OBSIDIAN HYDRATION DATING. In many regions of the ancient world, obsidian, a volcanic glass, was the preferred material for stone-tool production. Fracturing obsidian exposes fresh surfaces, on which hydration rinds may form. The thickness of a rind increases with the age of the artifact. Rind thicknesses, measured using powerful microscopes, can be used to date the production of artifacts.

The reactions involved in the production of a rind are complex. Recent studies indicate that four processes are involved: the leaching of alkali ions from the glass into solution, the replacement of these ions by H^+ or H_3O^+, the surface dissolution of the silica network of the glass, and the precipitation of reaction products. Factors related to these reactions affect the rate at which rinds form on obsidian artifacts. These include the chemical composition of the glass and solution, effective hydration temperature (EHT), pH, relative humidity, artifact shape, solution-flow rate, and exposure time.

Hydration measurements can be used for relative or absolute dating, with an accuracy dependent on control of these variables. Theoretically, hydration dating has no absolute temporal limitations, but rinds tend to crumble when they reach a thickness of 50 microns, making it difficult to date artifacts of great antiquity. Furthermore, several centuries must pass before a measurable rind forms. Although radiocarbon, thermoluminescence, and archaeomagnetic dating can be used to date Holocene sites, hydration dating is inexpensive and requires only rudimentary microscopy skills.

Hydration measurements are used in two fundamentally different ways to calculate the age of artifacts. The first method calibrates rind measurements with other temporal data, such as radiocarbon dates or even ceramic phases. Once a calibration curve is established, rind measurements from other contexts can be compared to the curve and absolute or relative dates can be determined. The advantage of this technique is that it is based on empirical in vivo measurements and does not require in vitro experiments under unnatural conditions. A disadvantage is that variation in local environmental conditions is not taken into account, increasing error.

Unlike the calibration approach, the induction method relies on laboratory experiments. Hydration is induced by exposing fresh obsidian to water vapor or liquid water. In order to increase the reaction rate, high temperatures and pressures are used. Under these artificial conditions, rind formation can be accurately modelled as a diffusion process, allowing the calculation of EHT-dependent hydration rates. In order to calculate absolute dates from obsidian artifacts, paleo-EHTs must be estimated. Contemporary EHTs can be measured using thermal cells or estimated using weather station data and extrapolated to the past. Although the experimental induction method is quite promising, it has serious flaws. First, in vivo rind formation is far more complex than laboratory-induced diffusion. Second, the equations used to model diffusion depend only on time and EHT, although field studies and induction experiments have demonstrated that relative humidity, pH, and other variables also affect rind-formation rates.

The earliest attempts to use hydration measurements to date artifacts were made by Irving Friedman and Robert Smith ("A New Method Using Obsidian Dating: Part I," *American Antiquity* 25 (1960): 476–522). Since then, hydration dating has been used widely, with particular success in California and the Great Basin of the United States. In this area, numerous regional chronologies have been constructed using the calibration method.

In *Mesoamerica, obsidian hydration dating has usually been used to supplement more traditional chronological data. Two important projects, however, have used hydration dating to form the backbone of the chronology. At Kaminaljuyu, Guatemala, Joseph Michels (*The Pennsylvania State University Kaminaljuyu Project—1969–1970 Seasons, Part I: Mound Excavations*, University Park, 1973) used the calibration method to produce 3,000 obsidian hydration dates that proved to be inaccurate. An unfortunate result has been that Maya archaeologists are now reluctant to use hydration dating. More recently, the experimental induction technique has been used in an attempt to fine-tune the chronology of *Copán, a Classic Maya site in Honduras. Although most of the 2,200 dates are consistent with other temporal data, several hundred are very late. David Webster and AnnCorinne Freter ("Settlement History and the Classic Collapse at Copan: A Redefined Chronological Perspective," *Latin American Antiquity* 1 (1990): 66–85) have used these dates to argue that a substantial population continued to occupy Copán until A.D. 1150. Other archaeologists question this conclusion, because very few Postclassic ceramics have been found at the site. Furthermore, there are no radiocarbon or archaeomagnetic dates later than A.D. 950. Until independent chronological evidence is found, it seems unlikely that a substantial Postclassic occupation will be accepted.

The Copán dates demonstrate that estimating error is a serious problem with the technique. Although current environmental conditions can be measured, an unmeasurable error is introduced when these conditions are extrapolated to the past. A shift in EHT of just 1 K, for example, can lead to dates that err by centuries. For this reason, hydration dating must still be considered a relatively inaccurate independent chronometric technique.

[*See also* ARCHAEO-PALEOMAGNETIC DATING; DATING THE PAST; DENDROCHRONOLOGY; FISSION-TRACK DATING; LUMINESCENCE DATING; POTASSIUM-ARGON DATING; RADIOCARBON DATING; SERIATION; STRATIGRAPHY.]

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OLDUVAI GORGE is located in northern Tanzania close to the Great Rift Valley. It was discovered by Reck in 1913, although it was the work of Louis and Mary Leakey especially during the 1950s and 1960s that realized its archaeological potential. The gorge at Olduvai is ca. 9 miles (15 km) long and 330 feet (100 m) deep, presenting a series of deposits deriving from lake basin sedimentation, which span a period of almost 2 million years. Olduvai provides the most complete sequence of *Pleistocene materials in Africa and was responsible, through intensive dating studies, for the establishment of an African origin for humankind. The deposits at Olduvai represent a range of