Introduction to Environmental Archaeology

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This text was prepared for the "Introduction to Environmental Archaeology" given in the "Asia-Pacific Region Cultural Heritage Preservation Training Course 2010 (Group Training): Study and Preservation of Archaeological Sites" conducted by the Asia-Pacific Cultural Centre for UNESCO (ACCU). In order to systematically understand environmental archaeology and put it into practice, the people who work at excavation sites have put together a list of points requiring special attention in the process of excavating sites, organizing archaeological materials, preparing excavation reports and storing analytical samples. This text shows what is to be done at excavating site and organizing archaeological materials when conducting environmental archaeological operations. We hope this text will be of assistance when you practice environmental archaeology in your country.

1. What is environmental archaeology?
2. Archaeological sites and features in which organic materials still exist
3. Things to remember concerning excavation sites
4. Things to remember concerning organization and documentation

1. What is environmental archaeology?

Environmental archaeology is a field of archaeology that studies the mutual effect of man and environment by reproducing the paleoenvironment around the site. The objective of environmental archaeology is not to merely learn about changes in the paleoenvironment, but to find out how people of the past adapted to the surrounding natural environment, how they obtained various resources from the natural environment and how they altered the natural environment.

Environmental archaeology can be roughly divided into geoarchaeology and bioarchaeology. "Environment" in geoarchaeology refers to the geographical environment. It borrows the concepts and research methods of topography, geology, pedology, geography and so on. "Environment" in bioarchaeology refers to the natural environment. It borrows the concepts and research methods of botany, zoology, anthropology and so on.

The type of research employed in environmental archaeology is generically referred to as "natural scientific analysis." As the fields of research used in environmental archaeology become more diversified, archaeologists must conduct joint research together with experts in various types of natural scientific analysis. It also demands that the respective results research be generalized. It is important for those involved in archaeological excavation to have a clear sense of purpose, and they need to have the necessary knowledge and must be prepared in order to employ environmental archaeology properly. Vague introduction of environmental archaeology without a clear objective must be avoided.

Because natural scientific analysis may however require special apparatus, preparations or chemicals, analysis is often outsourced to other institutions. In such cases, the person or persons responsible for study conducted at the excavation site and organization of archaeological materials and those responsible for analysis must share a clear sense of purpose. A system of cooperation that ensures verifiable records is kept while maintaining objectivity is required. The persons who outsource analysis must not merely leave all results, including interpretation of results, up to those responsible for analysis, but must rather assess and summarize the results of analysis while referring to the results of study conducted at the excavation site and organization of archaeological materials. Consequentially, one must have a certain degree of understanding of the principles of and techniques used for natural scientific analysis, even if one does not directly conduct analysis himself.

Because the method of extracting information from features and/or artifacts is a natural scientific technique, interpreting results obtained by it, i.e., reconstructing human activities that took place at or around the point in time in question by means of studies conducted at the excavation site, for natural scientific analysis is no different than that of archaeology. The results of natural scientific analysis contribute to the results of other archaeological research and the overall understanding of the dig.

Just as is the case with archaeology, natural scientific analysis has methodological premises and limits. The results obtained from natural scientific analysis, therefore, are recognized as speculative theory (hypothesis) about the past. It requires combining results of analysis with other archaeological results and coming up with highly probable interpretation of the results taking into account characteristics of analysis sample and problems of analysis method, rather than blindly taking an absolute view of analytical results.

2. Sites and features in which organic materials may still exist

Artifacts unearthed from archaeological sites can be divided into inorganic materials and organic materials. Inorganic materials include stone tools, pottery and metal artifacts. Organic materials include plant remains, animal remains and human skeletal remains. Inorganic materials are generally better preserved in the earth than organic materials.

Preservation of organic materials is significantly affected by climatic conditions and sedimentary soil. Japan has a humid temperate climate, and the majority of the Japanese archipelago is covered acidic soil of volcanic ash. Most organic materials decompose and decay in such an environment. Organic materials however surely remain in some sites and features.

It is necessary to check the possibility of organic materials remaining in any and all sites. It is important to always be aware of the possibility that organic materials may remain, and to excavate a site using the proper methods while taking the sedimentary environment into account.

Shell midden / shell stratum: Acidic soil is neutralized by calcium contained in shells to produce weak alkaline soil which acts to preserve human bones and animal remains. If the site is not so-called shell midden, a small shell stratum such as a shell stratum in a pit or shell stratum within a dwelling site may be unearthed, and proper sampling must be conducted.

Cave / rock shelter: Limestone caves have an alkaline sedimentary environment produced by decomposed calcium from limestone, which tends to preserve human bones and animal remains well.

Wetland site: Wetland sites don't have enough oxygen due to the presence of underground water in a saturated state. This suppresses activity of microorganisms so organic materials are well preserved. Animal remains also tend to be well preserved if the underground water is weak alkaline or neutral.

Dune sites: Decomposition of microorganisms is suppressed in an extremely dry sedimentary environment due to lack of moisture, and may sometimes preserve organic materials.

Open site: Organic materials may remain in ordinary open sites, as well as in special sedimentary environments such as shell middens and caves. These include (1) water-infiltrated sedimentary environment, (2) burnt soil, carbide layer and ash layer.

Because decomposition is suppressed by insufficient oxygen, plant remains and animal remains tend to be preserved in a (1) water-infiltrated sedimentary environment, just as in wetland sites. Features such as rivers, ponds, wells, gutters and water places may become channels for underground water after burial and may become a water-infiltrated sedimentary environment. However, because sedimentary materials of rivers are generally formed by interaction of erosion and sedimentation, artifacts of different ages may become mixed together making it hard to judge the age of the sedimentary layer.

In the case of (2) burnt soil, carbide layer and ash layer, organic materials are burned tend to remain because they become mineralized. If proper sampling and flotation are conducted for features such as dwelling remains, fireplace remains, stoves and rubbish pits, carbonized plant remains and burnt bones may be detected. This broadens the applicable range of analysis more than the previously mentioned sites and features and is valid for all sorts of sites and features.

3. Things to remember concerning excavation sites

In recent years, natural scientific analysis employed for archaeology has become increasingly diverse, and in many cases those responsible for excavation rely on outside institutions for individual natural scientific analyses. In this case, it is important for the person responsible for the study to record the sedimentation state and excavated state of the site. It is preferable for those responsible for excavation to cooperate with those responsible for analysis from the stage where excavation is carried out at the site if possible, rather than when the excavation is complete.

Those responsible for the excavation at the site should also be responsible for natural scientific analysis rather than relying on experts. The reason for this is because analytical data such as layer position and excavated state will be lost if not properly recorded at the excavation site.

The objectives of natural scientific analysis employed for archaeology are also wide-ranging. Here we will describe the things that generally require special attention at the excavation site when conducting natural scientific analysis.

Analysis plan: When conducting natural scientific analysis, it is important to establish a plan as early on as possible, rather than waiting until the excavation is complete. If a sedimentation layer, features or archaeological materials that are valid for environmental archaeology are confirmed by an adjacent site or trial excavation, it is necessary to properly take into account natural scientific analysis study, analysis and report into account from the planning stage of the study. When features for which natural scientific analysis is applicable are confirmed during the excavation, the study process needs to be reviewed, and the proper measures taken without delay for data sampling and analysis outsourcing.

State of site preservation: Archaeological materials that are applicable for natural scientific analysis are significantly affected by sedimentation state and state of preservation of the site. Consequently, it is necessary to consider what method or methods of analysis can be conducted, taking into account the sedimentation state and state of preservation of the site.

Clarification of objectives of analysis: When conducting natural scientific analysis, it is necessary for those responsible for excavation and those responsible for analysis to share a clear sense of purpose. If the person or persons responsible for excavation request natural scientific analysis without any clear objective, the overall view of the site could be lost and analysis could wind up impossible to assess or summarize for the excavation report of the site. It is necessary to consider specimen sampling and analysis method according to clear analysis objective and problem awareness while taking state of preservation of the site into account.

Importance of multifaceted analysis: Natural scientific analysis includes various characteristics of analysis. Thus, it is preferable to conduct a multifaceted comparison of research results combining more than one method of analysis, rather than a single method according to objective.

When conducting paleovegetational reconstruction of a site, for example, multiple analyses such as pollen analysis, plant opal or seeds should be combined, rather than conducting a certain natural scientific analysis alone. The reason for this is that cross-checking various results of analysis enables you to obtain complementary, consistent research results that cannot be obtained by a single natural scientific analysis .

Plant remains such as pollen, nuts and seeds and wood differ in terms of ability to remain, distribution and productivity of part or organ. Pollen tends to remain more than nuts and seeds and wood, so you can get a continuous understanding of vegetation for each stratification. Analysis of pollen, however, mostly involves anemophilous flower plants that produce massive quantities of pollen that is scattered over a wide area, so the composition of the pollen may not accurately represent the plant population of the immediate area. Entomophilous flower plants, on the other hand, produce less than 1/10,000 of the pollen that anemophilous flower plants produce, so the pollen does not scatter over a wide area. Materials such as nuts and seeds and wood do not tend to remain as much as pollen, and because they have more mass, then tend not to be removed from their source, and tend to represent vegetation of a smaller range of distance.

So, it is necessary to comprehensively conduct paleovegetational reconstruction of a site taking characteristics of each sample into account because they are significantly affected by the process (taphonomy) from the stage where the material existed as a plant until it became deposited at the site

Understanding of sampling stratification: The most important thing when collecting samples for natural scientific analysis is stratification. Because organic materials are not applicable to typology that helps in the formations of chronology, there may be a problem with contamination. An accurate understanding of stratification is a prerequisite to conducting a comparative study of archaeological research results and research results of natural scientific analysis.

The excavated state of the organic materials for analysis also provides information for interpreting the results of natural scientific analysis. The samples for analysis applicable to environmental archaeology are treated the same as pottery, stone tools, etc. Before they are retrieved the stratification and excavated state are recorded. If the person or persons responsible for analysis cannot collect samples at the site, the person or persons responsible for excavation must record the stratification and excavated state of the collecting samples take responsibility for conveying the information to the analyzer. When collecting samples, care must always be taken to not allow contamination to occur.

Sampling: Sampling method and amount of soil required differ according to the research objective(s) and method of analysis. The soil required for sampling may also differ according to research objective(s) and sedimentary environment. Consequently, those responsible for collecting samples must discuss requirements and conditions for analysis samples before having them analyzed. Sampling may also sometimes be required while the excavation study is being conducted.

Even if they cannot be confirmed by the naked eye, buried pit structures, floors, fireplace remains, soil burnt by stoves, ash layer or packing soil in pottery may contain minute burnt bone fragments or carbonized plant remains. When those responsible for excavation recognize the possibility of minute remains being contained, they should take a small quantity of soil samples during the excavation study, put through a 1 - 2 mm sieve while dissolving with water and check the remaining material for minute remains. If minute remains are observed, you should sample a certain quantity of soil and sort by an organized wet sieving.

It is indispensable for those responsible for the excavation to take soil samples that are suitable for the objective(s) of analysis with the clear vision of "what kind of analysis to conduct to reveal what about the site." Soil samples must be taken in an organized manner taking into account subsequent processing and time, budget and place required for storage. If sorting soil samples by wet sieving, the issues of securing a source of water and treating wastewater/soil produced by the process must be taken into account.

Contamination: "Contamination" refers to "other things being mixed in." This term is widely used in many fields such as biology and geology. Even if samples that could possibly be contaminated are analyzed, the results of analysis would be unreliable. It is therefore necessary to make sure samples for analysis do not get contaminated when collecting them.

If collecting samples of pollen or diatoms for analysis, for example, in order to prevent present day pollen or diatoms from getting mixed in with the samples, you must be careful that no other soil is allowed to contaminate the tools used for soil sampling. You must also scrape against the surface of walls to expose a fresh surface for taking samples. When analyzing DNA of human bones, in order to prevent contamination with the human DNA of people involved in the excavation, be sure not to touch samples with your bare hands. Be careful not to allow saliva or perspiration to come in contact with the samples.

Measures must be taken not only to prevent contamination during excavation, but during storage and/or organization prior to analysis. The problem of contamination not only involves those responsible for analysis, but those responsible for excavation and organization of archaeological materials, samples, etc. There are various possible contributing factors to contamination in the process of site formation processes, burial process, excavation, organization and laboratory work, and it is extremely difficult to completely eliminate the danger of contamination. It is therefore effective to take as many samples as possible or have some of the samples been used for the age determination such as radiocarbon dating,

It is especially important to record this in the excavation report so a third party may be able to refer to the history of the samples later on. You should also get a good understanding of the stratification, sedimentary environment and excavated state in which the sampling was conducted during excavation and properly record the locations from where the samples were taken and the sampling method used. The method by which soil samples are treated should also be properly recorded. If the person responsible for excavation does not directly conduct the natural scientific analysis, he should share an awareness of the problem of contamination with the person or persons responsible for analysis. The results of natural scientific analysis should be cross-checked with the findings at the site finding obtained from other artifacts; the results should also be interpreted and discussed.

Temporary storage prior to analysis: Even if samples are collected properly, if not handled properly during the stage before they are passed on to the person or persons responsible for analysis (temporary storage), the results of analysis could be affected. Temporary storage of and method of transportation of samples for analysis differ according to the type of natural scientific analysis. It is also necessary to take factors such as sedimentary environment into account, so those responsible for analysis should be consulted about what sort of storage is required. As a rule, transformation of properties and decomposition must be suppressed and contamination must be prevented while in storage.

The impact of chemicals used for conservation must also be taken into consideration, depending on the sample. The person or persons responsible for preserving samples should therefore be consulted in advance. For example, it has been pointed out that if resin or organic solvents in a binder, etc., get on or in a sample, it could affect carbon 14 dating. If conducting further analysis (dating, stable isotope analysis, DNA analysis, etc.) after analyzing human skeletal or animal remains, it is necessary to establish a plan quickly to provide the proper treatment.

Wooden materials such as wooden artifacts or wooden architectural members require measures to suppress decay while preventing drying are required. One method is to store in a tank of water or container to which an antifungal agent has been added. The condition of artifacts must be observed periodically with special attention on the danger of drying due to evaporation of moisture. Wooden remains left immersed in water will become contraction-distorted due to drying, and will not revert to the former shape even if returned to the water. Once dried, the wood texture is lost, rendering wood identification impossible. Soil sampled for pollen analysis or to collect insects must be placed in a hermetically sealed container and placed in a cool, dark place to prevent the soil from oxidation or drying and to discourage fungus and microorganism from growing. Nuts and seeds should also be placed in a hermetically sealed container and placed in a cool, dark place. Animal remains and human skeletal remains should also be naturally dried in a dark place. Because it may affect analyses such as stable isotope analysis or radiocarbon dating, use of absorbent cotton should be avoided during temporary storage or transportation.

Temporary storage is no more than an emergency means up to analysis or conservation treatment. Artifacts should not be left neglected in temporary storage. They should be recorded and analyzed without delay and managed/stored properly.

4. Things to remember concerning organization and documentation

There are points to be remembered not only at the excavation site, but during organization such as washing sampled soil (soil sorting). Contamination of samples must be prevented prior to analysis. Storage of samples after analysis is also important for assuring and re-verifying results.

(1) Soil sieving methods

Objective: If archaeological materials that have been observed by the naked eye only during excavation are collected, it is highly likely that many smallest items could be overlooked. These smallest items include chips, beads, animal remains such as fish bones, carbides, and plant remains such as nuts and seeds. Collecting such smallest items requires not only materials dug up by hand at the site, but soil sediment collected by sieving. It is therefore important to collect smallest items by sieving the soil during excavation. Along with a clear objective, soil sieving must be conducted efficiently in an organized manner while taking into account labor required for subsequent sorting and place for storage.

Sieving: The size of the sieve mesh differs according to the objective of analysis. Even in the case of soil sieving methods for the same objective, the volume of dirt to be sifted may differ according to sedimentary environment, state of preservation of materials or inclusion density. When outsourcing analysis of materials that have been sifted with a sieve, it is therefore necessary to consult with those responsible for analysis beforehand concerning method of sorting the sampled soil. Concerning what size mesh the sieve should have, try sifting with several sieves of different mesh size such as 5 mm, 2 mm, 1 mm or 0.5 mm to find out beforehand what each size yields and how much work is involved. If the sieve mesh is fine, minute remains can be detected at a high percentage, but the amount of material that cannot pass through increases, and requires more time for sorting afterwards. To ensure assessment of analysis results and comparison with other sites, sieves of clear mesh size are used for sorting soil. The size of the mesh of sieves actually used for sifting soil must be clearly indicated in the documentation.

Types of soil sieving methods: Soil sieving methods are divided into dry sieving, wet sieving and flotation method according to sedimentary environment and objective. Minute remains can be detected depending on the type of sieving. It is therefore effective to combine the soil sieving methods. The block division method and wash flotation method are used in combination for detection of insect remains.

(a) Dry sieving: Effective for shell midden and cave remains, or sandy soil remains. The sampled soil is placed in the sieve, the fine sand grains are sifted through and archaeological materials are collected from residue remaining in the sieve. The effective mesh size is generally about 10 mm or 5 mm.

(b) Wet sieving: Effective for sites viscous soil such as wetland sites or silt. The sampled soil is placed in the sieve, water is poured on the soil, and fine sand grains are strained through. Minute remains such as plant or animal relicts are very fragile, so soil should be unraveled with a brush. Viscous soil should be immersed in water as a pretreatment to wet sieving. You can use a sieve with finer mesh than that of dry sieving to separate artifacts from soil using water. Mesh sizes of 10 mm, 5 mm, 2 mm, 1 mm or 0.5 mm are often used for wet sieving.

(c) Flotation: Method whereby soil is dissolved with water and stirred so archaeological materials with low specific gravity such as seeds or carbides float to the top of the water where they can be collected. Smallest items float to the top when dry sandy soil is dissolved with water alone, but viscous soil is stirred to make artifacts with low specific gravity float up. This method required a sieve with fine mesh such as 0.5 mm or 0.25 mm. Actual soil sieving often combines wet sieving; artifacts that float to the top are recovered by flotation and those that remain in the sieve with wet sieving are recovered.

Drying: Contamination must be prevented if artifacts from a wet sieve are placed in a container and dried. Collected seeds and so on shrink when dried, which can result in cracking. Such artifacts are very fragile and should be stored in a hermetically sealed container in their wet condition until identified. Floating carbides that remain in the sieve using the flotation method can be protected from damage by drying by wrapping in a cloth instead of rapid drying. Cloths used for drying should be made of finely woven cotton or blended textile. Minute remains can get caught in the course texture of gauze, thereby destroying them or making them hard to recover. Gauze should therefore be avoided.

Weighing: In order to calculate the inclusion rate of various materials, the weight and volume of soil should be measured before sieving. Weigh each type of sorted artifact and calculate the inclusion rate of the contents of each succession of strata.

Sorting: In many cases, extraction and classification of smallest items from soil samples are not carried out directly by experts such those responsible for analysis. For actual analysis, non-expert staff may bring only materials recognized as bone fragments or seeds to the person or persons responsible for analysis. In other words, even if smallest items are collected by sifting through a sieve, materials not recognized as bone fragments or seeds may not be analyzed. In order to prevent such problems, non-experts can effectively extract and classify artifacts from soil samples on a sieve if those responsible for analysis conduct a preliminary extraction and classification. When extracting and sorting smallest items from residue of a sieve, experts should provide an easy-to-understand description of the color, size and morphological features of artifacts that need to be extracted to prevent them from being overlooked at the sorting stage.

Registration: Materials used for natural scientific analysis also contain smallest items and are therefore seldom annotated. Materials to be analyzed must be stored together with the excavation record label; care must be taken to make sure that records are not scattered and/or lost. It is also effective to annotate representative materials for analysis used for exhibitions, etc.

(2) Contents of archaeological excavation reports

The results of natural scientific analysis contribute to the results of other archaeological research and the overall understanding of the dig. The results of natural scientific analysis should therefore not be treated differently from other results such as being placed in an appendix at the end of archaeological excavation reports or as a natural scientific analysis edition, but rather should be provided before the general overview. Natural scientific analysis includes a wide assortment of methods that differ according to objective, and the reports contents therefore differ. Here we shall focus on the parts that are common to all natural scientific analysis reports.

The important thing when reporting natural scientific analysis is to state the information in such as way that a third party may verify or assess it. Also, in the case where analysis is outsourced, it is important to record necessary items such as "objective" and stratification and excavated state of "materials", soil sieving at excavating site and organizing archaeological materials in "method", and "discussion" not just for those responsible for analysis, but for those responsible for study and organization of archaeological materials as well. If conservation treatment is provided, the method of treatment should also be recorded.

Objective: Record the objective of natural scientific analysis when conducting excavation.

Materials: Provide a record of samples used for analysis. When doing so, also record the excavated state, stratification and preservation state of the samples for analysis. If chemicals are used for removal or conservation, you should record the names of the chemicals used. Record the location where samples for analysis are stored to ensure analysis results and verification by a third party.

Method: To ensure results of analysis as well, it is necessary to verify whether or not the method of analysis was proper. For this reason, clearly record the methods of sampling and analysis. If sampled soil is to be sieved, record the capacity of the sampled soil, the soil sieving method and size of the sieve mesh.

Results: Present fundamental data of analysis results so it can be verified by a third party. With radiocarbon dating, for example, in preparation of a new offset method or revision, clearly record not only the carbon 14 year, but the data used for offset or calibration. For analysis conducted to identify plant or animal remains, report photographs and descriptions that indicate basis of identification along with the identification list.

Use figures to facilitate understanding if the results of analysis include complicated data or massive quantities of data. The results of pollen analysis should be represented by pollen diagrams consisting of histograms, frequency of pollen/spore appearance, and pollen zone. If quantifying and presenting massive quantities of data, clearly indicate the method of quantification. There are several methods of calculation for reports of animal remains, such as minimum number of individuals (MNI) or number of identified materials (NISP), which can be selected according to condition of materials.

In the case of providing measurement values for analysis samples, provide graphic indication of the measurement points and method of measurement. If estimating stature from reports of human skeletal remains, clearly indicate the regression equation used for the estimate.

Discussion: Discuss the results of analysis based on the data provided and give the findings of the discussion. In some cases a clear, concise abstract such as given in the general overview may be provided. It would also be significant to discuss future themes in preparation for future excavations or organization of archaeological materials and to recommend proper methods of excavation and organization for implementing natural scientific analysis.

(3) Generalization of analysis results

The results of natural scientific analysis should therefore not be treated differently from other results such as being placed in an appendix at the end of the text of archaeological excavation reports or as a natural scientific analysis edition, but rather should contribute to the general understanding of the site.

To summarize the results of analysis, it is important to have a clear objective of analysis and an awareness of problems. The analysis method should be selected according to the objective while taking sedimentary environment and state of preservation into account. When doing so, using multiple analysis methods together while getting a clear understanding of the characteristics of each respective sample and analysis method enables you to obtain an interpretation with a higher probability of being correct.

Natural scientific analysis conducted for environmental archaeology often requires expert knowledge and special equipment, so it is sometimes outsourced to another institution. In such cases, the persons responsible for study conducted at the excavation site and those responsible for analysis must share a clear sense of purpose. A system of cooperation that ensures verifiable records is kept while maintaining objectivity is required. Results including interpretation of results must not merely be left up to those responsible for analysis, but must rather be assessed while referring to the results of study conducted at the excavation site and organization of archaeological materials. Even if you don't conduct analysis yourself, you must have a certain understanding the principles and techniques involved so you can discuss them with those responsible for analysis in order to have a general understanding of the site.

*If outsourcing natural scientific analysis to another institution, be sure that there is no lack of information that needs to be shared among those responsible for excavation, organization and analysis.

*Those responsible for excavation and organization should be aware that they bear responsibility as archaeologists and as the ones who outsourced the analysis.

*Provide the person or persons responsible for analysis with archaeological results obtained by excavation and organization and other results of natural scientific analysis in easy-to-understand terms. Also ask questions about the results of natural scientific analysis obtained until you understand.

*When doing so, keep in mind that meanings of terminology may vary slightly if there are differences in research background or fields of expertise.

*The results of respective natural scientific analyses should be compared before the deadline for turning in manuscripts in order to narrow the possibility of other interpretations of analysis. It is also effective to include a symposium-style debate.

(4) Storage of samples following analysis

Samples used for natural scientific analysis not only ensure research results but also make it possible for the results to be confirmed (re-verified) by a third party. If analysis is outsourced to another institution, storage and use of samples must be considered as well as the analysis results data.

Form of samples and method of storage differ for each type of analysis. Nuts and seed samples are placed in a small bottle and preserved in 70% ethanol solution to prevent drying and/or fungus. Leaves are placed in pouch film together with polyethylene glycol (PEG) and sealed with sealer. Pollen specimens should be provided together with the target sediment sample itself, the aggregate specimens that were analyzed, simple specimens of representative and typical pollen from the spot and strata, and prepared specimens that have been identified and counted as a set. For wood identification, prepared specimens are stored and administrated as voucher specimens. Because they ensure research results, samples for analysis must be clearly labeled with a specimen number, properly stored and disclosed.

Checklist for environmental archaeology (Nasu 2003)

1. Is the study sufficiently based on an objective? What is to be excavated and for what purpose?
2. How should theme be set when starting excavation?
   How should theme be deepened/expanded as excavation proceeds?
3. Has an effort been made to enhance the basic strength required for study and research?
4. When outsourcing analysis, etc., to another field (particularly the field of natural scientific analysis):
   (1) What do you want to know?
   (2) Is field correctly selected?
   What sort of analysis or study will be outsourced to which field?
   (3) Has the institution to which analysis is to be outsourced been correctly selected?
   Who should analysis be outsourced to in order to obtain reliable results that match the objective?
   (4) Have the objective and intention been sufficiently conveyed to the institution to which analysis is to be outsourced?
5. To what extent have problems at the site been pursued prior to outsourcing analysis?
6. Have the contents of reports of analysis results obtained by outsourced study been thoroughly understood and digested?
   (The party requesting analysis is the archaeologist responsible for the excavation.)
7. Are efforts constantly made to generalize?