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THE APPLICATION OF SOIL SCIENCE IN ARCHAEOLOGY

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The soil as the most stable part of the environment combines the effects of climate, hydrogeology, geology, geomorphology and biology that affect the surface of the earth. In addition, information can be obtained from soils about the human activity and the environmental characteristics of human dwellings. These were the objectives of the collaboration with Mr. and Mrs. Gábori. She spent long time in the soils laboratory to learn the process of soil analysis.

Soil analysis and the evaluation of the analytical data may have important role in archaeological research and soil science can only explain some phenomena by using archaeological information. What can archaeology obtain from knowledge of soils?

First of all let me begin with application of soil morphology. Soil morphology judges the sequence and features of soil horizons. According to the combined effects of living and nonliving environment a location specific characteristics soil profile develops in which the thickness, the sequence and other features of the horizons are determined. If the profile shows different features than that human activity can be assumed. It can be a mark of a dwelling-place, buried pits for waist material or storage, kunhalom (man made hummocks), earthwork, and ditches, the material of destroyed houses, and different burial places. These features gains the attention of the archaeologists by showing difference from the original soil profile. Soil morphology can help in the recognition of old fireplaces that shows the settlements of reindeer hunters. I have founded one in the Pap-by-way East from Vác in the wall of a loess canyon by recognising the contours of a brazier under the fireplace covered with 5m thick loess. The soil morphology could be altered by stones, bones, pieces of broken pottery in the plowed layer that show a place of old dwellings. Soil science helps in deciding that a horizon in the soil profile have natural or manmade origin.

Soil morphology includes the evaluation of the location and features of buried soil layers. In Hungary, they can be a result of two soil forming processes: burial by wind-blown sand and burial by sediment of river-flooding. Archaeological information from that is that the sand-movement is accelerated when human activity degrade the vegetation that covers the sand by farming and overgrazing which induces deflation.

The other way of forming buried soils is the sedimentation of the material carried by rivers. It accelerates when human activity destroys the forests in the watershed and water erosion increases or due to crustal movements. In this case buried soils can be formed due to the erosion of the uplifted ridges and the sedimentation on the subsiding areas without any human activity. There are examples for both case on the Great Hungarian Plain mainly on the watershed of the rivers Tisza and Szamos and on the sedimentation places.

If the buried soils contain archaeological finds then the soil type may give information on the living circumstances of the people lived there. A buried forest soil or a chernozem-type soil or a water affected soil indicates different living circumstances.

Soil morphology helps in searching for old dwelling places as they are usually located at the borders between forest soils and chernozem-type soils or water affected soils and chernozem-type soils. A border between soils formed on sand and loess is also a common place for archaeological finds.

Soil color can also give important information for archaeologists. As the soil color is determined by the organic matter content and quality, iron content, iron forms and their genesis. Places that were human dwellings for longer times show up on air photo. The darker patches predict the locations of archaeological research. The darker patches between white areas of salt affected soils shows the places suitable for settlement. Slopes susceptible to erosion are visible by their paler color on hilly territories, darker lines and patches show the outline roads and settlements. Where the reddish-brown accumulation horizon of forest soils get to the surface due to erosion the reduction of redness indicates the long activity of man.

The third important field of soil science for the archaeologists is the data of soil analyses. The first important data that useful for archaeologists is the quantity and vertical distribution of organic matter. Organic matter content gradually decreases from the top in natural profiles. If the organic matter content is higher in deep horizons it can be the result of human activity. Dwelling places also turn out by examining the color of the solution of humic substances because the light-absorption of the dilute solution of humic substances in the range of visible light shows even absorption at dwelling places and humic substances extracted from chernozem-type soils have higher absorption in the blue range than in the red one. The difference is higher in case of forest soils which is indicated by the tgα value (BALLENEGGER & DI GLÉRIA 1962; BUZÁS 1988, 1992).

The phosphor content of soil is also efficient in finding human dwelling places and activity. The map of the phosphor content of samples taken according to a dense 5-10 m net outlines the border of the settlement and helps in determining the location of archaeological research. Both the total phosphor and the dissolvable phosphor content can be used for this purpose. Besides the samples from the topsoil, the lower horizons can be sampled with an auger. With the help of data obtained from this horizons the marks of the buried settlements can be mapped.

The C/N content of organic matter can also be used for mapping the location of settlements because the C/N ratio is narrower in soils of the settlements than in untouched ones.

Both the total and dissolvable potassium content of soils indicates the resting area of herds because the fluid fecal of animals increases the potassium content of soils.

The calcium-carbonate content of soils shows if the soil was disturbed. In case of eluviated soils the calcium-carbonate content increases downward. The thickness of the carbonate-free horizons are determined by the magnitude of the process. If the distribution of calcium carbonate is different from this either man spread calcium-carbonate rich soil on the surface or it was eroded from higher locations and settled down there.

Information can be obtained from the data of the soils of caves on the time interval that the cave was inhabited, what kind of activity took place in them or what kind of territories were usually visited by the inhabitants. All these questions can be answered by analyzing the color, thickness, mineral composition and organic matter content of soils.

The grain size distribution can tell if the floor of the houses and storage pits were covered by sand.

The mineralogical analysis of red clay marks in graves can lead to the clay mines. This can be determined with the help of data on the mineral composition of the clay fraction and the differently soluble iron forms.

My last collaboration with Mr. and Mrs. Gábori was the exploration of the flint mine at Farkasrét. The deposit that filled the ditch which was formed by the mining activity was examined in order to determine if the layer rich in finds were formed by natural sedimentation of dust from the air or due to human filling activity.

The chemical analyses of the soil also includes the test for microelements which enables the finding of the location where soils are richer in copper and iron. It can represent the metal-working activity and usage of people living there.

Further investigation with soil data can be the identification of the place where a certain item was found. In this case microscope and microanalytical analysis of a small amount of dirt on the item can help. The dating of the humic substances in soils with the method based on the determination of ^{14}C ratio can also be used because the youngest fraction of the humic substances shows the date of the burial.

Analysis of soils before the excavation and analysis of the soil in which finds are located can help in determining the activity, farming and living style of man. Soil data can sometimes help in determining the ori-gin and age of the finds too.

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