



Doing Archaeology (PowerPoint 7)



Doing Archaeology

PowerPoint 8

- Archaeology is really a synthesis of three themes.
- The first is dating. Once we know how old things are and we can sort them into packages of time then we can get to the next level.
- The second theme is the reconstruction of the prehistoric life ways: site types, settlement patterns, subsistence, sociopolitical organization.
- Finally, the holy grail of prehistory is understanding the how and why of culture change. What happened when? How can we best explain those changes? Are there patterned regularities in culture process and can we develop explanations for human behavior? Doing what some have called “scientific archaeology”



Dating in Archaeology

- A first basic building block in any archaeological study is a focus on the age of the cultural materials represented at a site.
- However sometimes artifacts and sites can be notoriously difficult to date.
- Often it seems that controversy surrounds many of the methods used for placing sites in time.
- Even more so based on some of the more novel and experimental strategies for dating.



Dating in Archaeology



- Nevertheless, a critical and basic building block to any study of an artifact or a site and a preliminary to higher orders of interpretation is always the determination of its age.
- Therefore, chronological data is often crucial and a central question related to many other types of analysis in which it is integrated with other archaeological and environmental information.

Dating in Archaeology



- This presentation will briefly survey the range of dating techniques used in contemporary archaeological studies. This is just the preliminary and consider this a rather superficial overview.
- There are traditionally three broad categories of dating:
- **Relative dating** or indirect methods such as degree of weathering, superimposition analysis, **stylistic analysis**, and inter-site patterning.
- **Absolute dating** such as the application of
- **Direct dating** when you apply a **chronometric method** directly to cultural materials such as AMS (Accelerated Mass Spectroscopy) radiocarbon dating or XRF (X-ray fluorescence) dating of desert varnish



Relative Dating

- Relative dating techniques include observations on the **patterns of chemical and physical weathering**.
- The relative degree of patination of the rocks, the amount of revarnishing on artifacts, and the darkness of desert varnish on archaeological features or flaked stone artifacts.
- Various attempts have been made to operationally measure or quantify these characteristics



Absolute Dating



- Projectile point styles are very important temporal diagnostics – key time markers for California and Great Basin prehistorians
- The overall form (size, weight, and manner of production) of the points, their distinctive bases, blade form, and manner of attachment (corner-notched, basal-notched, eared, etc.) are all important distinctions.
- Here we provide a quick overview of the major point forms and their ages as reconstructed in the southwestern Great Basin

Desert Side-Notched & Cottonwood Arrow Points: AD 1300 - Historic

- Baumhoff and Byrne – first to describe
- Most recent, historic era back 500 to 1000 years
- Ethnohistoric examples are known



Desert Side-Notched & Cottonwood Arrow Points: AD 1300 - Historic

- DSNs - Hypothesized marker for Numic (Great Basin Shoshonean speakers) spread
- Distribution different
- DSN to the north (Fremont Valley)
- CT to the south
- Dating changes when move into the Mojave Desert...



Rose Spring and Eastgate

Arrow Points: AD 200 - 1300



- These are earlier arrow points.
- Typically weighing less than 3 grams – distinctively smaller than dart points.
- Many different base forms – corner notched, contracting stem.
- They are intended to tip the foreshafts of arrows.
- They mark the transition from dart and atlatl to the bow and arrow

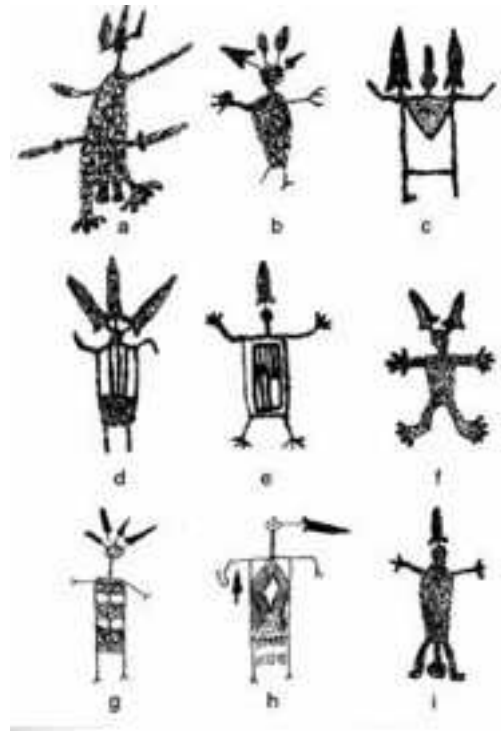
Elko Dart Points: 2000 BC – AD 200



- Depicted in dart point glyphs in the Coso Range and elsewhere in the Great Basin.
- Either shown hafted or unhafted and also in association with human or anthropomorphic figures.
- Various base forms: eared, corner-notched, contracting stems (the latter called Gypsum Cave).
- Different dating for western versus eastern Great Basin.

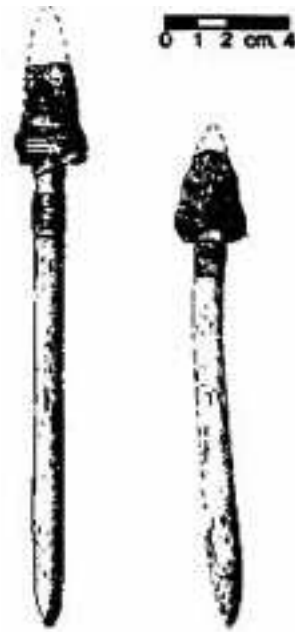


Elko Dart Points: 2000 BC – AD 200



Humboldt Darts, Thrusting Spears and Knives: 5000 BC to AD 800

- Recovered from Hidden Cave in Nevada attached to dart foreshafts.
- Association with game intercept drive sites
- Also found as grave offerings



Humboldt Darts, Thrusting Spears and Knives: 5000 BC to AD 800

- Small narrow based variant is early (5000 – 1000 BC)
- Larger, wider more finely finished form is late (500/1000 BC – AD 800).
- This form may be depicted in Coso projectile point petroglyphs adorning patterned body anthropomorphs



Humboldt:

5000 BC to AD 800

- Humboldts have several variants.
- Proven rather difficult to date due to simple form. Can be confused with earlier points.
- Counter-intuitive: smaller more gracile variant is earlier!

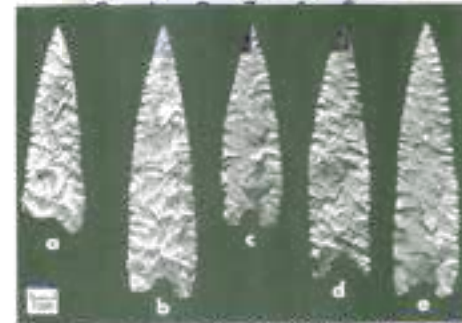


Figure 3: Five projectile points from Burial Pit 2 illustrate specific aspects of manufacture discussed in the text. Arizona State Museum catalogue numbers are: A, 75-65-1; B, 75-65-2; C, 75-65-3; D, 75-65-4; E, 75-65-5.

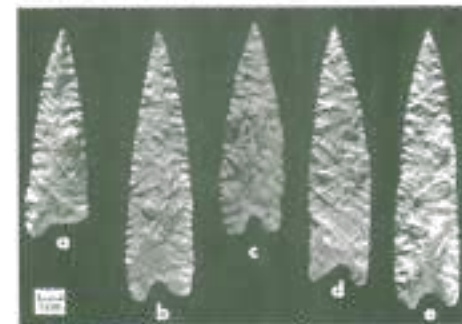


Figure 4: Reverse side of projectile points shown in Figure 3. The points were found with associated obsidian cores in their original position.

Pinto Dart Points: 5000 – 2000 BC



- Pinto points were first recognized in the Pinto Basin in southern California.
- Type site where they are most abundant in eastern California is called the Stahl Site just north of Little Lake (at the western edge of the Coso Range).
- Hundreds of such points were discovered.



Stemmed Series Points: Lake Mojave and Silver Lake 9000 – 5000 BC



- These are the Stemmed Series points associated with what is known as the Western Pluvial Lakes Tradition.
- Fashioned by percussion rather than pressure flaking.
- Found most often on the shores of ancient now dry Pleistocene lake shores.

Western Fluted and Concave Base:

11,500 - 9,000 BC

- Various identified – distinctive (often fluted).
- Earliest named points in United States – look like Clovis points known from Plains and American Southwest.
- Found throughout N. America, rarer in California and Great Basin
- Precise dating debated
- Classification is also controversial
- Associated with earliest peopling of the Americas



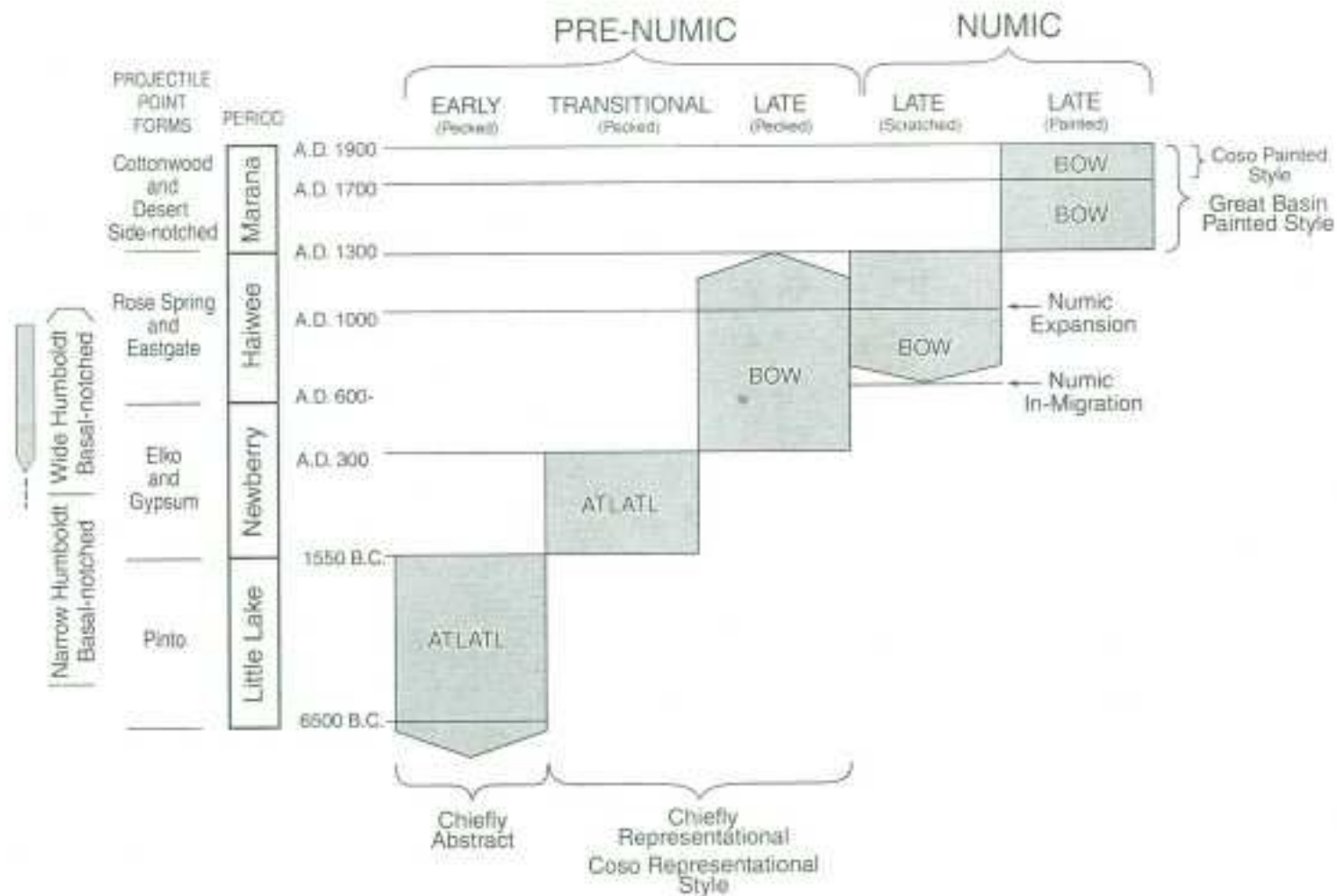
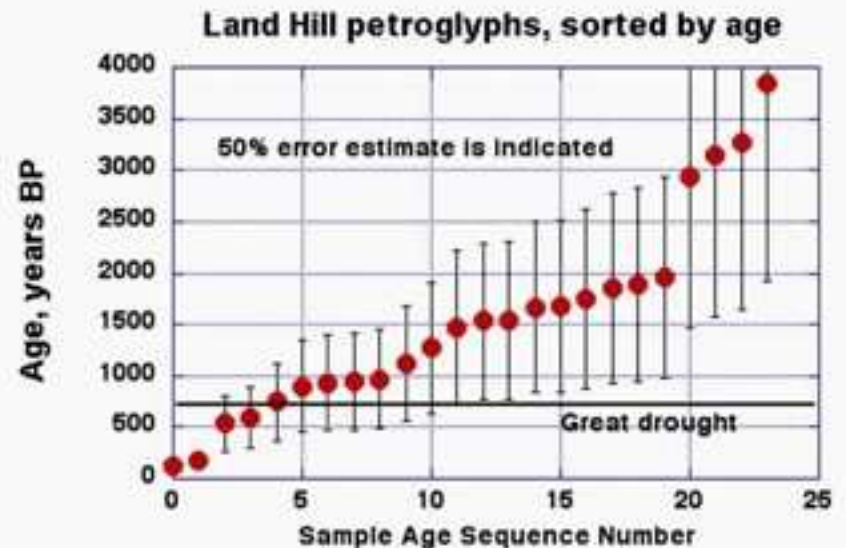


Figure 6.1 Dating of Weaponry, Rock Art Styles, and Population Movements.
(Adapted from Grant et al. 1968: 58)

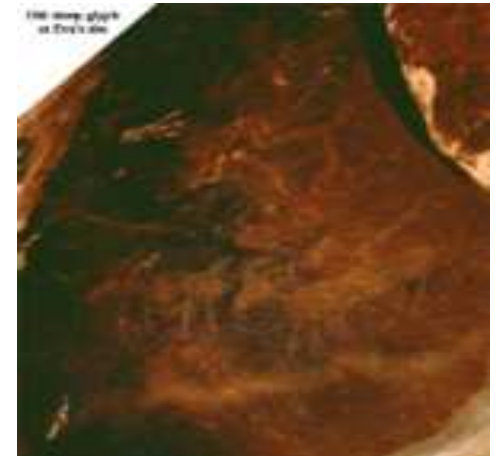
Direct Dating

- ***Direct dating*** relates to the application of chronometric techniques where we attempt to obtain age by directly assessing an image using analytical techniques such as AMS radiocarbon dating or XRF dating of the desert varnish of the pecked out image.



Relative Dating: Weathering

- Once an artifact has been crafted through flintknapping, pecked or abraded into, it is immediately subject to chemical and physical weathering.
- If this proceeds at a relatively steady rate the degree of weathering can be used as an indicator of absolute age.
- Differential weathering of has typically been used to suggest relative age differences.



Relative Dating: Weathering



- These age assessments are based on the notion that a less weathered artifacts will be younger than an artifact or features with greater signs of weathering.
- However, there are other factors which affect weathering rates, such as micro- environment, depth of engravings and so forth.
- Even so, there are some instances where significant differences in weathering clearly indicate significant differences in age.



Relative Dating: Superimposition



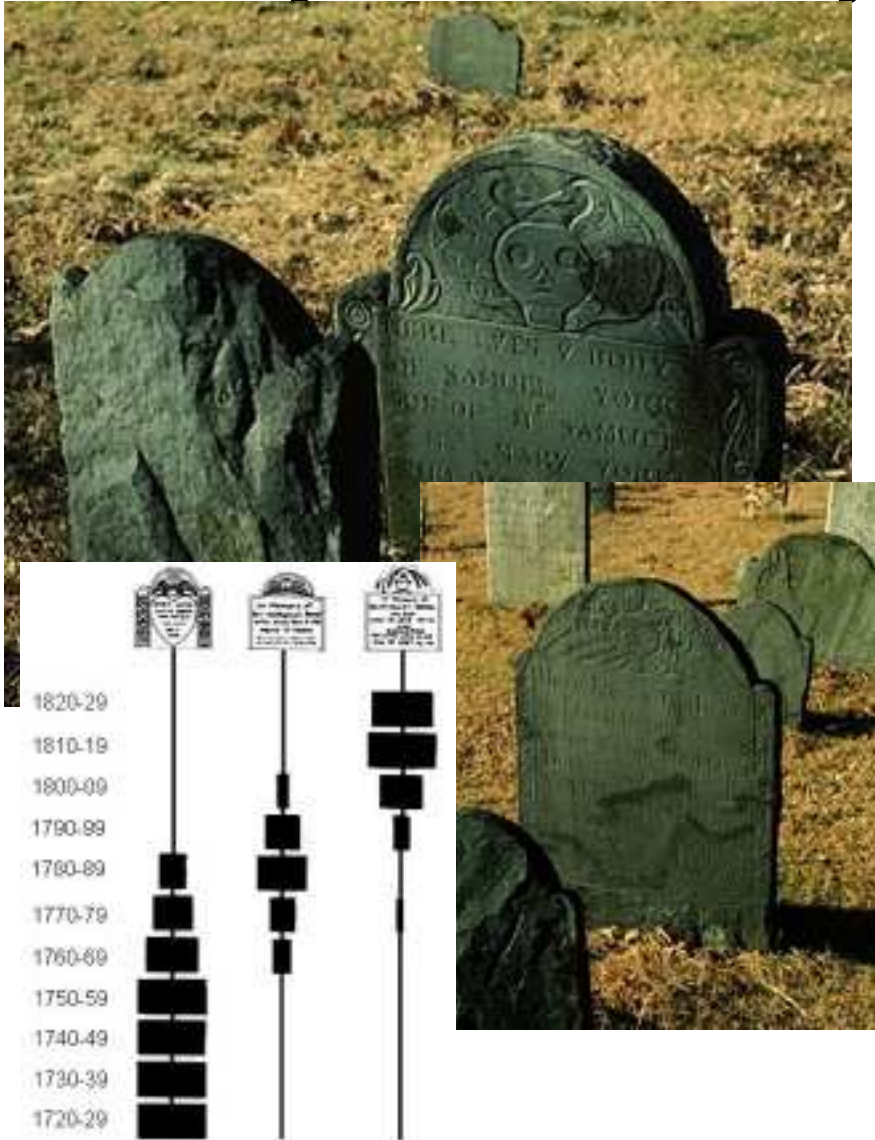
- The basis of this method is stratigraphic in that a design occurring over, or through, another is logically presumed to have been executed more recently in time.
- Simple as the idea sounds on paper, there are many complications.
- For instance, materials found in the uppermost levels of a deposit should be younger than those found deeper in a deposit
- However, there are a number of technical difficulties associated with the recording of superimpositions.

Stylistic Analysis: Seriation

- Seriation, was first used, and probably invented by the archaeologist [Sir William Flinders-Petrie](#) in 1899, seriation (or sequence dating) is based on the idea that artifacts change over time.
- Like fins on the back end of a Cadillac, artifact styles and characteristics change over time, coming into fashion, then fading in popularity.
- Generally, seriation is manipulated graphically.



Stylistic Analysis: Seriation



- The standard graphical result of seriation is a series of "battleship curves," which are horizontal bars representing percentages plotted on a vertical axis.
- Plotting several curves can allow the archaeologist to develop a relative chronology for an entire site or group of sites.
- The most famous seriation study was probably Deetz and Dethlefsen's work on changing styles of gravestones in New England cemeteries. The method is still a standard for cemetery studies.

Stylistic Analysis: Seriation

- Atlatl styles in the Cosos
- Number of weights
- Simplicity or complexity of atlatl rendition
- (no finger loops, one loop and two finger loops)
- Realist atlatls were the rarest and the most recent

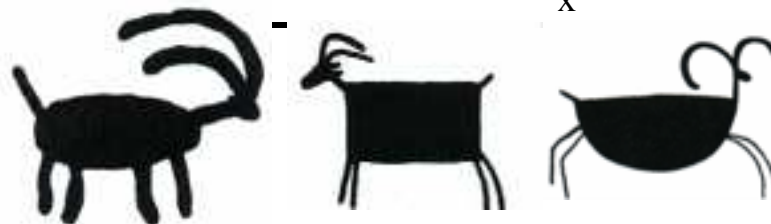


Coso Atlatl and Decorated Animal-Human



Coso Sheep Styles

	Other		Coso
	Type I	Type II	Type III
Side view, excessively long horns	x		
Side view, image appears stiff/motionless	x		
Head/horns seen from the side	x	x	
Side view, simple oval body	x	x	
Side view, rectangular body		x	
Side view, boat -shaped body		x	x
Patterns on body		x	x
Image appears in motion		x	x
Front or rear quarter-view of body			x
Head/horns seen from the front			x



Relative Dating: Spatial Analysis



- At some sites differential weathering and superimpositions indicate that 'bursts' of artistic activity have occurred over considerable time periods.
- In these cases intra-site patterning can reflect chronological patterning.
- By implication, there may be sites which were used for a short period of time only in which techniques, motifs and colors can be isolated and appear to have held cultural values determining site significance.
- If so, trends in the inter-site (and sometimes intra-site) distribution of artistic variables can provide evidence for a sequence.
- This of course assumes that a researcher can control for the various factors that might effect such patterning and other factors can be taken into account.

Absolute Dating: Subjects



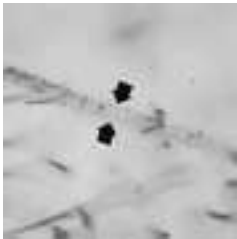
- The most common method employed for the direct dating has been to use situations where artifacts and deposits are 'stratified' in a dateable context.
- This can occur at the macro or the micro level.
- Artifacts occurs in macro-stratified contexts when it is covered by, or covers, dateable archaeological deposits.
- Depending on the nature of the association this can provide a maximum age) or a minimum age (e.g. a panel of rock art covered by deposits).

Absolute Dating by Association: Obsidian Hydration Dating

- Obsidian hydration dating of artifacts uses the rate of the diffusion of water molecules into volcanic glass artifacts to determine their age.

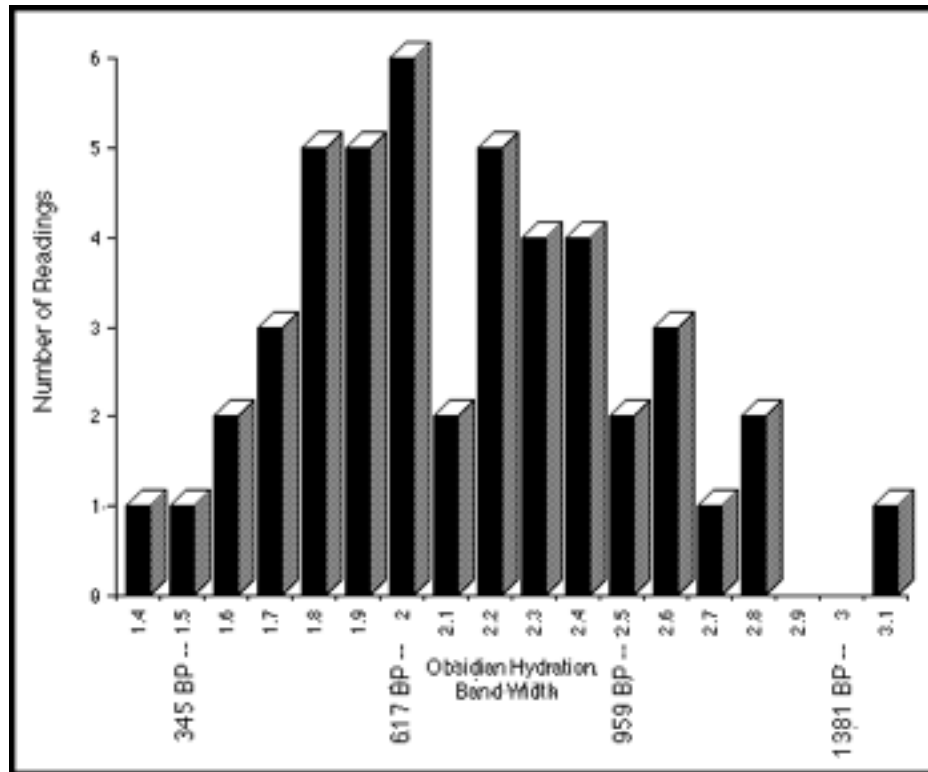


Absolute Dating by Association: Obsidian Hydration Dating



- After a new fracture, a rind covering the new break grows at a relatively constant rate.
- Dating limitations are physical ones; it takes at least a century for a detectable rind to be created, and rinds over 50 microns tend to crumble away.

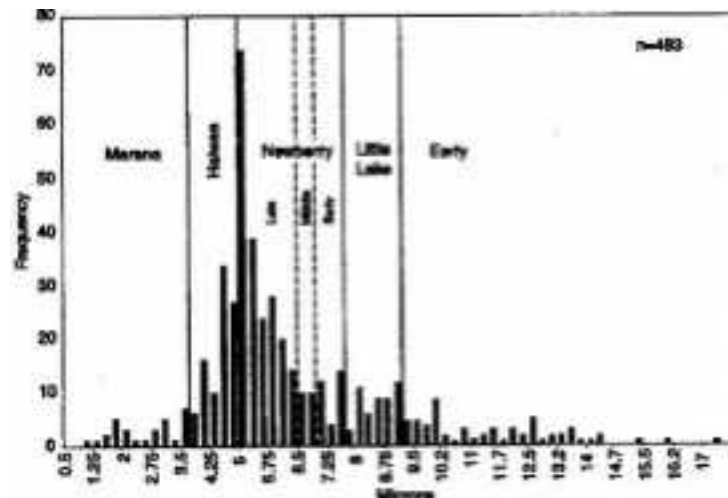
Absolute Dating by Association: Obsidian Hydration Dating



- Obsidian hydration dating produces measurements that can be used to date the intensity and longevity of cultural activity
- The particular obsidian source and associated temperature regime require rate adjustments

Absolute Dating by Association: Obsidian Hydration Dating

- In the Coso Region, most obsidian reduction occurs in the Newberry and early Haiwee eras
- More toolstone needed for larger dart points
- Most Coso activity occurs in the late Newberry (1500 BC – AD 200) and in the early Haiwee (AD 200-1000)
- Abandonment or cessation of Coso occupation occurs at ca. AD 1000/1300



Direct Dating



- Recent advances in dating technologies have significantly increased the number of dating opportunities for rock art relative to standard radiocarbon dating.
- In particular, the development of the Accelerator Mass Spectrometer (AMS) radiometric dating means that milligrams of organic material can now be dated.
- Other 'new' techniques include Cation Ratio (CR), amino acid racemisation, Optically Stimulated Luminescence (OSL), lichenometry, and micro-erosion.

AMS Radiocarbon Dating

- AMS (Accelerator Mass Spectrometry) radiocarbon dating is a way to obtain radiocarbon dates from samples that are far smaller than that needed for standard radiocarbon dating.
- Standard C^{14} dates require amounts of between 1 and 10 grams of charcoal!
- AMS can now use as little as 1-2 milligrams, and under special circumstances samples as small as 50-100 micrograms.
- In standard radiocarbon dating, scientists perform a limited or proportional count of the decaying C^{14} atoms.
- In AMS dating, researchers use an accelerator-based mass spectrometer to count all the C^{14} atoms, rather than just those atoms which are decaying.
- AMS dates are therefore more precise and require smaller samples.



Radiocarbon Dating

- Comparing the amount of C14 in a dead organism to available levels in the atmosphere, produces an estimate of when that organism died.
- So, for example, if a tree was used as a support for a structure, the date that tree stopped living (i.e., when it was cut down) can be used to date the building's construction date.
- Essentially radiocarbon dating uses the amount of carbon 14 available in living creatures as a measuring stick.
- All living things maintain a complement of carbon 14 in equilibrium with that available in the atmosphere, right up to the moment of death.
- When an organism dies, the amount of C14 available within it begins to decay at a half life rate of 5730 years; i.e., it takes 5730 years for 1/2 of the C14 available in the organism to decay.

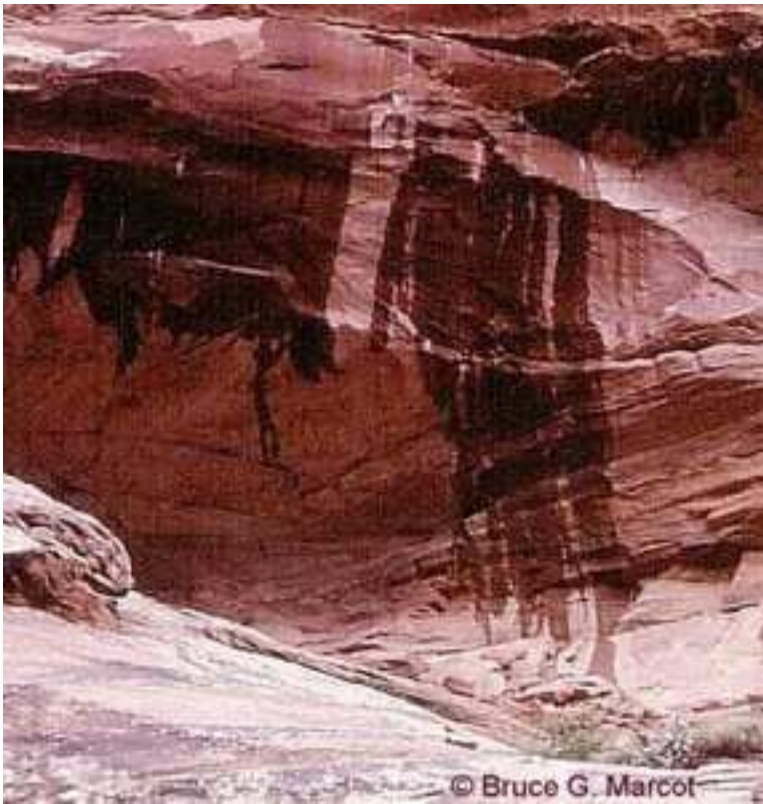


Radiocarbon Dating

- The organisms which can be used in radiocarbon dating include charcoal, wood, marine shell, human or animal bone, antler, peat; in fact, most of what contains carbon during its life cycle can be used, assuming it's preserved in the archaeological record.
- The prevalence of modern environmental contamination, require that several dates (called a suite) be taken on different associated samples to permit a range of estimated ages.



Cation (cat-eye-on) Ratio



- The **Cation Ratio** dating of desert varnish is based on differences in the mobility of different chemical constituents of desert varnish with some cations like potassium (K^+) and calcium (Ca^+) leaching out of the varnish faster than others like Titanium (Ti^+).
- If the cation-leaching curve can be calibrated using such techniques as K-Ar dating of basalt flows, tandem accelerator mass spectrometry radiocarbon dating of organic fractions, and ratios from surfaces of known age, the varnish can be dated to provide a minimum age for underlying engravings
- This dating method is still controversial at present.

Desert Varnish XRF Dating

- Desert varnish is created by bacteria over long periods of time, and as soon as a petroglyph is created the varnish starts to reform on the exposed rock.
- A new technique currently being explored is X-ray fluorescence. This can be done in the field with hand-held units, and is relatively rapid and cheap and is non-destructive to the glyph.



Desert Varnish XRF Dating

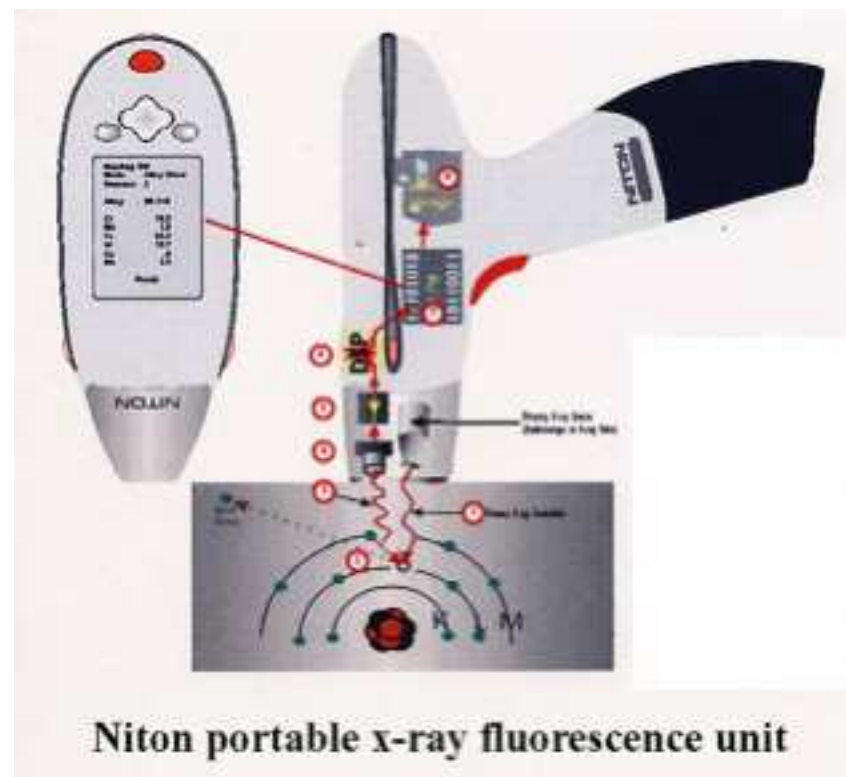


- DV is the natural dark coating found on rocks in desert.
- DV is created by bacteria that eat Mn (Manganese) and Fe (Iron) in the dust.
- DV consists of silica and clay plus lots of Mn and Fe.
- DV takes thousands of years to grow.



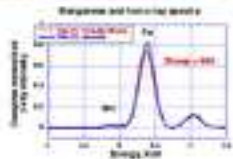
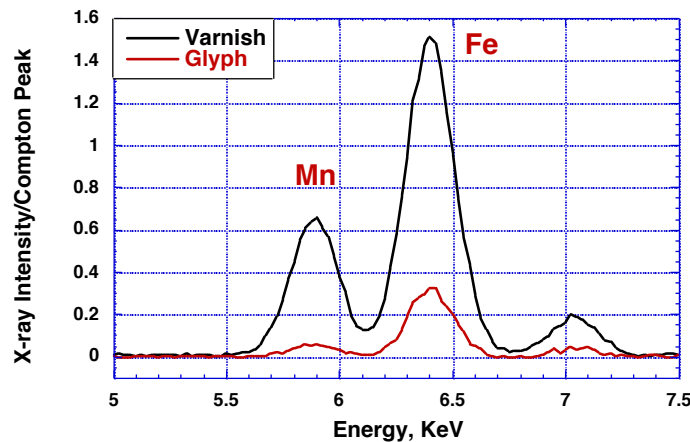
Desert Varnish XRF Dating

- By measuring the amount of Mn, Fe and Pb in the repatinated glyph one can determine the age of the glyph.
- Chemically analyze amount of Mn, Fe and Pb with x-ray fluorescence (XRF) technique.
- Technique is quick and non-destructive.
- Measure glyph and base rock. Subtract base rock from glyph. Look up age on calibration curve.



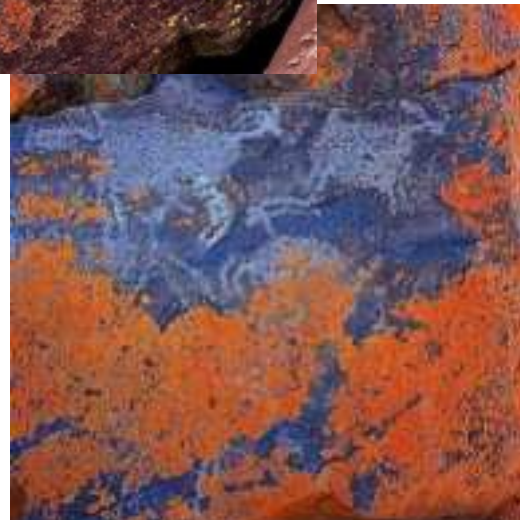
Desert Varnish XRF Dating

Coso X-ray Spectra From Varnish and Glyph



- The principle is to measure the concentrations of lead, manganese, and iron in the glyph and the surrounding unaltered varnish, calculate the ratio, and again apply a calibration curve.
- The calibration curve is developed from geologically-dated rocks, to arrive at a valid curve.
- The technique is promising, but is still experimental.

Lichenometry



- **Lichenometry** depends upon the development of a species-specific, lichen-growth curve by measuring lichen thallus diameters on dated rock surfaces: this can then be used to calculate the minimum age of rock surfaces by measuring the thallus diameters of the same lichen species growing on these surfaces (e.g. Joubert *et al* 1983).

Discussion, Caveats, and Cautionary Notes



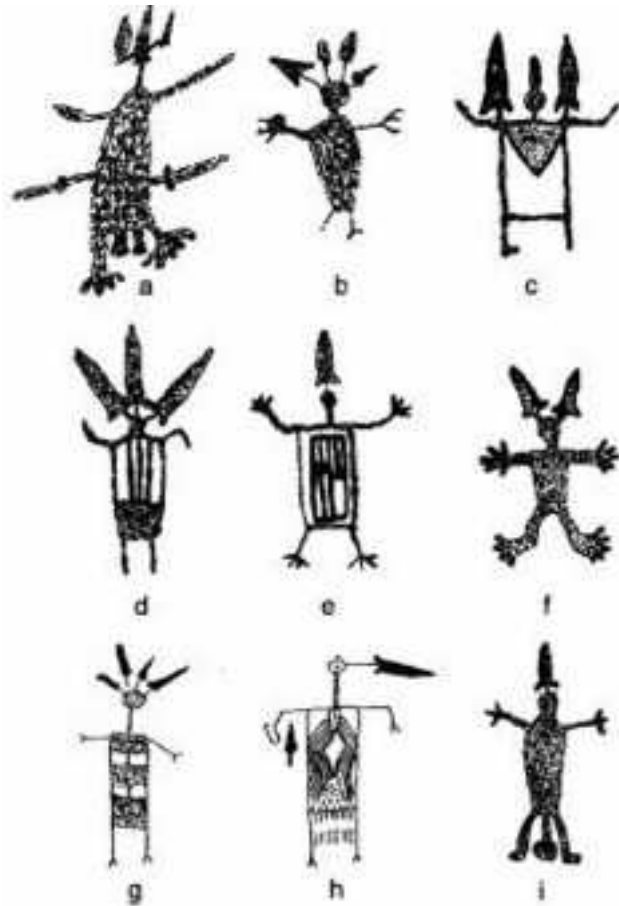
- Various methods are used by archaeologists to determine the dates of archaeological sites. Many different methods can help us determine the age of specific artifacts and particular archaeological sites.
- Each method and technique has its merits and challenges. They have their uses.
- One thing they all have in common is they cannot stand alone.
- Clearly, there is a great range of possible dating techniques and any particular method will offer a unique combination of potential approaches.

Discussion and Caveats

- The most convincing dated artifacts and archaeological sites and cultural sequences are those based on a range of data and the complementary use of relative and absolute dating methods.
- These methods can serve as independent ways to cross check the results and produce a reasonable and compelling chronology.
- A productive approach is to use relative methods to establish a large data base for sequential changes in rock art and to test and anchor this with a comparatively small number of absolute dates.

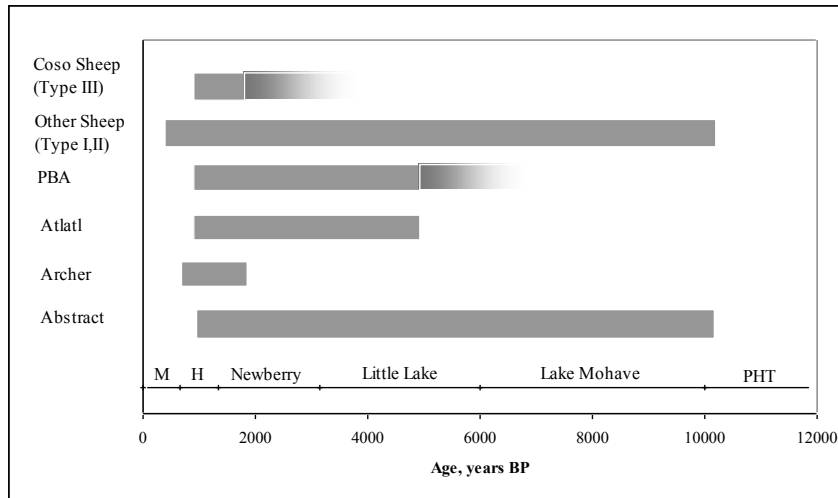


Discussion and Caveats



- Example: Garfinkel and Pringle attempt to date Coso projectile point petroglyphs.
- Good effort – incorrect result.
- Why we got it wrong.

Discussion and Caveats



- Sandy Rogers recent integration of multifaceted approach to archaeological dating.
- Uses style, cation-ratio, XRF, superimposition, seriation, subject matter, and associated obsidian hydration.
- Identifies rough dating for various styles of rock art forms.

Prehistoric Lifeways

- Once we have dated an archaeological site, we often find that we must then try to figure out what sorts of activities took place there.
- By doing so get a glimpse of the prehistoric lifeways that took place.
- If we can do so and patterns of site activities are arrayed across the landscape then we can develop site types and attempt a reconstruction of what we call settlement-subsistence systems.
- A fancy way of saying how people lived and what they ate.



Prehistoric Lifeways

- Prehistoric lifeways come as a function of looking at the physical residues of people conducting various activities on archaeological sites.
- Flaked stone artifacts tell us where they quarried stone from the land.
- Flaked stone debris gives us an indication of how intensively they occupied an area.
- Examination of the types of stone tools are clues to what they were doing? Butchering game? Processing seeds, nuts, or bulbs? Fashioning weapons for the hunt?



Prehistoric Lifeways

- Diet can be reconstructed using the residues of animal and plant remains found in the sites.
- Faunal analysis or zoo archeology is the study of the animal bones found at the sites. The bones tell us the game animals and their relative importance.
- Floral remains, plant macrofossils, seed parts, nut shells, and charcoal all are indicators of the relative value of various key economic plants.



Prehistoric Lifeways

- Through the identification of the seasonality of the relative availability of certain game animals or plants we can sometimes get a glimpse of the seasonality of the occupation.
- Was this a spring or fall encampment? Is this a winter village? Did they live here year round?
- Besides the artifactual remains - the flaked and ground stone, the beads, the plant residues and animal bones, archaeological sites often contain features of living.
- The presence of midden is one good indication of intensive recurrent sometimes long term occupations.
- House floors, storage cysts, caches of artifacts curated for a returning engagement, hunting blinds, dummy hunters, rock art, bedrock milling site furniture (bedrock mortars and bedrock metates - also called slicks)



Culture Process

- If we can reconstruct the age and character of settlements, we can chart the course of “cultural evolution”.
- What kind of societies existed?
- Did the changes that these cultures underwent were they correlated with environmental change?
- Did those environmental changes foster changes in land use patterns and subsistence strategies?
- Is there evidence for demographic stress?



Culture Process

- Is there evidence for:
- Resource depression?
- Development and elaboration of new technology?
- Intergroup conflict?



Culture Process

- How do those changes mesh with:
- The intensive elaboration of a marine economy?
- The development and elaboration of exchange systems and the inception of currency?
- Evidence of increasing sociopolitical complexity, inherited status positions, territoriality, and chiefdom level societies?
- Prehistoric population movements, abandonments, migrations, population replacements?



Culture Process

- Finally, what sorts of models of human ecology or other schools of thoughts best fit with the archeological data.
- Can we see in the record compelling evidenced for periods of site abandonment?
- Are there discontinuities in the record leading to the supposition of population replacements?
- In summary, how does all of this information, when collectively considered, provide us with an integrated picture of the developments of prehistory cultures across the centuries and millennia?

