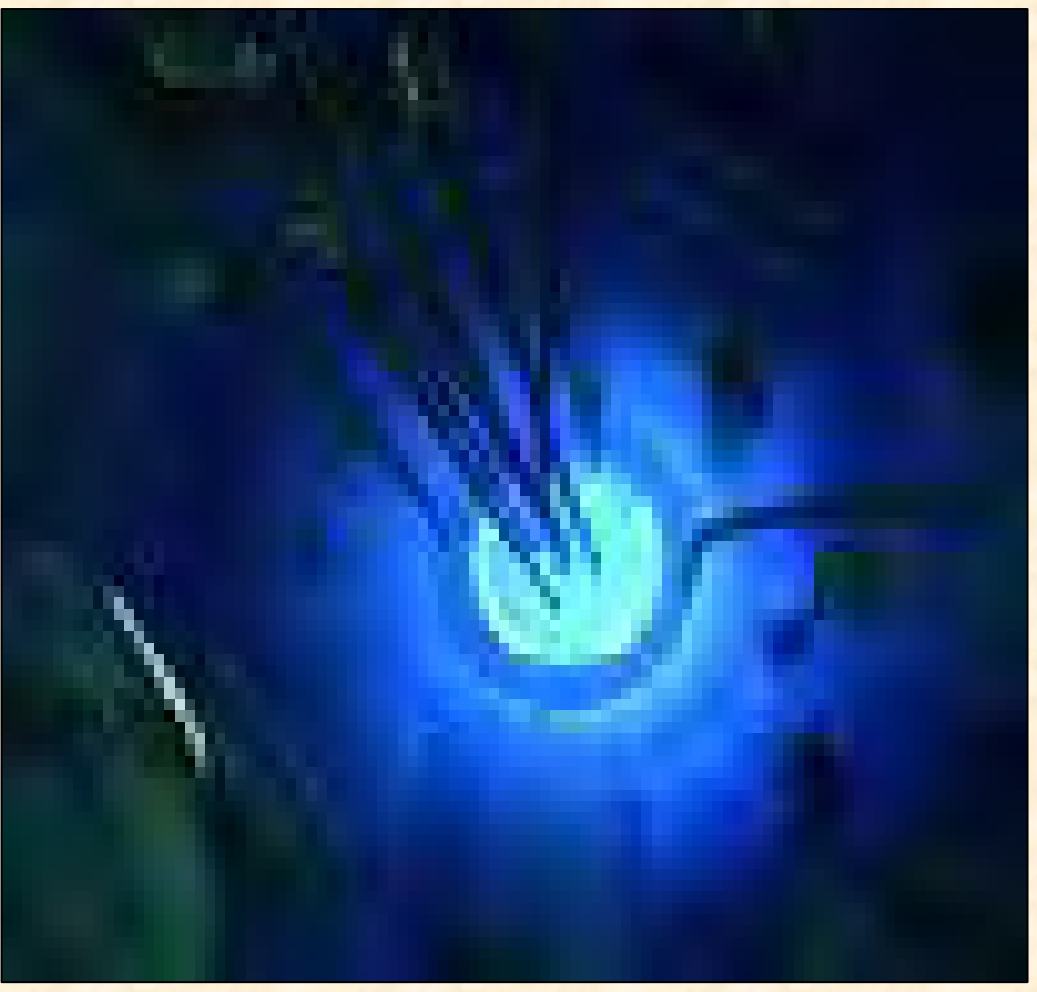




# Jasper Sources and Artifact Provenance in the Middle Atlantic

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## Introduction

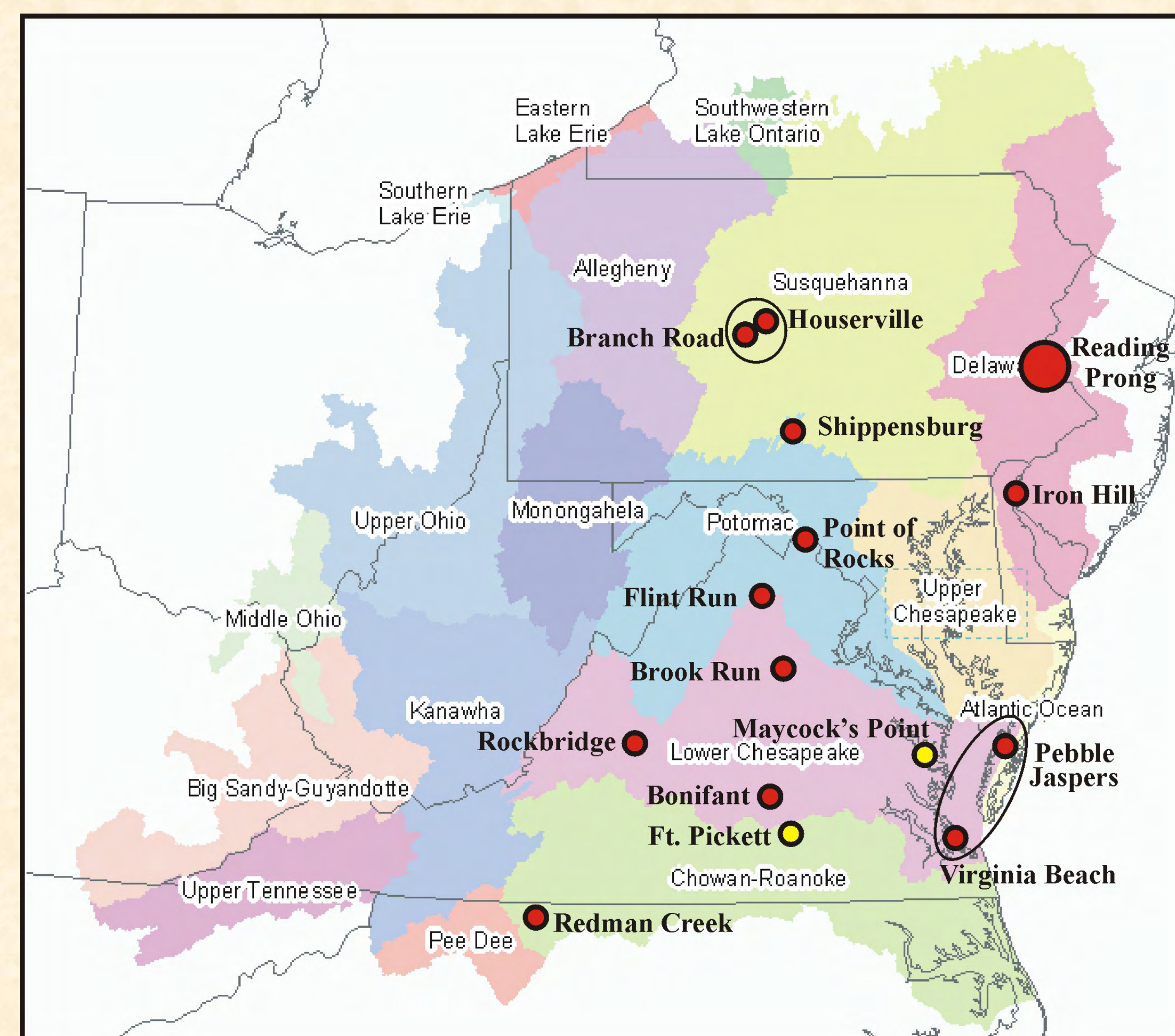
The focus of this research is to develop a statistical solution for determining provenance of jasper artifacts from the southern Middle Atlantic. Once baseline information has been established it may be possible to address the form and temporal variation of prehistoric exchange within Virginia. Here, we present results of chemical analyses by neutron activation analysis (NAA) of five jasper sources, and we show how the compositions of geological sources in different regions can be used to establish characteristic chemical signatures.

## Previous Studies

Archaeologists have pursued chemical characterization of jasper sources for more than a quarter century. This pursuit has become increasingly broad in scope and sophisticated in the treatment of analytical data. Efforts to characterize known sources have been paralleled by discoveries of new jasper deposits, bringing the total number of known sources on the eastern seaboard to 27 sources between Nova Scotia and Virginia.

- **Point Sources:** Discrete surface exposures made accessible by geological uplift and surface erosion.
- **Terrain Sources:** Secondary deposits of nodules, typically in alluvial contexts.

Figure 1: Jasper deposits (red circles) in the Middle Atlantic, and archaeological sites (yellow) discussed in the text.



Initial characterization studies involved X-ray fluorescence (XRF) analysis of sources from the Reading Prong, the Houserville/Branch Road source area, Iron Hill, and Flint Run (Figure 1, Stevenson et al. 1992). Results of these studies complemented the work of Miller (1982). Regional source areas were statistically discriminated, but individual sources within the Reading Prong did not have discrete chemical signatures.

King et al. (1997) used XRF data for 12 quarries from Stevenson et al. (1992) and 80 additional archaeological samples from sites located across the eastern seaboard. King et al. sought to evaluate Luedtke's (1987) observations that Pennsylvania jaspers were present in New England artifact assemblages.

King et al. (1997) built upon the discriminant solution of Stevenson et al. (1992) by normalizing the data so that they more closely met an assumption of normality required by canonical discriminant analysis (CDA). Observed versus predicted classifications distinguished each regional source grouping within Pennsylvania and Delaware; however, over 30% of source samples from Flint Run and the Reading Prong were misclassified. The 80 archaeological samples were assigned to three source groups:

- Reading Prong (n=20)
- Houserville/Branch Road (n=7)
- Flint Run (n=54)
- No artifacts assigned to Iron Hill.

The assignment of a large number of artifacts to Flint Run was problematic, and it was interpreted as resulting from the presence of artifacts from undocumented sources within the archaeological assemblage. This conclusion appears correct: Five new jasper sources have been discovered in Virginia since the King et al. (1997) publication. These newly discovered sources are located south of Flint Run in several physiographic regions (Figure 1). The possibility that Virginia sources account for a sizable portion of the Flint Run source assignments is intriguing, and may suggest that Virginia was a core area for distribution of jasper into the northern Middle Atlantic.

## Project Analyses

For this study, we conduct NAA on geological samples obtained from four jasper quarries: Bonifant, Flint Run, Rockbridge, Virginia Beach. We incorporate previously reported data from Brook Run (Monaghan et al. 2004) to develop a regional database of Virginia jasper sources. Also included in this analysis are ten artifact samples from sites in

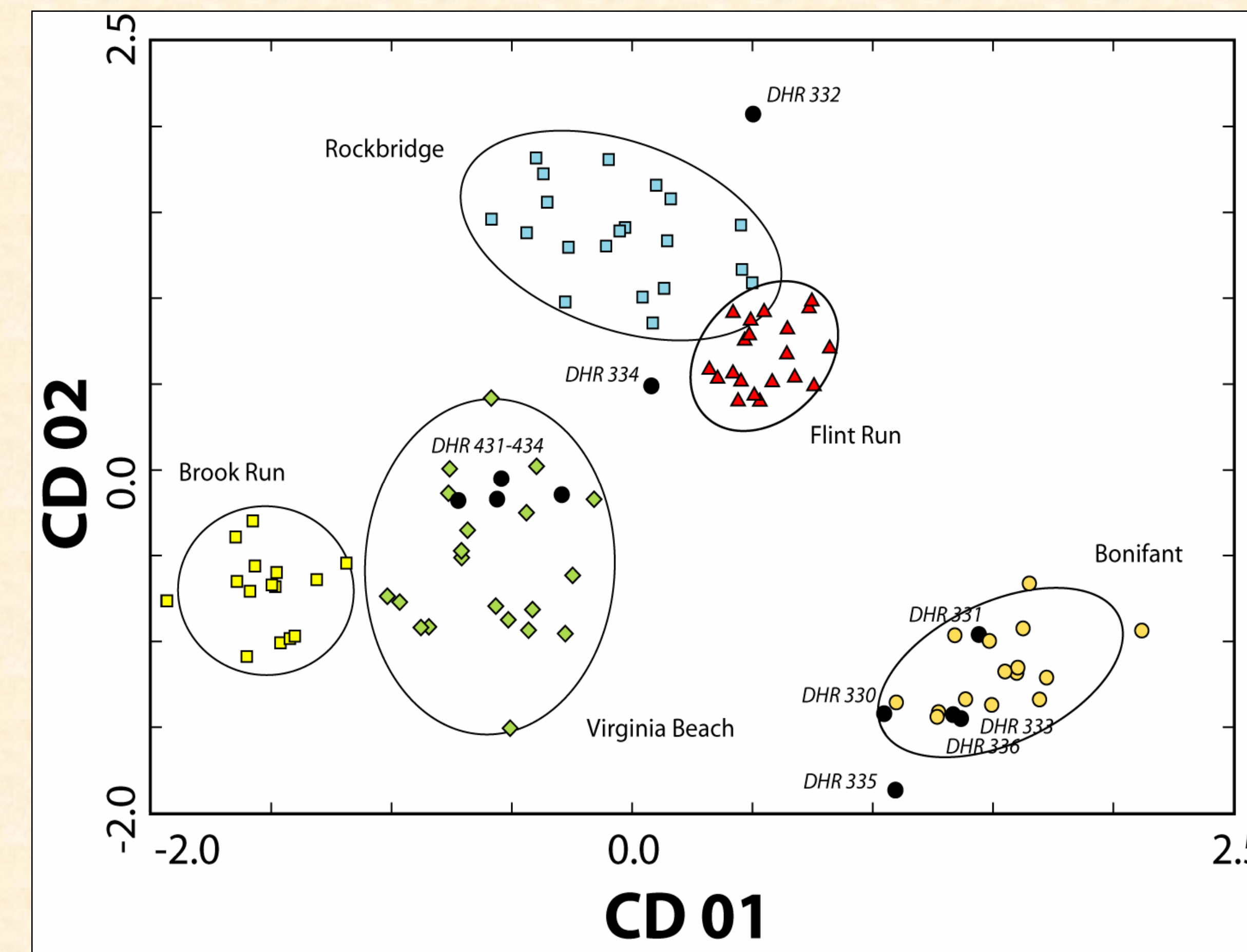


Figure 2: CDA groupings of jasper source samples and artifacts (black dots). Ellipses represent 90% confidence interval for group membership. Note relatively confident separation of all Point and Terrain Sources

southern Virginia. These are used to evaluate the potential for source-group assignments. Based on Hatch and Maxham's (1995) distributional analysis of jasper in Pennsylvania, we propose that the vast majority ( $\approx 80\%$ ) of artifacts in a region will be discarded less than 160 km from the geological source. If our discriminant solution is successful, we expect that eight of our ten unknowns will be assigned to a geological source within Virginia.

NAA was conducted at the University of Missouri Research Reactor (MURR) Archaeometry Laboratory. Previously developed procedures for sample preparation, irradiation, analysis, and tabulation (Glascock and Neff 2002) were used.

- **Canonical Discriminant Function**
- **Log-transformed Concentrations of 16 Elements (Figure 2) and 22 Elements (Figure 3)**

## Results and Discussion

CDA plots based on discriminant analysis of the geological specimens are shown in Figure 2 and Figure 3. These suggests a reasonable degree of differentiation between the five newly identified sources. Mahalanobis-distance-based probabilities for artifact specimens in the five geological source groups were calculated.

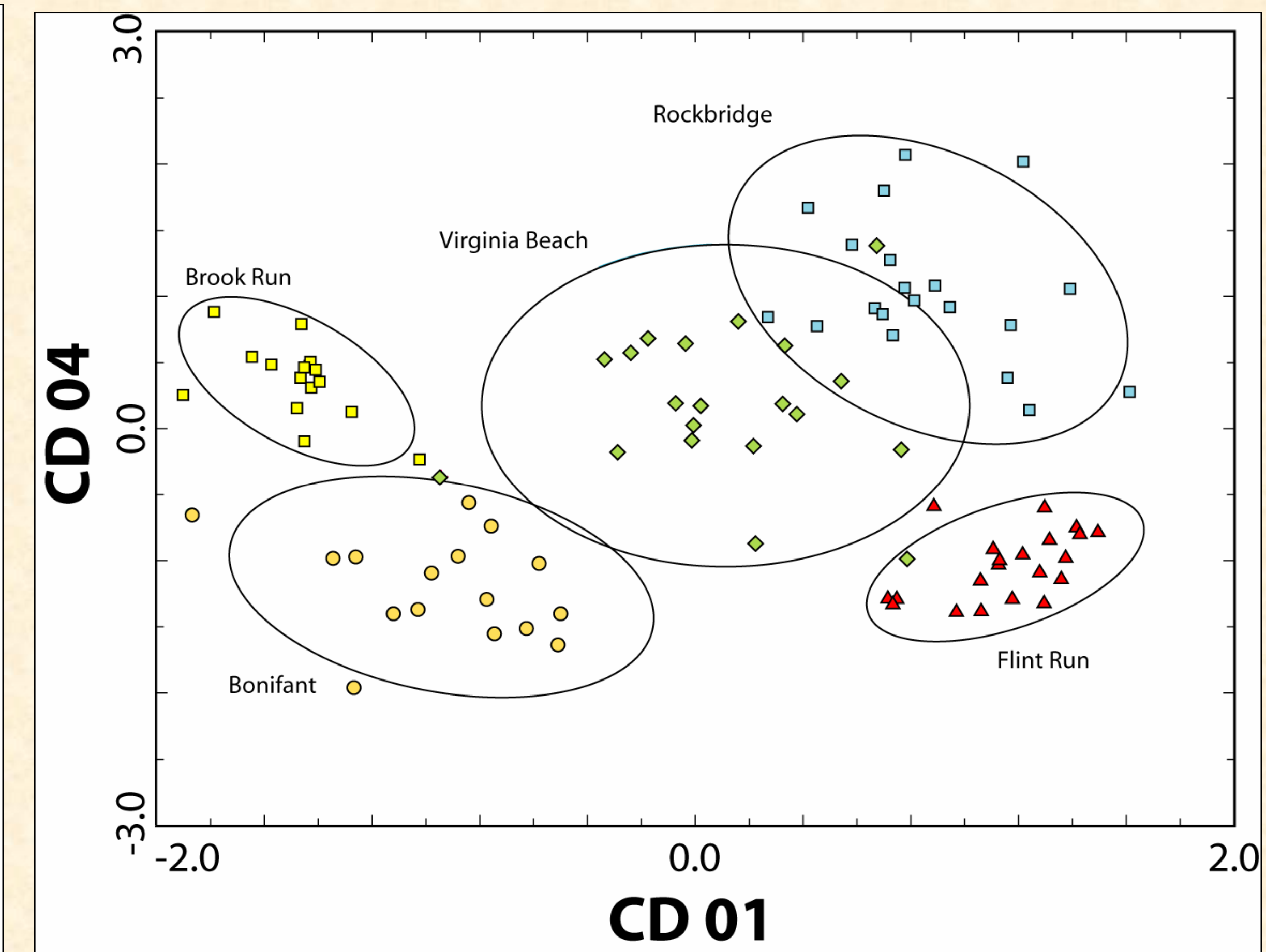


Figure 3: CDA groupings of jasper source samples. Ellipses represent 90% confidence interval for group membership. Note that all Point Sources are completely separated, yet the Virginia Beach Terrain Source shows substantial overlap with the Rockbridge and Bonifant quarries.

We may be reasonably confident in concluding that:

- Four of six artifacts from Fort Pickett are derived from stone from Bonifant (50 km distant)
- All artifacts from Maycock's Point appear to have been made from Virginia Beach jaspers (90 km distant)
- A greater number of elements does not imply better discrimination between jasper sources (22 vs. 16)

Sample DHR335 falls immediately outside the 90% confidence ellipse for Bonifant, and DHR334 has the highest probability of belonging to the Rockbridge group. DHR433 has a lower probability of belonging to the Virginia Beach source and may be associated with Rockbridge (Figure 2).

Classification of samples resulted in the assignment of 80% of artifacts to geological sources. Provenance could not be confidently established for the remaining 20%. These results are consistent with those of Hatch and Maxham: Up to 80% of jasper samples in Pennsylvania were discarded within 160 km of their geological source.

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