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ELECTROSTATIC EXTRACTION OF ARCHAEOLOGICAL PLANT REMAINS FROM SOIL: A NEW METHOD

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ABSTRACT. In arid regions extraction of plant remains from soil is usually a problem. Either no water for flotation is available or plant remains explode when they come into contact with water. Therefore a fast and reliable method for the extraction of plant remains from soil was sought and found in electrostatic extraction.

KEY WORDS: electrostatic extraction, archaeological plant remains, arid regions

INTRODUCTION

Plant remains rarely occur in pure hoards or high concentrations. Usually they are mixed with soil and have to be extracted before analysis. In arid regions the well-established method of water-flotation (cf. Greig 1989, p.34–38) is not always feasible due to lack of water and the fact that completely dry charred fruits/seeds tend to explode when they come into contact with water (cf. Renfrew et al. n. d., p.17).

The phenomenon of "exploding" charred fruits/seeds is poorly understood. One theory is that salt crystals form inside the fruits/seeds and that these salt crystals exhibit an hygroscopic activity when they come into contact with water. Another theory holds that archaeological plant remains are never completely charred and that the uncharred "islands", however small, swell on contact with water. Both hygroscopic activity of salt crystals and swelling uncharred "islands" lead to the destruction of fruit/seeds when they come into contact with water.

Flotation of archaeological soil samples with water-free chemicals (Thanheiser 1987) is only possible theoretically . Beside the high cost, transportation and disposal of large amounts of hazardous chemicals meet the financial and logistic limits of most excavations. Moreover, the health risk to those people who have to carry out the flotation without the usual protective measures available in a laboratory, is of concern.

So far the only method for the extraction of plant remains from soil in desert regions has been hand-sorting – an extremely boring and time consuming task which resulted in Dakhleh in a steadily growing pile of unsorted material. Furthermore, it was impossible to sort the size fractions below 2 mm diameter – the fractions that later proved to contain the majority of plant remains.

Therefore, an alternative method for the separation of plant remains from soil was sought and found in the electrostatic extraction. This method has been used successfully in mineralogy (cf. Gaudin 1972) and palaeontology (cf. Salmon 1983).

ELECTROSTATIC EXTRACTION OF PLANT REMAINS FROM SOIL

The basic rationale behind the electrostatic separation of different types of material (in this case plant remains from inorganic sediment) is that most things respond to exposure to electrostatic fields by electrostatic charging. The degree of charging at a certain field-strength depends on the physical and chemical properties of the material and on its shape. Therefore, plant remains and "sand" respond differently to electrostatic charging and can be separated in this way.

The procedure of electrostatic extraction of plant remains from soil is rather simple. The completely dry and loose soil sample is sieved through a set of geological test-sieves with mesh-widths of 4 mm, 2 mm, 1 mm and 0.5 mm. The 4 mm fraction has to be sorted by hand as the plant remains in this fraction are too heavy to be picked out by electrostatic charging. All other fractions are transferred separately to the sample-container of the machine. This container is funnel-shaped and releases the soil sample in a small stream on to a vibrating board. Through vibration the particles are moved towards the electrostatic field where the organic particles are extracted. The procedure has to be repeated one to three times to make sure that the majority of plant remains is recovered. It is necessary to run the different fractions separately as the individual size classes need electrostatic fields of different shapes and field-strenghts.

In archaeological excavations there is usually more than one type of sediment: quartz sand, shale, calcareous material, etc. All these sediments respond differently to electrostatic charging. Furthermore, it has to be remembered that taphonomic processes, such as encrustation with minerals, may alter both specific weight and electrostatic properties of plant remains. Therefore, the shape of the electrostatic field and the field-strength have to be adjusted for each type of sediment. This sounds rather complicated but it merely requires a little training and experience to work successfully with the machine.

The following Figs 1 and 2 show the efficiency of electrostatic extraction in lab tests. For these tests archaeological plant remains were selected: wheat (*Triticum* sp.) from the Roman town Flavia Solva, Austria, and "weeds" (*Rumex* sp., *Phalaris* sp. and *Lolium*-type) from the early dynastic cemetery at Minshat Abu Omar, Egypt. The plant remains were mixed with sterile quartz sand. These species were selected for the tests because an abundance of archaeological material was available. Furthermore, *Phalaris* sp. and *Lolium*-type represent the upper and the lower end of the 1 mm fraction; dock and grasses represent different shapes (angled and boat-shaped). Unfortunately, not enough roundish material (e. g. Fabaceae) and spikelet forks were available for the tests.

To assess the degree of possible fragmentation only whole specimens were selected for the tests. As seen from the results, fragmentation does not seem to pose a major problem. There was no fragmentation in *Triticum sp.* and *Phalaris* sp. From *Rumex* sp. and *Lolium*-type c. 5% were broken. The wings of the nut of *Rumex* sp. tend to splinter off. The fact that small fragments of these wings are easily recognisable led to the recovery of more items than were put into the original test sample (51 : 50).

Electrostatic extraction does not work selectively. In a mixed sample of "weeds" from Minshat Abu Omar all different types of shape were recovered at approximately the same rate (unpublished data).

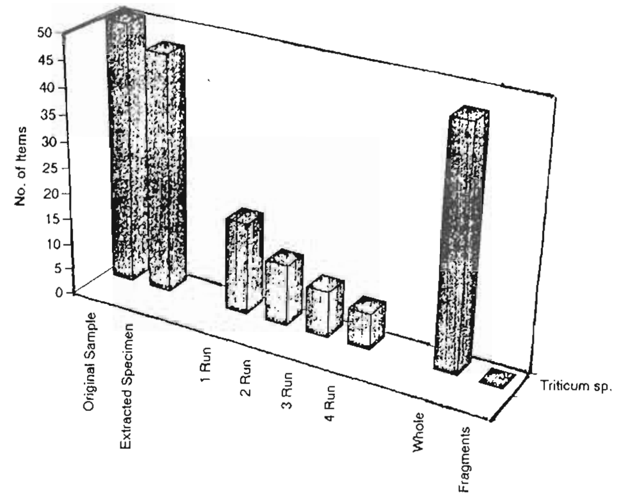

Fig. 1. Electrostatic extraction of wheat (2 mm fraction)

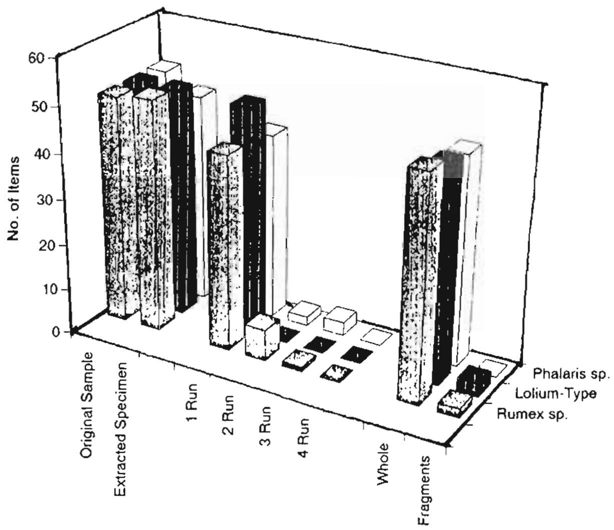

Fig. 2. Electrostatic extraction of "weeds" (1 mm fraction)

SUMMARY

The advantages of electrostatic extraction of plant remains from soil are manifold: a) no water is necessary, b) large amounts of soil can be worked in a comparatively short time, c) plant remains from soil fractions below 2 mm diameter are not lost, d) the recovery rate is high. It is hoped that this method will facilitate recovery of plant remains in arid regions and will result in an abundance of new data on subsistence economy in the desert areas of the world.

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