. The soil structure is platy on the uppermost 5 cm as a result of recent winter frost,

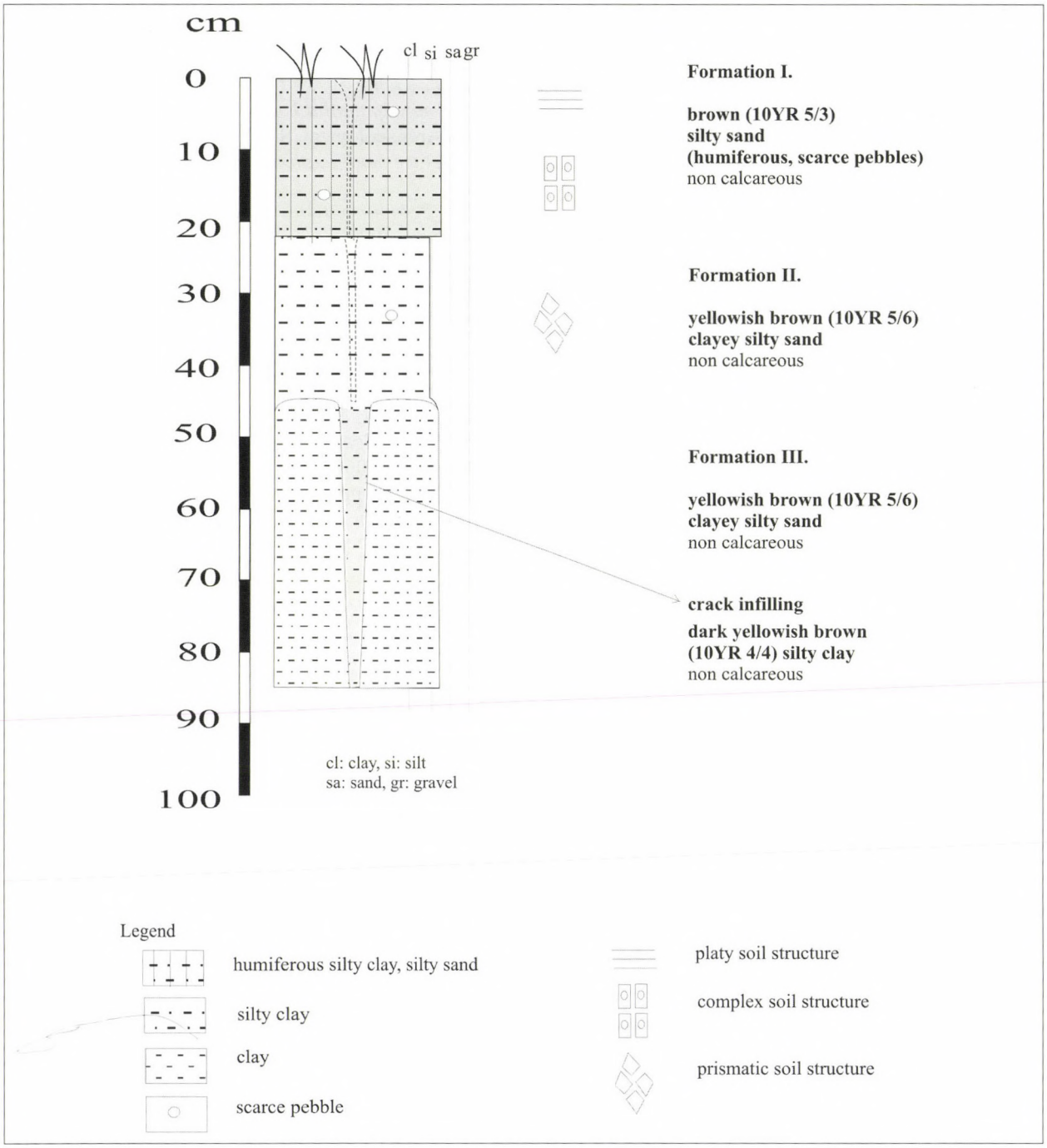

Fig. 1 Vanyarc: Paleolithic archeological site, geological column

granular below (5–10 cm) because of bioturbation and prismatic below (10–20 cm) due to repeated wetting and drying. Formation N° I. is non-calcareous. This formation could be qualified as the A_p horizon of an actual brown earth type soil.

The source area of the pebbles of medium roundness and sphericity is probably the outcrop of the Miocene terrestrial sediments about 300 m away on the slope.

Formation N° II. (22–45 cm) is a moderatly hard, yellowish brown (10YR 5/6) clayey, silty-, sandy sediment with scarce quartzite pebbles 2 mm to 1 cm in size. The soil structure is prismatic. The 1 to 10 mm thick cracks are partly opened and partly filled by hu-

miferous material probably derived from the topsoil. This formation is also non-calcareous.

Though montmorillonite is the dominant clay mineral in the clay fraction (<2 μm), vermiculite, illite and smectite were also detected.

Thin section study shows poro- and granostriated birefringent fabric with moderatly undulating extinction. Iron-stained clayey hypo-coatings are common. Few ferruginous nodules are visible as a sign of fluctuating redox conditions. The microstructure is cracked with few vughs.

Formation N° III. (22–45 cm) is very hard, yellowish brown (10YR 5/6) silty sand with a significant clay content. 3 to 5 cm wide, deep (~ 40 cm) polygonal cracks penetrate this layer. Cracks are filled by loose, dark yellowish brown (10YR 4/4) silty clay with few pebbles. This formation is also non-calcareous.

Clay mineralogy is similar to Formation N° II., montmorillonite is predominant in the clay fraction (<2 μm) next to vermiculite, illite and smectite.

Micromorphologically this formation is similar to Formation N° II. (poro- and granostriated b-fabric, common iron-stained clayey hypo-coatings, few ferruginous nodules), however, the microstructure is much less porous here, the material is hard and dense.

Summary and conclusions

By its mesomorphology, the hard, polygonally cracked Formation N° III could be the remnant of a former fragipan. Fragipans are thought to have been brought about either by intense frost action (LANGOHR-VAN VLIET 1979) or by strong seasonal desiccation and clay migration (WILDING–SMECK–HALL 1983).

Due to the lack of any clear evidence for frost within the studied profile in this case frost action could be rejected because neither the lowermost, hard layer (Formation N° III) nor the overlying similar but slightly less compact layer (Formation N° II.) displays platy-, or lenticular structure or any other sign of freezing.

Micromorphological observations from the two studied layers (N° II., III.) and from the infilling of the polygonal cracks show no pronounced clay accumulation (lack of clay coatings). The well developed birefringent fabric of the clay particles (grano-, poro-, cross-striated b-fabric), does not support the idea of intense clay migration in the studied profile either. Clay orientation between and around grains and pores may have formed, however, as a consequence of stress derived from repeated cycles of wetting (swelling) and drying (shrinking). This can be taken as an indication of *in situ* soil formation under strongly seasonal surface conditions.

Fragipan formation as a consequence of intense seasonal desiccation is a well-known phenomenon in albeluvisols (WORLD SOIL RESOURCES REPORTS 2001) under cool-temperate climatic conditions in flat, gently undulating surfaces.

Whether or not the hard clay pan of the Vanyarc site is a fragipan, is difficult to decide because of the likelihood of erosion suggested by the hilltop position of the profile. Even if clear evidence of significant erosion is not visible, the observed debris (quartzite pebbles mixed with the soil) could be the result of various mass movements along the gentle slope. The fact that archaeologists found lithic artefacts on the top of the hard Formation N° III. supports the idea that, indeed, some time, this layer could have been exhumed by erosion. In this case we should suppose that formation N° II. (same colour, similar composition, but less compact than Formation N° III.) is probably the result of redeposition by mass movements along the slope.

The lack of clay coatings in the pores (see above) as signs of clay migration driven fragipan formation may support another alternative, namely that the hard horizon (Formation N° III.), even if transitionally, could be a former soil surface. In this case, instead of being the remnant of a fragipan proper, the hard, compacted horizon with the observed polygonal network could be the result of repeated wetting and drying under ground-surface conditions. We suggest that further field observations would be necessary to clarify the lateral extent of the studied formations and thus to establish the true nature of the hard, polygonally cracked horzion.

The clay content (montmorillonite>vermiculite, illite) of the two subsurface horizons (Formation N° II, III.) supports pedogenic origin (vermiculite is a typical clay mineral in soils). The presence of swelling clay is considered to have played a role in the formation of the cracks (swelling-shrinking) whereas the hard (dense) appearance of the material may be the result of stress derived from repeated swelling and shrinking.

The predominantly montmorillonitic character of the clay permits a possible volcanoclastic contribution to the soil-froming substratum (weathered volcanogenic material spread over the eroding terrain?).[1]

Notes

1 Laboratory analyses was done by András Varga (ELTE, Dept. of Applied- and Environmental Geology), XRD analyses of samples by Dr. György Lovas (ELTE, Dept. of Mineralogy) thin sections were prepared by Sándor Kraus (ELTE, Dept. of Applied- and Environmental Geology).

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