OLD WOOD AND EARLY NAVAJO: A CHRONOMETRIC ANALYSIS OF THE DINETAH PHASE

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When the Athapaskan peoples arrived in the Southwest has been debated for years. Although some anthropologists doubt the entry occurred much before the Pueblo Revolt of 1680, the pre-Revolt occupation proposed by archaeologists based on the Navajo Reservoir salvage project is supported by subsequent archaeological studies in the Navajo Reservoir district and adjacent areas, especially La Plata Valley. Numerous chronometric dates have been compiled for assessing the age of the Dinetah phase, originally estimated at A.D. 1550–1700. Dates as early as A.D. 1250 have been obtained in La Plata Valley, supporting the validity of the pre-Revolt hypothesis and leading some archaeologists to extend the beginning back as early as A.D. 1400–1450. However, detailed analysis of chronometric assays and tree-ring dates using a model of Navajo wood-use behavior and its effects on archaeological dating techniques support the original formulation, suggesting that substantial revisions are unwarranted. Pushing the beginning back further than A.D. 1500 is not justified, although definition of the Dinetah phase as synonymous with the initial entry of ancestral Navajo peoples into the Southwest should be reevaluated.

INTRODUCTION

For many years, anthropologists have debated the timing, route, and effects of Athapaskan entry into the Southwest with little empirical evidence to guide their speculation. Even the historical records are deficient, because *Dinétah*, the ancestral heartland of Navajo oral traditions, was outside the mainstream of European observation and influence. The effects of Spanish settlement on Navajo groups were indirect, and most historical records were second hand, seldom distinguishing Navajo from Apache. While the Navajo were involved in hostilities that plagued the Southwest during the early period of Spanish rule, there appears to have been little European encroachment on Dinétah until well after the Pueblo Revolt of 1680. Certainly, the historic period did not begin in the Dinétah until after 1700.

Lack of historical data has made early Navajo studies a fertile area for archaeological research. Investigations at La Plata Mine over the past decade have provided data to evaluate the temporal parameters of Athapaskan settlement during the protohistoric and early historic periods. Early Navajo components excavated at 15 sites can be confidently assigned to occupation before 1800 (Brown 1991; Gaudy 1986; Hancock et al. 1988; Reed

NN028145

et al. 1988; Reed and Horn 1988). How early the earliest of these occupations might be is a matter of debate. Published estimates posit a mid-fifteenth century date (Hancock 1992; Hogan 1989) or earlier (Hancock et al. 1988; Reed et al. 1988; Reed and Horn 1988, 1990). These chronometric data are examined in this paper to assess the beginning of the Dinétah phase in La Plata region.

THE ORIGINAL PROPOSAL

The Dinétah phase was defined on the basis of salvage archaeology in the Navajo Reservoir floodpool and adjacent areas in the upper San Juan River drainage (Dittert 1958; Dittert et al. 1961). Surveys between 1956 and 1959 documented 523 sites and identified over 170 Navajo components that were classified into one of three phases: Dinétah, Gobernador, and Recent Navajo. The Gobernador phase had been previously established as historic in age, but the Dinétah phase was a new idea that provided a model of Navajo origins during the protohistoric period.

The beginning of the Dinétah phase, about 1550–1600, was viewed as the time when the Navajo had just arrived in the Southwest and distinguished themselves from other Athapaskan groups. This model assumed that both Navajo and Apache had descended from a hunter-gatherer adaptation to the High Plains of eastern Colorado (Dittert et al. 1961:247). The Navajo-Apache split was associated with the earliest Athapaskan entry into the Southwest shortly after the Spanish Entrada between 1540 and 1542. Thus, the Dinétah phase was proposed as the earliest Athapaskan occupation of the San Juan Basin; Navajo culture was distinguished from that of the Apache by this new adaptation.

Empirically, a subtractive definition was all that could be presented. Assuming the early complex to be relatively unaffected by Pueblo contacts, traits attributed to Pueblo influence were subtracted: painted and slipped pottery, masonry architecture, and animal husbandry. The hypothesized core of the Dinétah phase included forked-stick hogans, Dinétah Gray pottery, side-notched and corner-notched projectile points, side-notched axes, full-grooved mauls, and a diverse chipped-stone technology (Dittert et al. 1961:246). Corn, beans, and gourds were included on a later list of Dinétah-phase traits (Hester 1962:63). This polythetic approach was innovative in isolating one of the less visible, transitional occupations that logically had to occur in the area, but it was problematical because all traits were also included in the subsequent Gobernador phase.

Excavations gave little support to the hypothesis. In addition to expanding the survey assemblages, possible Dinétah occupations at two rockshelters were bolstered by stratigraphic superposition and geomorphology that documented Dinétah materials in an older, discrete zone underlying Gobernador deposits (Eddy 1966; Hester and Shiner 1963). Additional sites were identified as Dinétah components by the excavators, but these field judgments were questioned in the final synthesis that rejected the Dinétah phase as a recognizable manifestation (Eddy 1966).

BEYOND NAVAJO RESERVOIR

After Navajo Reservoir flooded the upper San Juan River, supporting evidence for the Dinétah phase was slow in coming because of its limited, subtractive definition and chronological problems, especially the difficulty with tree-ring dating of juniper, the most common early Navajo building material. Eddy's (1966) critical treatment of the Dinétah phase in the Navajo Reservoir district was joined by

NN028146

Carlson's (1965) skeptical appraisal in the adjacent Gobernador district. Even sympathetic researchers in the Chaco Canyon area were unable to document Navajo occupations predating the Pueblo Revolt (Brugge 1986; Vivian 1960).

The case was weakened further when Schaafsma (1979), who cut his teeth archaeologically at Navajo Reservoir, produced an alternative model of Navajo origins based on the Abiquiu Reservoir project along the Rio Chama to the east of the Continental Divide. The demise of the Dinétah phase appeared imminent when Schaafsma, a discussant at the 1979 conference on the protohistoric period, challenged "...those who would oppose a Plains entry (for Athapaskan groups) at a late date should step forward and clearly place their evidence before the scholarly community" (Schaafsma 1981:296). Outside the Navajo Reservoir district, the strongest argument supporting the Dinétah phase at that time was theoretical, using demographic and ecological retrodictions from historic baseline data (Brugge 1981, 1984).

Finally, contract archaeologists on the Cortez CO_2 pipeline produced enough chronometric evidence to revive the Dinétah phase, at least for continued consideration (Marshall 1985). The evidence included radiocarbon-dated ceramic assemblages from two excavated sites in Blanco Canyon: El Campo Navahu (LA 38946), with a sixteenth-century date, was described as a single-component Dinétah phase site; La Ceja Blanca (LA 38951), with four dates ranging from the sixteenth through eighteenth centuries, was interpreted as multicomponent, with both Dinétah and Gobernador phase occupations.

The most productive research on the Dinétah phase to be published thus far was done by a variety of investigators at La Plata Mine over the past decade. Intensive survey and testing resulted in a cultural-resource inventory of 338 sites with early Navajo components identified in 44 instances (San Juan Coal Company 1990). Eighty percent of the early Navajo components are assigned to the Dinétah phase. The situation is opposite that at Navajo Reservoir, where possible Dinétah sites were obscured by a heavy concentration of Gobernador remains. Instead, La Plata sites are characterized by an extreme rarity of Gobernador Polychrome and other late diagnostics, though several later sites with these materials are documented in adjacent portions of Colorado (Karlson and Biggs 1985; Leidy 1976).

Chronometric dating has been successful at most La Plata sites. The first results, produced by the Division of Conservation Archaeology (DCA), included radiocarbon dates from various protohistoric components, along with obsidian-hydration and thermoluminescence (TL) dates (Hancock et al. 1988; Reed et al. 1988). Additional radiocarbon dates were obtained from one site excavated by Nickens and Associates (Reed and Horn 1988), while another radiocarbon date was secured by the Bureau of Land Management (BLM) from a small camp with a few Dinétah sherds (Gaudy 1986). Mariah Associates provided numerous additional radiocarbon dates, along with obsidian-hydration and the only protohistoric tree-ring dates from La Plata region (Brown 1991).

The chronometric assays are provocative. The small site investigated by BLM provided one of the earliest ^{14}C dates: 600±40 B.P.: cal A.D. 1285–1408 (DIC-3334).[1] Comparable dates were generated by DCA, with the mean on the majority ranging between 570 and 210 B.P. (cal A.D. 1332–1659). DCA got direct TL dates on 27 Dinétah sherds from five protohistoric sites; mean dates range from

NN028147

470 to 250 B.P. (A.D. 1480–1700), with one very early outlier having a large standard deviation (610±122 B.P.). The dates are comparable to raw ^{14}C dates from the same sites but substantially later than ^{14}C dates that were tree-ring corrected (Reed et al. 1988:356). Thirty obsidian artifacts from protohistoric contexts also were dated; mean dates range from 643 to 333 B.P. (A.D. 1307–1617), comparing favorably with corrected ^{14}C dates, but on the whole they are statistically earlier than TL dates from the same sites (Reed et al. 1988:356).

One site tested by DCA was investigated further by Nickens and Associates (Reed and Horn 1988). The structure at this site (LA 49498), known as Kin 'Atśa, produced a homogeneous suite of radiocarbon dates. Combined with DCA dates from the same structure, the dwelling has five ^{14}C dates with means ranging from 490 to 370 B.P. (cal A.D. range 1300–1642). A sixth ^{14}C date in this range is associated with an outdoor hearth. Reed and Horn (1988:80) narrowed the range by averaging all six dates, arguing they were all contemporaneous; this procedure resulted in a (calibrated) mean of A.D. 1444, with an age range of A.D. 1437–1466, which they interpreted as evidence for a mid-fifteenth century occupation.

While DCA merely suggested the need to push the beginning date for the Dinétah phase back into the fifteenth century, Reed and Horn (1990) were unequivocal in claiming to have documented a Navajo component, at least one century older than the start of the Dinétah phase, as hypothesized by Dittert (1958; Dittert et al. 1961). I shall return to Kin 'Atśa later, suggesting that it is, in fact, a late Dinétah phase occupation, probably no earlier than A.D. 1600. Nevertheless, Reed and Horn were not alone in their initial reaction to early dates from these protohistoric sites. Most archaeologists hurried to reestablish the Dinétah phase and push back its origins before the European discovery of the New World (Hancock 1992; Hogan 1989; Reed and Horn 1990; Winter and Hogan 1992).

By 1988, when Mariah Associates began excavations at La Plata Mine, considerable data had been accumulated and most had been reported. This advantage made it possible to implement a refined research strategy that identified the absolute age and ethnicity of protohistoric sites as specific issues to be addressed (Brown 1991). The 1988–1989 excavations not only expanded the chronometric database but also produced dates that were generated precisely for refining the parameters of early Navajo occupation. This project was the first to recover datable tree-ring specimens from a protohistoric site in La Plata region. This site and three others provided a suite of 23 radiocarbon dates associated with Dinétah assemblages; the means range from 800 to 190 B.P. (cal A.D. 1039–1807).

At face value, the array provided by chronometric analyses of La Plata sites is both exciting and confusing. Exception for the tree-ring dates, the rate of error associated with these techniques, is not well established. In addition, there are significant interpretive obstacles to applying even the most exact dates to cultural processes and events that are of interest. These aspects of archaeological dating must be considered before returning to La Plata results.

SOME METHODOLOGICAL CONSIDERATIONS

Although archaeologists commonly study extinct cultural systems, they too often ignore gaps between behavioral processes that generate archaeological deposits and the

NN028148

physical remains available for study after a site has been abandoned for a number of years. Schiffer (1972, 1976) addressed this problem by distinguishing the archaeological context of cultural materials from what he called systemic context (i.e., dynamic behavior that produced the remains). Dating provides a classic example: radiocarbon assays determine the time that organic material was generated, most commonly plant tissue formed during the life of a tree. Growth occurs long before human beings gather wood for use as fuel or construction material. Schiffer (1986, 1987) calls this the old-wood problem and notes that, especially in arid environments, dead wood preserved on the ground is usable centuries after the death of a tree. Dates provided by dendrochronology, therefore, can be much older than cultural activities, such as building a fire or hogan.

Radiocarbon dates on wood can be even older because the inner rings of the trunk can be several centuries older than outer rings produced just prior to death. Smiley (1985) calls this additional problem the "cross-section effect" and notes that it too is acute in arid environments where tree growth is slow and intermittent and tree rings accordingly are thin and dense. The tendency for inner wood to be preserved and most likely used for either radiocarbon dating or dendrochronology must be taken into account along with the old-wood problem. Such dates must be used to infer when people occupied archaeological sites.

Such problems are not limited to radiocarbon and tree-ring dating. Dean (1978) urges archaeologists to be explicit in applying dating techniques and distinguish between "dated events" and "target events." The latter are most interesting to archaeologists, generally being equivalent to the systemic context. General rules can be used to link the events dated through various techniques and the target events of archaeological interest. Dean shows how some rules are best applied using information on systemic context such as wood-use practices. His study of Navajo wood-use behavior illustrates situational and idiosyncratic factors that influence the results obtained through archaeological dating (Dean 1981). These factors tend to produce patterned results that, to some extent, can be controlled in archaeological applications.

While systemic factors are hard to control, failing to take them into account leads to overestimating the age of cultural target events. The frequent association of ancient tree-ring dates from forked-stick hogans with Gobernador Polychrome and even historic artifacts illustrates the magnitude of the old-wood problem at early Navajo sites. Cross-section effect is less obvious, but countless tree-ring studies show the disparity in ^{14}C dates that would be obtained from different portions of a log. Finally, wood reuse may be most common in sedentary cultural systems, but it occurs opportunistically among other groups, too. An outstanding example is a tree-ring specimen with inner wood nearly 1,400 years old that was obtained from a Navajo corral built less than a quarter century before the specimen was collected (Smiley 1985:28). Considering that a ^{14}C date based on charcoal might be affected by all of these factors, the need to integrate basic interpretive principles into chronometric analyses should be obvious.

AN INTERPRETIVE MODEL FOR PROTOHISTORIC RADIOCARBON DATES

Although archaeological principles to adequately control such extraneous variables as old wood, cross-section effect, and wood reuse are poorly developed at this time, I incorporated these factors in La Plata chronometric analysis. Because my primary

NN028149

focus is on ^{14}C dates, wood-use behavior and wood preservation are critical elements of the dating model proposed below. The model was developed using methodology expounded by Schiffer (1987) and principles relevant to early Navajo sites, based on the work of Dean (1981) and Smiley (1985).

Excavated architectural features at La Plata Mine consist of brush structures and forked-stick hogans, the latter built in shallow, excavated depressions, sometimes hexagonal in plan (Brown 1991; Brown and Hancock 1992). The most common characteristic of these features is their burned condition (Figure 1), unlike Gobernador structures of the Navajo Reservoir district and other areas where collapsed but intact forked-stick hogans are abundant. Some well-preserved hogan features at La Plata Mine show that as many as six major logs formed the main support structure, and numerous smaller logs were leaned against the forked-stick framework. Juniper seeds in roof fall suggest that green branches were placed over the conical superstructure; juniper bark was also identified in some forked-stick hogans. Rocks were occasionally placed around the perimeter and sometimes over the structure, perhaps to hold down the closing material. Copious amounts of earth then covered the hogan superstructures.

From an archaeological perspective, quantities of charcoal, some burned seeds, and occasionally bark are available for dating. The latter, especially seeds, were eagerly sought during Mariah's excavations, since their use of radiocarbon dating circumvents the old-wood problem and cross-section effect. Flotation analyses show juniper to be the most common construction material and fuel wood, augmented by piñon and occasionally other materials. The implication of widespread reliance on juniper is significant for evaluating radiocarbon dates. (1) Juniper is remarkably well adapted to Southwestern deserts. Its tolerance for drought creates erratic tree-ring patterns that make this wood hard for dendrochronologists to date. (2) Thin tree rings exacerbate the cross-section effect by compressing many years into a small piece of wood. (3) Juniper trees live a long time, and the inner wood may be several centuries old at the time of the tree's death. (4) Finally, juniper is well preserved in arid areas, standing long after death, thus, avoiding moist ground conditions fostering wood decay (see Schiffer 1987:165–177).

In sum, it should not be surprising if wood in early Navajo hearths and hogans was hundreds of years old at the time of occupation. Unlike *vigas* used for pueblo roof construction, the main superstructure in forked-stick hogans was frequently built from dead trees that provided sizable logs having hundreds of tree rings.[2] While smaller logs in a forked-stick hogan might be younger, perhaps averaging 100 years, the main posts probably would be at least 200 years old. The leaners comprise greater mass in a typical hogan, but they would be most apt to burn up completely, along with the outer portions of all logs.

Smiley (1985) used tree-ring data and computer models to find that cross-section effects on juniper and piñon logs is about 30 percent, based on volume. Thus, if a 200-year-old log is completely charred, a random collection of charcoal for radiocarbon dating would be 30 percent older than the outermost ring. In this example, the ^{14}C date would be 60 years before the tree's death. An average cross-section effect of 45 years is probably conservative, given the intense blaze that seems to have destroyed most La Plata hogans. Elimination of this factor necessitates identification of outer rings. This was possible

NN028150

Figure 1. Structure 1 at Site LA 61852, showing the burned remains of a hexagonal forked-stick hogan securely dated to the Dinétah phase. View is toward true north.

in a few cases (Brown 1991; Hancock et al. 1988).

The old-wood problem is more difficult to assess. Its effects are also more random because of the variable ages of dead logs available in any given place. Tree-ring analyses demonstrate this by showing a spread in the dates instead of a cluster, which could be interpreted as a construction date (Dean 1981).

In terms of preservation, Schiffer (1987:166, Table 7.1) puts juniper into the category of resistant/very resistant. The good condition of unburned Gobernador-phase hogans at open sites in northwestern New Mexico indicates that very old logs could be used; those in many unburned hogans are still adequate for construction two to three centuries after site abandonment. Observations in chained woodland areas suggest that several decades would be minimally desirable for trees to age to a condition where they could be used as forked sticks without extensive trimming. Based on detailed tree-ring studies and ethnographic data, Dean (1981) shows that hogans on Black Mesa make extensive use of dead wood, while wood reuse is less common and less consequential to

NN028151

chronological analyses (see also Kemrer 1974; Smiley 1985). Where dead wood was abundant, it seems likely that trees that died over a century ago would be optimal for hogan construction. Tree-ring dating of Gobernador-phase and historic hogans tends to support this assumption.

Considering a cross-section effect averaging 45 years and dead wood of a century or more old, I have adopted a rather arbitrary 150–200 year lag as a common gap between the dated event (radiocarbon date) and the target event (hogan construction) for protohistoric hogans. The problem is probably less severe in hearths that would commonly utilize smaller branches, especially inside structures. I do not advocate blindly employing this figure as a "correction factor," but as a reasonable guideline for interpreting broad trends in radiocarbon data and evaluating disparities between multiple dates from a single component. As an alternative to simply discarding "anomalous" dates, or assuming correspondence between ^{14}C dates and the age of occupations, such an approach is warranted.

CHRONOMETRIC ANALYSIS OF LA PLATA SITES

In attempting to assess the age of the Dinétah phase, I employed two main approaches. The first utilized the full radiocarbon database available from La Plata Mine—46 protohistoric ^{14}C dates from 13 sites, along with earlier dates for comparison. Data were pooled to discern broad patterns in the ^{14}C dates. The second approach focused on particular components and dates indicated by the first procedure to be candidates for "early" Dinétah phase occupations (i.e., earlier than A.D. 1550). The philosophy here was that, if there were early occupations, we should be able to scrutinize the data from individual sites and identify examples. A convincing argument for phase units and age ranges should require type sites and instances supporting the argument, rather than simply a generalized analysis of pooled data.

Analyzing pooled dates was a tedious task. Individual ^{14}C dates were first calibrated. The University of Washington (1987) CALIB computer program was used to normalize the data and plot probability distributions for each date range. Unlike uncorrected dates, calibrated age ranges do not have a normal distribution with a clearly defined central tendency (mean) and standard deviation. Instead, the probability distributions are generally multimodal and skewed, illustrating "...the kinked and distorted time surfaces of the chronometric scales" (Clarke 1973:10). Individual plots drawn by the computer were superimposed on a single timeline for comparison. The area under the curve of the normalized probability distribution was then summed in 20-year increments to produce graphs for three separate categories of dates: Athapaskan, Anasazi, and preceramic. While the first category is germane to this paper, the Anasazi graph was of interest because it demonstrated a general lag of 100–200 years where dating peaks could be correlated with distinct ceramic periods. For Athapaskan sites, a well-defined probability peak was shown between A.D. 1260 and 1680 (Figure 2). At face value, this sounds like the Dinétah phase, but the beginning is much earlier than might be suspected.

The second stage in the analysis entailed a search for particular sites that would aid in refining the age span for the Dinétah phase. Based on the model presented above, only dates 150 years older than the A.D. 1550 target event provide convincing evidence that behavior occurred prior to that time. Consequently, I went back to the original date

NN028152

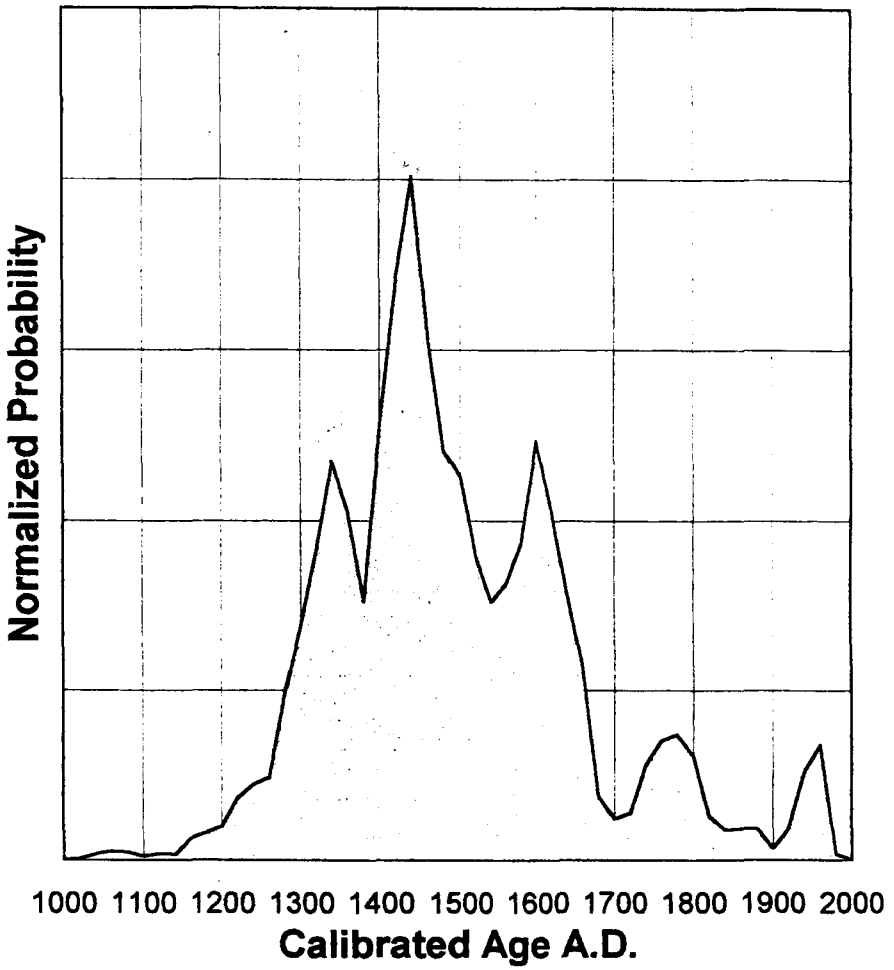

Figure 2. Normalized probability distribution after pooling of 46 calibrated radiocarbon dates associated with Dinétah phase components at La Plata Mine.

plots and identified all ^{14}C dates with a major probability during the fourteenth century or earlier. Eighteen of the 46 protohistoric dates (39 percent) fall in this range. Interestingly, they form a distinct mode in the early end of the probability graph. If they are more than just sampling errors, I would expect these cases to cluster at particular sites and be supported by other lines of evidence.

Eight sites produced one or more early date, but some are readily attributed to sampling error. Two sites excavated by DCA, LA 38536 (Hancock et al. 1988) and LA 56841 (Reed et al. 1988), fall into this category, with each site having disparate dates obtained from a single hearth. At the latter site, the early date came from upper fill in the hearth, while the lower fill gave a much younger date. Given old-wood concerns, it seems prudent to accept the younger dates as relevant to human occupation. Another DCA site, LA 56843 (Reed et al. 1988), has three early dates from an open camp; a fourth date (cal A.D. 1330–1624) in this part of the site was not classified as "early" but supports a relatively early Dinétah assignment. Two protohistoric structures elsewhere at the site have younger dates, suggesting an early Dinétah open-air camp with a later, more

NN028153

permanent occupation. The four dates on the open-air camp are statistically contemporaneous and can be averaged to provide a single date of 504±26 B.P.: cal A.D. 1332–1440 with a 93 percent probability in the A.D. 1394–1440 range. This early component is regarded as a strong case for an early Dinétah occupation, but, in terms of the wood-use model discussed here, occupation during the sixteenth-century is most likely. Several TL dates on Dinétah Gray pottery support a sixteenth-century age for the open-air area.

The open camp documented by BLM, LA 56844 (Gaudy 1986), is a fourth candidate for the early Dinétah phase. A single feature and one date exhaust the potential of this site, however. As noted earlier in this paper, the date is early and supports the inference of occupation during the sixteenth century or perhaps earlier. With only a single date, however, this site is a weak case.

Kin 'Atśa, touted as an example of early Dinétah occupation by Reed and Horn (1990), did not produce any dates judged "early" in terms of standards proposed here. Although there are six protohistoric dates from the site, most are redundant. Reed and Horn (1988) provide three dates from general fill in the structure and one from an extramural hearth, while Hancock et al. (1988) report two dates from what they regard as outer rings from two different charred logs in the structure. While Reed and Horn averaged all of the dates, it seems more appropriate to average only the two "cutting dates" provided by DCA, since only they control for at least cross-section effect. Both dates are the same, providing a mean of 420±42.4 B.P.: cal A.D. 1413–1627 with an 88 percent probability in the 1413–1524 range. Assuming the use of dead wood in building the structure, construction during the sixteenth century or possibly later is indicated.

Reed and Horn (1990:288–289) questioned the validity of DCA's TL dates from Kin 'Atśa because of the low-firing technology typical of Dinétah Gray, but this would produce obviously anomalous dates if it had any effect (Robert C. Dunnell, personal communication 1991). Thus, rejecting two statistically contemporaneous TL dates (A.D. 1650±60 and 1680±20) in favor of six earlier wood charcoal dates is not warranted. The most parsimonious interpretation is that the ^{14}C dates overestimate the true age of the site, even more than suggested by the wood-use model; the occupation may be as late as the seventeenth century.

Early Dinétah phase dates were obtained at four sites excavated by Mariah Associates (Brown 1991). A hogan at one site, LA 61828, yielded two dates in the 1222–1437 range with no contradictory evidence. One date is on scattered charcoal, while the other is on the outer rings of a charred pole, but it is only 20 years younger. Relatively early construction appears likely, but, assuming the use of dead wood, occupation as late as the sixteenth century cannot be ruled out. A weak case can be made for occupation during the fifteenth century or even earlier.

Another site, LA 61838, is of special interest because two early dates can be compared with later dates, including tree-ring dates. Both early dates are from cooking features in an outdoor activity area and fall in the 1285–1463 range. A third cooking feature is slightly later (cal A.D. 1443–1955 with a 93 percent probability in the 1443–1669 range). Tree-ring samples from one of the "earlier" features produced dates toward the later end of the early range: 1455vv[3] and 1464vv. Both tree-ring and charcoal samples

NN028154

were identified as piñon. Because inside dates were obtained on the tree-ring samples (1391 and 1322p, respectively), the cross-section effect can be evaluated. With pith present on the latter sample, clearly a minimum of 142 years is represented; the vv outer date indicates much more than this, suggesting that a 45-year cross-section factor in this case is not enough. Comparing tree-ring dates with the ^{14}C date from this feature (1303–1463) also suggests that a significant cross-section effect is operative.

A partially burned forked-stick hogan at this site produced both tree-ring and ^{14}C dates, although the latter were not classified as early. The ^{14}C dates are both on outer rings from charred poles, one piñon and one juniper. The two are very similar with a combined range of 1399–1642 and an average of 1415–1629. The same piñon specimen that provided a ^{14}C date also produced a tree-ring date: 1560vv. Another date of 1490vv was determined from a juniper specimen. The ^{14}C and tree-ring dates complement each other. However, if it had not been possible to control cross-section effect in this case by collecting outer wood, this factor would evidently have been great. Both tree-ring specimens lack pith rings and true outer rings, yet the piñon specimen documents 164 years and the juniper, 174 years.

Predictably, this occupation is over-estimated by ^{14}C dates, despite the control for cross-section effects. Even tree-ring dates overestimate the occupation, since sapwood is lacking on all four specimens, and the hogan, at least, probably could not have been built before 1600, even if live trees were cut. Given probable dead-wood use, construction of the hogan most likely occurred during the early to mid-seventeenth century, at the youngest extreme of the youngest ^{14}C date ranges. The activity area at this site might be earlier, but occupation still must have occurred well after the youngest tree-ring date, probably no earlier than the early sixteenth century. Again, however, this is much later than associated ^{14}C dates suggest, occurring at the youngest extreme of the youngest date. Thus, Site LA 61838 is rejected as a good case for the "early" Dinétah phase.

A third site, LA 61848, produced two "early" dates, 1039–1284 (86 percent probability in the 1150–1284 range) and 1278–1417, which only barely overlap. The earliest date is associated with a post in a burned brush structure, while the other sample was obtained from a hearth just outside. Scattered charcoal in the burned structure dated later, 1642–1955 (84 percent probability in the 1642–1886 range). While the earlier dates appear susceptible to both old-wood and cross-section effects, the scattered charcoal in this case is probably most reliable, since the mass of Navajo brush structures is comprised largely of younger woody materials less complicated by old-wood use and reuse (Dean 1981). I am inclined to attribute the early dates to old-wood and cross-section effects and employ the late date to infer a late seventeenth-century or possibly even eighteenth-century occupation.

The last candidate for the early Dinétah phase is a strong case. Six out of 12 ^{14}C dates from LA 61852 fall in the 1218–1486 range. Even the latest of the dates has a 93 percent probability of being older than 1625, and no evidence at all contradicts an early assignment. Several of the "later" dates are on juniper seeds and bark, not affected by dead-wood or cross-section effects, supporting both the model of lag time and the inferred early status of this site. However, seeds and bark in all three hogans produced dates encompassing the early 1600s, suggesting that post-1550

NN028155

occupation cannot be ruled out, despite the number of wood dates in the "early" range. The earliest date that I can offer is provided by charred seeds from Structure 1, 1415–1634, with 76 percent probability of being older than 1530. Wood dates could be used to argue for an occupation at the early end of this time span, but even an outer-ring date (1280–1417) overlaps the date on juniper seeds.

In conclusion, this well-dated site provides evidence that forked-stick hogans were built in La Plata region at least as early as the sixteenth century, and possibly earlier. Most conclusively, however, comparisons between charred seeds and outer wood indicate the old-wood problem in protohistoric hogans might commonly be on the order of 100–150 years. Cross-section effects exceeding 45 years on both piñon and juniper also are common. The analysis demonstrates that these factors need to be reckoned with, since combined they can produce dates that overestimate the age of protohistoric occupations by 200 years and more.

Although some attempts to push the Dinétah phase back to the fifteenth century are advertised as conservative, I would argue that they, in fact, employ liberal interpretations of chronometric data. Still, the fact that the Dinétah phase appears well established by A.D. 1500, complete with formalized forked-stick hogans and a distinctive ceramic assemblage, indicates the antecedents of this complex and other aspects of protohistoric occupation remain a fruitful arena for continued research.

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—Western Cultural Resource Management, Inc., Placitas, New Mexico

ENDNOTES

[1] Radiocarbon dates were corrected using tree-ring calibrations published by Stuiver and Pearson (1986), so that ^{14}C dates can be compared with dendrochronological, TL, obsidian-hydration, and other calendar dates (e.g., historic events). The computer program, CALIB, developed by the Quaternary Isotope Lab at the University of Washington (1987) was employed in all calibrations, probability plots, and averaging. Calibrated dates are rendered in years A.D. with the "cal" prefix, while ^{14}C dates with the suffix "B.P." are uncorrected determinations as reported by radiocarbon laboratories. ^{14}C ranges were calculated with two standard deviations and expressed as two-sigma values.

[2] The model developed for chronometric analysis of the Dinétah phase is explicitly designed for dating protohistoric features. Since it was first presented (Brown 1990), several individuals have brought to my attention ethnographic instances of hogan construction using green wood and archaeological features dating to the historic period that incorporated ax-cut logs that would have been difficult to fell if they were long-dead trees. Critics have not summoned evidence for these practices predating the introduction of metal axes, which appear to have been highly valued, nor has the

NN028156

inclusion of stone axes on the original Dinétah phase trait list (Dittert et al. 1961) been supported by subsequent research. Direct evidence of hogan construction using dead-standing trees and description of procurement without axes have also been produced (Brown et al. 1992), since the model provided here was originally presented.

[3] p Pith ring present.

vv There is no way of estimating how far the last ring is from the true outside.

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NN028161