Ancient Pollen: Unlocking the Secrets of the Past

Instructor material and lesson setup

In this lesson, students will learn how scientists use pollen from lake sediment to explore the past. Students will use a straw to collect a sample core of "sediment" from a physical model of a lake bottom. *Note: the instructor must order sodium polyacrylate and prepare the lake model in advance.*

This lesson was adapted from the Lake Sediment Coring and Pollen Identification Activity provided by the Continental Scientific Drilling Facility, University of Minnesota. https://cse.umn.edu/csd

Arizona Earth and Space Science Standard 8.E1U1.6	Analyze and interpret data about the Earth's geological column to communicate relative ages of rock layers and fossils.
Diné Content Standard	7th-8th Culture Standard Concept 1: I will develop an understanding of Diné way of life. Performance Objective 1: I will engage in activities that will increase my sense of self-worth.
NGSS Performance Expectation	Students will use a physical model of a sediment core to determine patterns of proxy variations and infer environmental changes and use an interactive geographic map to determine patterns of warm and cold cycles.

Instructor Setup

Materials

- Spoons for mixing
- Small plastic containers/tupperware to hold mixtures (alternatively: glass jars)
- Sodium Polyacrylate (see next page)
- Spices (see next page; mustard seeds, sesame seeds, celery seeds, poppy seeds, crushed dried leaves)
- Paper towels
- Clear plastic tubes with sealed ends/bowls/containers (alternatively: long glass or hard plastic vases may work)
- Small spatula for smoothing the gel
- Scotch tape

Sodium Polyacrylate

There are many brands available on the market and they all require a different ratio of water to powder to achieve a gel. Email Kat Cantner at cantn001@umn.edu to confirm your material source before purchase.

Spices

I find that full seeds are preferable to ground spice powder. Keep in mind that they must be small enough to fit in the straws and be collected during coring. I have had success with fennel seeds, but they are more challenging to use than smaller seeds. You can also use potting soil or other small dried materials. The number of "pollen" types you want to create will depend on how many environmental indicators you want students to discern. The following materials have been found to be successful:

- Mustard seeds (yellow and/or brown)
- Celery seeds
- Poppy seeds
- Sesame seeds (white and/or black)
- Dill
- Red pepper flakes/black pepper (be careful when working with younger kids)
- Dried basil/parsley/marjoram (any crushed leaf)

Pick Your Pollen

You may choose any combination of spices to represent your pollen. Below is an example relevant to the midwestern climate transition after the last glacial maximum. You can choose whatever is relevant for your students.

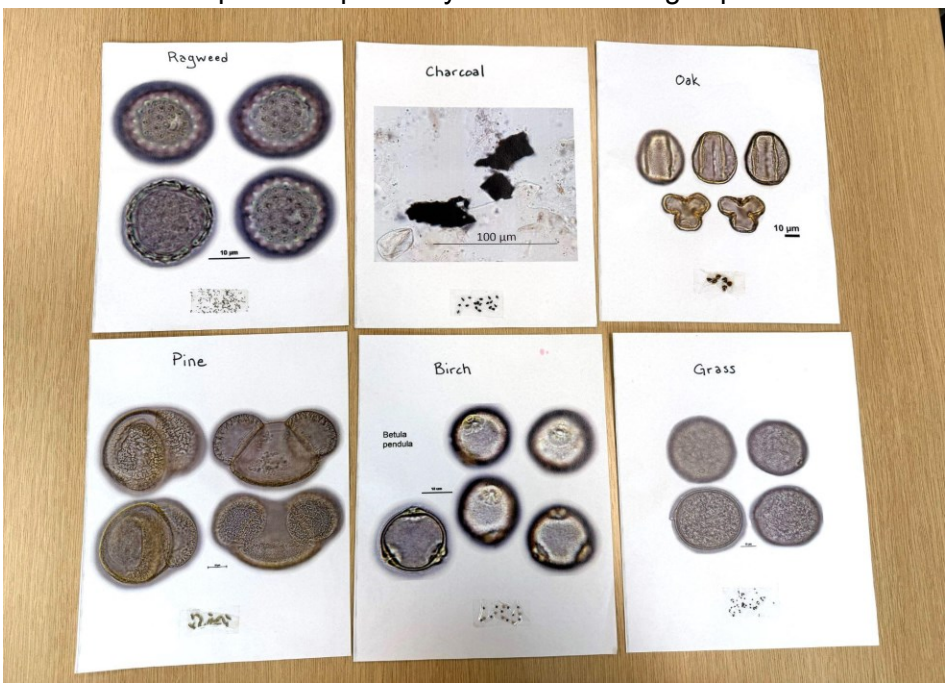
- Pine = fennel or celery seed
- Birch = mustard seed
- Grass = poppy seed
- Ragweed = dill
- Oak = white sesame seed
- Charcoal = black sesame seed

When constructing your lake model, consider laying spices to approximate realistic climate changes. For example, here are six layers for the Midwestern Holocene Climate Transition (top to bottom)

1. Recent record: Ragweed - often used as a marker for agriculture
2. Late Holocene: Pine and Birch
3. Charcoal (date of 4,000 years ago)
4. Mid-Holocene: Oak and Grass - overall transition to more non-arboreal pollen/fewer trees
5. Charcoal (date of 8,000 years ago)
6. Early Holocene: Pine

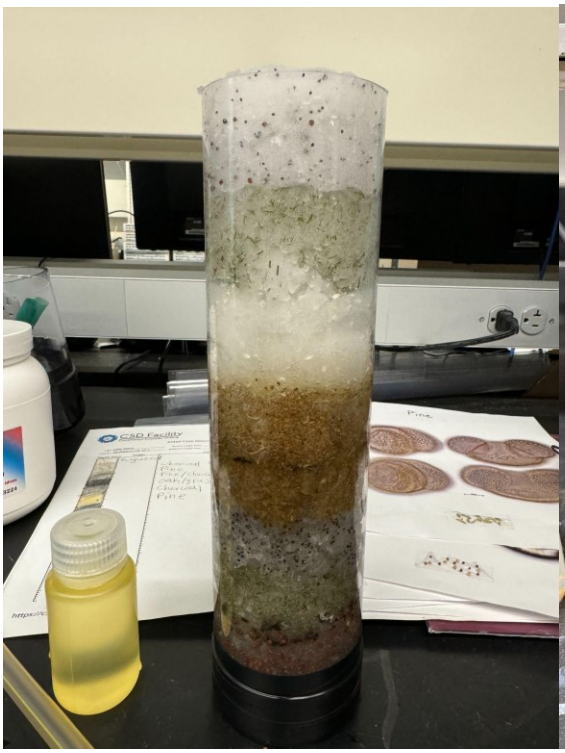
Print Pollen Images

At the end of this document, you'll find images of pollen under the a microscope. Print these images and use scotch tape to adhere a small amount of your chosen spice to the relevant image, so students can interpret the spice they find in the coring experiment.



Selecting a Container

The container for your lake model must be watertight on the bottom. The two examples below are core liners with core caps taped onto the bottom with electrical tape. An average straw is 8 inches long. If your container is deeper than the straw, the students will not be able to sample the lowest layers. You may use a 2-liter bottle or juice container with the top cut off, however, remember that the wider your container, the more gel you will have to make to fill up the volume of your lake model.

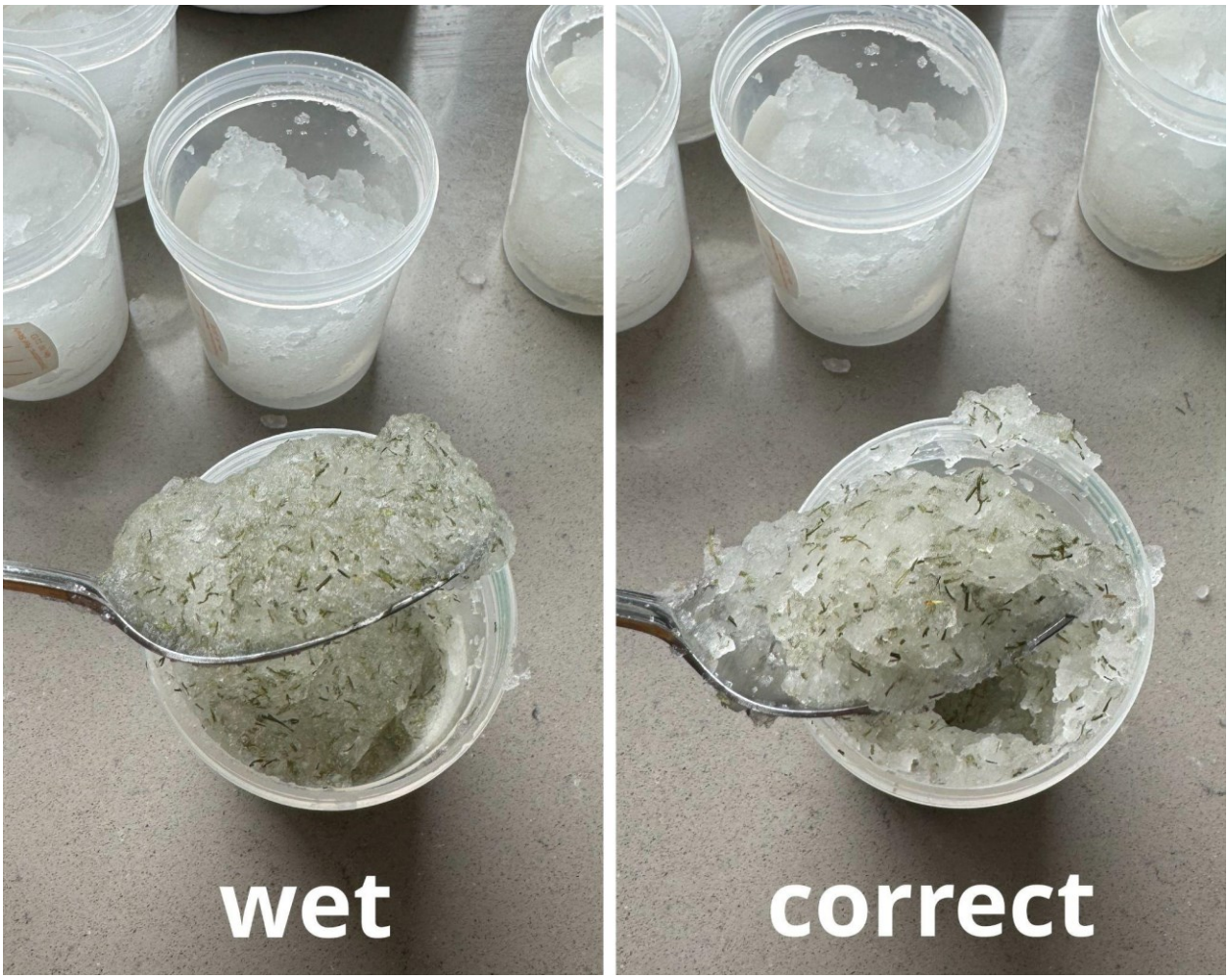


Create the Lake Model

Do ahead of time The gel and lake model should last a week once made.

Create your lake sediment material by mixing sodium polyacrylate and water to create a gel. The amount of material you need to create a substantial layer will depend on the container size you are using for your “lake”. For a polycarbonate tube, I use around 100 ml of water per layer.

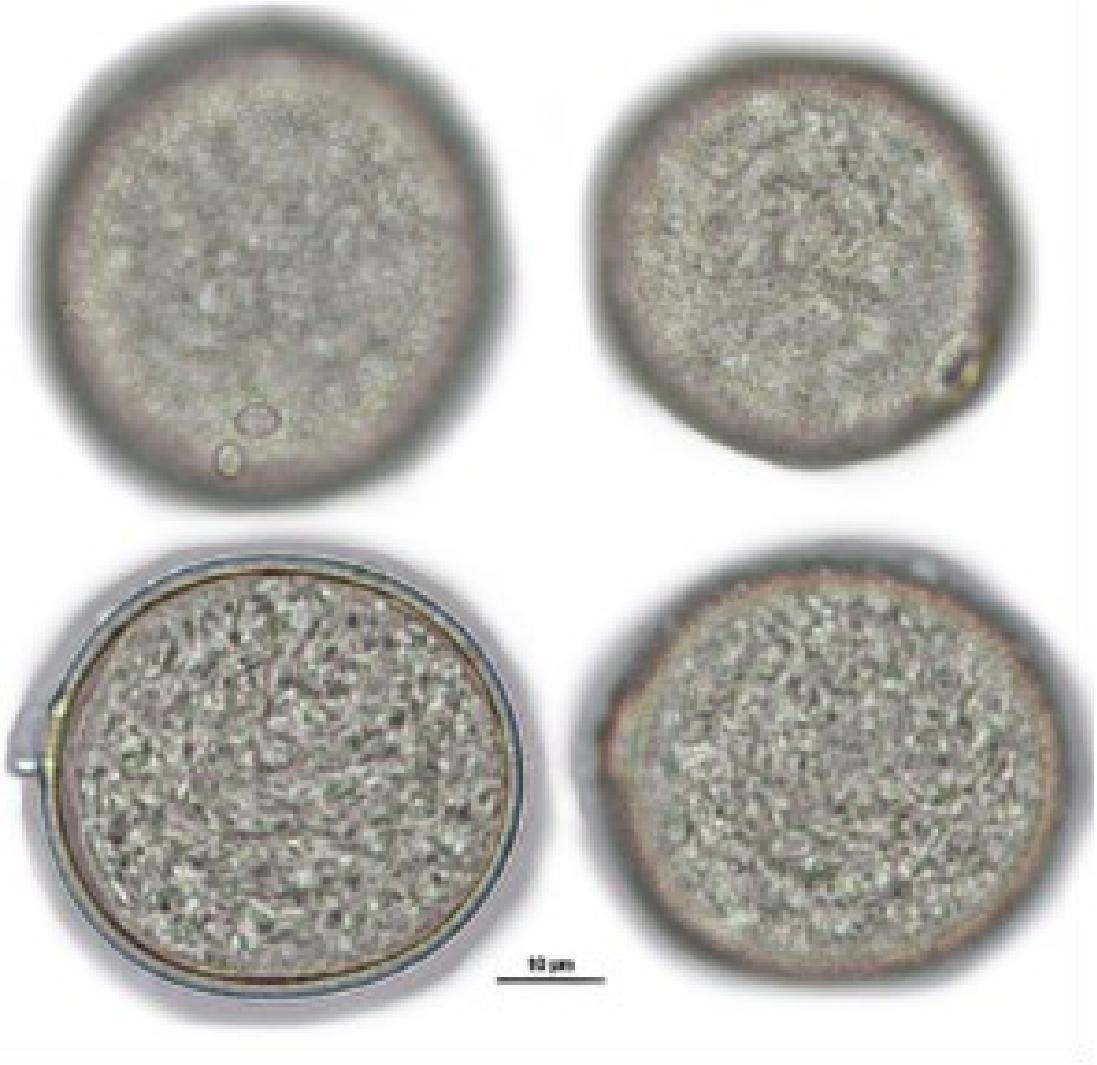
For each layer in your lake model, mix your chosen spice into the gel and let sit for around 20 minutes. The polymer will react with the spice and become looser (wetter). After equilibrating, add more polymer powder to stiffen up the material. Repeat until you have enough “sediment” volume for at least 6 layers in your lake container.



Carefully spoon the mixtures into the lake container one at a time, smoothing after each addition to create even layers. Remember you are adding the OLDEST layer to the model first, so it will be at the bottom of your core. Repeat until all six different spice mixtures are layered to make up your lake model.

Congrats! You now have made a model of lake sediment, which students can explore in the “student” version of this document, which can be found on https://paleopresto.com/education.html.

Grass



Fun Facts

Super Pollen Producer: One ragweed plant can produce up to **a billion grains of pollen** in a season, contributing significantly to seasonal allergies in temperate climates.
Temperature Tolerance: Ragweed thrives in warm climates and can survive in temperatures up to **95°F (35°C)**, making it a robust species across various parts of North America.
Resilient Native: Although ragweed is native to North America, it's considered a nuisance because it spreads aggressively, especially in open, disturbed areas.

Oak

Fun Facts

Mighty Acorns: An oak tree can produce **millions of acorns** in its lifetime, providing food for wildlife in **temperate and subtropical regions** of North America.
Temperature Adaptability: Oaks can thrive in a wide range of temperatures, from the cool climates of the northern U.S. and Canada to the warmer climates of the southern U.S., tolerating temperatures from **-30°F to 100°F (-34°C to 38°C)**.
Native Powerhouse: Most oak species are native to North America, though some like the **English oak** have been introduced from Europe.

Pine

Fun Facts

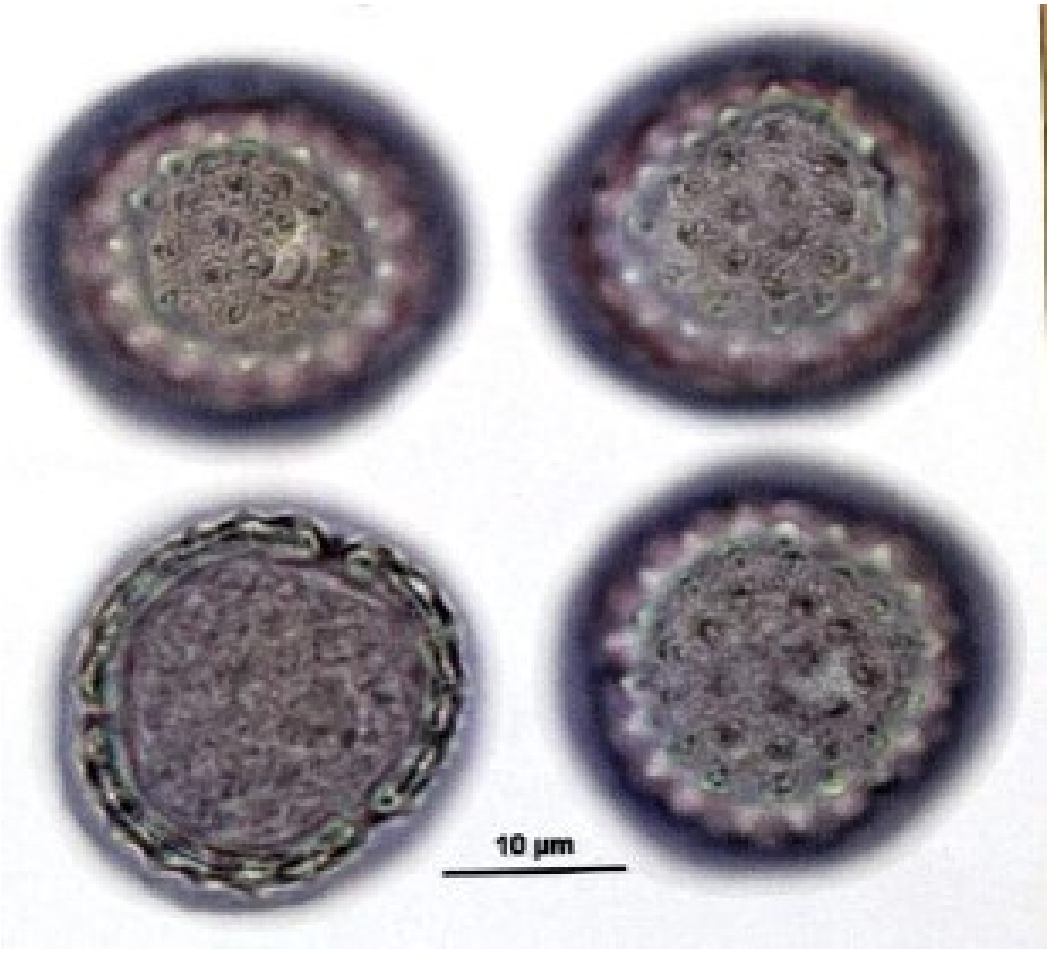
Longest Living Tree: Certain pines, like the Bristlecone Pine, can live for over 4,000 years and survive in extreme temperatures ranging from -40°F to 100°F (-40°C to 38°C).
Cold Climate Survivor: Many pine species thrive in cold climates and mountainous regions of North America, making them common in states like Colorado and Montana.
Adaptable: Pine species are typically native, but some species like the Scots Pine are exotic to North America, originating from Europe and Asia.

Birch - Cold Climate

Fun Facts

Paper Bark: The bark of the birch tree is **waterproof** and has been traditionally used by Indigenous peoples in **temperate climates**, particularly in areas with harsh winters like the northern U.S. and Canada.
Cold Climate Lover: Birch trees prefer **cool temperatures** and are often found in regions where the climate can drop as low as **-40°F (-40°C)**, making them a hallmark of northern forests.
Rapid Growth: Native to North America, birches grow quickly and are often used in reforestation projects in cooler climates.

Ragweed - Warm Climate



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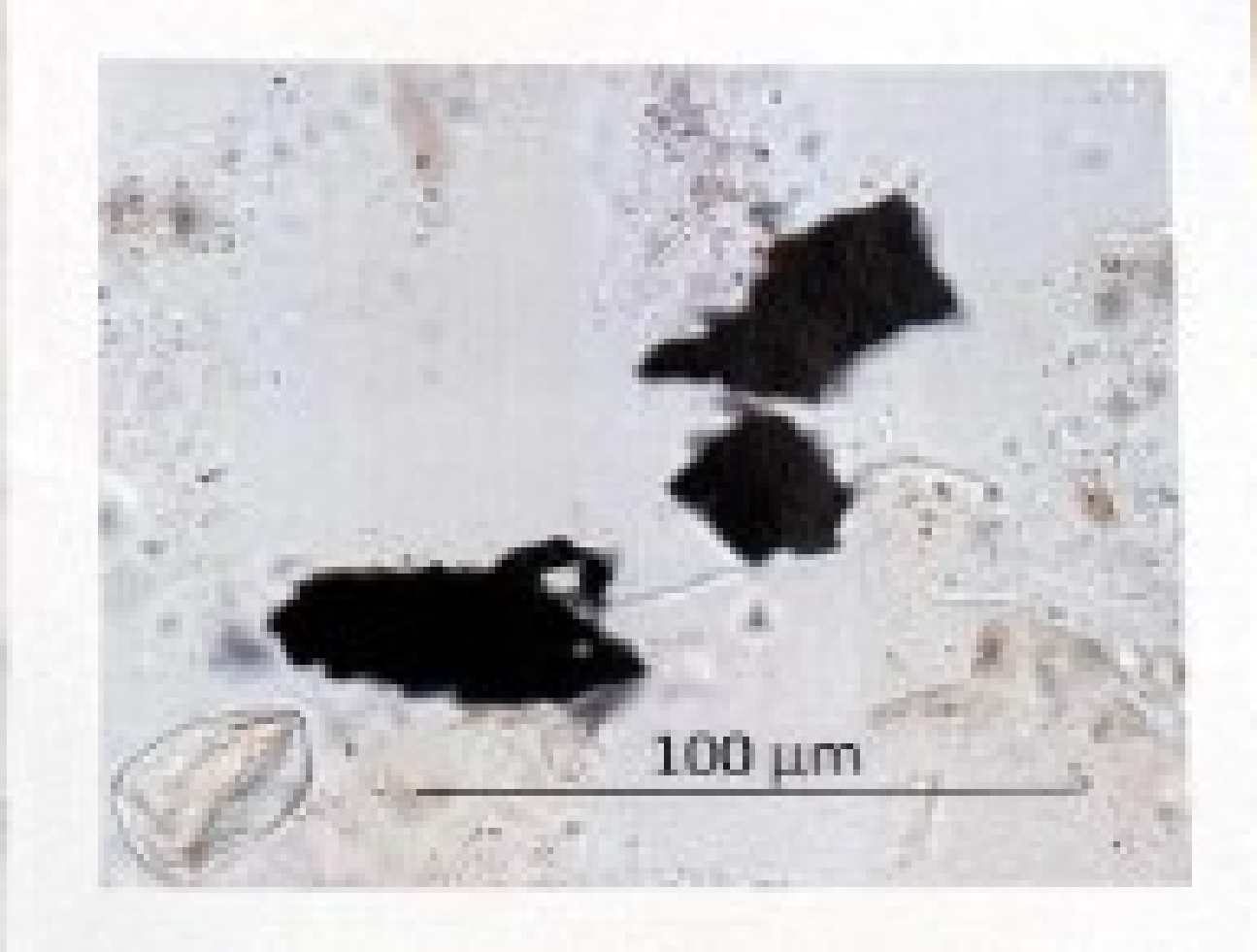
Charcoal



Evidence of fire