



## Sources of obsidian for the Sinagua of Northern Arizona (USA)

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## ABSTRACT

Obsidian was an important resource for prehistoric people in the North American Southwest. Elemental analysis of obsidian samples from Southwestern archaeological sites has been widely successful in identifying the raw material sources used by the people in the region. X-ray fluorescence (XRF) is the most commonly used method for sourcing obsidian artifacts because it is a rapid, non-destructive analytical technique with high discriminating ability. In this study, we analyzed over 450 pieces of obsidian from several Sinagua sites near Flagstaff, AZ. Obsidian debitage and unfinished points are common on these sites. The majority of points, and almost all the debitage, are from Government Mountain, the expected primary source. A few other sources have a minor presence, and it is likely that any points made of obsidian from these sources reached the sites as completed arrowheads, rather than being made there. Our limited data from survey finds and early points on late sites suggest that the pre-Sinagua Archaic populations were more mobile and used a wider variety of stone sources.

## 1. Introduction

Identification of obsidian sources through chemical characterization has been a productive avenue of archaeological research for some 50 years. In the American Southwest, prominent obsidian sources were exploited over the whole span of regional prehistory, and their products widely spread. Our archaeological projects in northern Arizona focus on the prehistoric culture known as the Sinagua, who occupied a zone of cultural contacts not far from heavily-exploited obsidian sources. In sourcing a large number of obsidian artifacts from our sites, we hoped to see patterns of change through time and reflections of the Sinaguas' place in regional systems of exchange and cultural contact, as previous work in the region has suggested (Brown, 1991; Horn-Wilson, 1997; Rondeau, 1979; Shackley, 2005).

## 1.1. The Sinagua

One of the numerous archaeologically-defined cultures in the prehistoric North American Southwest, the Sinagua people occupied a relatively small but culturally central zone in Northern Arizona near the modern city of Flagstaff (Colton, 1946; Cordell and McBrinn, 2012; Kamp, 1998). Sites are defined as Sinagua on the basis of characteristic brown-ware pottery and early pithouse forms. Later Sinagua sites are

mostly small masonry pueblo villages with pithouses continuing as part of the architectural suite. The Sinagua sequence begins somewhat before the eruption of Sunset Crater in the two decades after 1060 CE (Elson et al., 2007). The two centuries after the eruption saw the height of Sinagua population and culture (Pilles, 1988, 1996). The Sinagua were dry farmers, growing the usual Southwestern suite of crops in a volcanic landscape with little water (Kamp and Whittaker, 1999). Their agriculture was always marginal, and a climatic downturn after the 1250s led to the abandonment of most of the scattered small villages, and retrenchment of the population into a few larger sites. By about 1300, these sites too were abandoned, and the people appear to have moved south and west to large sites on Anderson Mesa and among the ancestral Hopi (Kamp and Whittaker, 2009; Pilles, 1988, 1996; Whittaker and Kamp, 2012).

Several major archaeological cultures intersected in the Sinagua region of northern Arizona. The Sinagua received goods and influence from the Hohokam to the south, including raw shell and cut shell ornaments, and rare copper bells and macaws passed on from even further south. The Sinagua enjoyed a lively trade with the Anasazi (Ancestral Pueblo) communities to the north and east. About 10% of the pottery in our Sinagua sites is painted wares from the Kayenta and Little Colorado Anasazi (Kamp and Whittaker, 1999). The Anasazi appear to have had little interest in Sinagua brown-ware pottery, even though it was finely made, so

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Fig. 1. Map showing Sinagua sites and obsidian sources.

something else was moving north in exchange for Anasazi pots. The Sinagua may have traded as middle-men in the exchange of shell and other southern goods, and perhaps also exchanged cotton, yarn, or cloth. Cotton seeds are common in our Sinagua sites (Hunter et al., 1999).

The area north and west around the San Francisco Peaks was occupied by Cohonina groups (Garcia, 2004; Hanson, 1999; McGregor, 1951). Some ceramic vessels traveled both ways, but the most important obsidian sources were in the Cohonina cultural zone, at Government Mountain and RS Hill, approximately 30 km or a hard day's walk from the sites in our study. Obsidian is another potential exchange good for the Sinagua. It has long been recognized (Jack, 1971; Schreiber and Breed, 1971) that Government Mountain obsidian was one of the most widely used sources in the southwest, reaching Hohokam sites such as Snaketown and Palo Verde Ruin in southern Arizona (Shackley, 2005:156, 166), and into the Anasazi area as far north as Black Mesa (Parry, 1987:31).

### 1.2. Southwestern obsidians

Obsidian is a volcanic glass which may contain crystalline structures whose formation is dependent on the rate of cooling of the lava and its chemical composition. Low moisture (less than 2%), high silica (up to 77%), and alumina (up to 15%) are required for optimal obsidian formation (Shackley, 2005:14). Fast cooling produces obsidian, while slower cooling allows time for crystal growth, producing rhyolites and other volcanic rocks, some of which are sufficiently homogeneous and cryptocrystalline to also be exploited for stone tool manufacture. The best obsidian is glassy and homogenous from rapid cooling. Although trace elements vary usefully in obsidians, the quality of the obsidian is determined primarily by physical characteristics, rather than elemental composition. Both the flaking quality of the stone and the size and

quantity of available pieces influenced prehistoric use.

Shackley (2005) provides a thorough survey of obsidians in the Southwest. Only a few of the many known sources are relevant to us. The Sinagua lived close to two extensive volcanic fields, the San Francisco Volcanic Field, and the Mount Floyd Volcanic Field. Both of these produced obsidian from several chemically-distinctive sources (Fig. 1). The San Francisco Volcanic Field includes the most important sources for the Sinagua. The obsidian at sources close to the San Francisco Peaks such as at O'Leary Peak and Robinson Crater is generally of poor quality with many phenocrysts, and was little used. Further west from Flagstaff some 20–25 miles (32–40 km), the Government Mountain and RS Hill sources were extensively exploited. The obsidians at Government Mountain and RS Hill are visually similar. They are not as glassy as some of the small marekanite (“Apache Tear”) obsidians from southern Arizona, but are of excellent flaking quality and occur in relatively large pieces easily collected from the surface or shallow diggings (Hanson, 1999). Shackley (2005) reports large nodules, up to 30 cm, but these are exceptional. The largest pieces Whittaker has observed on the surface over the last 30 years are in the 10–20 cm size range, quite adequate for both early dart points and Sinagua arrow points. Even after prehistoric use and considerable modern collecting, surface obsidian is plentiful at these sources. The Government Mountain material occurs all over the substantial rhyolite dome at the source, and is widespread in the surrounding flats and washes. RS Hill obsidian is just as good as obsidian from Government Mountain, but is less common in most archaeological sites, probably because much less material is available in a more limited area on the slopes of that dome. Government Mountain obsidian was an especially popular tool stone, and has been found in Archaic through Late period contexts as far east as Chaco Canyon and as far south as the Mexican border (Shackley, 2005:21). Shackley suggests this is due to the large nodule sizes of the

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