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Preliminary Report on the Pizzica Pollen Samples

Pollen analysis has been carried out on a number of sediment samples from the Pizzica site of the Metaponto excavations. Initial pollen extractions produced mixed results; some samples yielded abundant, well-preserved pollen, while others contained little or no pollen, or pollen in poor condition.

This report contains information on the nature of the evidence derived from pollen analysis, extraction procedures used, and the data collected from several of the Metaponto samples. Additional data will be forthcoming as modified extraction procedures produce more samples suitable for analysis.

Pollen Analysis

Pollen analysis is a technique which is used to help reconstruct the condition of the vegetation in an area over time. The analysis involves extraction of preserved pollen and spores from sediments, identification and counting of pollen and spores in the extraction, quantification of the data, and interpretation.

Successful application of the technique includes a number of variables. Two of the more important variables are the condition and concentration of the pollen. Pollen grains preserve best in fine-grained sediments which are constantly wet (lake, marine and bog sediments have the best potential for preserving pollen). Pollen may also be preserved in arid environments (cave deposits in desert regions, for example). Where pollen is incorporated in deposits subject to alternating wet and dry conditions, it generally does not preserve well. In such an environment pollen will be oxydized, and more resistant pollen types may be selectively preserved. Pollen may also be adversely affected by the chemical make-up of the deposit.

The concentration of the pollen in sediments has a bearing on the success of the pollen analysis. Where sedimentation rates are very high, and/or the sediments are coarse-grained, the absolute number of pollen grains in a sample may be lower.

The preserved pollen is extracted from a sediment sample by a series of chemical reactions which effectively dissolve, or otherwise eliminate, the mineral matrix and most of the extraneous organic fraction. The extraction procedure used may vary according to the nature of the sediments in which the pollen is contained.

Once the pollen has been extracted, a sample is mounted on a microscope slide. The pollen is identified and counted using a magnification of about 400X. The number of pollen grains counted to produce a reliable analysis varies. In some cases 200 grains/sample is sufficient. Counts as high as 1000 grains/sample may be necessary.

Interpretation of the pollen data is based on a comparison of the relative abundance of different pollen types. Again, a number of factors contribute to the abundance of any particular pollen type. Plants do not produce equal quantities of pollen. Some taxa tend to be over-represented in a pollen sum because they produce great quantities of pollen. Pine (Pinus spp.) and olive (Olea europa), for example, produce more pollen than vine (Vitis spp.). Insect pollinated plants tend to be under-represented or absent from the pollen sum. A region dominated by insect-pollinated plants may yield a very misrepresentative pollen diagram.

Interpretation of the results of a pollen analysis must take these and other variables into account. As a result, several alternative interpretations for changes in the vegetation may need to be considered.

Extraction Procedures and Counting for the Pizzica Samples

The nature of the Pizzica sediment samples differed considerably in organic content, carbonate content, texture and consistency. These differences dictated modifications in the sample preparation, but the basic procedure is given below (after Gray, 1965).

Samples of 1.2 or 2.4 cc were placed in test tubes. A tablet containing a known quantity of Lycopodium spores (11,850±200) was added to each sample. These spores are counted along with the pollen and are used to determine absolute pollen concentrations (Stockmarr, 1971), and to monitor the condition of the pollen at the end of the extraction process.

The samples were then subjected to a sequence of chemical treatments. Hydrochloric acid was used to remove carbonates, hydrofluoric acid to remove silicates, nitric acid to remove humic compounds, potassium hydroxide to deflocculate clays and eliminate some organic material, and an acetolysis mixture to remove cellulose. All samples were sieved through a 125 micron screen in the early stages of the preparation to remove coarse material. The pollen was stained with

1% Safranin and stored in silicone oil (2000 centistokes). The silicone oil served as a mounting medium. The extraction procedure, usually done on six samples at a time, required two or three days to complete.

Many of the Pizzica sediments contained excessive amounts of resistant organic material, carbonate or charcoal. This resulted in extractions which were of poor quality. These samples required second, or even third, attempts at preparation using modifications of the basic procedure.

Several of the Pizzica samples contained adequate concentrations of well-preserved pollen. Others, however, have yielded poorly preserved pollen or pollen in low concentrations. For these samples, additional attempts will be made to secure good pollen extracts, however, I suspect that in at least some of these cases, the sediments involved were subject to wetting and drying over long periods of time and do not contain pollen in a good state of preservation. Evidence that these samples were subject to a fluctuating water table (several explanations could be suggested for this) include the formation of calcium carbonate nodules, blocky structure, and some $CaCO_3$ cementing. These samples were sandy and very dry when they arrived at the laboratory. These dry samples sometimes contained small burrows, and yielded high percentages of Liguliflorae-type pollen, suggesting that they were above the water table and were subject to tunnelling by burrowing bees. These bees deposit large amounts of pollen, particularl Liguliflorae-type pollen, in dry sediments(Bottema,1975). This deposition of pollen, which postdates the original deposition, renders these samples highly suspect.

An additional difficulty in interpreting the Pizzica samples is the lack of information on the modern pollen rain. In order to fully interpret the results of the analysis it is necessary to know the relative percentages of pollen types being deposited at the site today. Surface samples from the surrounding area are needed to fill this gap in the data. As a result, it is not possible to compare the pollen record from ancient sediments to the present state of the vegetation.

Results of Preliminary Counts

The results reported here are incomplete. Further results will be reported as more samples are counted. These additional counts may alter somewhat the interpretations given here.

The best evidence of the nature of the vegetation at the Pizzica site comes from pollen samples spanning the period from the middle 4th to the early 3rd centuries (about 2/3 of the samples are represented in this time span). The best preservation was found in samples 185s-193s, and 199s. Samples 519a,b and c produced low pollen concentrations.)

There was considerable variation in the abundance of several important pollen types during this period of time. The most abundant pollen types were Olea europa (olive), Graminae (grasses), Chenopodiaceae-Amaranthaceae (goosefoot-amaranth), Typha spp.(cattail), Cyperaceae (sedge) and two as yet unknown pollen types. (I am preparing additional reference material from specimens in the U.C. herbarium collections in an effort to identify the unknown pollen types and I hope to have these identified soon.) One of the unknown types probably represents a member of the rose family.)

Of lesser importance were Quercus spp. (oak), Castanea sp. (chestnut), Compositae (sunflower family) and Alisma-type (arrowleaf) pollen.

The preliminary pollen counts suggest several changes during the middle 4th to early 3rd centuries. Agriculture, including olive and grain production, appears to have been very important locally. The combined olive and grass pollen accounts for about 30-40% of all the pollen encountered. There is a temporary drop in olive in the late 4th century and a decrease in grass pollen in the early third century. Vitis (grape) pollen was only rarely encountered in the samples from this period. Vitis is not a produgous produces of pollen, but the very low counts of this pollen (less than 1%) suggest that it was not an important local crop.

The aquatic pollen types, Cyperaceae, Typha and Alisma-type, show increases from the mid-4th to late 4th century. This implies that a marsh surrounded the reservoir, and that this marsh increased in extent during this period. There is at least a suggestion here that the reservoir was getting shallower, either by filling in or by a lowering of the water level. There is also a substantial increase in Chenopodiaceae-Amaranthaceae pollen in the late 4th and early 3rd centuries. This also suggests that the reservoir was getting shallower, with plants from these families colonizing the upper shoreline.

The lack of certain pollen types is also suggestive. Vegetation maps indicate that maquis and mixed coniferous forest should be located near Metaponto. However, pine/fir percentages are very low (less than 1%) and oak is relatively low (less than 5%). These trees generally produce larges amounts of pollen. Their relatively low pollen percentages may indicate that maquis and coniferous forests were not very widespread near the site. This assertion must be considered cautiously, however. It is possible that the vegetation immediately surrounding the reservoir was contributing enough pollen to mask the contribution from outlying areas. Surface samples of the modern pollen rain would shed more light on the interpretation of these percentages.

Samples from the 1st-3rd centuries and the 6th century had not been very productive. But recently I was able to get good pollen samples from a few of them and should have data from these samples soon. A cursory look at 6th century samples showed high numbers of Plantago spp. pollen. High proportions of this pollen type are generally thought to suggest fairly intensive grazing.

I am continuing to prepare other samples which had not earlier yielded pollen in sufficient quantity. I am also increasing the pollen counts for most samples, an; am preparing additional material to clarify the unknown pollen types. As new data become available I will forward additional reports.

References

Bottema, S. 1975. "The interpretation of pollen spectra from prehistoric settlements (with special attention to Liguliflorae)". Palaeohistoria v.XVII:17-35.

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