SOURCE PROVENANCE OF OBSIDIAN ARTIFACTS FROM VARIOUS SITES IN THE NORTHWESTERN CAUCASUS MOUNTAINS, RUSSIA

by

M. Steven Shackley, Ph.D., Director
Geoarchaeological XRF Laboratory
Albuquerque, New Mexico, USA

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Drs. Liubov Golovanova and Vladimir Doronichev
Laboratory for Prehistory
St. Petersburg, Russia

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INTRODUCTION

This report documents the EDXRF analysis of 19 additional obsidian artifacts from a number of sites in the Caucasus of Russia, and two additional Zayukovo source rocks. As with the previous analyses, and based on these data and the literature it appears that the artifacts were produced from the Zayukovo source and the rest appear to be from the Kojun Dağı (Paravan) source in southern Georgia (Golovanova et al. 2010).

LABORATORY SAMPLING, ANALYSIS AND INSTRUMENTATION

All archaeological samples are analyzed whole. The results presented here are quantitative in that they are derived from "filtered" intensity values ratioed to the appropriate x-ray continuum regions through a least squares fitting formula rather than plotting the proportions of the net intensities in a ternary system (McCarthy and Schamber 1981; Schamber 1977). Or more essentially, these data through the analysis of international rock standards, allow for inter-instrument comparison with a predictable degree of certainty (Hampel 1984; Shackley 2011).

All analyses for this study were conducted on a ThermoScientific Quant'X EDXRF spectrometer, located in the Archaeological XRF Laboratory, Albuquerque, New Mexico. It is equipped with a thermoelectrically Peltier cooled solid-state Si(Li) X-ray detector, with a 50 kV, 50 W, ultra-high-flux end window bremsstrahlung, Rh target X-ray tube and a 76 µm (3 mil) beryllium (Be) window (air cooled), that runs on a power supply operating 4-50 kV/0.02-1.0 mA at 0.02 increments. The spectrometer is equipped with a 200 l min\(^{-1}\) Edwards vacuum pump, allowing for the analysis of lower-atomic-weight elements between sodium (Na) and titanium (Ti). Data acquisition is accomplished with a pulse processor and an analogue-to-digital converter. Elemental composition is identified with digital filter background removal, least squares empirical peak deconvolution, gross peak intensities and net peak intensities above background.
The analysis for mid Zb condition elements Ti-Nb, Pb, Th, the x-ray tube is operated at 30 kV, using a 0.05 mm (medium) Pd primary beam filter in an air path at 200 seconds livetime to generate x-ray intensity Ka-line data for elements titanium (Ti), manganese (Mn), iron (as $\text{Fe}_2\text{O}_3$), cobalt (Co), nickel (Ni), copper, (Cu), zinc, (Zn), gallium (Ga), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), lead (Pb), and thorium (Th). Not all these elements are reported since their values in many volcanic rocks are very low. Trace element intensities were converted to concentration estimates by employing a least-squares calibration line ratioed to the Compton scatter established for each element from the analysis of international rock standards certified by the National Institute of Standards and Technology (NIST), the US. Geological Survey (USGS), Canadian Centre for Mineral and Energy Technology, and the Centre de Recherches Pétrographiques et Géochimiques in France (Govindaraju 1994). Line fitting is linear (XML) for all elements but Fe where a derivative fitting is used to improve the fit for iron and thus for all the other elements. When barium (Ba) is analyzed in the High Zb condition, the Rh tube is operated at 50 kV and up to 1.0 mA, ratioed to the bremsstrahlung region (see Davis 2011; Shackley 2011). Further details concerning the petrological choice of these elements in obsidian is available in Shackley (1988, 1995, 2005, 2011; also Mahood and Stimac 1991; and Hughes and Smith 1993). Nineteen specific pressed powder standards are used for the best fit regression calibration for elements Ti-Nb, Pb, Th, and Ba, include G-2 (basalt), AGV-2 (andesite), GSP-2 (granodiorite), SY-2 (syenite), BHVO-2 (hawaiite), STM-1 (syenite), QLO-1 (quartz latite), RGM-1 (obsidian), W-2 (diabase), BIR-1 (basalt), SDC-1 (mica schist), TLM-1 (tonalite), SCO-1 (shale), NOD-A-1 and NOD-P-1 (manganese) all US Geological Survey standards, NIST-278 (obsidian), U.S. National Institute of Standards and Technology, BE-N (basalt) from the Centre de Recherches Pétrographiques et
Géochimiques in France, and JR-1 and JR-2 (obsidian) from the Geological Survey of Japan (Govindaraju 1994).

The data from the WinTrace software were translated directly into Excel for Windows software for manipulation and on into SPSS for Windows for statistical analyses when necessary. In order to evaluate these quantitative determinations, machine data were compared to measurements of known standards during each run (Table 1). RGM-1 is analyzed during each sample run for obsidian artifacts to check machine calibration. Other appropriate standards from the above list are used for other volcanic rocks. Source assignment made by reference to Poidevin (1998), Poupeau et al. (2010) and source data in this laboratory.

**DISCUSSION**

The similarity of source provenance with the earlier studies from Mezmaiskaya Cave suggest consistent procurement of obsidian through the Late Middle to Early Upper Paleolithic transition (Golovanova et al. 2010). While it is hazardous to assign obsidian artifacts to source with a small sample of source standards, it is consistent with the earlier studies (Table 1 and Figure 1). The source provenance of the artifacts seems to be evenly split between those produced from obsidian procured from the Kojun Daği (Paravan) source located to the southwest of the Caucasus in southern Georgia, and the Zayukovo source (Keller et al. 1994; Poidevin 1998). The elemental concentrations of the Kojun Daği artifacts are clustered around the Kau 10 data from Kojun Dag as listed in Poidevin (1998:200), similar to the earlier studies (see Figure 1).
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Poidevin, J-L.
Schamber, F.H.

Shackley, M. Steven


Table 1. Elemental concentrations for the archaeological specimens and two source standards. All measurements in parts per million (ppm).

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RGM1-S4
Figure 1. Rb versus Zr biplot of the elemental concentrations for the archaeological artifacts.