METHOD	HOW ACCOMPLISHED
Potassium Argon	Use of a focused laser to liberate trapped radiogenic gas...to measure nuclide abundance ratio present in decay of potassium 40 to argon 40 (parent/daughter relationship). To give you an idea of the depth but lack of precision of this method, Potassium 40 half life is 1.3 **billion years.**
Radiocarbon dating	Cosmic rays naturally emit radioactive isotopes into the atmosphere at a more or less constant rate. One of these is Carbon 14, which is in turn absorbed by plants through photosynthesis. In turn, carbon 14 decays at fixed exponential rate (half life of 5,730 years).
Thermo-luminescence	Form of luminescence through which heating or "illuminating" releases and measures the number of isotopes trapped in lattice structure (micro level) of items such as clay vessels vis a vis light from emitted photons. The resulting luminescence approximates the age of the vessel where the number of isotopes approximates the amount of radiation accumulated via isotopic decay.
Electron Spin Resonance	Similar to thermoluminescence, but instead of trapped electrons being illuminated, samples are exposed to microwaves, causing trapped electrons to vibrate. This technique is based upon the behavior of electrons in crystals exposed to naturally occurring radioactivity; used to date limestone, coral, shell, teeth, and other materials.
Dendochronology	Creates chronology of tree rings by overlapping matching rings of trees. Developed by A.E. Douglass (1867-1962), an astronomer who eventually founded the Tree Ring Laboratory here at the University of Arizona. Can tell us when a tree was felled, but not when a room was constructed. This is also a method with environmental modeling utility where tree rings are essentially fatter in times of plenty and thinner in times of drought. Rings also reflect what are known as de Vries effects - systemic anomalies on a global scale. These may correspond with solar flare-ups or magnetic pole shifts. De Vries effects are also discernable in radiocarbon dating and thus, tree rings can be used to calibrate global carbon decay anomalies to a standard time scale (first carbon date by Libby was on wood of known age).

radiometric dating methods, based on radioactive decay

Archaeological Dating

- Only dendrochronology can date with a precision of +/- 10 years, but only has an age range up to 12,000 years
  - Precision becomes an issue if you're looking at a culture that may have changed within the span of a generation
- Potassium-Argon dating can date back billions of years without anywhere near the same type of precision
- Even theoretically "absolute" dating methods like Radiocarbon dating depend on environmentally-dependent assumptions of constant and steady decay, which does not necessarily happen in practice - de Vries effects
  - Need to calibrate radiocarbon dates - calibration curves take into account local, temporal and global fluxuations
    - Human effects - the Industrial Revolution released CO2 into the atmosphere via burning of fossil fuels **decreases** level of C14 in atmosphere (Suess effect).
    - The atomic bomb **doubles** the amount of C14 in the atmosphere. This is one of the reasons that BP is measured from 1950.

Method	Material Required	Age Range	Example
Dendrochronology	wood with visible ring structure	0 to 12,000 years	
Radiocarbon	Organic material: wood, bone, shell, leather, hair, plant remains	300 to 50,000 years	
	Volcanic rock or ash		
Electron Spin Resonance		1,000 to 1 million years	

100,000 to several billion years	300 to 50,000 years	Thermo-luminescence	0 to 100,000 years
Potassium-Argon	fire clay, pottery	tooth enamel, calcite, bone	wood with visible ring structure

Willard Libby and the Atomic Age

Willard Libby (1908-1980) developed Carbon-14 Dating, which can be used to date anything organic.

After the start of World War II, he worked on the Manhattan Project. Libby was responsible for the gaseous diffusion separation and enrichment of the Uranium-235 (used in uranium-lead dating) which was used in the atomic bomb on Hiroshima.

Because he spent most of his career building sensitive Geiger counters to measure radioactivity in the atmosphere, he realized that in the wake of the atomic bomb explosion, the amount of radioactivity in the atmosphere more than doubled. This is one of the major reasons why BP is measured from 1950

1960 - Nobel Prize for chemistry

Shroud of Turin and Accelerator Mass Spectrometry (ASM)

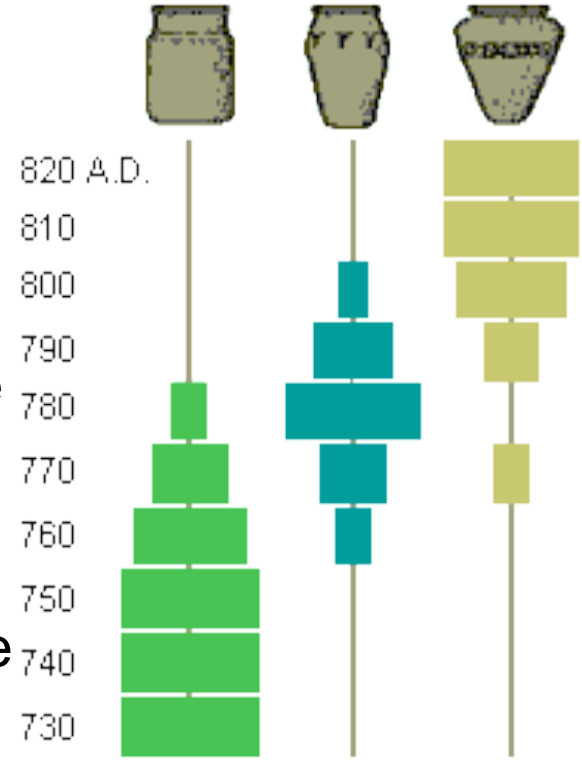
ASM - "**a research instrument primarily used in physics to accelerate streams of charged subnuclear particles to high velocities in order to sort and analyze them. This technique is now also used to count carbon isotope atoms for radiocarbon dating. The advantage of this technique over the conventional radiocarbon method is that it requires a far smaller sample size and can potentially provide dates going back to around 100,000 B.P. At present, however, AMS dates generally are for events less than 60,000 years old." (anthro.palomar.edu)**

Shroud of Turin and ASM

While conventional particle decay would have required too large a sample size of the cloth than the Catholic Church would allow, the advantage of ASM was that only a small fragment - a strand of the cloth - could be used to measure C14 decay.

~a dozen threads removed and ASM used to correlate the date from a piece of Egyptian cloth known to be +/- 2010 Radiocarbon Years Before Present (RCYBP) and strands from the Turin Shroud. These measurements were then correlated between three labs. The samples from the Shroud showed to be much younger than the Egyptian cloth.

Terminology



Coprolite – Ancient POOP! Helps us to reconstruct past diet and subsistence

Seriation – stylistic, typologies, relative dating. Observable changes in artifacts over time.
Example: Changes in Coca-Cola bottle

Ecofact ===> Materials in the archeological record that are naturally occurring vs. Artifact ===> Materials in the archaeological record that are man-made.

Palynology- The analysis of fossil pollen as an aid to the reconstruction of past vegetation and climates.

Flotation- using water to process soil or feature fill to recover tiny artifacts. Dried soil is placed on a screen, and water is gently bubbled up through the soil. Seeds, charcoal and other light material float off, and tiny pieces of stone, bone fragments, and other relatively heavy materials are left behind.

Silica bodies, macrobotanical remains, phytoliths, pollens
Ex. Barnacles, honeysuckle... How can they be useful?

Zooarchaeology - the study of faunal remains found in archaeological sites and their cultural significance...
What are some examples of "micro"- and "macro"- fauna?
Environmental Anthropology- inter-disciplinary research, involving archaeologists and natural scientists, is directed at the reconstruction of human use of plants and animals, and how past societies adapted to changing environmental conditions... How is this related to *zooarchaeology?*

Andrew Ellicot Douglass - Astronomer at the UA who developed Dendochronology while studying sun spots.

Dendrochronology- Creates chronology of tree rings by overlapping matching rings of trees. Developed by A.E. Douglass, an astronomer here at the UA. Can tell us when a tree was felled, but not when a room was constructed. Can help us also understand ancient environment.

Social Archaeology

Androcentrism
Glynn Isaac (1937-1985) at Koobi Fora at Turkana, Northern Kenya

- tightly controlled excavation and recording of provenience
- allows recording of discrete activity areas (bone processing, stone working, resource caches) at some of the earliest archaeological sites known
- microstratigraphy

Environmental Effects that Changed Thermopylae & Easter Island

Thermopylae: (Pg 347)

- Alluvial shift changed geography
- Deposition has buried it and pushed the shore back several miles
-
-

Easter Island: (Pg 228)

- Archaeological record indicates many deserted settlements
- How do we know there was once rich plant life?
- How do we know what the people ate?
- What happened on Easter Island?

Elman Service (1915-1996)

Bands --

Tribes --

Chiefdoms --

City-States --

Problems with this system?!?