Obsidian Provenance Study and Lithic Analysis for a Survey on the Coconino N.F.

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Introduction

This research entails an obsidian source provenance study and lithic analysis of 529 artifacts collected by Cornerstone Environmental and EcoPlan & Associates during surveys on the Coconino National Forest during July and August of 2019. The purposes of this study are to: 1) identify the sources of obsidian represented in lithic assemblages recorded during the survey, and 2) Identify any evidence of Paleoindian or Archaic period use of the survey area.

Methods

I analyzed the microchemistry of the obsidian debitage and other artifacts using an Olympus Delta Pro portable x-ray fluorescence (pXRF) spectrometer. The Olympus Delta Pro XRF spectrometer produces a 4-watt x-ray beam. I programmed the XRF spectrometer to analyze each obsidian specimen for 5 seconds with a 40kV beam followed by 30 seconds with a 10kV beam. I controlled the beam width by setting the collimator to 5 mm. I standardized my results by maintaining these same settings throughout this study, including data collection from all reference samples and artifact collections.

I compiled the raw XRF data in an Excel spreadsheet and arranged the data into columns that are informative for obsidian analysis after Shackley (2005). I then performed exploratory data analyses (EDA) by arraying the XRF data (in ppm) from the collections together with obsidian source reference data in pairwise scatterplots of Fe, Mn, Rb, Nb, Sr, Zr, and Y. I established the source provenance of the obsidian artifacts by identifying where the XRF data from the artifacts consistently clustered when arrayed with the obsidian source reference data in six pairwise comparisons (Sr-Nb, Sr-Fe, Sr-Mn, Sr-Y, Sr-Zr, and Sr-Rb). I analyzed a total of 440 obsidian artifacts using this process. Examples of exploratory data analyses are provided in Figures 1.1 – 1.6.

After determining the source provenance of the obsidian artifacts, I conducted lithic analysis of debitage using the techno-morphological categories from Smiley (2016) and the projectile points using the typologies from Smiley (2018) and Justice (2002).

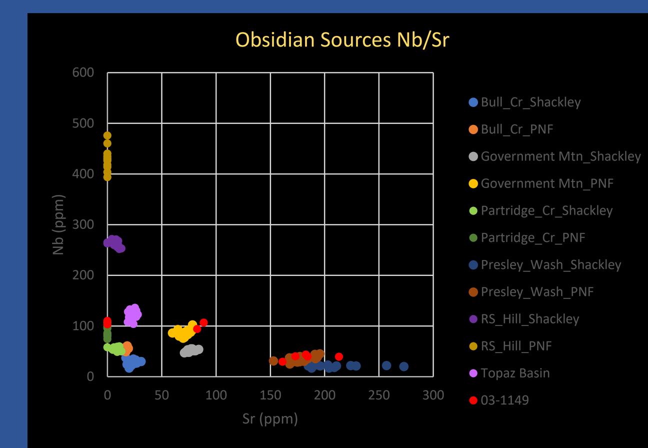

Figure 1.1. Pairwise scatter plot showing concentrations of strontium and niobium in reference samples from obsidian source areas analyzed with the same instrument or based on published data (Shackley 2019). Nine artifacts from site 03-1149 have been added for comparison.

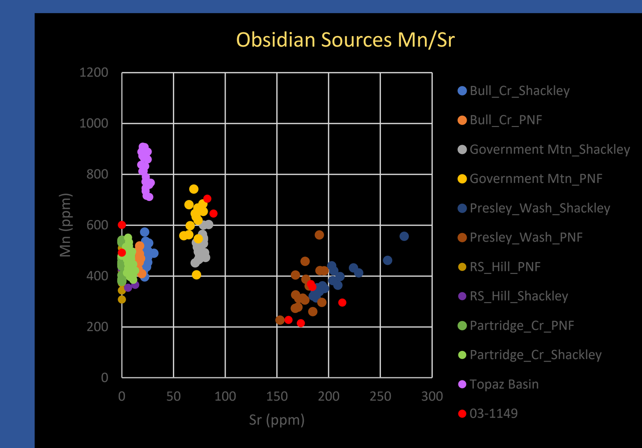

Figure 1.2. Pairwise scatter plot showing concentrations of strontium and manganese in reference samples from obsidian source areas analyzed with the same instrument or based on published data (Shackley 2019). Nine artifacts from site 03-1149 have been added for comparison.

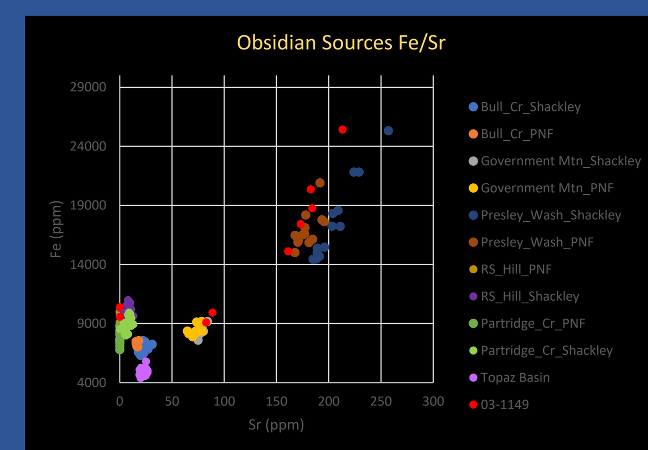

Figure 1.3. Pairwise scatter plot showing concentrations of strontium and iron in reference samples from obsidian source areas analyzed with the same instrument or based on published data (Shackley 2019). Nine artifacts from site 03-1149 have been added for comparison.

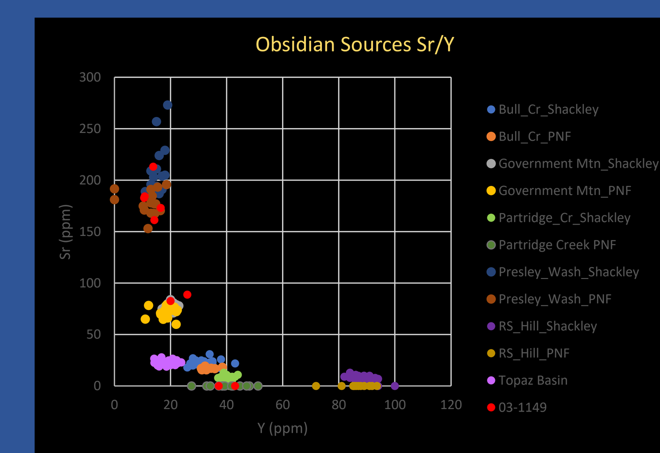

Figure 1.4. Pairwise scatter plot showing concentrations of strontium and yttrium in reference samples from obsidian source areas analyzed with the same instrument or based on published data (Shackley 2019). Nine artifacts from site 03-1149 have been added for comparison.

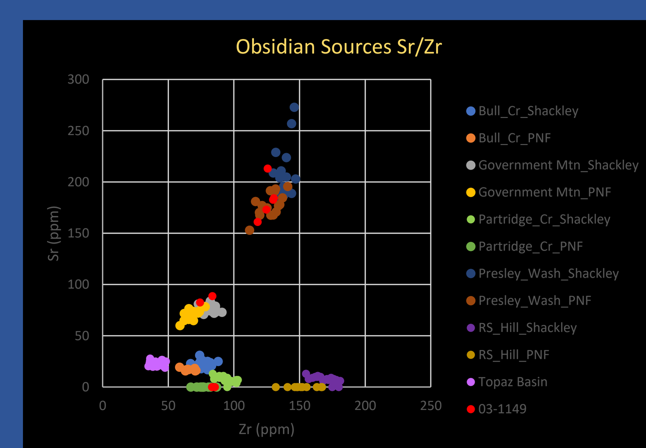

Figure 1.5. Pairwise scatter plot showing concentrations of strontium and zirconium in reference samples from obsidian source areas analyzed with the same instrument or based on published data (Shackley 2019). Nine artifacts from site 03-1149 have been added for comparison.

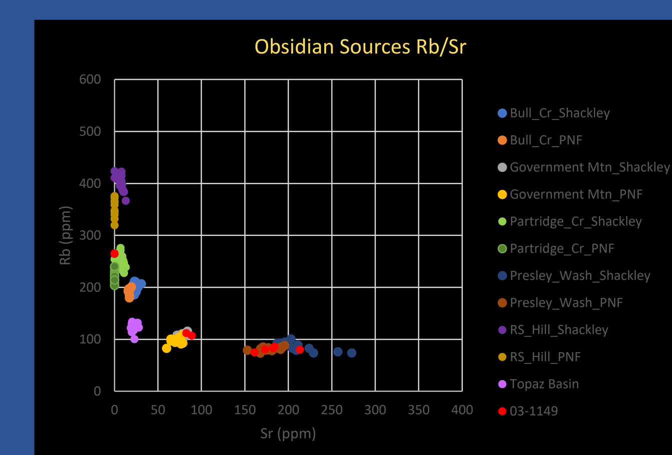

Figure 1.6. Pairwise scatter plot showing concentrations of strontium and rubidium in reference samples from obsidian source areas analyzed with the same instrument or based on published data (Shackley 2019). Nine artifacts from site 03-1149 have been added for comparison.

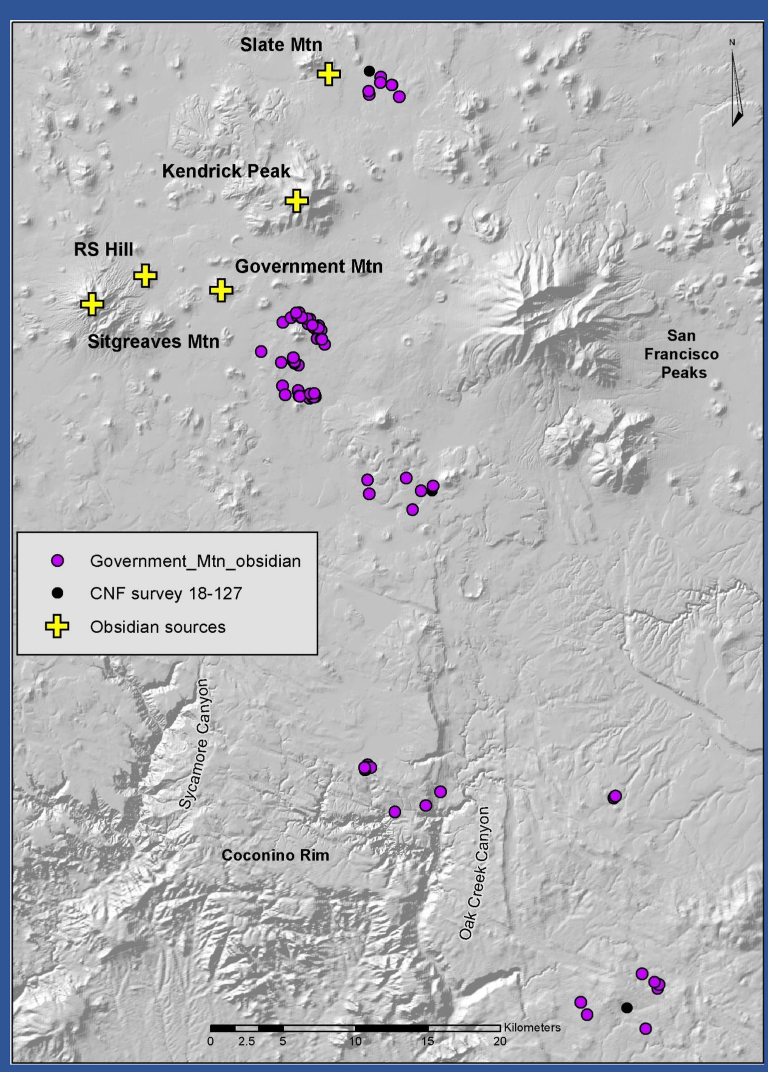

Figure 1.7. Survey sites with Government Mountain obsidian artifacts.

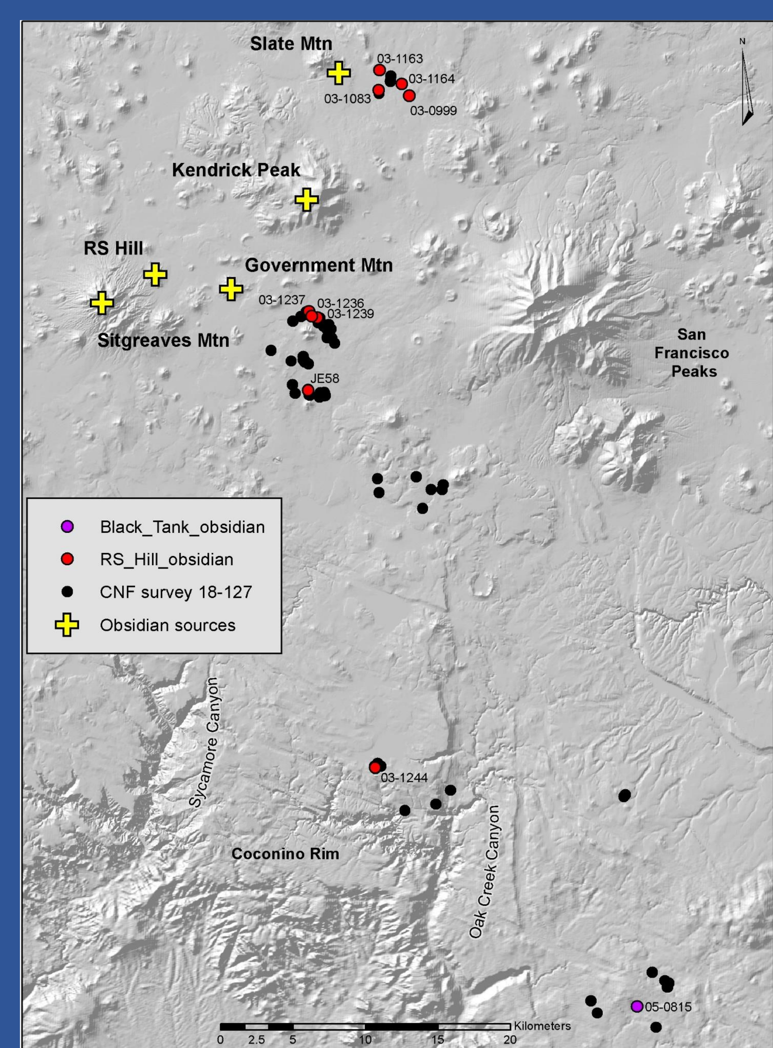

Figure 1.8. Survey sites with RS Hill or Black Tank obsidian artifacts.

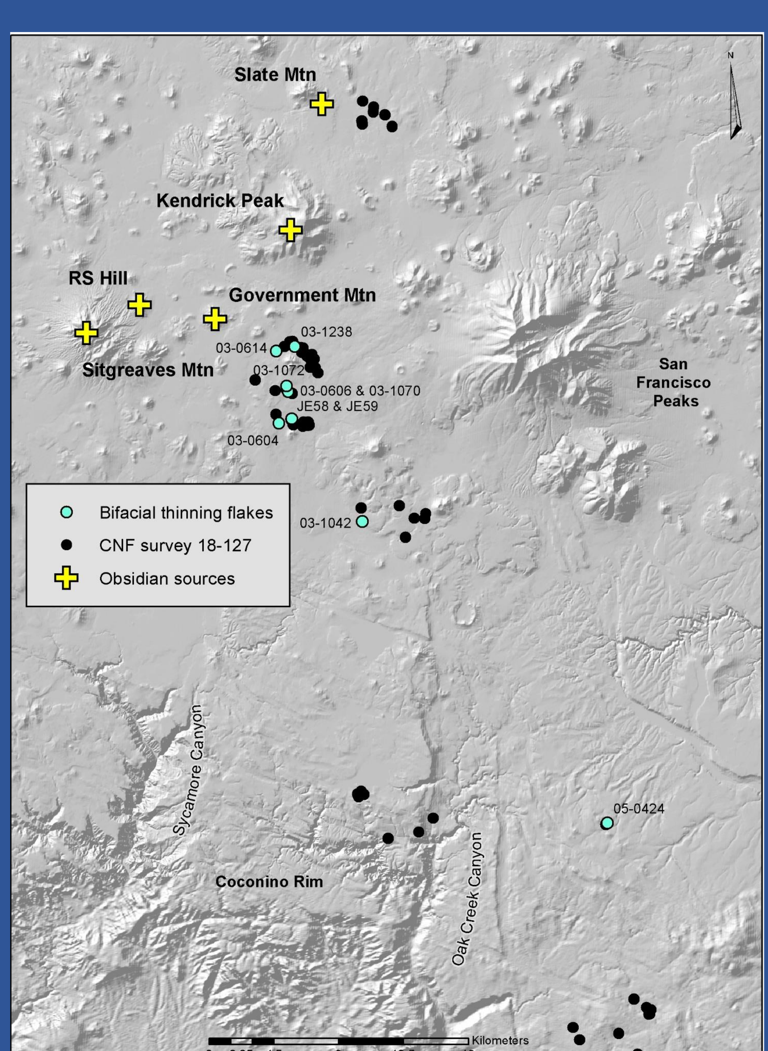

Figure 1.9. Survey sites with bifacial thinning flakes.

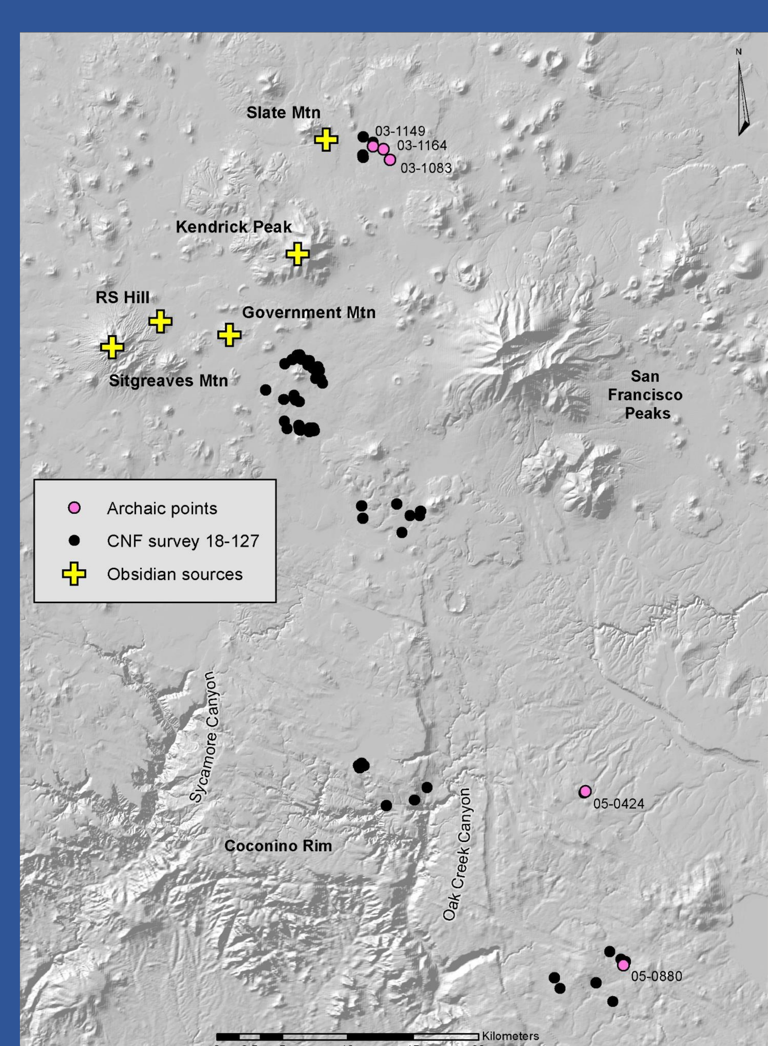

Figure 1.11. Survey sites with Archaic points.

Results

Collections from Survey 18-127 include a total of 523 obsidian artifacts and six artifacts composed of Kaibab chert (n = 1), jasper (n = 1), quartz (n = 1), or fine-grained basalt (n = 3). I assigned source provenance to a total of 440 obsidian artifacts. I was unable to assign source provenance to 83 tiny flint chips (TFC) with maximum dimensions less than 5 mm (collimator width).

The Survey 18-127 collections include obsidian artifacts from at least seven different source areas. The lithic assemblages in 88% of the sites (n = 79) in the survey area include obsidian artifacts from the Government Mountain source area. Government Mountain is the most ubiquitous lithic source throughout the study area. The spatial distribution of Government Mountain obsidian artifacts across the study area is illustrated in Figure 1.7. The lithic assemblages in 10% of the sites (n = 9) in the survey area include obsidian artifacts from the RS Hill source area. The spatial distribution of RS Hill obsidian artifacts across the study area is illustrated in Figure 1.8. The lithic assemblages in 6% of the sites (n = 5) in the survey area include obsidian artifacts from the Presley Wash source area. Two of the sites in the survey area include obsidian artifacts from the Partridge Creek source area. One site in the study area includes a single artifact from the Black Tank source area (Figure 1.8). Another site in the study area includes a single artifact from the Slate Mountain source area. Six artifacts in the IO54 collection and one artifact in the site 03-1164 collection are from unknown obsidian sources.

I identified a total of 11 bifacial thinning flakes in the collections from 10 sites in the survey area (Figure 1.9). Examples of bifacial thinning flakes are illustrated in Figure 1.10. I also identified seven Archaic projectile points in the collections from five site in the survey area (Figure 1.11). Examples of Archaic projectile points are illustrated in Figure 1.12.

Conclusions

The diversity of obsidian and other flake-stone material types in the Survey 18-127 collections indicates intermittent use of the survey area by wide-ranging, highly mobile groups of hunter-gatherers. The preponderance of Government Mountain obsidian, in combination with the absence of obsidian from Sitgreaves Mountain or Kendrick Peak in the collections indicates that Government Mountain was the preferred source of raw flake-stone material the survey area through time. The high proportion of debitage to tools in the 18-127 surface collections indicates a significant level of lithic reduction prior to transport in proximity to the obsidian sources of the San Francisco Volcanic Field – consistent with high-mobility groups or long-distance foraging strategies. The presence of biface thinning flakes and Archaic projectile points indicates early use of the survey area by nomadic Paleoindian and Archaic bands.

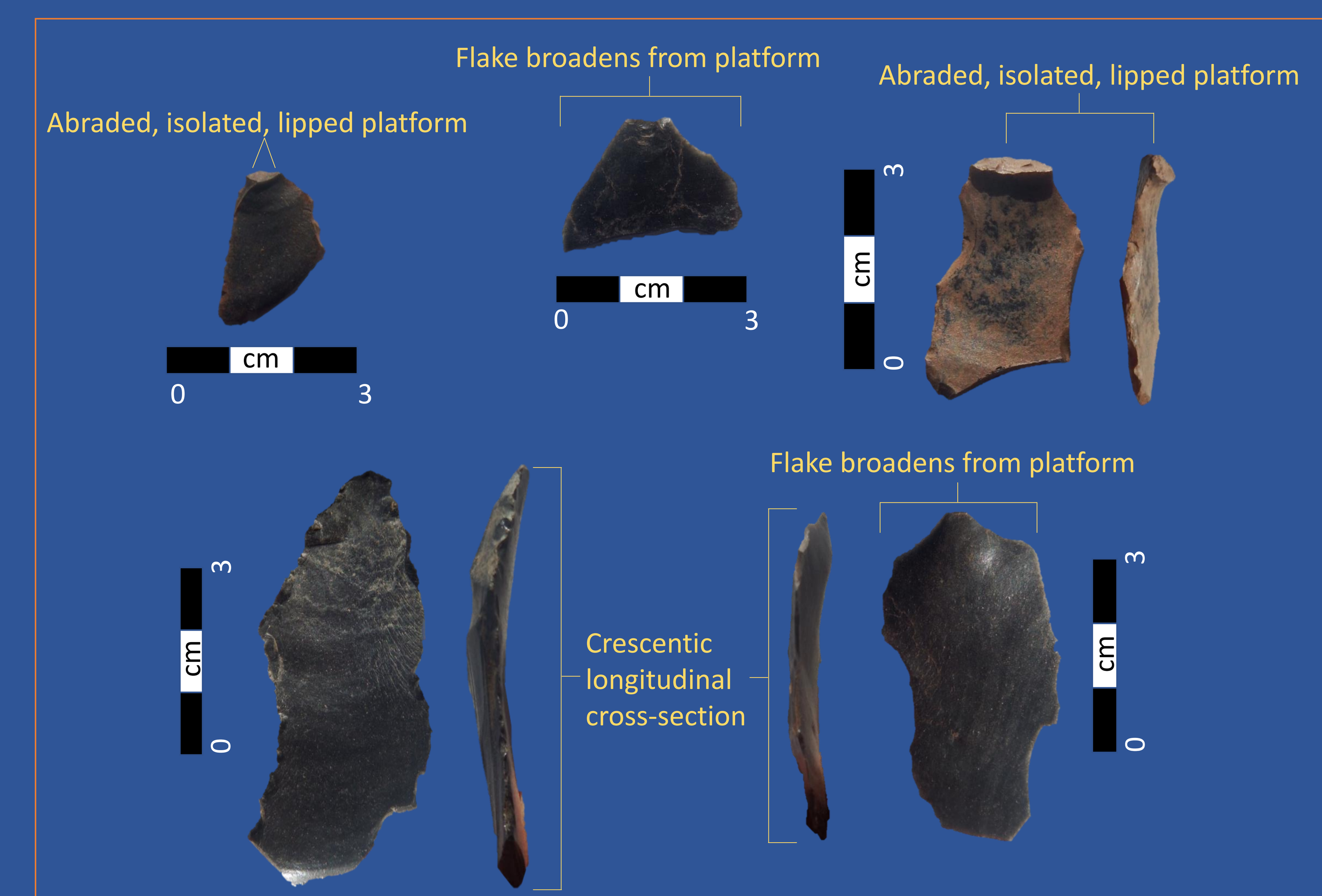

Figure 1.10. Bifacial thinning flakes from 18-127 collections.

Figure 1.12. Archaic points from 18-127 collections.

References

Justice, Noel D.
2002 *Stone Age Spear and Arrow Points of the Southwestern United States*. Indiana University Press, Bloomington.

Shackley, M. Steven
2005 *Obsidian: Geology and Archaeology in the American Southwest*. University of Arizona Press, Tucson.
2019 http://swxrflab.net/swobsrcs.htm.

Smiley, Francis E.
2016 Lithomatic: Lithic Artifact Baseline Sort Techno-Morphological Categories. Northern Arizona University, Flagstaff.
2018 The Ancient Ones: Ten Thousand Years of Hunting and Gathering at the Grand Canyon. In *The Archaeology of the Grand Canyon: Ancient Peoples, Ancient Places*, edited by Francis E. Smiley, Christian E. Downum, and Susan G. Smiley, Figure 2.1, page 29. Grand Canyon Association, Grand Canyon, AZ.