Obsidian sourcing and hydration studies at MURR

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4. Obsidian Sourcing and Hydration Studies at MURR, *Jessica Ambroz, Michael D. Glascock (MURR), Craig E. Skinner (BioSystems)*

In regions where obsidian was abundant, large quantities of the volcanic glass were used by prehistoric peoples to manufacture sharp-edged stone tools. By employing a variety of analytical techniques, these tools are examined by present-day archaeologists to study ancient culture and trade patterns. The geochemical properties of obsidian make it ideal for archaeologists who are interested in the sourcing and dating of obsidian artifacts.

Geologic obsidian specimens from more than a dozen sources in northern California, Idaho, and Oregon were characterized by instrumental neutron activation analysis (INAA) at the University of Missouri Research Reactor (MURR). These data are being used to create an extensive geochemical database for obsidian sources located in the Northwest. Although X-ray fluorescence (XRF) data already exist for many of these sources, INAA provides a larger suite of elements that give superior resolution between individual sources and enables discovery of chemically distinct subgroups within complex source systems.

The obsidian source data collected in this study are also being used to investigate the effects of chemical composition on the rate of obsidian hydration. Intrinsic water content, density, and hydration rate are being measured on each of the geologic specimens. Understanding correlations between these factors and chemical composition will be important in future investigations of obsidian artifacts being studied for dating purposes.

EXPERIMENTAL

All obsidian samples undergo two irradiations at MURR, one short (5 s) and one long (70 h). The short irradiation is followed by a 25-min decay and a 12-min count. The long irradiation is followed by two separate counts:

1. Nine or ten days after the end of irradiation, the samples are counted for 2000 s each.

2. About 3 or 4 weeks later, the samples are recounted for 3 h each.

Gamma rays emitted from the radioactive samples are measured by high-purity germanium detectors and analyzed using a computer-based spectral analysis program. The sample sizes are ~100 mg for the short-irradiation samples and ~300 mg for the long-irradiation samples. However, it is possible to analyze samples as small as 5 mg. All samples are analyzed rela-

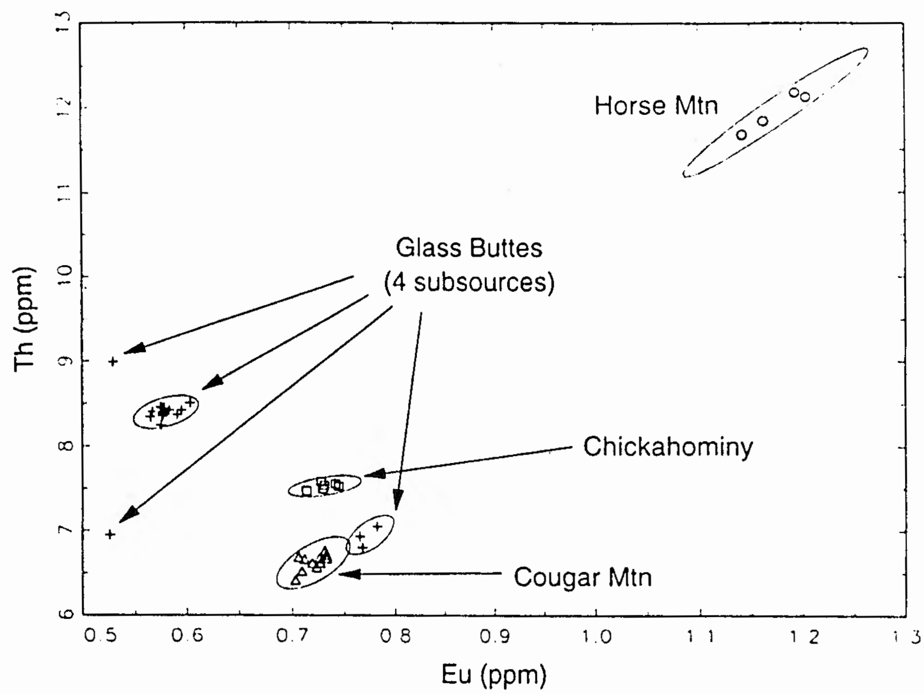

Fig. 1. Plot of europium compared with thorium for several obsidian sources in southeast Oregon.

tive to the National Institute of Standard and Technology obsidian standard reference material (SRM)-278 obsidian rock to determine absolute concentrations. The procedures enable determination of concentrations for up to 27 elements in most samples.

The INAA results are also being used in the obsidian hydration experiments. The intrinsic water content is determined from an infrared scan of 1-mm-thick sections of obsidian. The thick sections are cut from source nodules using a slow-speed diamond saw. An FTIR spectrometer is used to scan the bands at 4500 and 5200 cm^{-1} for intrinsic water content. A density measurement and an induced hydration experiment to determine hydration rate were performed to measure the other variables required to investigate the relationships between chemical composition and other factors affecting the ability to determine dates for obsidian artifacts.

RESULTS AND DISCUSSION

Obsidian sources in the Northwest most recently analyzed came from southeastern Oregon, central Idaho, and the Medicine Lake Highlands and the Warner Mountains of northern California. The individual obsidian sources are generally homogeneous, and there is greater variation between sources than within. In most cases, there is greater similarity between sources from the same region than between sources from different regions.

The Oregon data are very interesting as shown in the plot comparing europium and thorium in Fig. 1. In particular, the Glass Buttes source data from INAA clearly indicate the presence of four different compositional groups (or flows) that were not identified by previous XRF analyses. The existence of clear differences between compositional groups characterized by INAA give archaeologists a high degree of confidence that obsidian artifacts can be traced to their sources reliably. The additional research to improve our understanding of the role of composition, intrinsic water content, and density on hydration rates for obsidian artifacts makes INAA an extremely valuable technique for archaeological research.

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