Site Prospection through Phosphate: Evidence from Cumidava, Romania

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Locating sites is one of the most vital tasks of archaeology, and in some cases the most difficult. While the old work horse of site prospection, surface collection, is still widely used and preferred, it is not effective in unplowed areas, limiting the areas where sites can be found. There are a wide variety of different remote sensing methods that have been used to fill in these gaps, each with their own benefits and limitations. I will be focusing on one, phosphate spot testing, which amongst the ones with the widest range of usability. By looking at the details of the method, as well a case of its application, the usefulness of this tool will be made clear.

Phosphate Spot Test

The link between phosphate and archaeological sites has been know since the early twentieth century, first observed by Arrhenius, when he discovered a correlation between high phosphate levels and prehistoric sites.[1] He later applied the method to other regions, such as sites in the Americas.[2] Through much development, a weak acid extraction has become the preferred method of processing phosphate samples,[3] to avoid burying the anthropogenic phosphate in naturally occurring phosphate.[4] The largest contributor of anthropogenic phosphate is usually produced through trash deposits, particularly discarded bone. As such, any survey conducted with phosphate is locating primarily trash deposits.

The ring chromatography test, or the spot test, utilizes a fast weak acid digestion, and the addition of molybdenum blue is used to mark the phosphate, which will produce spots, rings, and radiating lines dependent of the amount of phosphate in the soil.[5] The test provides relative data, and due to variability in soils ability to fix phosphate,[6] results should be focused regionally. This method of spot testing has been used both for very large surveys[7], as well as at a smaller scale.[8] It is at this small scale that the case study was focused.

The test involves taking a small, pea-sized sample from the soil collected, and adding a solution of ammonium molybdate and 6 molar hydrochloric acid. After the sample digests for 30 seconds, a solution of ascorbic acid is added. Then after 2 to 2½ minutes, the sample is placed in a stop bath of sodium citrate and sodium bicarbonate. The degree of reaction is then evaluated based on the amount and intensity of blue remaining. The durations of digestion allow for 20 samples to be tested comfortably, and with multiple people, many series can be run without increase of supplies.[9]

This method offers several benefits for survey, regardless of size. First, it can be conducted in the field without the use of a formal lab, making it convenient to use anywhere, regardless of conditions. In the case study, these tests were conducted outside at the campsite of the project. Second, the method does not cost very much. The chemicals used in the test, with the exception of 6 molar hydrochloric acid, are readily available, and easy to transport. The hydrochloric acid needs to be acquired in the project country, but is easily obtained from any chemistry department. Beyond the chemicals, the only supplies needed are soil probes, a scale, a graduated cylinder, droppers, and filter paper, which are again are inexpensive, and easy to obtain. Third, the sampling is only limited by the depth the probe can reach. While some issues can arise because of variable phosphate levels, by and large variation from background levels are still noticeable. This wide range of usability, coupled with a smaller learning curve compared to other remote sensing techniques, such as electric resistivity and ground penetrating radar, make phosphate spot testing are very effective tool in site prospection.

Case Study: Cumidava Archaeological Research Project

Located in Rasnov, Romania, the Cumidava Archaeological Research Project (CARP) is seeking the civilian settlement that would have supported the Roman frontier fort in the area, as well as other activities around the Castrum Cumidava. During the 2010 field season, a phosphate survey was conducted over the area. In the 1000m by 500m area, we used a 25m by 25m grid for collecting points. These samples were tested using the molybdenum blue phosphate spot test, and ranked 1 through 5, as seen in Figure 4. Only depths sample from 30 cm and below were considered, to reduce the influence of surface contamination. The highest reading within each sample, 30 cm or below, was designated in Figure 4.

From this data, a rather high level of background phosphate can be seen across the area. As such, only those reading points having 4s and 5s will be examined in greater detail. While the image does not show the depths that these occur, with two exceptions, all the in greater detail. While the image does not show the depths that these occur, with two exceptions, all the high values are at the depth that corresponds to the Roman occupation, and point EC21, which is located in the castrum. Of the two exception areas, the two points at WH37 and WH38 are just high at the 30cm mark, and are the location of modern trash deposits. The other point, WD24, is at a depth of 1.4 m, twice that of the layer of interest. As such, these two areas will be disregarded from further discussion.

Of the remaining areas of interest, we see some patterns of phosphate readings. Two areas have points of high phosphate bundled closely together. These indicate heavy use of the area, possibly organized trash areas. One of these areas, the one just northwest of the castrum, appears to be located along the path that the *Via Principalis* would have run. The region the the southwest of the castrum appears of a different nature. Five points enclose an area of roughly 37500m^2, without high phosphate value neighboring points. It is possible that these points deliminate the boundaries of settlement.

These interpretations are preliminary, as phosphate survey requires ground truthing to firmly establish the period that produced the phosphate. This is the focus of the upcoming 2011 field season of CARP. In forthcoming seasons, the survey are will be expanded 500 m to the east of the castrum, to have a 1 km^2 survey area around the castrum.

Conclusion

Phosphate surveys offer greater possibilities in archaeological site prospection. The low cost and ease of use make the method ideal for students starting their research. While involving a few more steps than a traditional field walking to establish what materials are being dealt with, flexibility of land that it can be used on allows for exploration of areas that have been previously untouched due to the difficulty of locating sites in none plowed areas. The method also scales well, making it versatile for a great many research questions. While certainly not the best method of prospection in all cases, it is a very useful tool to have at your disposal.

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[1] Arrhenius 1929a and Arrhenius 1929b

[2] Arrhenius 1963

[3] See Eidt 1973, Eidt 1977, and Proudfoot 1976 for further details about the development and changes of the method

[4] Wells et al. 2007

[5] Salisbury 2010

[6] White 1978

[7] See Edit 1973 and Thurston 2001

[8] See Woods 1984

[9] Modified from Eidt 1977, Thurston 2001.