

# Glossary of terms and techniques, with links of interest

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## Atomic absorption spectroscopy:

- Acquires data on the elements in artifacts; these data are often used to explore the provenance of the analyzed samples. Typically the spectrometer is attached to an instrument that atomizes the sample, such as ICP-MS (see below), so the method is destructive. Once the atoms are in a gaseous state, different wavelengths of light are emitted and absorbed by atoms specific to that element. Their identity and amount in the sample can be determined.
- To learn more, see: [http://en.wikipedia.org/wiki/Atomic\\_absorption\\_spectroscopy](http://en.wikipedia.org/wiki/Atomic_absorption_spectroscopy) (includes diagrams and images)

## Binocular microscopy, optical microscopy:

- Typically used to examine artifacts under magnification (from 5x to 20x). Such magnification facilitates identification of the materials the object is made of and any patterns of use or alteration on the object.
- To learn more, see: [http://en.wikipedia.org/wiki/Optical\\_microscope](http://en.wikipedia.org/wiki/Optical_microscope) (includes image of instrument)

## Biogeochemical prospecting:

- The scientific discipline that studies chemical cycles; for example, the use of oxygen, carbon, and nitrogen by living things. In archaeology, these cycles are important for radiocarbon dating and isotope analysis; the way that plants use carbon and oxygen, for example, helps determine their age and the type of soil they grew in (i.e., its origin).
- To learn more, see: <http://en.wikipedia.org/wiki/Biogeochemistry>

## Dendrochronology:

- Studies growth rings in trees in order to establish when people felled the tree and presumably used it. The method is also employed to study past climate conditions, particularly precipitation and temperature.
- To learn more, see: <http://ltrr.arizona.edu/about/treerings> (includes images)
- Enjoy an interactive “learn to crossdate” activity: <http://www.ltrr.arizona.edu/skeletonplot/introcrossdate.htm>

## Electrical resistivity:

- Sends an electric pulse into the ground to locate underground archaeological features. Because these features are usually either more or less resistant to electricity than their surroundings, they will show up differently in the resulting map. This allows researchers to identify the features and determine their extent.
- To learn more, see: [http://en.wikipedia.org/wiki/Electrical\\_resistance\\_survey\\_%28archaeology%29](http://en.wikipedia.org/wiki/Electrical_resistance_survey_%28archaeology%29) (with images)

Energy dispersive X-ray fluorescence spectrometry (EDXRF), *see X-ray fluorescence*

## Geochemistry:

- A field of study that looks at chemical elements in soil, water, and air to examine the processes that affect the earth. In archaeology, it is employed in the study of materials such as ceramics, lithics, and metals. Geochemical differences in elements and isotopes often relate to where the material came from, so these differences provide important information for provenance studies.
- To learn more, see: <http://en.wikipedia.org/wiki/Geochemistry>

## Inductively coupled plasma mass spectrometry (ICP-MS), laser ablation inductively coupled mass spectrometry (LA-ICP-MS), multi-collector-inductively coupled plasma mass spectrometry (MC-ICP-MS):

- Uses an instrument that acquires data on the elements in artifacts; these data are often used to explore the provenance of the analyzed samples. The technique is destructive. Powdered material (e.g., ceramic) is ionized by a plasma, and the individual elements and their amounts are determined by the mass-to-charge ratio of the ions (an atom in which the number of electrons does not equal the number of protons). The MC-ICP-MS has additional ion collectors for faster and better detection of some elements. The use of a laser in LA-ICP-MS allows very small areas on a sample to be precisely targeted for analysis.
- To learn more, see: <http://minerals.cr.usgs.gov/icpms/intro.html> (includes diagrams)  
[http://serc.carleton.edu/research\\_education/geochemsheets/techniques/MCICPMS.html](http://serc.carleton.edu/research_education/geochemsheets/techniques/MCICPMS.html) (includes images and diagrams)  
[http://archaeometry.missouri.edu/icpms\\_overview.html](http://archaeometry.missouri.edu/icpms_overview.html) (includes discussion of LA-ICP-MS)

## Lead isotope analysis:

- Uses instruments (such as ICP-MS) to determine the amounts of different lead isotopes in an object. These isotopes, and particularly their ratio, are often characteristic of particular sources of materials used in artifacts (e.g., sources of copper and turquoise). Through comparison of the lead isotope ratios in an artifact with those in potential raw material sources, researchers can often determine a likely provenance.
- To learn more, see: [http://en.wikipedia.org/wiki/Isotope\\_analysis](http://en.wikipedia.org/wiki/Isotope_analysis)

## Magnetometry:

- Detects buried archaeological features by using differences in the direction and magnitude of the magnetic field of archaeological features in comparison to the surrounding soil. In particular, human-induced burning activities will often give archaeological features a different intensity and direction to their magnetic field. The resulting map reveals the shape and size of buried features.
- To learn more, see: <http://www.pastperfect.org.uk/archaeology/magneto.html> (with image)

## Neutron activation analysis (NAA), instrumental neutron activation analysis (INAA):

- Uses a nuclear reactor to determine the elements present in an archaeological artifact (e.g., ceramics, glass, metals, lithics) and their amounts. This destructive technique irradiates a sample and then counts the emitted gamma rays (a form of electromagnetic radiation) as the atoms decay from their radioactive state. The elemental data provide information on chemically similar samples and, in some cases, their provenance in comparison to source raw materials.
- To learn more, see: [http://archaeometry.missouri.edu/naa\\_overview.html](http://archaeometry.missouri.edu/naa_overview.html)  
[http://serc.carleton.edu/research\\_education/geochemsheets/techniques/INAA.html](http://serc.carleton.edu/research_education/geochemsheets/techniques/INAA.html) (includes images and diagrams)

## Paleomagnetic dating:

- Uses the magnetic polarity of a fired material to establish its date based on the variation in the magnetic north pole through time. By matching the polarity of the object, which was reset when it was fired, with a scale of known changes in magnetic polarity, the date can be established.
- To learn more, see: [http://archserve.id.ucsb.edu/courses/anth/fagan/anth3/Courseware/Chronology/11\\_Paleomag\\_Archaeomag.html](http://archserve.id.ucsb.edu/courses/anth/fagan/anth3/Courseware/Chronology/11_Paleomag_Archaeomag.html)

## Periodic Table of the Elements:

[http://en.wikipedia.org/wiki/Periodic\\_table](http://en.wikipedia.org/wiki/Periodic_table)

### Petrography/Thin section analysis:

- Examines a rock through a special microscope that allows identification of the minerals and the rock type. For ceramics, the minerals and rock fragments in sand temper can be specified and the clay characteristics seen. This information usually relates to where the raw materials may be found, and this, in turn, provides a provenance for the lithic or ceramic artifact. Thin slices of the rock or ceramic are mounted on a slide, and called thin sections.
- To learn more, see: [http://geology.isu.edu/geostac/Field\\_Exercise/Cassia\\_mtns/thinsect.html](http://geology.isu.edu/geostac/Field_Exercise/Cassia_mtns/thinsect.html) (with images)

### Portable X-ray fluorescence spectrometry (pXRF), *see X-ray fluorescence*

### Potassium-Argon dating (K–Ar):

- Dates volcanic geological strata by measuring the radioactive decay of potassium isotopes into argon isotopes. As the rate of decay is known, the amount of argon in the sample establishes the date for the original deposition of the potassium in the strata.
- To learn more, see: [http://en.wikipedia.org/wiki/K%E2%80%93Ar\\_dating](http://en.wikipedia.org/wiki/K%E2%80%93Ar_dating)  
[http://anthro.palomar.edu/time/time\\_5.htm](http://anthro.palomar.edu/time/time_5.htm) (includes diagrams)

### <sup>14</sup>C Radiocarbon dating:

- Establishes the age of organic materials based on the amount of <sup>14</sup>C carbon isotope in a sample. After a plant dies, it no longer absorbs <sup>14</sup>C, and what is currently in the plant will decay at a constant rate. In comparison with stable <sup>12</sup>C, the amount of <sup>14</sup>C left establishes when the plant died.
- To learn more, see: [http://en.wikipedia.org/wiki/Radiocarbon\\_dating](http://en.wikipedia.org/wiki/Radiocarbon_dating)  
[http://anthro.palomar.edu/time/time\\_5.htm](http://anthro.palomar.edu/time/time_5.htm) (includes diagrams)

### Remote sensing:

- A set of techniques that helps to locate archaeological features underground. It includes various types of satellite imagery and aerial photography to detect soil differences that may indicate where archaeological features are located.
- To learn more, see: [http://en.wikipedia.org/wiki/Remote\\_sensing\\_%28archaeology%29](http://en.wikipedia.org/wiki/Remote_sensing_%28archaeology%29)

### Scanning electron microscopy (SEM):

- A technique that uses an instrument with an electron beam to create high-magnification images of objects. In archaeology, this can be done nondestructively and can also provide qualitative data on elements in the sample. Destructive analysis can be done that allows the chemistry of specific areas of a sample to be quantitatively established.
- To learn more, see: [http://serc.carleton.edu/research\\_education/geochemsheets/techniques/SEM.html](http://serc.carleton.edu/research_education/geochemsheets/techniques/SEM.html) (includes images and diagrams)

### Soil science:

- The study of many aspects of soil, including moisture content, chemistry, formation processes, and fertility. Within archaeology, human modification of soils can be examined by looking at particle size and chemistry changes in comparison to natural soils.
- To learn more, see: [http://en.wikipedia.org/wiki/Soil\\_science](http://en.wikipedia.org/wiki/Soil_science)

### Strontium isotope analysis:

- Uses instruments (such as ICP-MS) to determine the amounts of different strontium isotopes in an object. These isotopes, particularly their ratio, are often characteristic of where plants and animals have lived and of rock sources. Through comparison of the strontium isotope ratios in an object and established ratios in plants and rocks, an origin can often be suggested.
- To learn more, see: [http://en.wikipedia.org/wiki/Isotope\\_analysis](http://en.wikipedia.org/wiki/Isotope_analysis)  
[http://www.wessexarch.co.uk/projects/wiltshire/boscombe/bowmen/strontium\\_isotope.html](http://www.wessexarch.co.uk/projects/wiltshire/boscombe/bowmen/strontium_isotope.html)

### Thermal ionization mass spectrometry (TIMS):

- Uses an instrument that acquires data on the isotopes in artifacts; these data are often used to explore the provenance of the analyzed samples. The technique is destructive, and powdered material is ionized thermally on metal ribbons. Then, a mass spectrometer identifies the individual ions and their amounts based on their mass-to-charge ratio.
- To learn more, see: [http://serc.carleton.edu/research\\_education/geochemsheets/techniques/TIMS.html](http://serc.carleton.edu/research_education/geochemsheets/techniques/TIMS.html) (includes images and diagrams)

### Thermoluminescence dating (TL), optically stimulated luminescence (OSL):

- Two dating techniques. TL examines the amount of photons released in a sample when it is heated. These photons are the result of displaced electrons that built up over time from when the sample (usually a ceramic or hearth material) was last heated. The amount of photons is related to the time elapsed since this event. OSL looks at the amount of photons released from quartz grains in soil or ceramics. This amount establishes a date when the object was last exposed to light, which can also displace electrons.
- To learn more, see: [http://anthro.palomar.edu/time/time\\_5.htm](http://anthro.palomar.edu/time/time_5.htm) (includes diagrams)  
[http://en.wikipedia.org/wiki/Thermoluminescence\\_dating](http://en.wikipedia.org/wiki/Thermoluminescence_dating) (includes diagram)  
[http://en.wikipedia.org/wiki/Optical\\_dating](http://en.wikipedia.org/wiki/Optical_dating)

### X-ray diffraction:

- Identifies the crystalline phase of an object (for example, quartz and specific clay minerals). This provides important information on the material of an artifact. The destructive analysis examines the pattern of emitted diffracted X-rays that are characteristic of particular crystal structures.
- To learn more, see: [http://serc.carleton.edu/research\\_education/geochemsheets/techniques/XRD.html](http://serc.carleton.edu/research_education/geochemsheets/techniques/XRD.html) (includes images and diagram)

### X-ray fluorescence spectrometry, energy dispersive X-ray fluorescence spectrometry (EDXRF), portable X-ray fluorescence spectrometry (pXRF):

- Uses an instrument that acquires elemental data in artifacts; these data are often used to explore the provenance of the analyzed samples. The technique can be destructive, with powdered pellets bombarded with X-rays. This excites the atoms, and as they de-excite, they emit a secondary X-ray (or fluorescent) specific to the identity of the element. pXRF uses a nondestructive method to acquire chemical data.
- To learn more, see: [http://serc.carleton.edu/research\\_education/geochemsheets/techniques/XRF.html](http://serc.carleton.edu/research_education/geochemsheets/techniques/XRF.html) (with images)  
<http://www.swxrflab.net/anlysis.htm>