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A Pocket Guide to Radiocarbon Sampling

Field – Lab – Museum

By the Penn State Radiocarbon Laboratory

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This pocket guide is brought to you by Penn State's Radiocarbon Laboratory, a division of the Energy and Environmental Sustainability Laboratories (EESL), which are supported by Penn State's Institutes of Energy and the Environment.

This pocket guide is intended to assist researchers collecting ^{14}C samples in the field, lab, or museum to make the best decisions to achieve their research goals with the best possible results. In the moment of choosing your samples you are often facing physical, intellectual and logistical challenges: weather extremes; time crunches; complex stratigraphic observations; and the inevitable critical find at 3 p.m. on the last day of the field season. The purpose here is to provide a resource to help clarify your decision process in those moments, and to allow you to remain focused on doing good science.

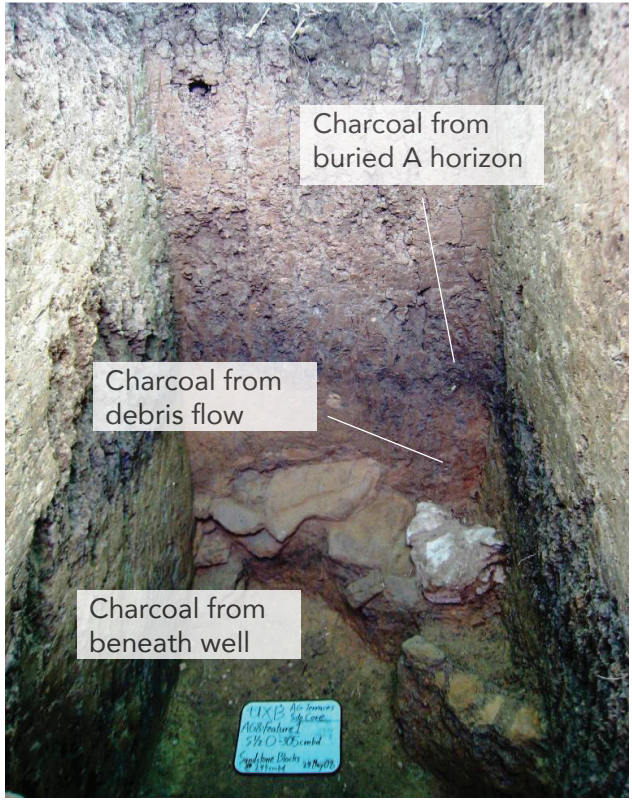
The advice and recommendations that follow are not meant to say that if you fail to do one thing correctly you've ruined your ^{14}C sample irrevocably. The more you apply these ideas the greater the confidence you will have in your results. Whenever you have the opportunity to improve the quality of your sample—even incrementally—do it. Do your best given your experience, your budget, the conditions, and the tools at hand.

Defining the Context

Sampling from an excavation context is guided by an understanding of depositional processes and interpretation of natural and cultural stratigraphy. Collecting samples opportunistically during excavation is a good idea, but targeted sampling when the entire context is fully understood is critical. When you collect a sample, **always define the question that will be answered by the getting a ^{14}C date**. Write this down explicitly in your notes when you collect the sample. It may seem obvious that charcoal from a fire pit tells you the age of the pit, but it also may indicate the age of the floor it's built on, the age of associated artifacts, and constrain the age of another stratum that overlays it. **Write it all down.**

Target abrupt changes in stratigraphy or lithology, which indicate changes in external conditions. Sample directly above and below such breaks, to determine whether the break also represents a hiatus of deposition. Sample all discrete features. Take more samples than you expect/can afford to analyze.

Sampling strategy to constrain timing of wall construction, subsequent burial by debris flow, and later swidden land us at an ancient Maya site.



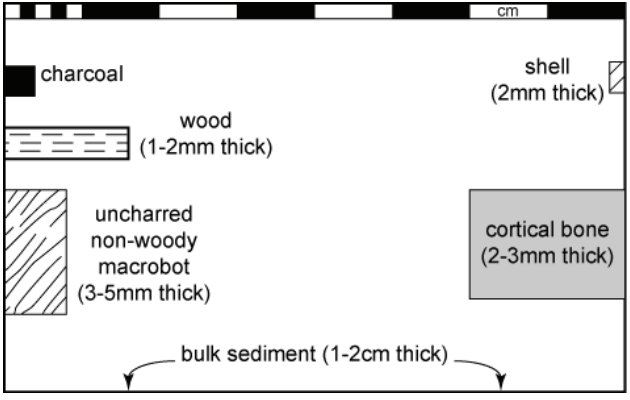
Sample Selection

Usually the ^{14}C age of a dated sample is indirectly related to an event of interest. When we date charcoal from a hearth, we want to know when the hearth was made and the timing of associated artifacts and behaviors. What we actually date is the death of the plant from which the charcoal derived, which can predate the hearth by decades or centuries in some cases. To reduce the effects of old wood and in-built age, short lived samples are recommended where possible.

- **Single year growth**: seeds; grains; nutshells; pinecones; inflorescences; leaves; twigs; grasses; outer wood; outer lip of mollusk shells
- **<10 years**: most animal bone collagen (incl. brief lifespan and collagen turnover); smaller branches; certain mollusks.
- **10+ years**: inner wood of trees; collagen in dentine and the petrous portion of the temporal; bulk soil organics.
- **Avoid multiple or mixed samples**

The table on the next page gives recommended sample sizes for analysis by AMS, assuming an optimal 0.7-1.0 mg of final carbon after processing.

Material	Sample Weight
organics (uncharred)	20-100 mg
charcoal	5-50 mg
bulk sediment	10-100 g
bone	200-1000 mg
bone collagen	>5 mg
calcined bone	1-5 g
hair/fibers/textiles	10-100 mg
carbonates	25-50 mg



Storing your samples

Common containers for ^{14}C samples include aluminum foil packets, Ziploc- or WhirlPac-style bags, film canisters (back when cameras used film), and centrifuge tubes. Using paper bags for storage is not a good idea for organic samples, as standard pretreatment methods (ABA) will not remove cellulose from a deteriorating/soggy bag. Similarly, a paper sample tag kept with a sample should have its own plastic bag to protect it.

Aluminum Foil: Most kitchen foil is coated to help it separate from the roll, and this likely contains some form of carbon. There is a legend that only either the shiny side or the dull side has this coating; in fact it's on both sides. Being food grade, though, the coating is water soluble and will be removed by standard pretreatments. Uncoated chemistry grade foil is available as well.

- **FOLD YOUR FOIL, DON'T CRUSH IT!**

Plastic Bags: Depending on your sample type, bags from 2-4mil thickness are recommended for durability. Typical sandwich bags are often too thin to handle soils, shells, wood fragments, etc., without puncturing. Off-gassing of carbon compounds from polypropylene is typically not an issue that effects ^{14}C samples.

The air- and water-tight conditions a plastic bag can create, which can foster growth or bacteria, mold and fungi that can physically degrade the material and introduce modern carbon contamination. As with cellulose, standard ABA treatments will not necessarily remove this contamination. Allow moist samples to air dry as soon as you can get them into a protected environment. Wet samples (e.g. from a lake core or bog deposit) are best kept submerged in a vial with distilled water until they can be dried.

Consolidants and Adhesives

If a bone or artifact must be consolidated in the field before removing it, use the minimum required and record where specifically it was applied so it can be avoided or removed when later sampled in the lab. Always note the possible presence of a consolidant when submitting the material to a ^{14}C lab.

Sampling in the Lab and in Museums

Whether working with field samples back in the lab, or collecting samples in a museum setting, certain tools and materials are always useful to have on hand:

- Aluminum foil: A clean surface, disposable between samples
- Forceps, scalpels, spatulas
- Methanol or isopropyl alcohol for cleaning tools (do not use ethanol)
- Kimwipes
- Dremel tool with disposable cut-off wheels and drill bits/burrs for sampling bone and shell
- Safety glasses
- Nitrile gloves
- Sharpies
- Bags, vials and other containers suitable for the sample material

Cutting bone with a Dremel should be done in a hood, with safety glasses and a particle mask if necessary. Bone dust is messy and not good to inhale.

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