Table of Contents

This book was originally edited by Takeshi Yamazaki and Hisako Uenaka. Respective sections of the text were written by the following authors: Taisuke Murata, "Description of sediments" and "Importance of facies observation"; Yasuharu Hoshino, "Wood" and "Observation of wood structure and partial storage of analytical samples"; Hisako Uenaka, “Pollen, phytolith and diatom” and “Soil sampling method”; other sections were written by Takeshi Yamazaki. Maki Tanigawa and Okamura Printing Co., Ltd. collaborated on the layout design, and Maiko Matsui collaborated on the illustration.

In writing this book, commentary and assistance were provided by Yuka Sasaki (Paleo Lab Inc.), Yumiko Murakami (Institute for Global Environmental Studies), Hiroo Nasu (Graduate School of Advanced Studies), Akihiro Kaneda and Ichiro Nakamura (Nara National Institute for Cultural Properties).

Translation of the geological technical terms is following J-global (https://jglobal.jst.go.jp/) and Glossary of terms used in geological maps (Rough draft for TS:2008) by Investigation Group for the Terms Used in Geological Maps (https://www.gsj.jp/publications/pub/openfile/openfile0486.html).

In March 2014, the Environmental Archaeology Laboratory of the Nara National Research Institute of Cultural Properties published CAO Newsletter No. 155, "Environmental Archaeology for the Field," as a site manual for flora and fauna related to environmental archaeology.

We revised the content to make it easier to use on site, and created a mobile version using waterproof paper in a field-book sized document. Note that due to the specialization of the content for the excavation and survey of sites, we do not refer to "sample storage after reporting" due to the limitation of pages. Please also refer to COA Newsletter No. 155, "Environmental Archaeology for the Field".

Purpose and how to use this manual

Current Status of the Research on Animal and Plant Remains

Research on animal and plant remains related to environmental archaeology requires living specimens as well as special equipment and facilities. For this reason, it is common to request scientific analysis and reporting of animal and plant remains by external institutions — such as universities, research institutes, and analysis companies. The Excavation Director, who is the “investigator”, must have a collaborative system with the experts at these external institutions, the “specialists”. However, there are cases where the collaboration system is inadequate. For example, the investigator and the specialist are not “sharing” necessary archaeological information and are “leaving” the other to determine interpretations. Specialists who are not present at the excavation site will interpret the site without consideration of the sedimentary environment of the ruins, the nature of the remains, the excavation status of the remains, or the appearance of accompanying artefacts. Thus, even if the analysis result is rigorously reported, the discussion will fall short of a thorough and correct interpretation.

Understanding the deposition environment

Since the outside specialist cannot be stationed at the survey site, the excavation manager must properly record the “lost information” at the excavation and inform the specialist properly. This lost information is the deposition environment and excavation status.

It is necessary to determine the origin of the deposit, always keeping in mind "how the soil at the site was deposited and how the relics were buried." By properly grasping whether the accumulation is due to human activity, natural mechanisms, or sediment affected by both, you can establish the research objective and select the analysis method accordingly. It also greatly influences the interpretation of the analysis results of any animal and plant remains. It is of utmost importance to properly understand the depositional environment at the survey site.

Description of sediment → page 6, importance of facies observation → page 12

Clarification of analysis purpose

In order to build an effective collaboration system, it is important for the person in charge of research (i.e. the investigator) and the specialist in charge of scientific analysis to share a clear sense of purpose. If

investigators request the analysis of animal and plant remains without a clear purpose, the results may not be adequately evaluated. It is important to set a research hypothesis for the survey site and select an appropriate analytical method for testing and verification. If so, it will be easier to summarize the excavation survey report at the end.

In addition, depending on the purpose, it may be necessary to combine multiple analytical methods. Because each analysis has its own characteristics, it is possible to obtain complementary, and consistent, research results by using multiple analytical methods together rather than using a single method.

Points to be noted by excavation research personnel

Many excellent reference books on animal and plant remains have been published. However, these reference books are mainly intended for specialists of animal and plant remains. There has not been much written from the perspective of “what should be done on-site” by the investigator —because it was assumed there will be the request for specialist analysis.

Therefore, this document summarizes the points that investigators should be aware of when animal or plant remains are unearthed. For each animal and plant find, the "effective deposition environment", "points to keep in mind at the excavation site", and "temporary storage before analysis" are described along with the proper protocols at the excavation site.

Seed → page 16, wood → page 18, bone → page 20, pollen / diatom / plant opal → page 30

Negative effects of manualization

This document was created to establish appropriate levels of handling animal and plant remains on the excavation site. However, various conditions related to the survey, such as the sedimentary environment on site, the cost and period of excavation research and rearrangement work, vary from site to site. Thus, prioritize on-site situational judgment without consulting this manual.

In addition, this book is based on the current state of animal and plant remains that must be shared from the excavation site for lab-analysis and reporting. However, there are many problems that will be solved if a specialised analyst of plants or animal remains can participate in the excavation survey. In addition to the “Coping Therapy” as in this book, discussions on the survey system regarding animal and plant remains are required.

Description of sediments

Determining the nature (soil properties) of sediments at the survey site is an important task in deciding the survey policy. In this work, the elements and methods to focus on differ depending on the specific site factors – such as geology, soil structure, archaeology, geography, and agriculture. Therefore, it is necessary to determine the research purpose, and select or combine the points and methods appropriate for the site.

In particular, in order to use methods in a complex manner, it is important to clarify each definition and avoid using it in a way that is convenient for one's hypothesis.

This section summarizes important viewpoints and methods for identifying Holocene deposits that make up the surface geology, particularly alluvium.

Listed items

When describing sediments, it is necessary to always consider the system by which the sediments were deposited through observation of lithology (facies). In order to understand the characteristics of sediments, it is important to evaluate and describe the following five factors.

1) Soil hue: Basic index of sediment components

Use a soil colour book or soil colour measuring instrument to measure, classify and enter. It serves as a clue to determine the degree of soil formation (oxidation degree and/or reduction degree) and the characteristics of the minerals contained and, in many cases, also serves as an index of organicity.

2) Grain size: a basic index showing the formation process of deposits

See Figure 1 and Table 1 on the next page for the names and categories used for description. Since there are differences in the grain size composition and sedimentary structure between the natural deposits and the artificial deposits, they can be used as a criterion for both.

3) Inclusions: Environmental indicators at the time

It refers to the chemical and biological characteristics of sediments – such as secondary minerals, biological remains, and fossils – and mainly reflects the environment of the sedimentation site. Regarding

organic matter, describing the relative content and degree of decomposition and its origin will be effective information when determining the analysis policy and examining the deposition environment.

In addition – since it also provides a clue for targeting samples for radiocarbon dating – it is preferable to describe the occurrence of biological remains in as much detail as possible.

4) Special deposits: volcanic ash and event deposits

Some of the strata act as key layers and guarantee the isochronism of deposits. In particular, volcanic ash (layer) enables stratigraphic correlation by identifying the volcanic origin of eruption. It can be said that event sediments that deposit sediments in a short time – such as floods, tsunamis, and sandstorms – have similar characteristics.

5) Sedimentary structure: Indicates a specific sedimentary environment and topography

Sedimentary structure itself shows a specific sedimentary environment and topography – such as foliage, grading, and inverse grading. In the description, it is necessary to identify the relationship between the upper and lower layers (conformable, unconformable, etc.), the artificial layer and the naturally deposited layer, and the human-affected layer.

Description legend and description method

An example of the legend for deposits (Table 2) is shown on pages 10-11.

See also the following documents for the legend and description method.

Column “Layer facies cross-section” of Excavation Survey Guide: *Excavation of Settlement Sites* (p.110)

Figure 2 “Example of schematic description of sediments in the soil layer cross section (outcrop)” of COA Newsletter No. 155 *Environmental Archaeology for the Field* (pp.18-19)

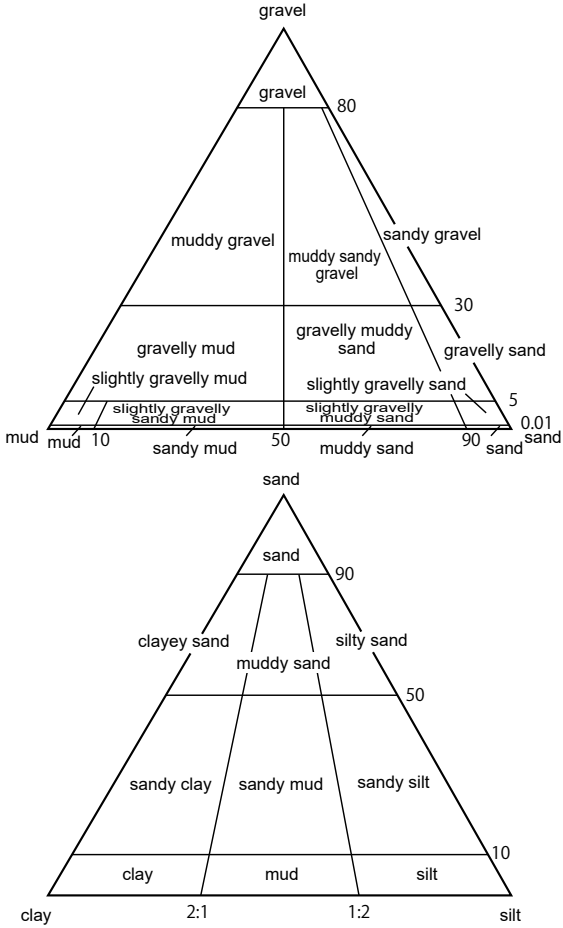
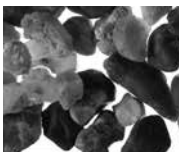


Figure 1. Soil classification based on grain size composition
(after *Excavation Survey Guide: Excavation of Settlement Sites* (p.112)

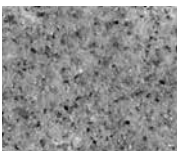
Substrates of soil can be classified by the mixing ratio of particle sizes. The triangular diagram in Figure 1 visually represents the relative quantity ratio of clay, sand, and silt. Numbers represent proportions and composition ratios. In recent years, unified standards classified by engineering based on soil layer observation evaluation, particle size composition, liquid limit, plastic limit, etc. have been proposed, and Fukuda and Uno (1997) should also be referred to.

Table 1. Wentworth particle size classification and debris

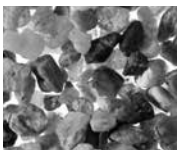
Grain size		Boulder		aggregate	
mm	Phi (φ) Scale (1)				
265	−8	boulder	gravel	boulder	conglomerate
64	−6	cobble		cobble	
4	−2	pebble		pebble	
2	−1	granule		granule	
1	0	very coarse	sand	sandstone	
1/2	+1	coarse			
1/4	+2	medium			
1/8	+3	fine			
1/16	+4	very fine			
1/256	+8	silt		siltstone	mudstone
		clay		claystone	



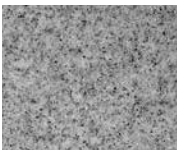
pebble gravel
(64-4 mm)



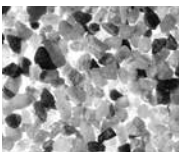
medium sand
(0.5-0.25 mm)



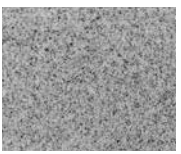
granule gravel
(4-2 mm)



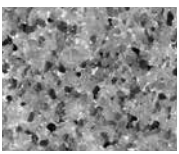
fine sand
(0.25-0.125 mm)



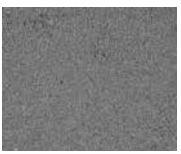
very coarse sand
(2-1 mm)



very fine sand
(0.125 mm-63 μm)



coarse sand
(1-0.5 mm)



silt
(63-0.24 μm)

Below is clay

Figure 2. Granularity sample (actual size)

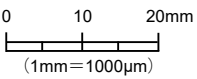


Table 2. An example of an expression method for describing the facies observation

1) General particles


gravel


sand and gravel


sand


silt


clay

2) Fossils, remains


allochthonous


autochthonous

shell


wood


humic matter


undecomposed peat

herbacelous peat


decomposed peat


woody peat


loess doll (trace fossil: limonite)


soil


loam

3) tephra (volcaniclastic material)


scoria


pumice


volcanic glass


lithic fragment

4) Other symbols


cross laminace


pararell laminace


uncomforminity


alternation


debris flow

Including the legend in the facies allows the facies to be visually grasped, and the basis of the interpretation of the sedimentary site and the sampling point can be clarified.

The legend can be changed as necessary in the field – including the specific analysis purpose, and analysis item – but it is important to always explain the definition of each legend.

Importance of facies observation

Careful observation of soil colour, grain size composition, inclusions, and sedimentary structure is the most important clue for examining excavation policies and analysis. Here are some tips for interpreting the information obtained from on-site observations.

●Relationship between human activities and sediment

The process of soil accumulation becomes complicated when it is related to human activities, and it greatly influences the investigation policy and analysis. At least consider which of the four patterns below applies.

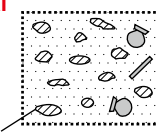
Human
Nature

1) Artificial deposition/artificial structure layer (= remains)
2) Natural sedimentary layer in the remains (= artificial)
3) Natural sedimentary layers that reflect human activities behind
4) Natural sedimentary layer

1) Artificial sedimentation/artificial structure layer (=remains)

: There are many topographic differences to nature.
For example: fills, buried soil, etc.

1) Image of facies



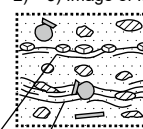
No clear structure on the substrate (matrix)
Relics such as many pseudo-gravel (mud lumps) and earthenware fragments are mixed.

Pseudo-gravel (mud lumps)

2) Natural sedimentary layer in the remains (= human-made)

: There are many topographic differences to nature.
For example: channels/ditches (waterways, etc.); pits (wells, ponds, cultivated land, etc.);
or, hydrological deposits that bury the remains.

2)・3) Image of facies



The substrate has a clear natural deposition structure such as lamina. On the other hand, there are many artifacts such as pseudo-gravel (mud lumps) and earthenware pieces.

Plant remains
Lamina etc.

3) Natural sedimentary layer that reflects human activity

: When the topography is natural, but the effects of human activity are reflected in the sediments.
For example: cultivated plant seeds and natural deposits containing a large amount of charcoal.

4) Natural sedimentary layer

: As a general rule, artificial deposition is not involved.
***Particularly important points of sediment layers are summarized on pages 14 and 15.**

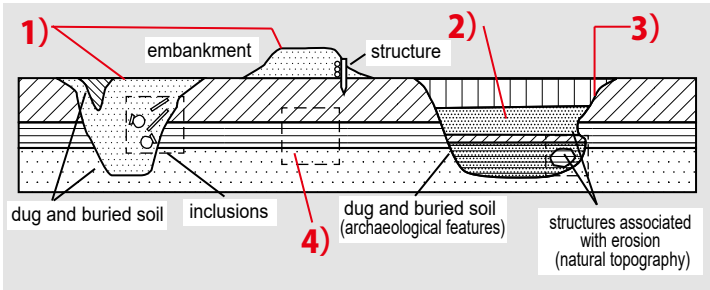


Figure 3. Four patterns of human activities and sediment relationships

For example: In the situation where the stratum section is being observed at the excavation site, we will examine which of the above four patterns is applicable.

What is the target sediment cross-section...?

Many relics such as gravel (mud lumps) and earthenware pieces are mixed to compose and bury the remains ------1)

- Geological layers deposited by human activities such as land reclamation

Gravel, sand, etc. arranged regularly form lamina etc.

The influence of human activities can be seen in the vicinity

The remains are buried in natural sediments ------2)

- Although it is a place of human activity, the accumulation is due to the efforts of nature (water, wind, etc.)

Natural deposits intercalating many relics ------3)

- A little away from the place of active human activities, and the accumulation is due to the force of nature (water, wind, etc.)

No influence of human activities around the area ------4)

- Possibility of natural sedimentary layer

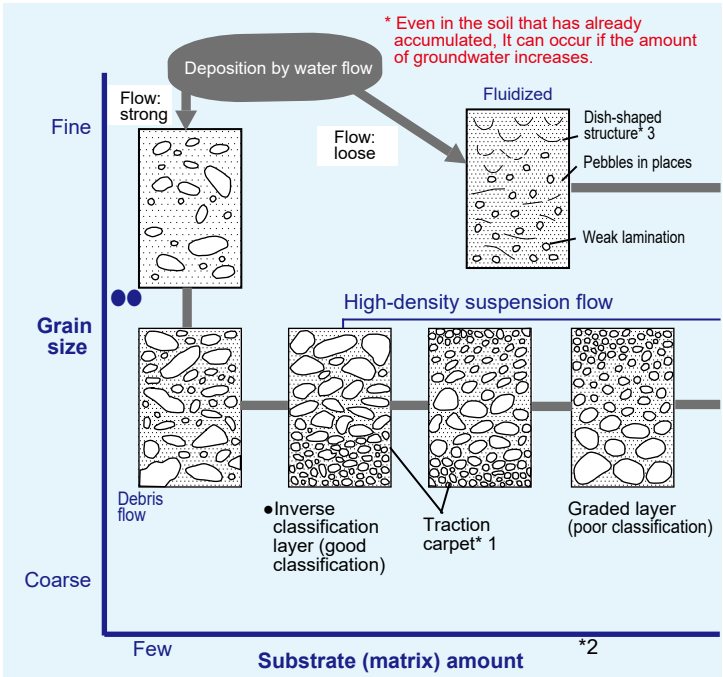


Figure 4. Image of sediment concentration and particle size (facies are different depending on water volume and flow will be different)

*It is important to understand which part you are watching when observing the soil layer.

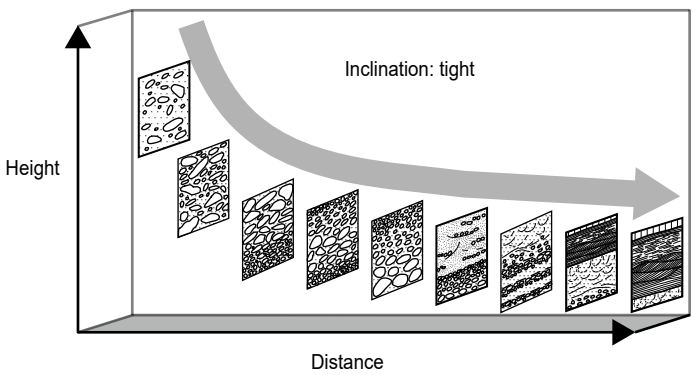
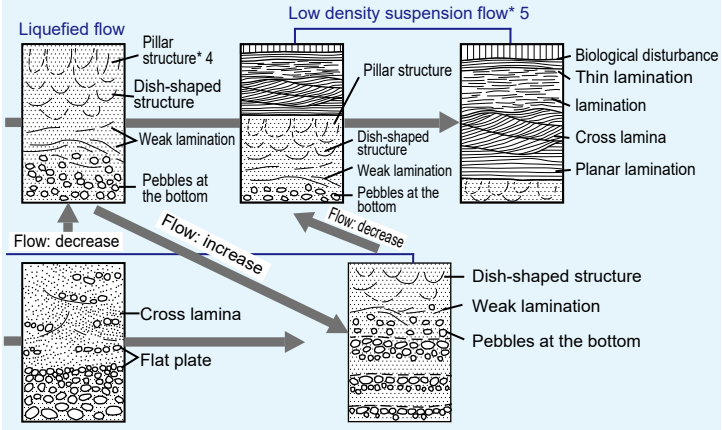


Figure 5. Image of topographic gradient and land accumulation

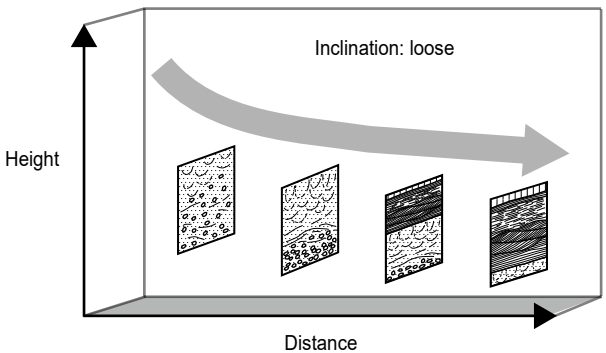


- Scour and gravel in places
- Graded layer and poor classification
- Smooth layer and inverse grade

Many

: Direction of water flow and facies transition (evolution)

*1) The movement of the sediment while it is in contact with the riverbed.
*2) Small particles that fill the gaps between large particles.
*3), 4) A type of structure that can be created when underground water escapes toward the surface.
*5) Low density refers to a suspended flow (mud and water in a floating state) with a sediment concentration of approximately 20% or less.
High density refers to a suspension flow with a sediment concentration of about 20% or higher.



*In the water flow, the facies changes depending on the slope and distance.

Seeds and fruits

Effective deposition environment

- Uncarbonized seeds and fruits may be found in the flooded sediments.
- Flotation method is effective because carbonized seeds and fruits may be detected from the remains of furnaces, burnt soil, burned-out houses, etc. (→ page 22)

Points to note in the field

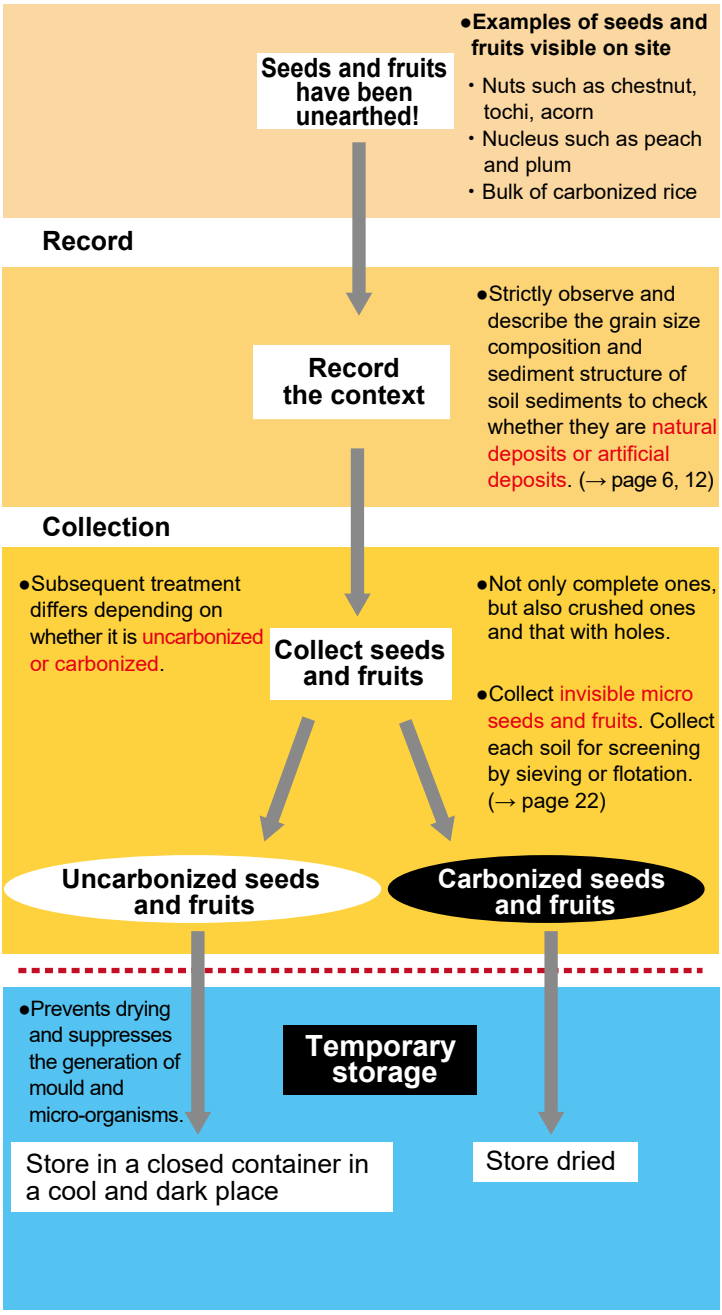
- When collecting directly at the site, make sure to record the excavation situation and examine whether it is an artificial deposit or a natural deposit. (→ page 6, 12)
- Not only complete seeds and fruits but also crushed seeds and pierced seeds should be taken up properly, since the effects of processing, disposal and post-disposal can be examined.
- Subsequent treatment differs depending on whether it is a non-carbonized seed/frut or a carbonized seed/fruit. Observe the colour and surface of the seeds to determine whether they are uncarbonized or carbonized.

***Estimated amount of soil collected**

- **Non-carbonized seeds and fruits:** For large sediments and leaves containing sediments, 500 to 1000 cc or more, and for sediments containing many small seeds, collect about 100 to 500 cc of soil.
- **Carbonized seeds and fruits:** Depending on the scale of the target structure, about 1 to 20 litres of soil should be collected.

Temporary storage before analysis

- Store uncarbonized seeds in a closed container in a cool, dark place to prevent them from drying out and to prevent the growth of mould and micro-organisms.
- Wrap sedimentary soil for washing and sorting in plastic wrap or aluminium foil, and store in a cool and dark place.
- Carbonized seeds and fruits can be dried.


●Examples of seeds and fruits visible on site
・Nuts such as chestnut, tochi, acorn
・Nucleus such as peach and plum
・Bulk of carbonized rice
Seeds and fruits have been unearthed!
Record
Record the context
●Strictly observe and describe the grain size composition and sediment structure of soil sediments to check whether they are natural deposits or artificial deposits. (→ page 6, 12)
Collection
●Subsequent treatment differs depending on whether it is uncarbonized or carbonized.
Collect seeds and fruits
●Not only complete ones, but also crushed ones and that with holes.
●Collect invisible micro seeds and fruits. Collect each soil for screening by sieving or flotation. (→ page 22)
Uncarbonized seeds and fruits
Carbonized seeds and fruits
●Prevents drying and suppresses the generation of mould and micro-organisms.
Temporary storage
Store in a closed container in a cool and dark place
Store dried

Effective deposition environment

- Wet and low supply of oxygen, such as old river channels and wells. If excavation is expected, a plan for temporary storage, analysis, and preservation processing should be established in advance.
- When carbonized in a burned-out house or kiln, when it is in contact with bronze products in a stone chamber of an old burial mound, or when it is protected from rot by a lacquer coating, it is excavated even in a dry deposition environment.

Points to note in the field

- Wooden remains excavated in a wet state will be significantly deformed when dried. After the detection, the excavation situation will be recorded and taken up promptly.
- Excavated wood is diverse – including wood products, construction materials, and natural wood. Considering the survey period, budget, state of condition, and storage after picking up, prioritize the handling and efficiently excavate.
- Avoid metal excavation tools and be careful not to scratch the wooden surface with a bamboo spatula. If scratched, keep a record so that it can be distinguished from the traces of past processing.
- If it takes time from excavation to picking up, cover it with a high water-retaining material such as a sponge with water, cover it with black plastic sheet, and spray it with a mist or sprayer to retain water, to shield light and to avoid frost.
- Natural trees are also very effective for vegetation restoration around the sites. Consider storing a partial sample even if it is unavoidable to eventually discard it. (→ page 26)
- Wooden remains excavated from a dry sedimentary environment should be protected from sudden changes in temperature and humidity without being sprayed with water.

Temporary storage before analysis

- As a general rule, trees excavated in a wet condition should not be dried. Store in water.
- Pour water into a pool, container, tapper, etc. for temporary storage, or put it in a plastic bags filled with water and seal.
- When temporarily storing multiple samples in a large container, attach a label with a wide tapes and be careful not to scratch the surface.
- In case of temporary storage for a long period of time, maintain good water quality and prevent deterioration of the sample by exchanging water or adding a fungicide.
- It is desirable to carry out observations, measurements, and various analyses before the preservation process.

A wood is unearthed!

- **Do not dry trees that have been unearthed in a wet condition.**
- Be careful not to cause sudden changes in temperature and humidity for trees excavated from a dry environment.
- Prioritize handling by rinsing with water to understand any processing marks.

Record

Record excavation status

- Record and collect as soon as possible.
- Use a sponge or a black plastic bag to keep water, shade, and to avoid frost.
- If the surface is scratched, keep a record so that it can be distinguished from the traces of past processing.
- Natural trees are also effective for identifying past vegetation around the sites.

Collection

Collect wooden remains

- If fragile, cure with urethane.
- For natural wood, consider partial sample storage. (→ page 26)

Temporary storage

- Store materials excavated in a wet condition under water.
- If the temporary storage period becomes prolonged, change the water to maintain good water quality.
- When storing multiple samples, label them so that the sample numbers are not mixed up. If you use a wide tape, it will not damage the surface of the tree.
- Save for observations, measurements, tree species identification, tree ring dating, carbon dating and other analyses. It is desirable to carry out before processing.

Bone

Effective deposition environment

- Human bones and animal bones are excavated from shell mounds, caves, and lowland sites.
- Cremation bones are often excavated because the bones burnt by fire tend to remain. In addition, burnt animal bones may remain in the furnace or ash and charcoal deposits, so soil selection is effective. (→ page 27)

Points to note at the excavation site

- Perform “tentative identification” on site to determine whether the excavated bone is a human or an animal bone. (→ page 28)
- Record on the excavation plan the particular bone, its direction and orientation. Take pictures from different angles. It is effective to shoot in several stages according to the progress of excavation.
- Be careful not to wash the bones too much with water when taking a picture, as it will weaken the storage condition and affect DNA analysis.
- Use bamboo bellows instead of metal tools to prevent bone damage. In particular, the jaw bone and epiphyses (both ends of long bones) are effective sites for species identification and age estimation, so they should be carefully selected.
- Bone weakens when exposed. Promptly carry out actual measurements and photographs, and carry out the work from excavation to collection in a short time. There is a possibility that missing teeth and burial items will be overlooked in the surrounding soil, so soil should be collected.
- If cremation bones or burnt bones are excavated, check on-site if there are any traces of burning or fire. Record the excavation status, such as whether there is a burnt surface or whether the soil contains charcoal or ash.

Temporary storage before analysis

- Do not use absorbent cotton for transportation or temporary storage of bones as it will affect stable isotope analysis and radiocarbon dating.
- Because the condition of bone preservation is greatly affected by the deposition environment, wash it while checking the condition of the bone. If it is not stored well, dry it in the dark without washing in water and remove mud and sand with a toothbrush or brush.
- Store in a cool dark place to prevent mould formation.

A bone is excavated!

- Determine whether it is a human bone or an animal bone.
- Bringing human bone models and skeleton charts to the survey site will be useful for proper recording and survey.

Record

Record excavation status

- **Excavation situation that should be recorded**
  - Concentrations of excavated bones
  - Bone derived from the same individual
- **Points to observe the excavated bones**
  - Is it a single species? Are multiple animals mixed?
  - Does it retain its anatomical position?
- **Points of photography and actual measurement**
  - Several steps will be taken as the bones are collected.
  - Photos should be taken from multiple angles.

Collection

Collect the bones

- For bones record the excavation situation, and keep the number of each bone attached so that they can be collated later. (→ page 28)
- Take care not to damage the teeth and epiphyses because they are effective for species identification.
- Bone becomes fragile when exposed, so work from excavation to picking up Work as quickly as possible.
- Soil is sorted by a sieve so that invisible micro bones are not overlooked. (→ page 22)
- If the bone is very brittle, there is a risk of breaking the bone when being picked up, so take measurements and photos in advance.
  - Measure the maximum length of the limb bone, which is effective for estimating height (body length).
  - Take a close-up of the teeth and epiphyses as well as the entire picture.

Temporary storage

- **Depending on the condition of bone preservation treatment will differ.**
  - Bones excavated from a shell mound and grilled bones are dried naturally. Human bones are more brittle than animal bones so washing with water is not desirable and should be avoided.
  - Reinforce weak bones with chemicals.
  - Keep a record of the chemicals used.

Soil screening method

By collecting only large relics visible at the excavation site, fine animal and plant remains such as seeds and fish bones are overlooked. It is necessary to collect soil remnants by filtering soil deposits during excavation. Soil sorting work is effective not only for animal and plant remains, but also for the investigation of microscopic remains such as chips and beads.

Types of screening

Depending on the sedimentation environment and purpose, the soil sorting method can be divided into a dry screening method, a washing screening method, a flotation method (a floating relic screening method), and the like. Various fine remains can be collected by combining these soil selection methods.

Planning

It is necessary to collect soil in a planned and efficient manner – taking into account the labour involved in soil treatment and the storage location – as well as a clear purpose.

1. Do a "trial sieve"

Efficient soil sorting will be possible by conducting a trial screening (→ page 27) and collecting any remains from buried soil in which fine relics can be confirmed.

Soil selection work can take a huge amount of time and money, and if soil is collected unplanned, there is a risk that it will be a great burden for subsequent work. Therefore, a trial screening will be conducted at the site of the excavation to grasp the amount of soil selection work required and formulate a work plan.

2. Items to check before implementation

Before carrying out the soil selection work, carefully consider the purpose, location, cost effectiveness (time, budget, personnel), etc.

Prioritize targeted soil sediments to ensure work is completed within

the time and budget.

Sifting loamy deposits with a 1 mm sieve has become difficult both in terms of budget and time. Therefore, a method of sieving some of the soil sediments with a fine mesh and a method of sieving other soil sediments with a comparatively coarse mesh is also used.

Purpose: To clarify what soil selection method is appropriate for recovery. Depending on the type of fine remains, the method of soil selection and the mesh-size of the sieve used will differ.
Place: “Temporary storage place for collected soil (sandbags)”, “Place for performing soil sorting work”, “Securing water for washing and sorting”, and “Treatment of soil-washed wastewater”. If soil selection work can be performed at the survey site during excavation, it will be easier to deal with problems such as the storage location of the collected soil and drainage, and the labour of subsequent work can be reduced.
Personnel/Time: Consider not only the personnel and time required for soil selection work, but also the personnel and time required for extraction, classification and weighing of soil-selected contents.

Soil sampling

Soil is sampled at points that cover all levels to reveal stratigraphic changes in the contents. Then, in order to understand the planar distribution of the contents, the soil is sampled from as many points as possible.

There is also a block sample. The columnar sample is obtained by sampling soil in a square columnar shape (for example, 50 x 50 cm) according to the stratigraphy from the section-wall of the survey area where the soil layer cross section can be observed. Block samples are soil sediments collected from any strata. (→ page 6, 32)

Washing and sorting method

1) Measure the volume and weight of the collected soil.
2) If the soil sediment is extremely viscous and the mesh of the sieve is likely to become clogged, or if the soil adheres to the remains, soak the soil in water as a pre-treatment before rinsing and sorting.
3) Agitate the soil with the water flow of the shower **[A]**, float the carbonized seeds, carbonized materials, and small shells, and then skim with the sieve (about 0.25 mm or 0.5 mm. It is possible to use a dust net or tea strainer) And collect the suspension without breaking it (Flotation method) **[B]**.

A

B

4) After stirring the soil, do not pour it into the sieve immediately, but let it rest. Immediately after stirring and pouring, soil will enter the supernatant. If it is stirred and poured too slowly, the floating material will sink.

C

5) Repeat soil stirring and sampling of suspended solids until the supernatant becomes transparent and there are no suspended solids **[AB]**.
6) Open the sedimented soil in a sieve (5 mm and 1 mm), vibrate in a water-filled container, and apply a shower water flow to strain the soil.
7) Use a stream of water to collect fine relics without breaking them. By laying a mesh sheet finer than the size of the intended contents underneath, it is possible to collect the fine remains left on the surface of the sieve without breaking them by the water flow of the shower **[C]**.

D

Selection, extraction and weighing of fine remains

Extract fine relics from the sieved contents and measure the mass of each **[D]**.

Materials that were not recognized as “bones” or “seeds” at the time of extraction are not sent to experts for analysis itself. Preliminary extraction and classification of the contents subjected to screening by an animal and plant remains expert (the specialist) enables effective extraction and classification with less oversight even by non-specialists.

Column

Observation and analysis of timber structure / Partial storage of samples

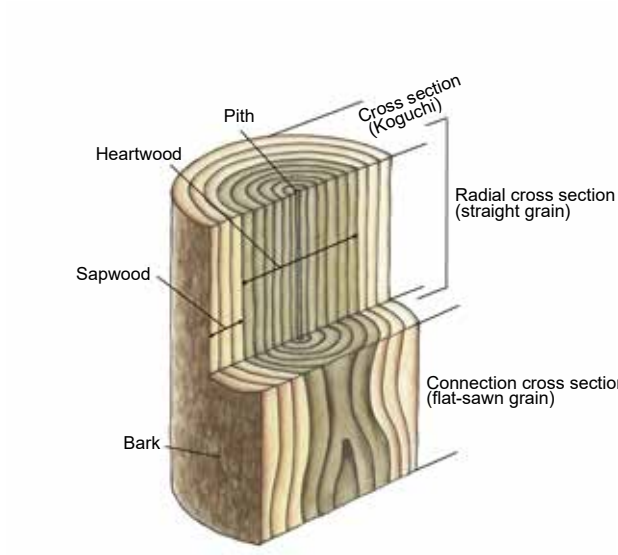
Observation of wood structure

Records regarding grains(such as straight grain or flat-sawn grain), the presence or absence of the central part (pith) and outer parts (sapwood or bark) of the tree, the number and width of annual rings, etc. can be obtained from the samples used for tree species identification and annual ring dating. It will be basic information and will be useful for restoration of log diameter and age.

Partial storage of analytical samples

Depending on budget and storage location, it may be difficult to store all tree remnants. However, since trees have valuable information – such as the vegetation conditions around the ruins – we would like to take measurements recording diameter and length, and store some even if they will be reluctantly discarded.

For example, a block of about 1 cm on a side that contains more than one annual ring is sufficient for: tree species identification; annual ring age measurement; and, radiocarbon dating. The part including the outermost layer is sliced, or a core with a growth cone, will be effective.



Column

Recommendations for test sieving

When half-cutting the remains, part of the excavated soil is tested on-site and culled. As a result, only the remains in which minute remains, such as seeds and bones are confirmed, will be brought back and each sedimentary soil layer will be washed and sorted. This trial screening will enable more efficient soil sorting.

In addition, work efficiency varies greatly depending on the content of fine remains contained in sedimentary soil. Therefore, it is necessary to take the labour (time and personnel) required for soil selection using a trial sieve, and to accumulate the collected soil for which formal soil selection is feasible within the remaining time and budget.

By actively conducting a trial screening on-site as if it were a prospecting survey, it is possible to recover the remains of the flora and fauna remaining in the sites without missing them. Waterlogged sedimentary environments such as wells and ditches, and burnt soil and ash layers such as furnace traces are valuable sedimentary soils for trial screening.

Column

Recommendations for temporary identification

It is desirable to have some understanding of the animal species and skeletal parts when recording and picking up excavated bones. In particular, if it is possible to determine whether it is a "human" or "animal other than human" at the excavation site, it is possible to understand the nature of the remains, and to conduct accurate surveys and records.

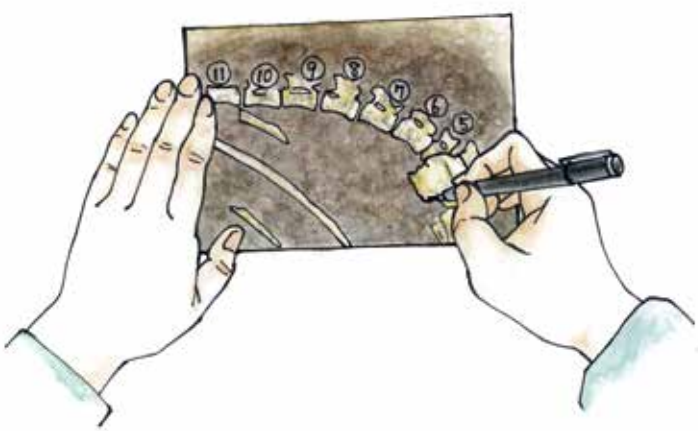
When a large number of bones are excavated, it is important to judge whether they are bones of the same individual or a mixture of bones of various animal species. In the case of human bones, it is possible to conduct more appropriate investigations and records by judging whether the human bones retain their anatomical position or are scattered.

Human bone and animal bone skeleton charts are useful for this judgment. For local government authorities where human bones are often excavated, it is desirable to purchase a “separated skeleton model of human bones” and bring it to the excavation site for reference use. The bone model can be purchased for tens of thousands of yen. An accurate diagram can be efficiently created by writing an actual measurement diagram while comparing it with a human bone model at the excavation site.

At the excavation site, provisional identification to understand the animal species and skeletal site may be a tentative decision. Accurate identification is referred to an expert after picking up the bone.

If the bones are unearthed, it is convenient to take a picture with a digital camera and print it. Along with the whole picture, take a partial picture so that the orientation of the bone can be confirmed. When picking up bones, write down the number of each bone on the printed photo and pick each number.

It is important to keep a record so that the location and orientation of individual bones can be confirmed later – even if the type cannot be determined beyond a temporary identification when on-site.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Pollen, phytolith and diatom

Effective deposition environment

- Microfossils such as pollen, phytolith, and diatoms are easily preserved in sediments in lakes and wetlands.
- It is contained in sediments of about the same particle size as fine fossils such as sand and silt/clay (→ page 9).
- Deposits that have been repeatedly dry and wet after being deposited or have been soiled may be poorly preserved. (*Refer to each analysis item for details.)

Points to note in the field

- In order to study how micro-fossils (allospheres) were deposited on the site, the investigators and specialists will discuss the geological formations together with the findings obtained from the excavation survey.
- If the specialist cannot come to the survey site, it is necessary to properly inform the specialist of the information on the locations sampled by the surveyor.
- Do not mix micro-fossils of “natural” or “different layers” in the sample. Avoid rainy weather and collect from fresh walls except weathered and dry surfaces in order to prevent contamination by modern or different layers of microfossils.
- Clearly observe vertical cracks, existing plant roots, and traces of animal activity to avoid sampling. (→ page 32)
- Correspond the sampling layer and the drawing. If the layers are determined by excavation and sampling is performed after drawing the wall diagram, there is little confusion between the sample and the drawing.
- Samples will be collected layer by layer, and the sampling points will be drawn on the drawing and a photo record will be kept.

Temporary storage prior to analysis

- Store the sample in a cool and dark place, not in a bad environment such as high temperature and high humidity.

Pollen [Index to restore past vegetation]

The majority of plant pollen and spores fall on land surfaces and water, some of which remain long in the soil. Pollen in sediment provides clues to restore past plant populations (vegetation).

Things to know	Samples suitable for analysis
- Vegetation and climate around the sites - Land use - With or without farming	- Lake sediments near the site - Small water areas (moats, ditches, etc.) within the site - Paddy field traces, cultivated soil, etc.

Phytolith [Indicator to restore past vegetation and paddy field traces].

Some grass and woody plants, such as Gramineae and Cyperaceae, take in silicic acid in soil into cells and form plant opal (plant silicic acid body). Even if the soft tissue decays, it remains in the sediment. Since it has characteristics depending on the species, it serves as a clue for restoring past vegetation and paddy field traces.

Things to know	Samples suitable for analysis
- Vegetation around the sites - Estimation of paddy field and rice production - Presence of rice, wheat and millets	- Sediments containing plant remains and humic traces - Paddy fields, such as cultivated soil - Fired earthenware (firing temperature below 800 ℃)

Diatom [Indicator to restore past water environment]

The characteristics of species distribution differ according to the aquatic environment (salt concentration, water temperature, pH, strength of water flow, turbidity of water area, type of aggregator, etc.). It is also well preserved in sediments and allows for species identification. Diatom bodies and fossils provide clues to restore past aquatic environments.

Things to know	Samples suitable for analysis
- Water topography - Strength of water flow - Presence of large aquatic plants - Water quality (salt concentration, water temperature, pH)	•Hydrological deposits in general (a moderately slow sedimentation rate is a good condition) •Some terrestrial sediments such as marsh sediments (peat beds, etc.)

Soil sampling method

A Clean the wall surface to create a fresh surface

*Take a photo for record purposes before collecting.

A

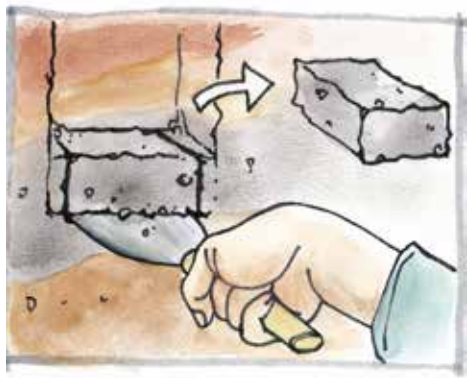
B Take a sample for each stratum

*Considering the case where multiple microfossil analyses and additional tests are performed, the sample should be collected in a slightly larger block.

*For example, cut out a block measuring 5 cm in length × 10 cm in width × 5 cm in thickness with a spatula.

*Even if it is not a spatula, there is no problem as an analysis sample if it can be collected in blocks.

*Care should be taken to ensure that the sample does not mix with other formations, but if it is proposed to scrape the block surface in the room before analysis, it is not necessary to pay close attention to washing the tool each time.



B

C Wrap block sample in aluminium foil.

*The shape of the sample taken can be maintained and light can be shielded.

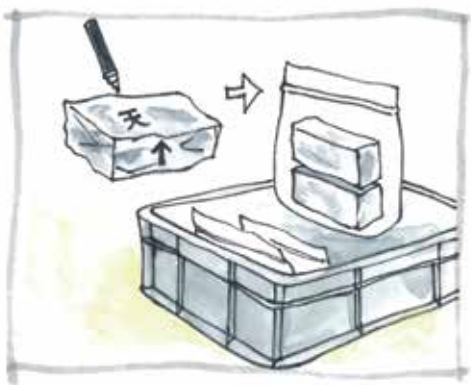
*Since the aluminium foil may deteriorate, the sample may dry, and mould may develop, it is desirable to carry out the analysis as soon as possible.

*In addition to aluminium foil, select a plastic case, sun wrap, or other easy-to-use item.

C

D Write the top of the formation on the surface of the aluminium foil, put it in a plastic bag so that it does not get dirty, and temporarily store it in a top box until analysis.

*The top and bottom of the stratum are important information for conducting analysis. “↑” is added to the cross section along with the sample number.



D

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