

## 2009 Leupp Kiln Conference Black-on-White Firing Observations

We just arrived back home after nearly a month in Germany, Turkey, Morocco and Spain! Before we left I laid out all of the pots that were fired in Snowflake, recorded which kiln fired them and made some interesting observations about the three black-on-white kilns that were fired. For convenience I will refer to them as Bob's (Bob Casias, Figure 1), Bill's (Bill Lucius, Figure 2) and John's (John Olson, Figure 3) kilns. Before anyone complains, I know that each kiln was dug, constructed, loaded and tended by a number of different folks. My kiln names simply reflect who was the kiln boss. After being home for a few days I again laid out my fired black-on-white pots just to reinforce my earlier observations and to get up the energy to write this little report. Doing so will aid in the writing of the conference report. Any comments that might occur to you about this paper are welcome and should be sent to [ourlkcpage.multiply.com](http://ourlkcpage.multiply.com) in the hopes of starting some conversations.

To preface the following discussion, I took a lot (but not all) of the pots that I had made for the firing. Specifically, I wanted to bring a wide range of clay types, all slipped with a variety of clays and painted with a variety of paint types in order to see how each combination performed. And in most cases I brought a bowl and mug pair that were made using the same body clay, slip and paint type. Because we fired three different black-on-white kilns, I was able to put pieces in all three kilns and the results are informative of just how different and yet similar each kiln was.

And because a number of the pots were painted with iron oxide, I have an effective means of



Figure 1 - Bob's Kiln (preheating fire)



Figure 2 - Bill's Kiln (setting pots)



Figure 3 - John's Kiln (construction)

gauging the degree of reduction in the kilns. There is no implied criticism and indeed if everyone fired exactly the same I would have nothing to write about.

To summarize the kilns, Bob's and Bill's kilns were true trench kilns, excavated less than knee deep into the hardpan and lined (sides only) with upright sandstone slabs. John's kiln was more of an entirely slab lined shallow trough. All three were approximately 1 meter long and were set with preheating fires of juniper with green ware pots placed around the edges of the kilns. Bob's and Bill's kilns used a significant amount of fuel, which when burned down to coals created a hand span of live coals, upon which cold, small sandstone slabs or kiln furniture were placed. The pottery in Bob's kiln (Figure 4) was stacked on the slabs and loosely covered with bisqued sherds to create a loose saggar chamber, which served to protect the pots and minimize fire clouds. The same stacking was used in Bill's kiln but no cover sherds were used. For approximately one hour the pots were allowed to slowly heat up over the hot but flameless coals, which served to safely expel free and chemical water (water soaking) in the pastes and to slowly pass through the temperature of quartz inversion (573.3 degrees C), which is required in order to minimize crack formation. In contrast, the live coals were shoveled off the sandstone slabs in John's kiln (Figure 6) and an improvised juniper branch was used to sweep the kiln clean before placing the pots upon similar cool sandstone slabs. From this point on each kiln was treated very differently, and so each will be discussed separately.



Figure 4 - Bob's Kiln (cover sherds)



Figure 5 - Bill's Kiln (cribbing on fire)



Figure 6 - John's Kiln (swept and setting pots)

In Bob's kiln the pots were carefully covered with a substantial amount of cut and split juniper fuel approximately a forearm in length, using the tops of the upright slabs to enclose the

load. The resulting conflagration was impressive, resulting in a pyrometer temperature something above 950 degrees C in less than an hour's time. Any small openings into the interior of the kiln were plugged by selectively adding juniper fuel. When deemed appropriate (apparently when no flames remained) the soil that was removed for kiln construction was shoveled over the live coals, effectively sealing the kiln from any further penetration of oxygen, which also served to freeze the pots at whatever state they were at the end of the firing. Late in the day the kiln, still somewhat hot, was opened by removal of the soil cover and the cover sherds. The amount of black, angular charcoal in the kiln interior was notable, as was the almost total lack of ash, which makes sense given covering the kiln with soil negated ash formation. The charcoal is a good indicator of a generally reducing atmosphere within the saggar.

Indeed, my bowls and mugs in Bob's kiln were well fired (they all ring when tapped) and with some notable exceptions, almost good enough to pass off as prehistoric Pueblo! But on closer inspection it became apparent that all of my pots from the kiln had a decidedly gray cast. I would argue that soil smothering allowed some of the free carbon in the saggar to tint the surface color so that most of the pots are really black-on-gray. The two bowls (bottom row of Figure 7) that came out black-on-white were slipped with virtually iron free white clays (Hopi White and Cannonball Mesa White) but were gray where slip did not cover the body clay. Despite the light smudging,



Figure 7 - Pots from Bob's Kiln

Bob's approach is very suitable for the production of organic painted Black-on-white if slipped with basically iron-free clay, which apparently does not absorb carbon except where covered by protective ash. Interestingly, a number of iron painted pots came out with black paint. In most cases the black comes from beeweed binder that was protected by the iron, which merely rubbed off. The remaining areas of iron paint are generally soft and under fired, and accompanied by pencil layout lines which have not burned off, indicating that some parts of the kiln may have been much cooler. And because two bowl/mug pairs were included in the kiln (top row of Figure 7), it is very obvious that the amount of reduction was also variable within the saggar. The exterior paint on the mugs is black-on-gray (mostly from the beeweed) while the identical interior iron paints on the bowls is soft and quite red. However, the outside of the bowls look much like the outside of the mugs in terms of paste color, perhaps indicating that the reducing gases (and associated heat) were somehow unable to penetrate to the bowl interiors.

In contrast with the use of cut and split juniper in Bob's kiln, Bill's kiln utilized long, forearm sized juniper tree limbs to fire the pottery. Using the tops of the upright slabs for support, alternating cribbing was carefully built up to about waist height, resulting in a very open yet sturdy framework which when ignited (Figure 5) resulted in an oxygen rich and therefore furious blaze that allowed the cribbing to slowly and safely sag down over the pots. Although no one seems to have been paying attention to the pyrometer, large pyrometric cones recorded that a temperature exceeding 950 degrees C. After the main heat of the fire had subsided, additional fuel was placed on the kiln in order to cover holes. Additionally, coals exterior to the kiln were shoveled back into the kiln and the kiln was allowed to burn down without any soil cover. In the morning the tops of some pots could be seen, surrounded by a quantity of white ash, which extended down to the kiln furniture. In retrospect, the kiln was really too hot when it was opened, due in part to the insulating properties of loose ash.

Two iron painted bowls document that overnight the kiln became slightly oxidizing (Middle row of Figure 8). Additionally, premature opening of the still hot kiln led to immediate surface re-oxidation of what good black-on-white pots. Dunting cracks also resulted from the hot pots being exposed to the cool morning air. A beeweed painted mug and the long-unfired mortuary pig, both slipped with Cannonball Mesa White came out black-on-white (bottom of Figure 8) with only spotty surface re-oxidation. The beeweed paint on Dolores White slipped pots took on a brown cast and became watery because of the oxidation. We had noted similar oxidation on pots from three previous, nearly identical Leupp kiln firings. Although we blamed it on persistent overnight winds, the total lack of even a breeze during the night suggests that the loose ash associated with this type of firing, although heat insulating, does not block the infiltration of oxygen during the cool down cycle.



Figure 8 - Pots from Bill's Kiln



In John's kiln the preheated pots were allowed to slowly heat up by the addition of small amounts of pinyon as well as juniper fuel which at first did not touch the pots. The fuel was slowly moved in, leaving the upper portions of the pots open to view, which allowed them to be rotated until the organic paints had visually blackened in response to the rising heat. At that point additional fuel sufficient to create quite a blaze was added to cover the pots and then allowed to burn down without any final soil cover. No pyrometer was available, but large pyrometer cones recorded a temperature exceeding 950 degrees C. Indeed, an Apple Shed White mug in his kiln and its identical bowl in Bill's kiln both suffered vitrification. All three beeweed painted pots in John's kiln (Figure 9) came out black-on-white, although the paints appear somewhat watery or exhibit white ghosts that appear to outline the carbonized paint. One previously fired bowl split into three portions and exhibits unusual tears in the clay fabric. Similarly, a stress crack along a mug handle suggests that this type of manipulative firing may have been even more stressful than the other two firing approaches. Otherwise this novel firing approach resulted in quite acceptable black-on-white pots. Particularly interesting was the ability to ensure that organic paints had fully carbonized prior to the final addition of fuel. Unfortunately, no iron painted pots were included in the firing to see if this approach might result in sintering of those paints.

Figure 9 - Pots from John's Kiln

In summary, three very different yet surprisingly structurally similar approaches to firing black-on-white pots were attempted during the 2009 Leupp Kiln Conference. The old axiom that it is possible to reach the same results from very different routes requires that the archaeological record needs to be enlisted to decide which of the approaches is most likely to have been used by prehistoric Pueblo potters. The use of cut and split wood used in Bob's kiln can be ruled out since they had no steel axes or carbide tipped saw blades, whereas the long tree limbs as used in Bill's kiln and the use of the tops of the upright slabs for construction of the cribbing is consistent with Pueblo II and III kilns in the Mesa Verde Region. The use of cover sherds as in Bob's kiln has not been documented in archaeological kilns, but then we have only excavated a handful of them with no concern about their unambiguous identification. John's kiln used only an occasional sherds, primarily to cover jar mouths. Although suggested from the excavation of several kilns on the Mesa Verde, I am uncomfortable with the final covering of the kiln with excavated dirt since it does leave a carbon trace which is inconsistent with what I have observed in the analysis of thousands of archaeological sherds. Indeed, a touch of oxidation at the end of a reduction firing tends to brighten up the surface and results in the opalescent finish characteristic of Pueblo III organic painted whitewares. However, it is now apparent that burning the fuel to a white ash results in an unacceptable amount of oxidation. Firing down, which involves the occasional addition of a decreasing amount of fuel through the night and/or the use of cover sherds might serve to protect pots from re-oxidation overnight. We also need to reschedule the

firing so that we have time to let the kiln cool off properly. John's trough kiln has no counterparts in the archaeological record but again we have almost no knowledge of temporal or regional kiln variability. Further, there is no reason to believe that every potter in the Pueblo Southwest followed a standardized set of rules about how to build or fire black-on-white pottery. Indeed, my continuing inability to achieve respectable iron paint black-on-whites suggests that to do so requires a distinct firing technology. Some combination of all three approaches might allow us to consistently replicate prehistoric Pueblo black-on-white pottery. We might eventually even become bored when we figure it out, but I am not too worried about that happening anytime soon.