

## Investigations at the Bog Hole Locality

James Schoenwetter  
Department of Anthropology  
Arizona State University  
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The Bog Hole locality occurs within Meadow Valley in section 32 of T. 22S, Range 17E on the Patagonia District of the Coronado National Forest. The original stimulus for these investigations was the discovery of archaeological sites which would be adversely impacted if a plan to create pond habitats was implemented. Prior survey demonstrated the need to identify the character and extent of potential impact on archaeological resources. I had volunteered to aid Mr. L.D. Smith of the Forest Service in dealing with these matters and to offer expert advice in matters of palynological sampling.

Archaeological sites of the locality tend to occur in areas where coarse siliceous gravel outcrops at the surface, and the principle evidence of prehistoric human activity occurs as flakes and tools made of this raw material. It was soon determined that a significant proportion of the stone artifacts were heavily "rolled", i.e., strongly abraded by rubbing against other rock surfaces. This observation lead to concern as to whether the rolled artifacts might not be considerably more ancient than those which were not rolled, introduced into the locality along with the gravel itself. It was also observed that though rolled artifacts were easily found at locations where unrolled artifacts were also found, rolled artifacts were not observed where gravel was exposed but no unrolled artifacts were recovered. Essentially, this meant that there were artifact concentrations at some areas of gravel exposure and not at others.

Since this should not be the case if the rolled artifacts were introduced to the locality as a constituent of the gravel, we become concerned as to whether our observations were adequate. The most straightforward means of resolving the matter was to identify the stratigraphic position of the gravel in the sequence of deposits at the locality. Hopefully, this would allow determination of the temporal relationships of the sites to one another and subsequent evaluation of the relative antiquity of the rolled and the unrolled artifacts.

T The prior survey had recovered an artifact which was diagnosed as a possible tool of the Paleo-Indian horizon. On the first day of our work we recovered a projectile point of a style characteristic of the Chiricahua Cochise cultural horizon at the same site (site 27), and we obtained some potsherds and a projectile point of a style more characteristic of the San Pedro Cochise horizon at another site (26). These finds compounded and intensified our resolve to determine the temporal sequence of sites and artifacts through analysis of the sequence of the deposits of the locality. Before the end of the first day a hypothesis of the sequence of beds was developed. This hypothesis was put to the evidence of test pits placed at sites 26 and 27 on the second day.

The test pit at site 27 documented that the gravels with which both the Chiricahua-style point and the possible Paleo-Indian tool were associated lay as a thin surficial veneer above a massive clay deposit. All of the artifactual record was contained in that surface veneer. The test at site 26 revealed a similar lack of depth to the context of artifactual materials, though at that locus the surface deposit was a soil

mantle above the degrading rock of an igneous dike.

Examination of the cut-banks of the locality on the second day revealed two significant things. First, it became clear that the gravel deposit was confined within an ancient channel system which did not follow the course of the modern channel system. Second, at a point on the north-south transect between sites 27 and 28 major changes occurred in the appearance of stratigraphic sections. To the north, the cut banks revealed sediments of an alluvial character superimposed upon the channel fill gravel, capped by a brown surficial layer above a stabilized soil horizon. To the south, the sediments were principally more ancient than the channel fill gravel and represented deposits trenched by the channel. Though facies variations occurred, these older beds tended to be massive silt deposits upon whose surface a cienega soil had developed. To the north, the modern channel cross-cut and exposed the ancient channel pattern quite frequently on both the eastern and western sides of Meadow Valley. To the south, however, the ancient channel was only infrequently exposed at either the surface or in the modern cut-banks.

It would appear that both the occurrence of younger deposits and the occurrence of more numerous exposures of gravel are responses to the <sup>structure</sup> geological of Meadow Valley. The Valley is transected by a series of dikes of igneous rock which occur more frequently in the northern than the southern portion of the locality. The present pattern of erosion has breached the dikes through headcutting, with the result that modern channels flow directly down grade from north to south. The ancient channel, however, was not formed in the same fashion. The ancient channel

skirted the dike barriers through the development of meander loops (and perhaps a good deal of braiding). As there are more dikes in the north, the ancient channel was more sinuous in that portion of the locality and so has been more frequently cross-sectioned by the modern channel. Similarly, it would seem that the greater number of dikes in the north has served to constitute barriers to degradational processes which result from sheet runoff. Thus the younger sediments have been trapped and retained in the north, but do not occur in the south.

Definition of the stratigraphy and close inspection of the cut banks provided necessary information for archaeological analysis of the locality. Since all of the artifactual materials were constructed of the siliceous rock of the gravels, none of the artifacts we had found could possibly predate the filling of the channel with this rock. Since the cut banks revealed not the slightest indication of cultural material in the alluvium superimposed upon the gravel bed, it appeared far from probable that any continuous occupation of the locality had occurred since that gravel was laid down. This is in keeping with the fact that considerable surface survey of the locality had failed to produce any specimens of fire-cracked hearth rock or fragments of manos. These are the two ubiquitous products of Cochise habitation sites, and it seems inconceivable that occupancy of the locality by Cochise culture residents would not result in a plethora of such materials. Rather, it would seem that at the time the gravels were deposited as a channel fill, people who participated in the Cochise cultural system came to Meadow Valley to exploit this source of raw material. At temporary camps on the edge of

the channel -- possibly occupied for no more than a few hours at a time -- they practised the arts of chipped stone tool making. Waste flakes from this process, and even some of the tools themselves, were left as discards on the spot. Some, falling or washing back into the channel gravels, became rolled and abraded as they were tumbled within the channel by ensuing waters.

A further observation, however, remained to puzzle us at the end of the second day. The test at site 27 had indicated that a clay deposit underlay the gravel channel fill, and clay was observed to underlie the gravel at other sections in the northern portion. But, as was evidenced clearly in the southern portion of the locality, the channel was cut into silt deposits which had supported a cienega soil. What remained to be resolved was the question of whether the clay underlying the gravel was also a channel fill deposit or whether it bore some other relationship to the older silts.

On the third day, closer inspection of the southern portion of the locality revealed three things. First, a ground stone artifact -- a shallow basin metate -- was located in the area of site 25. This site, like site 26 where pottery and the younger style of projectile points were found, is located on the flanks of a dike. These two sites are not directly associated with the gravel filled channel, which seems to indicate a somewhat different pattern of usage by more recent occupants of the valley. Second, we observed that the silt deposits which supported the cienega soil were themselves underlain by a semi-indurated clayey sand deposit. The parent material of this sand was clearly the rock

of the igneous dikes of the locality. The sand did not occur at all in the upstream area of the southern portion of the locality (e.g. near sites 26 and 27).and it became thicker downstream and east of site 27. The sand is deeply stained by the organic material which formed in the superimposed silts as a product of the cienega soil. The sand, in turn, overlies a massive clay deposit which also is heavily stained with organic materials. Third, we determined that the massive clay which underlies the siliceous gravels is the same deposit as the massive clay which underlies the silts and/or sands intruded by the ancient channel. However, where the massive clay deposit underlies channel gravels it is not stained with organic debris, while the same clay commonly is deeply stained where it underlies beds stained as a consequence of cienega soil formation.

Apparently, the oldest deposit of the locality is a massive clay. This is observed from the southernmost portion of the locality (where it is overlain successively by sandy clay and silt deposits) to the northernmost portion of the locality (where it is most frequently overlain by the channel fill and subsequent deposits). The color of the massive clay varies from a deep black where superimposed by deposits stained by cienega soil formation, to a mottled gray yellow-black where overlain by silt deposits which supported only meadow soil formation in the upper layer, to an even orange-brown where overlain by channel fill subsequent deposits. These variations indicate that the environmental conditions responsible for the coloration of the massive clay came into existence only subsequent to the in-filling of the ancient channel.

Similarly, the coloration of the silt deposits is a function of processes occurring subsequent to the deposition of the silt unit itself. In the middle portion of the locality, in the area of sites 26 and 27, cienegas formed following the deposition of the silt. Cienega soil formation at that time stained the silts a deep black and contributed a high clay component to the upper layer of this deposit. But further upstream only a meadow, or prairie, soil developed on the same stabilized surface so the lower layers of the silt unit are not stained with organic detritus. Yet higher in the section, the silts are not stained at all, where they yet occur intact below the gravel channel fill.

#### Reconstruction

The earliest event of which we have evidence at the Bog Hole locality appears to be the deposition of a massive clay unit. The ecological conditions responsible for this event are difficult to identify from the present perspective. Clay deposits occurring in the San Pedro Valley which are of Middle to Late Pleistocene Age (Abengroad, 1967) and marl deposits dated 12,000-22,000 B.P. (Haynes, 1968) are thought to have lacustrine origins and to be functions of pluvial conditions. This may be true of the Bog Hole locality clay also, and a correlation with the lacustrine marl observed by Haynes at Murray Springs (Unit E) is not unreasonable. But the upper contact of the clay of the Bog Hole locality seems to follow the modern gradient downstream through Meadow Valley. Reconstruction of lacustrine conditions must await accurate mapping of the gradient expressed by the upper contact of the clay and analysis of the characteristics of the deposit by a competent sedimentologist.

At least below the baffles of the dikes, the next event of the sequence was the deposition of a sandy unit. The source of the sand was the degradation and erosion of the material of the dikes themselves. Such erosion, and deposition would not be inconsistent with a wetter climate sufficiently cold to produce significantly more frost weathering than presently occurs. This depositional unit, could, in fact, represent the last pluvial maximum. Particle analysis of the sands should swiftly confirm or deny this hypothesis. The test should be carried out on samples collected where the exposure of this unit is thickest, near the base of the dike directly east of the windmill and southeast of site 26.

The next depositional event to occur involved the massive silt. This unit appears to have been deposited essentially between the dike which occurs just north of site 25 and that which occurs in the area of site 29. Within this district of the locality the silt unit attains maximal thickness and it is also uniformly and consistently stained by the cienega soil formation. North of this district the silt unit is both less massive and less deeply stained where it occurs at all; south it is far thinner. At site 27, the test pit revealed no evidence of the silt unit. There the gravels derived from the channel fill lay disconformably upon the surface of the massive clay. However, in the cut-bank to the east of this test the silt unit was superimposed upon the clay at an elevation lower than that of site 27. The implication of these observations is that in the area of site 27 the silt unit was deposited in a fairly deep depression. This depression would appear to have been a channel somewhat wider than



the  
modern channel which was entrenched into the clay unit in essentially the same course as is followed by the modern arroyo of the Bog Hole locality.

It seems not unlikely that this channel was carved into the massive clay by the same waters which laid the sand unit immediately downstream, and thus the channel involved is only a distinctive expression of the same environmental conditions. Yet a different expression -- perhaps sheet erosion -- may have occurred in the more northerly portion of the locality.

Following this modification of the clay surface, a silt deposit filled the channeled area and "backed up" to the gradient level upstream. The silt unit was replaced by a stream which essentially followed the course of the modern arroyo and in-filled what was apparently a similarly headcut channel. The climatic-environmental conditions which existed at the time of the silt deposition probably are those which would be required to accommodate the in-filling of the modern channel. Pollen analysis and other paleoecological techniques could perhaps be applied to determine as much as possible about the characteristics of such a climatic-environmental condition. This information would be of more than academic concern, for it may enable us to simulate such conditions as a way of stabilizing or reversing the headward erosive process in certain areas.

After the deposition of the silt unit, the then-existing surface became stabilized by a heavy vegetative cover. In the middle portion of the locality a cienega formed on the silt deposits. This marsh situation produced a great deal of decomposing organic matter and trapped a high

component of clay size sediment particles from the waters which moved very slowly down gradient. In the northern portion of the locality the silt surface was stabilized by grassland vegetation and the less deeply stained, less clayey, soil profile characteristic of meadows and prairies developed.

It was this stabilized surface which was entrenched by the gravel-filled channel. This channel is of particular interest because it does not follow the course of either the modern channel nor that entrenched in the ancient clay deposit. While these earlier and later channels cut through the barriers created by the dikes, the channel incised into the silt deposits skirted the dikes and traversed back and forth across the valley in its path downstream. If the modern channel is the result of headcutting processes, it would seem that the channel incised into the silts reflects a different process developed under distinctive climatic-environmental conditions.

Headcutting occurs when the erosive action of surface flow is accelerated by gravity as it drops to a lower gradient level. Frequently, this erosive action is encouraged by the elimination or degradation of vegetative cover acting to stabilize the soil surface. Headcutting begins at the mouth of a stream when the gradient becomes markedly lower, leaving a hanging valley. As stream flow drops to the lower level it successively cuts the upstream "lip" of the hanging portion. The channel incised into the silt unit cut a stabilized soil surface and did not follow the route of today's headcut channel. The route of this older channel would seem to have been developed from the upstream end of the

gradient by a process which involved the meandering of water across the valley surface along the line of least resistance to gravity-induced flow. This does not seem likely to have been a consequence of sheet wash but, instead, a consequence of persistent gentle flow such as might occur through the continuous release of water from a small upstream source. I conclude from this that the route of the channel was established during the period of meadow and cienega soil formation some time prior to the incising of the silt deposits, and that the waters which established the route were those which maintained the cienega. The incising of the silt deposits, with consequent draining of the marsh, seems to be the result of water rushing through the previously established route. This could not be a consequence of some catastrophic downstream event which "pulled the plug" on the marsh for such an event would have initiated headcutting. More probably, it was the result of some event occurring upstream which released relatively great quantities of water into that part of the hydrographic system very suddenly but did not provide water to other areas as well.

This could have been a catastrophic geological event, such as an earthquake, which allowed an upstream pool or lake to overflow sending a water surge down the existing waterway. But judging by modern topography, it seems most unlikely that a lake could ever have existed between the Bog Hole locality and Saddle Mountain. It is far more probable that climatic conditions were responsible for the creation of the channel. A likely candidate is the occurrence of one or a series of flash floods occasioned by torrential downpours at the highest elevations (5400-5800

feet) of the area.

The reconstruction of a climatic period in which flash flooding could be commonplace is attractive in light of the characteristics of the channel fill deposit: the cobbles and boulders of the siliceous gravel. The occurrence of heavily rolled artifacts and the characteristics of the channel itself seem additional evidence for flash flooding. However, this sort of event should have occasioned mudflows. No such deposits were observed as channel fill.

The great proportion of large boulders and cobbles in the channel fill documents that the waters which coursed the channel had considerable energy. Given the topography of the upstream reaches of Meadow Valley, this could not have been provided through the acceleration of gravity fall. The power required to transport and emplace the siliceous rock, then, is likely to be imparted through surges of water which issued from the rock source area in the highlands with high energy in a short time, as is true of highland torrential downpours. But the channel itself is neither broad nor deep despite the fact that the silts into which the channel incised are not highly resistant to erosive action. Thus the waters which flowed in the channel had sufficient energy to carry great masses of rock, but not sufficient power to erode the channel at the same time. This indicates that the greatest energy of the waters using the channel was expended at the headwaters area -- probably in overcoming the inertia of the transported rock -- and as the water moved downstream (despite the acceleration of gravity fall) it progressively lost carrying and erosive capacity. Such a situation is consistent with a reconstruction of water

surges resulting from torrential rainstorms in the highland reaches of the watershed. But it is not consistent with a reconstruction of continuous flow provided by a highland spring or snowpack melt nor with the reconstruction of an excessively rainy period. In an unusually rainy period, rains would not be concentrated in the highland reaches of the area at the source of the siliceous rock.

The occurrence of rolled artifacts indicates that the channel was active -- at least the gravels were being actively tumbled -- when the artifacts we have linked to Cochise culture were made. But the fact that rolled artifacts are only found in the areas where unrolled artifacts are also found indicates that the rolled artifacts were not moved significant distances from the points of their manufacture and discard. This "tumbling in place" is best explained by a reconstruction of swift, but relatively energy deficient, waters in the channel. Again, the evidence points in the direction of water surges having a high the highland source area of the siliceous gravel which moved swiftly down channel but lost much energy along its course.

The sequence of events subsequent to the deposition of the massive basal clay deposit, then, is the following: (1) development of a channel in the clay through a process of headcutting with the simultaneous development of a sandy unit where the same process resulted in the deposition of eroded dike material; (2) emplacement of a silt deposit in the channel; (3) development of a stabilized surface on the silt, expressed in some places as a cienega soil and in others as a prairie soil, and

simultaneous establishment of a meandering the valley gradient; (4) incising of the meandering channel; and (5) filling of this channel with siliceous boulders and cobbles. This sequence appears to have been initiated in response to a period of colder wetter climate, but the second and third portions of the sequence more probably occurred under climatic conditions very much like those which obtained in southern Arizona prior to 1850. The channel incising and filling may well have been a response to a markedly warmer period during which most rainfall was concentrated above 5400 feet elevation and occurred as torrential summer downpours.

The sequence of geomorphologic variations compares quite favorably with that described for the Lehner and early Fry Formations of the Murray Springs locality by Haynes (1968). That sequence is initiated by the filling of drainageways cut across lacustrine beds with clayey sand and gravel deposits ( $F_1$  deposition). Following this a "black mat" deposit ( $F_2$ ) was laid down and then a gray calcareous silt ( $F_3$ ). Haynes (1968) identified this as the  $F_4$  deposit of the Lehner Formation, but he now considers it to be the  $G_1$  deposit of the succeeding Fry Formation (pers. comm.). A paleosol developed in the middle of the  $G_1$  deposition constitutes a surface upon which Cochise artifacts were found. I would correlate the  $F_1$  deposition at Murray Springs with the sandy clay deposit and coincident headward channeling at Bog Hole (event 1) above. The  $F_2$  and  $F_3$  depositions at Murray Springs seem together correlative with events 2 and 3 at Bog Hole, and I would correlate the  $G_1$  deposit with the siliceous gravel channel fill (event 5) at Bog Hole.

Haynes provides absolute age estimates for the deposits as well. The F<sub>1</sub> deposition contains extinct fauna and Clovis artifacts which provide the basis for an 11,200 B.P. date. Haynes suggests that the F<sub>2</sub> deposition was initiated 10,800 B.P. and that the channel in which the G<sub>1</sub> deposition was emplaced dates ca. 8,000 B.P.

Haynes' descriptive reconstruction of the succeeding Escapule Formation could have been written to characterize the situation for the sediments superimposed upon the siliceous channel fill at Bog Hole:

"...after deposition of the Wiek member [G<sub>1</sub>] a period of soil formation followed, and this continued while erosional-depositional events were taking place...During this sequence of events the Murray Springs Valley was occupied intermittently by people of the Cochise culture, later by pottery making cultures and finally by ranchers."

Eight erosional and depositional events occurring between 8000 and 100 B.P. are thought to have occurred in the Murray Springs Valley. Only two appear evidenced at the Bog Hole locality: the deposition of coarse alluvium and the deposition of a younger clayey silt alluvium of a lighter color. The downcutting phases evident in the Murray Springs sequence may be absent at Bog Hole because its substantially higher elevation reduced the effects of headcutting during this period. There is no evidence at Bog Hole of the existence of a yet younger formation such as occurs at the Murray Springs locality.

The Escapule Formation, and the correlative deposition above the channel gravel at Bog Hole, seem most likely to represent conditions of semi-arid to arid climate. Erosion apparently occurred through headcutting in the lower portions of streams during climatic intervals very similar

to that of today, while periods of more ameliorated conditions were responsible for the depositions. These fluctuations are consistent with reconstructions (e.g. Martin, 1963; Schoenwetter, 1962) of summer and winter-dominant rainfall patterns. Interestingly, it would appear to be the conditions of this horizon that account for the deep penetration of organic stain through the silts superimposed by cienega soil into the underlying clay.

#### Recommendations

The major value of the Bog Hole locality from the perspective of archaeological and paleontological research is the prospects it offers for paleoecological study. Thorough and sophisticated sedimentological, palynological and faunal studies should be undertaken as a means of mitigating the impact -- indeed the near total loss -- on the quarternary geology of the locality if project plans are approved. This need not be an unusually elaborate undertaking, but it would require sampling controls which were not available to our field party. Precise elevational positions of samples and an accurate fence diagram of the deposits are necessary, for example. It is for this reason that pollen samples were not collected to date. Any mitigation program should also include study of the Bog Hole locality in relation to other localities in the headwaters of the Santa Cruz. This would minimally include other localities north of Mowry Wash in the Meadow Valley and Sheep Ranch Canyon basins.

Archaeologically, the sites of the Bog Hole locality have been determined to be essentially surficial in character and to represent



temporary specialized activity occupations. There seems little reason to identify them as sites of National Register quality or potential. However, intensive collection and analysis of the artifactual materials of the sites seems particularly judicious if project plans are approved. Some of these sites represent a significant and unusual opportunity to provide collections of manufacturing waste and tool discards of Cochise culture context. Almost all other Cochise sites known to science are camp or habitation locales. The contrast in artifact inventories should prove particularly enlightening, and the potential value to archaeology of the analysis of Cochise tool manufacturing waste is very high. The distinctions in placement and artifact recovery of sites 25 and 26 imply that activities undertaken at those sites were distinct in kind as well as in time. Particularly in light of the data made available by investigations of Cochise sites in the San Pedro Valley (Wahlen, 1975), these sites deserve professional attention.

Though there is no surface evidence to this effect, habitation areas may yet lie buried in the areas of sites 28, 29 and/or 30. Particularly at the last named locus, a substantial mantle of more recent deposits overlies the siliceous gravel channel fill. Archaeological testing procedures do not seem called for, but an archaeologist should monitor any earth moving operations projected for these areas, and allowance should be made for the possible requirements of emergency salvage archaeology if cultural features are unearthed.

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