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DATING THE VALDEZ PHASE: CHRONOMETRIC RE-EVALUATION OF THE INITIAL ANASAZI OCCUPATION OF NORTH-CENTRAL NEW MEXICO

by
Jeffrey L. Boyer

Submitted by
Timothy D. Maxwell
Principal Investigator

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ADMINISTRATIVE SUMMARY

In 1992, the USDA Forest Service Rocky Mountain Research Station awarded to the Office of Archaeological Studies (OAS), Museum of New Mexico, a grant to investigate the dating of the initial Anasazi occupation of the Taos District of north-central New Mexico. Archaeologists know this occupation as the Valdez phase. This report describes the results of the *Dating the Valdez Phase* project. Descriptions of the Valdez phase by archaeologists, including dates for the phase derived by cross-dating, are examined. The project research questions are then presented. In the following chapters, the results of various chronometric analyses are presented, along with an attempt to assess their relationships and implications for determining the age of the Valdez phase.

1. What are the dates of the Valdez phase?

Tree-ring dates from Valdez phase sites, while a small sample, show construction of sites after A.D. 1100 and, for the most part, after 1120. A larger body of tree-ring dates from Pot Creek-phase sites shows that the transition to small, aggregated surface-structure villages took place in the early 1200s. Analyses of archaeomagnetic dates provides a mean phase date of 1075 to 1225. The necessity of accommodating one clearly pre-1100 date results in dates for the phase of 1050 to 1225. Archaeomagnetic and tree-ring dates show that the initial Anasazi movement into the Taos District took place in the last half of the eleventh century and that the numerous twelfth-century dates represent increased immigration, internal population growth, and significant internal population movement during that century. There is no evidence to suggest that there was an "evolution" from simple pithouse sites to more complex sites with pithouses and surface structures during the course of the phase.

2. Are there significant differences in the timing of the formation of the two "communities" (was one formed earlier than the other)?

Analyses of archaeomagnetic dates reveal no significant differences between north community dates and phase dates, between south community dates and phase dates, or between north community and south community dates. The significance of this conclusion with regard to Taos Pueblo origin stories is discussed.

3. Can we isolate the cause(s) of chronometric discrepancies between techniques, which is critical for assessing the significance of dates obtained by different techniques?

   a. Why has radiocarbon dating often yielded dates that are significantly older than dates obtained by other chronometric techniques?

Comparative radiocarbon and tree-ring dating of log samples from Pot Creek Pueblo shows that contamination by calcium carbonate from the soil in the Pot Creek area probably was not a factor in producing radiocarbon dates from nearby sites that are older than associated tree-ring and archaeomagnetic dates.

Pooling or averaging dates is useful for determining whether dates that appear to be widely dispersed may actually have the same or nearly the same ages and may actually be contemporaneous with other associated dates. However, it is important to assess the effect of variation in materials within the sample group, since material variation is an important source of date dispersion.

Valdez phase radiocarbon samples suffer from generally low quality. In particular, the samples are characterized by low material quality, although context quality is usually high. This suggests that samples were usually collected from appropriate contexts, but that materials available from those locations were limited in quality, resulting in unreliable radiocarbon dates. Low sample quality is the primary cause of radiocarbon dates that are older than other associated dates.

b. How much variation in ground temperature is present at sites throughout the region and how are obsidian hydration dates affected by this variation?

Effective hydration temperatures (EHTs) can vary significantly between sites and within sites at different depths. Since EHT variation can result in a change in calculated hydration date of 10 percent for each degree of EHT difference, the 1 to 3 degree differences observed can be expected to produce significant variation in hydration dates. The same degree of variability in EHTs, hydration rates, and resultant dates is potentially present within sites, depending on on-site topography and vegetation. In addition to soil temperature and humidity, sample depositional context is critical for assessing the reliability of the hydration dates and the association of those dates with site features, activities, or activity locations.

Given the considerable variability inherent in the conditions that produce and affect the hydration rim and resultant dates, obsidian hydration dating requires stringent sample collection and selection procedures in order to obtain dates that can be associated with site features or activities. However, examples of Anasazi collection and use of obsidian artifacts from older sites can be seen. This raises a number of questions about procurement and use of nonlocal resources during the Valdez and subsequent phases.

3. Which of the chronometric techniques provide the greatest accuracy and precision for dating sites and intrasite features and deposits?

Tree-ring dates can be both accurate and precise, but are not necessarily so. Their accuracy is affected by one's ability to securely associate the dated specimen to the context from which it is collected and to the context one would like to date: the construction of the pithouse. In the case of Valdez phase sites, one must be concerned about material salvaging and the probability that even a cutting date may not reflect construction of the structure in which the specimen is found. Thus, the date may not accurately represent the age of the collection context. The precision of tree-ring dates relates to noncutting dates and the number of years (rings) missing from the specimen.

Archaeomagnetic dates appear to be the most consistently accurate and precise, although considerable variation is evident in the archaeomagnetic dates from Valdez phase sites. The dates can be clearly associated with site features, usually hearths but also including the burned pithouse floor at LA 9206, and events, the last burning of the feature. Consequently, we can accurately associate the date with both collection context and the context we wish to date - the last use or abandonment of the pithouse. When the precision of archaeomagnetic dates is compared with that

of radiocarbon and obsidian hydration dates, two-sigma archaeomagnetic dates are only about half as long, on average, as one-sigma radiocarbon and obsidian hydration dates. It is for this reason that archaeomagnetic dates are used to define the dates of the Valdez phase. The relative precision of archaeomagnetic dates also allows, in some cases, some sites to be dated within the Valdez phase.

In comparison, radiocarbon and obsidian hydration dates are much less accurate and precise. Lower accuracy is related to the problems involved in unambiguously associating the date with the collection context and, particularly, with the context we wish to date. In the case of Valdez phase radiocarbon dates, context and, especially, material quality problems lead to unreliable dates, with discrepancies between the dated events and the target events. Similarly, examination of the collection contexts of dated obsidian artifacts shows that we cannot assume an association between the dates and site features, activities, or activity locations. On the other hand, the dates do point to collection and use of obsidian artifacts from older sites.

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ACKNOWLEDGMENTS

As with any research project, a number of people have made substantial contributions to the *Dating the Valdez Phase* project. Dr. George Peterson of the USDA Forest Service Rocky Mountain Forest and Range Experiment Station in Fort Collins, Colorado, worked with us in developing the project plan, research design, and budget. Oversight of the project was later transferred to Dr. Joseph Tainter of the USDA Forest Service Rocky Mountain Forest and Range Experiment Station in Albuquerque, New Mexico. Joe has been patient and cooperative as the project moved along more slowly than perhaps it should have. Rudy King, Rocky Mountain Research Station biostatistician, reviewed the statistics and provided important discussions and information on outliers and their treatment. On a local level, Dr. Jon N. Young, Carson National Forest Archaeologist, allowed us to return to previously excavated sites on the Forest's Questa and Camino Real Ranger Districts to re-excavate portions of pithouses and collect archaeomagnetic samples. Since most of the previously excavated Valdez phase sites are on the National Forest, Jon's cooperation was obviously critical for the project's success.

The field crew consisted of Eligio Aragon, of Alley Cat Excavating, whose soft touch with a backhoe greatly facilitated re-excavation of the pithouses, Ibrahima Thiaw of Rice University, Jeffrey Cox, Dr. Daniel Wolfman, and Jeffrey Boyer of the Office of Archaeological Studies.

Dr. Michael Adler of Southern Methodist University kindly provided us with three wooden beam samples from Pot Creek Pueblo. Those samples, which were submitted for tree-ring and radiocarbon dating, were vital to the experiment to determine the possible effect of carbonate contamination in radiocarbon samples from the Pot Creek area.

Mr. Donald Rumsfeld, in addition to allowing us to re-excavate five pithouses on his property near Valdez, graciously provided critical assistance at a time when an administrative blunder threatened the project's results. It is fair to say that the results, particularly the definition of phase dates from archaeomagnetic dates, would have been much less substantial without his help.

Drs. Darden Hood and Ronald Hatfield of Beta-Analytic provided radiocarbon data and valuable insight on the eccentricities of radiocarbon dating. Dr. Christopher Stevenson of Archaeological Services Consultants provided the wet and dry cells for the effective hydration temperature (EHT) and ground humidity study, as well as wisdom concerning the effects of varying EHTs on hydration dates. Dr. William Robinson of the Laboratory of Tree-Ring Research discussed the tree-ring dates from Pot Creek Pueblo and the Valdez phase sites. Processing and dating the archaeomagnetic samples was conducted by Ibrahima Thiaw and Jeff Cox in OAS's Archaeomagnetic Dating Laboratory. Each of these experts in their respective fields was kind enough to spend time aiding in interpreting different kinds of chronometric data. In the end, of course, the interpretations presented in this report, while ideally benefiting from the expertise and largess of these individuals, are my own fault, and any errors, misconceptions, or other problems rest solely on my shoulders.

This report was edited by Robin Gould. Figures were drafted by Ann Noble and Rob Turner.

Finally, this project would likely never have happened had it not been for my project co-director, Dan Wolfman. Dan, who was an insatiable fund-raiser, saw the project as an opportunity to involve OAS in a chronometric research project (as opposed to a "contract" project) and as a chance to return to the Taos Valley, where he received some of his first field experience over 30 years ago. When Dan died unexpectedly on November 25, 1994, the field of chronometry lost a valuable colleague, OAS lost the founder and director of its Archaeomagnetic Dating Laboratory, and many archaeologists lost a friend and one of the profession's most colorful characters. This report would undoubtedly have been a different document had he been its co-author. Nonetheless, and hopefully to his credit, this report is dedicated to Dan's memory.

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INTRODUCTION

In 1992, the USDA Forest Service Rocky Mountain Research Station awarded to the Office of Archaeological Studies (OAS), Museum of New Mexico, a grant to investigate the dating of the initial Anasazi occupation of the Taos District of north-central New Mexico (Fig. 1). Archaeologists know this occupation as the Valdez phase. The instigating factor in the grant application was a project conducted by OAS for the New Mexico State Highway and Transportation Department (NMSHTD), the Pot Creek Data Recovery Project (Boyer et al. 1994a). During that project, OAS archaeologists excavated two Valdez phase pithouse sites. While examining the regional context of these sites, it became clear that one significant characteristic of the Valdez phase is disagreement about its dates. This disagreement, in turn, is the foundation to differing perspectives of the early Anasazi occupation of the region. Consequently, resolving the issue of the dates of the Valdez phase is critical for assessing those perspectives since, as I (Boyer 1994a) have pointed out, they are largely based on varying interpretations of what are otherwise largely the same data.

The decision to approach the USDA Forest Service for grant funding was based on an emphasis on chronology and chronometrics defined by USDA Forest Service archaeologists at their *Tools to Manage the Past* conference (see Tainter and Hamre 1988). In a call for unified research themes tying together archaeological research and management on National Forests, Upham (1988:142) states that "the ability to date site occupations undergirds virtually every important aspect of archeological interpretation." He goes on to quote Cordell, Schiffer, and Upham (1983:25-26) in pointing out that "one of the most persistent obstacles to processual studies continues to be our inability to date precisely past cultural events," and "without sound chronological frameworks, it is nearly impossible to conduct refined studies on rates of change in behavior or organization, or to correlate changes in cultural phenomena with changes in environmental conditions." This concern is echoed by Cartledge and others (1988:159), who state that "the kinds of research questions that currently occupy archeologists' attention cannot realistically be addressed without [chronological] control." They go on to say that appropriate strategies for understanding archaeological resources rely:

> on reasonably secure and exact knowledge of the dating of past sociocultural events, temporal relationships between communities, and temporal relationships between activities that take place at residential loci and activities that occur elsewhere. Unless the material remains of past human activities can be accurately and precisely dated, it will be impossible to construct the refined, high-resolution chronologies necessary to produce the required knowledge. (Cartledge et al. 1988)

Cartledge and others (1988:169) summarize by saying, "Without question the current top priority for prehistoric research in the Southwestern Region is directly related to the issues of chronometric dating techniques and site dating."

Given this emphasis, OAS secured funding from the Santa Fe National Forest for the Jemez Mountains Chronology Study (Wolfman 1994). The principal goal of that project was to "obtain or tell how to obtain more refined dating of archaeological sites in the Jemez Mountains, particularly on the basis of material found on the surface of such sites" (Wolfman 1994:3). In part,

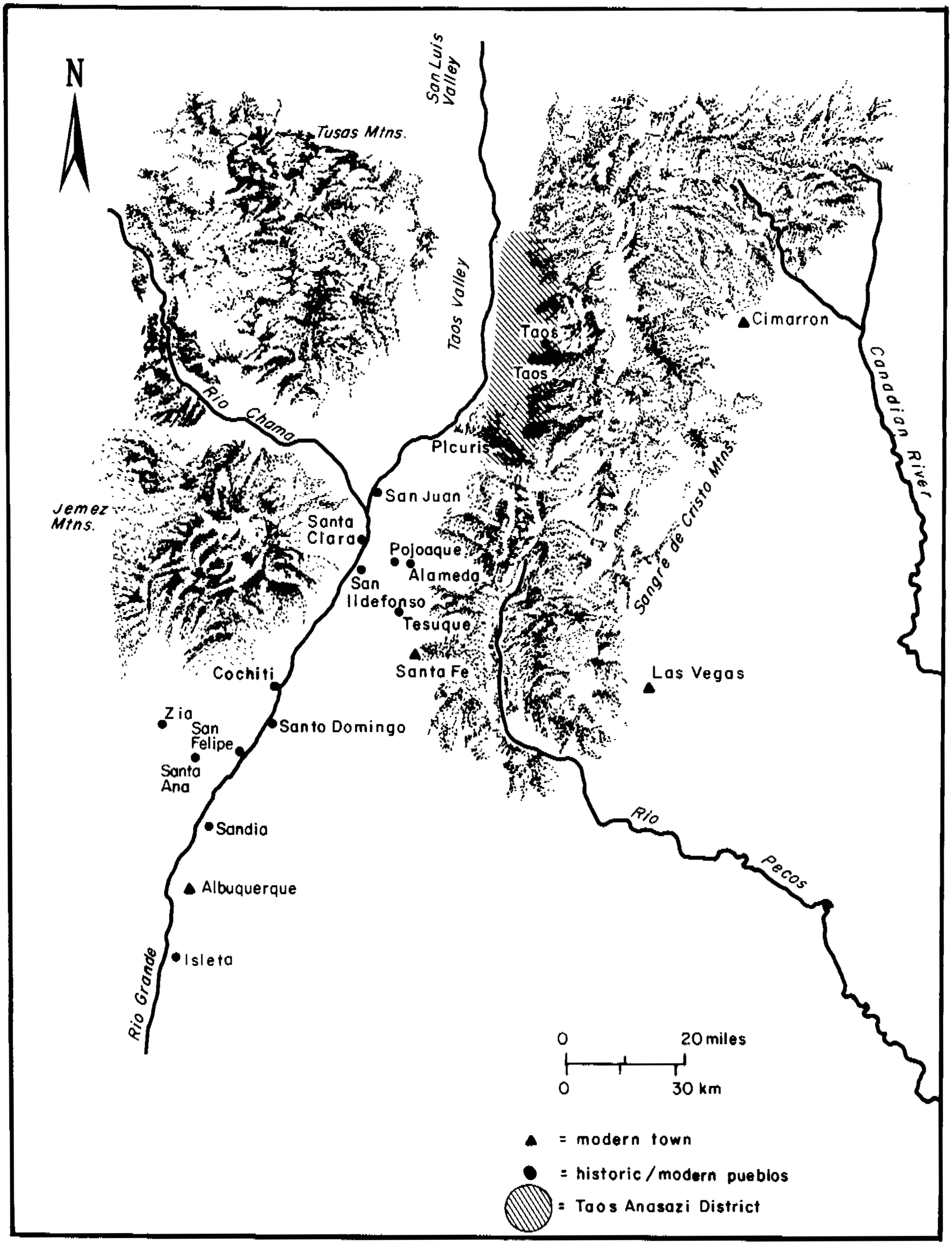


Figure 1. The Taos Anasazi District.

this would take place by evaluating chronometric dates associated with specific artifactual assemblages, hopefully allowing for refinement in dating those assemblages and, thereby, in cross-dating similar assemblages.

A second factor in approaching the USDA Forest Service for grant funding for the *Dating the Valdez Phase* project was the fact that most excavated Valdez phase sites, at the time the grant proposal was submitted, were located on the Carson National Forest (Fig. 2). These include sites investigated by Southern Methodist University's Fort Burgwin Research Center archaeological field school (Luebben 1968; Green 1976), the University of New Mexico's archaeological field school (Loose 1974), and the Museum of New Mexico (Peckham and Reed 1963; Boyer et al. 1994a). The results of chronometric analyses are available for several of these sites and comprise much of the chronometric data for the Valdez phase. Consequently, a chronometric re-evaluation of the Valdez phase is not only an undertaking with important research potential; it has significance for cultural resources management on National Forest lands, as well. Current understanding of the distribution of Valdez phase sites suggests that most of the sites are, because of land ownership in the region, located either on private lands or on the Carson National Forest. Given this situation, we are more likely to be able to preserve and study those sites on National Forest land as a group. Private-land sites may be investigated in contract-salvage situations involving state or federally funded projects, such as Taos County's Blueberry Hill Road project (Boyer and Urban 1995). However, just recording private-land sites is often a "hit-or-miss" situation dependent on land-use zoning requirements, and the few instances of more intensive investigations of private-land sites that were not required by state or federal laws involved 30-year old field school or research programs (Blumenschein 1956, 1958, 1963; Loose 1974; Green 1976). In contrast, federal management regulations require that when sites are identified on a National Forest, their data potential must be considered and protected. This means that we must assume that, as a group, the sites that represent the initial Anasazi occupation of the region are likely to be better "managed" on USDA National Forest Service land than on private lands. With this in mind, it seems appropriate for the USDA Forest Service to sponsor research that will aid its management responsibilities.

This report describes the results of the *Dating the Valdez Phase* project. In the chapters that follow, I will examine descriptions of the Valdez phase by archaeologists, including dates for the phase derived by cross-dating. The project research questions are then presented. Following this, I address the answers to the questions. In these chapters, the results of various chronometric analyses are presented, along with an attempt to assess their relationships and implications for determining the age of the Valdez phase. This report is not an evaluation of specific chronometric techniques, because I am not a chronometrician. That role was to be fulfilled by the late Daniel Wolfman, my colleague at OAS, the co-director of this project, and the founding director of OAS's Archaeomagnetic Dating Laboratory. Instead, the emphasis is an evaluation of dates from the perspective of a field archaeologist who needs "good dates" from his sites.

DESCRIPTIONS OF THE VALDEZ PHASE

The earliest Anasazi occupation of the Taos District is known as the Valdez phase. It was given its first description by Herold (1968) based on the results of his 1960 survey of the Rio Grande del Rancho and Arroyo Miranda valleys. From 110 recorded sites, Herold defined three prehistoric "pottery groups" representing distributions of pottery types and their associations with varied structural types. One such assemblage, Pottery Group 1, is equivalent to the Valdez phase and characteristic of 65 percent of his sites. It includes Taos Black-on-white, Taos Gray plain, and Taos Gray incised (Herold 1968:27). A variety of structural remains were recorded at Group 1 sites, including pithouse depressions, small pueblo mounds, and rock alignments. Some sites had no evidence of structures but, assuming structures to be present if not evident, Herold assigned them to a category called "obliterated structures" (Herold 1968:33). In sum, Herold characterized Pottery Group 1 by stating that:

> the stage distinguished by Taos Black-on-White as the only painted pottery has the simplest composition, the longest duration, the greatest number of sites and the broadest distribution of all prehistoric pottery groups in the survey area. (Herold 1968:27)

In 1968, Wetherington's seminal report on Pot Creek Pueblo was published (Wetherington 1968). In addition to a decade of excavations at the site, Wetherington discusses the context of this large pueblo within the Anasazi occupation of the Taos Valley. He also compares Taos Valley archaeological developments with those of the Santa Fe and Albuquerque areas and the eastern plains, as these areas were known in the late 1960s. Wetherington's report is the first published use of the name "Valdez phase" to describe the earliest Anasazi occupation of the region. The actual origin of the name, taken from the village of Valdez in the Rio Hondo Valley north of Taos, appears to have been Green's (1963) thesis, which was updated and published in 1976 (Green 1976).

By the time Wetherington's report was published, several Valdez phase sites had been excavated and Wetherington could incorporate survey and excavation data into a broader picture. The Valdez phase ceramic assemblage consists, according to Wetherington (1968:75), of Taos Black-on-white, some Kwahe'e Black-on-white, as well as plain, incised, and neck-banded Taos Gray. Architecturally, sites consist of pithouses, sometimes in groups of two to four but often single, with small surface structures of coursed adobe. He notes Peckham and Reed's (1963) excavation of an isolated *jacal* structure. He also notes that while many of the excavated pithouses were circular, rectangular ones were known, especially from Blumenschein's (1956, 1958, 1963) excavations near the Rio Hondo and Arroyo Seco. Survey data indicated that three "areas of site concentration" could be defined in the northern, central, and southern parts of the region, with site locations ranging from about 2,130 m (7,000 ft) on the valley floor to narrow benches on ridges near 2,440 m (8,000 ft) (Wetherington 1968:77). These "areas of site concentration" appear to follow river drainages.

Following a well-defined normative line, Wetherington assumes an evolutionary trend from pithouses early in the phase to a time:

> where in the latter part of the Valdez phase the people began to

> build small surface units of contiguous adobe-walled rooms. These, and the evidence from some *jacal* construction, suggest a growing tendency toward surface habitation, with the persistence of the pithouse essentially unchanged. (Wetherington 1968:79)

After considering evidence for the presence of kivas, Wetherington is able to draw these conclusions regarding the Valdez phase:

> Present evidence suggests that during most of the Valdez Phase social groupings consisted of several physically separated nuclear and extended family domiciles in several preferred areas in the district. It is logical to assume that these groups were mutually cooperative and friendly, since they all participated in the same subsistence pattern--growing maize and hunting. There is no evidence that they had either a common ceremonial complex or a common economic organization at this time. (Wetherington 1968:80)

Green's (1976) report on Valdez phase sites describes the results of excavations at six sites in the Pot Creek, Talpa, and Llano Quemado areas south of Taos. Excavated structures at five sites were pithouses; the sixth site, TA-47, consisted of two subterranean structures and two surface room blocks, one superimposed on the other. Green does not provide a description of the Valdez phase; rather, she refers the reader to Wetherington's report. She does summarize the artifactual material from the sites and draws certain "condensed anthropological inferences" about the Valdez phase Anasazi.

Like Herold and Wetherington, Green characterizes the phase's ceramic assemblage as including plain, incised, and neck-banded varieties of Taos Gray. She prefers to call the mineral painted pottery "Kwahe'e Black-on-white: Taos Variety" rather than Taos Black-on-white, the name used by Mera (1935), Peckham and Reed (1963), Wolfman, Wolfman, and Dick (1965), Herold (1968), and Wetherington (1968), arguing that the differences between Kwahe'e and Taos Black-on-white are insufficient to distinguish them as types (see Lent 1991; Levine 1994). The Valdez phase, she says, "begins with the local manufacture of ceramics in the Taos area and ends with the introduction of Santa Fe Black-on-white into the region" (Green 1976:63). Excavations demonstrate that both pithouses and surface pueblos were used during the phase and that "there is no reason to believe that pit houses and pueblos were not occupied contemporaneously" (Green 1976:64).

Apparently ignoring the fact that earlier Basketmaker habitation sites had not and still have not been found in the Taos Valley and that the Taos Anasazi sequence begins later than its counterparts in other parts of the northern Southwest, Green argues that:

> Without evidence to the contrary, it is presumed that the population of this region during the Tenth Century was descendant from earlier peoples there. There is no doubt that pottery manufacture was introduced from elsewhere--from the south, probably around Santa Fe--but whether or not the other items of material culture were part of the local tradition is still problematical. (Green 1976:64)

Green (1976:68-69) sees only limited evidence for extensive contact and trade between the Taos area and Anasazi populations to the south. This interpretation is based on her assumption that the Valdez phase inhabitants of the valley were descended from local hunter-gatherers who learned pottery manufacture and adobe architecture from Anasazi living to the south. Having accounted for these traits, she sees little else to indicate continued contact with people to the south until the introduction of Santa Fe Black-on-white. On the other hand, the considerable intra-regional ceramic homogeneity suggests to Green that there was significant contact among Valdez phase villagers.

A more recent description of the early Anasazi occupation of the Taos Valley comes from Woosley (1986), whose research purports to "suggest alternative interpretative models for prehistoric puebloan developments" in the region (Woosley 1986:145). Woosley does not use local phase names, preferring instead to discuss prehistoric settlement and demography in terms of Wendorf and Reed's (1955) classification. In this system, the Valdez phase falls into the Developmental Period. Woosley (1986:148) states that, "Early Developmental period sites consist of pit house clusters and are followed at a slightly later date by small surface pueblos of less than 10 rooms with or without a kiva." Her assignment of these sites to the early Developmental Period, usually dated between A.D. 600 and 900, will be discussed later. It is important to remember Green's (1976:64) statement that there is no evidence to suggest that pithouses and surface structures were not occupied contemporaneously. Woosley (1986:148) goes on to describe Developmental Period sites near the village of Los Cordovas by saying that "Thirty-seven of the 85 sites located in a 10 km^2 area consist of small, single-story room blocks, some with associated pit houses, and two with obvious kiva depressions surrounding surface rooms."

Since this information is derived from survey data, one must wonder how Woosley can distinguish between pithouse depressions and "obvious kiva depressions." Further, a site from this period (or any other) with kiva depressions surrounding a room block must certainly be considered an anomaly. Woosley provides no obvious assessment of the sociocultural situation that might have prompted the construction of communal ceremonial structures. She does, however, interpret site density in a way that may show why community religious organization would be present when she says:

> The existence of a large number of contemporaneous, or at least partially temporally overlapping, sites suggests a local population of some size. Contemporaneity is determined on the basis of settlement type and associated artifacts, with ceramics considered the most sensitive temporal markers. (Woosley 1986:149)

Thus, Woosley assumes that *all* Developmental period sites were either roughly or exactly contemporaneous. They must, then, have had fairly long use-lives, as reflected in her statement that the Cerrita site, consisting of a remodeled pithouse and a remodeled surface structure, was occupied for about 250 years (Woosley 1986:153). Several studies show, however, that pithouses had an expected use-life of 7 to 12 years before major repair and structural remodeling became necessary, after which their use-lives might be extended to 20 or 30 years (Ahlstrom 1985; Schlanger 1985, 1986; Cameron 1990), roughly one-tenth the time postulated by Woosley for the Cerrita site. Cameron's (1990:162-163) revised figures for the Mimbres Valley, assuming pithouse life of 15 years instead of the 75 years assumed by Blake and others (1986), decrease regional population estimates by about 75 percent. This is an important issue since Woosley describes changing site density in the Taos region solely in terms of changing levels of population aggregation. She argues for a transitional phase between the Developmental and Coalition Periods defined "by settlement aggregation, elaborations in architecture, and overlapping time-diagnostic ceramics" (Woosley 1986:148).

Woosley observes an increase in the number of sites per square kilometer beginning with the Developmental period, but a decrease during the transition from late Developmental to Coalition periods. Relying on the assumption of site contemporaneity and a consequent large regional population, she states:

> the occurrence of fewer numbers of sites is not related to a concomitant reduction of total Taos District population, but is viewed as a shift from a more dispersed settlement system represented by many small villages to a greater aggregation of the population into fewer but larger pueblos. (Woosley 1986:150)

She describes this process as "one of gradual local development and [it] is not due to an influx of peoples from outside the district" (Woosley 1986:161). In fact, she insists that:

> changing settlement distribution, increased complexity in site organization, as well as alterations in material culture assemblages such as ceramics can all be easily interpreted in terms of a Taos District continuum of gradual cultural development within the local Anasazi sequence. (Woosley 1986:160)

However, the changes monitored by Woosley are anything but gradual. Her data show that between the early and late Developmental period, there is an average 446 percent increase in the number of sites, with local area increases ranging from 191 to 1,380 percent (Woosley 1986:150). These startling increases took place, according to Woosley, in about 350 years. Even more remarkable are the changes supposedly taking place in Woosley's 75 to 100-year-long transition period between the Developmental and Coalition periods. In that time, site densities decreased an average of 85 percent, with local area decreases ranging from 33 to 96 percent. Thus, in the course of 300 to 350 years, site densities climbed an average 446 percent and then plummeted an average 85 percent in the next 75 to 100 years. Woosley maintains that these trends reflect gradual local developments, including normal population growth followed by population aggregation. If she is right, one would expect *all* Coalition period sites to be *very* large to accommodate the tremendous population from sites abandoned after the Developmental-Coalition transition period. In fact, only a few large sites are known, and they cannot be securely assigned to the Coalition period.

What seems more reasonable is that Woosley's site numbers reflect (1) misidentification of sites and (2) high mobility within the local population prior to the Coalition period. In the first case, Woosley follows a traditional evolutionary scheme in suggesting the development of small pithouse villages followed by larger communities including surface structures, and finally the beginnings of population aggregation. However, we have seen that her model can hardly account for the tremendous shifts in her own data, particularly assuming site contemporaneity. If, in fact, Developmental period (Valdez phase) sites can consist, as they seem to judging from the reports of Blumenschein (1956, 1958, 1963), Peckham and Reed (1963), Wolfman, Wolfman, and Dick (1965), Luebben (1968), Wetherington (1968), Loose (1974), Green (1976), Boyer et al. (1994a), and Boyer and Urban (1995), of pithouses, small clusters of pithouses, surface structures, and pithouses with surface structures, then all or most of Woosley's Developmental and Developmental-Coalition transition period sites may fall into the Valdez phase. This, of course, serves to actually increase the relative difference in site numbers and density between the Developmental and Coalition periods (Valdez and Pot Creek phases). It also brings her numbers closer to Herold's (1968), whose survey results show a 76.4 percent drop in site numbers from Pottery Group 1 (Valdez phase) to Pottery Group 2 (Pot Creek phase). This exacerbates Woosley's problem of explaining such enormous population decreases through aggregation, unless we eschew Woosley's assumption of site contemporaneity in favor of population mobility and relatively short site life, whether due to seasonal use (Gilman 1987), short structural use-life (Cameron 1990), or both. The issue becomes even more critical if the Developmental period-Valdez phase was not actually 400 to 450 years as postulated by Woosley.

Cross-Dating the Valdez Phase

Dating Valdez phase sites has traditionally been accomplished by ceramic cross-dating of the mineral-painted ware commonly known as Taos Black-on-white. Peckham and Reed (1963) follow Mera (1935) in relating Taos Black-on-white to Kwahe'e Black-on-white, thought to be descended from Red Mesa Black-on-white ("Chaco 2") (see Wolfman, Wolfman, and Dick [1965:15-20] and Wetherington [1968:51-54, 75-77] for lengthy discussions of the presumed "lineage" of Taos Black-on-white). The latter is dated between A.D. 850 and 1050-1125 and is present on early Developmental-period sites in the Rio Grande Valley (Wendorf and Reed 1955). In the late Developmental period, it is largely replaced by Kwahe'e Black-on-white, which is tree-ring dated between A.D. 1115 and about 1200 (Smiley et al. 1953; Breternitz 1966), although Breternitz lists tree-ring dates for Kwahe'e as early as A.D. 963. Mera (1935) dates Taos Black-on-white between A.D. 1150 and 1250; Peckham and Reed (1963) agree. Breternitz (1966) states that tree-ring dates are inadequate to change these dates, but the site he refers to is LA 1892 (Jeançon's Llano Pueblo), presumably a Pot Creek-phase pueblo where Taos Black-on-white was associated with Santa Fe Black-on-white. Smiley, Stubbs, and Banister (1953) give tree-ring dates for LA 1892 of 1207+ to 1239. Thus, while the site may provide information relevant to the end date for Taos Black-on-white, it is not helpful when determining the beginning date. Tree-ring dates from LA 1892 are discussed in some detail later.

Were we to follow Mera, who provides the earliest description of Taos Black-on-white, the Valdez phase, which is characterized by this type, would date between A.D. 1150 and 1250. Indeed, these are the dates used by Peckham and Reed (1963) and Wolfman, Wolfman, and Dick (1965). If Taos Black-on-white is in fact related to Kwahe'e, we might modify the dates to 1115 to 1200, following Smiley, Stubbs, and Banister, and Breternitz. In either case, dates in the twelfth and early thirteenth centuries are suggested for the Valdez phase. Wetherington (1968), on the other hand, pushes the beginning date for the Valdez phase back to A.D. 1000. His reasons are not stated, but may have to do with Breternitz's earlier dates from Kwahe'e sites. Although Wetherington's reasoning is not clear, A.D. 1000 has become the accepted beginning date for the phase (see, for instance, Luebben 1968). It is also used for cross-dating sites in the Cimarron area (Glassow 1980) and near Trinidad, Colorado (Wood and Bair 1980), where Taos Black-on-white has been found.

There are three dissenters who argue that the Valdez phase began before A.D. 1000. Loose (1974) argues that the presence of purported Red Mesa Black-on-white sherds at several Valdez-area pithouse sites shows that they were occupied between 850 and 1050 or 1100. She feels that these dates concur with dates derived from comparative studies of pollen samples from LA 9200, a Valdez phase site excavated by the UNM field school. Although she attempts to correlate her pollen data with regional climatic changes, they actually seem to point to on-site changes in vegetative communities resulting from human rather than natural activities (Boyer 1994a). Cordell (1978) suggests that the supposed Red Mesa sherds from the Taos area be petrographically examined to determine their real identity. This calls into question their utility for dating the occupation of the sites and the phase.

Green (1976) dates the Valdez phase between A.D. 900-950 and 1200 on the basis of the presence of "Kwahe'e Black-on-white: Taos variety" sherds. It is not clear why she chooses to push the dates back to the early tenth century, unless she is using Breternitz's early dates from Kwahe'e sites. If so, then her interpretation of Breternitz's data may conflict with Wetherington's, assuming that Wetherington relies on Breternitz for his A.D. 1000 beginning date. However, it is important to remember that Green sees the Valdez phase residents as descended from local hunter-gatherers who adopted Puebloan ceramics and architecture. In her view, they were culturally, if not ethnically, Anasazi. Consequently, her model requires a longer period of time for assimilation and acculturation to take place.

Finally, as noted above, Woosley (1986) prefers to date sites according to Wendorf and Reed's (1955) classification. Valdez phase sites fall into the Developmental period, which she dates between A.D. 750 and 1100. These dates are not those used by Wendorf and Reed, who date the period between A.D. 600 and 1200. Why she deviates from their dates is not clear from her discussions. Woosley (1980, 1986) consistently discusses Anasazi sites from the early Developmental period (A.D. 600-900; Wendorf and Reed 1955), although she never states the bases for assigning sites to these years. Further, a review of her dates for this and other periods shows them to be 50 to 100 years older than those used by other researchers in the region. For instance, in arguing for a Developmental-Coalition transition period, she ignores the fact that a transitional phase was already proposed by Herold (1968; his "Pottery Group 2"). Named the Pot Creek phase by Wetherington (1968), it has become an accepted part of the local phase sequence and represents the Coalition period between the Valdez and Talpa phases (Developmental and Classic periods). Because she argues for ending the Developmental period at 1100 instead of 1200, her transition period comes about 100 years earlier than accepted dates for the Pot Creek phase. Although her description of her transition period matches in some ways the Pot Creek-phase descriptions, differences are due to the fact that, by making her periods 100 years older than those used by other researchers, Woosley includes sites in her Developmental and transition periods that others would include in the Valdez phase.

We have seen that dating the Valdez phase has most commonly been tied to dating a mineral-painted ceramic ware known variously as Taos Black-on-white or Kwahe'e Black-on-white: Taos Variety. With the exception of Woosley, who provides no justification for her dates, differences in dating the Valdez phase are primarily based on opinions about the relationship of Taos to Kwahe'e, the dates for Kwahe'e, and whether Taos/Kwahe'e is really the earliest painted ware in the valley. These differences will not be resolved without petrographic analysis of sherds representative of the various wares (see Lent 1991; Hill 1994) and, more importantly, without chronometric dates for Valdez phase sites. Their resolution has important implications, however, since on them hang questions of the age of the phase and whether it represents an evolutionary development or an Anasazi immigration.

RESEARCH QUESTIONS

The primary objective of this study is to evaluate the chronology of the initial Anasazi occupation of north-central New Mexico, focusing on the Taos District. Accurate chronometric dating of the Valdez phase, representing the initial Anasazi occupation of the Northern Rio Grande region, is critical for understanding developments during and after the phase. It is also vital for dating contemporaneous Anasazi occupations of adjacent areas, particularly to the east and northeast. This evaluation is a process that involves the collection and analysis of samples appropriate to several different chronometric techniques: tree-ring dating (dendrochronology), archaeomagnetism, radiocarbon analysis, and obsidian hydration analysis. This chapter discusses the questions that guided our research and the procedures used to collect appropriate data. The study provides data necessary to address the following research questions:

1. What are the dates of the Valdez phase?

This includes beginning dates and dates showing the end of the phase and the transition to the succeeding Pot Creek phase. Resolution of this question is critical for securely determining whether the initial Anasazi occupation of the region was a gradual developmental process, as seen by Green and Woosley, or a process of colonizing a sociocultural frontier, as proposed by Boyer (1994b). Addressing the first research question requires chronometric dates from as many sites as possible. With these, we can build a body of dates showing when Valdez phase sites were occupied. Beginning dates for the phase can only be gleaned from such a body of dates. The same data can suggest end dates for the phase. End dates can also be defined by gathering dates for subsequent Pot Creek phase sites.

> a. **Tree-ring dating.** Because the research focuses on dating, we hoped to collect samples from previously excavated sites so as not to intrude upon otherwise undisturbed features and deposits. Loose (1974) states that samples from the UNM field school sites north of Valdez were submitted to the Laboratory of Tree-Ring Research but that dates were not available when she wrote her report. Robinson and Cameron (1991) do not list any of these sites as having tree-ring dates. Blumenschein (1956) implies that samples from her sites along the north rim of the Rio Hondo were submitted for dating, but the sites are not listed by Robinson and Cameron (1991).
>
> We hoped that correspondence with the Laboratory of Tree-Ring Research, University of Arizona, would reveal that undated samples are being curated by the laboratory. If undated samples were housed there, we would have at least some samples dated. A review of materials curated by Maxwell Museum of Anthropology, University of New Mexico, shows the museum curating wood samples from the field school sites. If the wood samples included tree-ring samples, we would submit at least some for dating. In addition, we made arrangements with Dr. Michael Adler, director of Southern Methodist University's Fort Burgwin Research Center field school, to allow us to submit several samples from Pot Creek Pueblo for tree-ring dating. Since the excavations at Pot Creek Pueblo have not focused on its Valdez phase component, these samples would likely be from the latest, Talpa phase, component at the site. However, they are necessary for

our study of variability in radiocarbon dates (research question 3a), as discussed below.

b. **Archaeomagnetic dating.** Collection of archaeomagnetic samples require that we have access to burned features, usually hearths found in structures. Since we did not want to disturb unexcavated deposits or features, we focused on previously excavated sites. Because of the history of excavation in the region, most such sites dating to the Valdez phase are related to the activities of the UNM field school north of the Rio Hondo (Loose 1974) and to the early activities of the Fort Burgwin Research Center in and near the Rio Grande del Rancho Valley south of Taos (Luebben 1968; Green 1976).

The locations of most of the UNM field school sites (Loose 1974) were incorrectly recorded, both with the Carson National Forest and with the New Mexico Historic Preservation Division's Archeological Records Management Section. I relocated the sites and recorded their locations on the USGS quadrangle. I also relocated Southern Methodist University (SMU) field school sites excavated by Luebben (1968) and Green (1976). We re-excavated pithouses at several Valdez phase sites, five UNM field school sites (LA 9201, 9204, 9206, 9207, and 9208) and one SMU field school site (TA-18), using a backhoe and hand tools to remove enough fill from backfilled pithouses to expose their hearths and portions of floors. Archaeomagnetic samples were collected and the fill returned. Loose (1974) states that archaeomagnetic samples were collected from the UNM field school sites but that analysis revealed that only one sample was adequate to produce a date (LA 9205). We secured the original archaeomagnetic data for reanalysis to determine if dates can now be produced.

In addition, we planned but were unable to collect an archaeomagnetic sample from the kiva at site TA-26, a Pot Creek phase site near Pot Creek Pueblo (Vickery 1969) currently being restored by the Carson National Forest. No chronometric dates are available from the site. If we had been able to obtain an archaeomagnetic date from TA-26, it would have added another to those Pot Creek phase sites whose dates can help establish the end of the Valdez phase and the transition to aggregated pueblo villages.

c. **Radiocarbon dating.** As I have discussed (Boyer 1994b), radiocarbon dating has yielded very mixed results with regard to the Valdez phase. Although charcoal samples are included in the UNM field school material at the Maxwell Museum, I focused my efforts in radiocarbon dating in keeping with research question 3a, as discussed below.

d. **Obsidian hydration dating.** Like radiocarbon dating, obsidian hydration analysis has yielded mixed results (Boyer 1994b). In large measure, this is the result of concern for and attempts to work with variation in ground temperature within a small part of the region. With that in mind, I focused my efforts in obsidian hydration analysis in keeping with research question 3b.

2. Are there significant differences in the timing of the formation of the two communities (was one formed earlier than the other)?

Valdez phase sites typically consist of a single pithouse and an associated, small, adobe or *jacal* surface structure. Two large Valdez phase "communities" consisting of dispersed sites have been defined in the Taos District (Boyer 1994a). One of these is in the southern part of the district and the other is in the northern part. It is important to remember that it was the north community sites that yielded sherds thought to be Red Mesa Black-on-white on the basis of curvilinear designs (Loose 1974). If they actually are Red Mesa sherds, the north community may be older than the south community. Consequently, obtaining accurate chronometric dates from north community sites is vital to establishing the dates of the phase (Question 1) as well as to understanding differences between the communities in formation and structure. If Boyer is correct in asserting that the region was an Anasazi frontier, this information will be very helpful in distinguishing and describing immigration conditions. We also do not know whether one community began the transition to aggregated Pueblo villages before the other. With a body of dates from both communities, we can begin to explore that transition as it occurred in both areas.

3. Can we isolate the cause(s) of chronometric discrepancies among techniques, which is critical for assessing the significance of dates obtained by different techniques?

a. Why has radiocarbon dating often yielded dates that are significantly older than dates obtained by other chronometric techniques? Factors may include

1. material contaminants that were not removed by normal laboratory processing;

2. the cultural context of the dated material. For instance, selection and/or use of different types of wood for different purposes (fire vs. construction, construction of roof vs. roof supports) by site residents could influence the type and suitability of material available for dating (Smiley 1985); and

3. the archaeological context of the dated material. For instance, charcoal from hearths or ash pits may be from the heart of a log, which is older than the outer growth more likely to have burned away (Smiley 1985).

Our efforts in radiocarbon dating focused on defining the factor(s) resulting in discrepancies between radiocarbon and other dates. Specifically, I used tree-ring samples from Pot Creek Pueblo to compare tree-ring and radiocarbon dates. After the samples were dated by the Laboratory of Tree-Ring Research, I submitted dated ring segments to Beta-Analytic, Inc. for dating. The results are compared with the tree-ring dates to assess the accuracy of the radiocarbon dates.

b. How much variation in ground temperature is present at sites throughout the region and how are obsidian hydration dates affected by this variation? Ridings's (1991) research suggests that there is potentially a great deal of variation in ground temperature and that use of inappropriate EHTs will produce spurious dates. Although Ridings's research is important for pointing out the potential for serious discrepancies resulting from inappropriate data, she does not address the issue of accuracy.

During this project, ground temperature cells were placed at several sites. Although the project does not include collection and analysis of obsidian hydration samples, accurate ground temperature data are critical for future obsidian hydration research. Ridings's (1991) research suggests considerable variation in ground temperature within a small portion of the Taos District. This variation results in significant variation in dates obtained through obsidian hydration analysis (Boyer 1994b). Resolution of this situation will rely on additional study of ground temperature variation, which is beyond the scope of the project. However, information gained from cells placed during this research will provide data necessary to structure future study.

4. Which of the chronometric techniques provide the greatest accuracy and precision for dating sites and intrasite features and deposits?

Although the Valdez phase was originally defined as being 200 to 300 years long (Wetherington 1968; Green 1976; see also Woosley 1986), other research suggests a time frame of about 100 years (Peckham and Reed 1963; Wolfman et al. 1965; Boyer 1994b; see also Dick 1965; Dick et al. 1966). This study promises an excellent opportunity to assess the utility of various chronometric techniques through cross-sample and cross-technique comparison. It should provide data applicable to a more rigorous study of comparative chronometry. This information is also important for subsequent phases, which are defined as shorter than the Valdez phase.

The issue of accuracy is tied to the answers of research questions 1 and 2. When we have established through chronometric means the dates of the Valdez phase, we can then compare new dates to assess their accuracy. Available chronometric dates strongly suggest that tree-ring and archaeomagnetic dates will provide the greatest precision, primarily because they provide the smallest ranges of time within which a sample could date. Radiocarbon and obsidian hydration dating have, thus far, provided dates that, even if they more closely matched those obtained from tree-rings and archaeomagnetism, have such long ranges that they cannot tell more than that an artifact or feature dated in or near a particular phase (Boyer 1994a). If the issues raised in research question 3 can be resolved, it may be possible to use radiocarbon and obsidian hydration dating when several samples are available from a single context because they can suggest periods when most of the samples could date, even if the individual date ranges are too long.

VALDEZ PHASE CHRONOMETRIC DATES

Introduction

As we have seen, there is considerable disagreement about the timing of the Valdez phase. Fortunately, however, there are fewer disagreements about the archaeological characteristics of the phase, particularly structural features and associated ceramic types. This is important if we are to evaluate the dating of the phase, because we must be able to agree on which sites we are to date. For the following discussion, I will focus on chronometric dates obtained from sites whose artifactual and architectural characteristics fit a normative model based on the results of survey and excavations (Boyer 1994a).

Tree-Ring Dates

Valdez Phase Sites

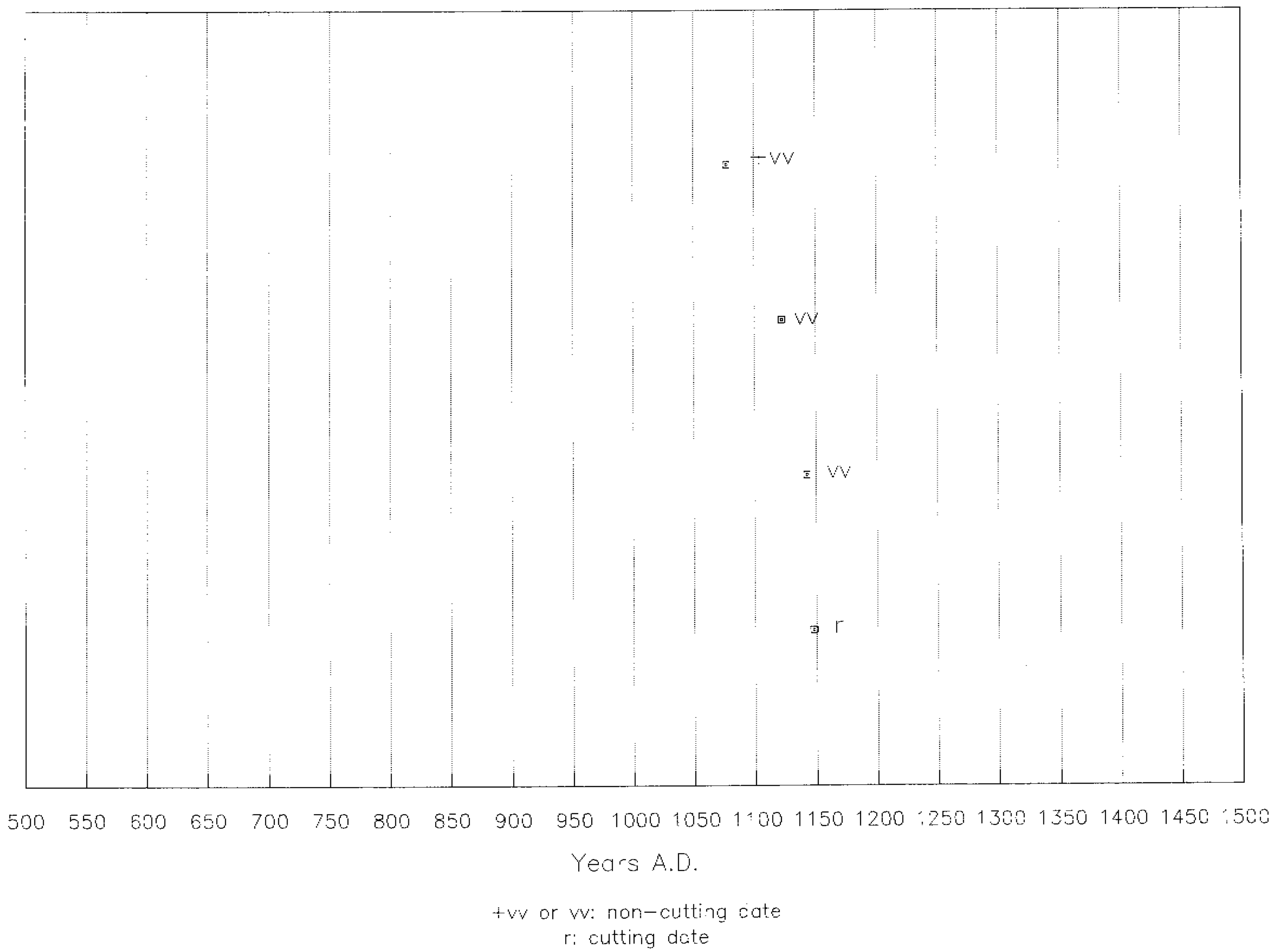
Three Valdez phase sites have yielded four tree-ring dates (Table 1). They include the pithouses at LA 2742 and TA-18 and one of the "kivas" at TA-47. One date from TA-47 is an "r" date, meaning that the last growth ring is present around a portion of the specimen's circumference. This may be a cutting date. Three dates are "vv" or "+vv" dates, indicating that the last growth ring is missing and it is not possible to estimate that number of missing rings or, therefore, years. These dates are older than the actual cutting date by an unknown number of years.

Table 1. Valdez Phase: Tree-Ring Samples

SITE	SAMPLE	DATE (A.D.)	REFERENCE
LA 2742	TNM-23	1122 vv	Boyer et al. 1994a
TA-47	RG-4382-1	1147 r	Robinson and Warren 1971
TA-47	RG-4381-2	1077 +vv	Robinson and Warren 1971
TA-18		1142 vv	Crown 1990

With the exception of the A.D. 1077+vv date, the samples fall tightly between A.D. 1120 and 1160 (Fig. 3). The A.D. 1077 date is earlier than the actual cutting date and the tree was likely cut near or after 1100. Interestingly, the difference between the 1077+vv date and 1147r date, both of which are from TA-47, is 70 years. In discussing these dates, William Robinson (pers. comm. 1995) told me that an informal observation of analysts at the Laboratory of Tree-Ring Research is that vv dates are often 70 to 100 years older than the cutting dates of the specimens. Were this the case with the +vv date from TA-47, the specimen's cutting date could be 1147, the same cutting date obtained from the other sample from the same site.

Figure 3. Valdez Phase: Tree Ring Dates



Together, available tree-ring dates from Valdez phase sites show construction of Valdez phase structures after 1100 and, for the most part, after 1120. Because only one date is a cutting date, tree-ring dates cannot suggest the end of Valdez phase construction in the same way that Crown (1991) postulates both beginning and ending construction dates at Pot Creek Pueblo.

Crown (1990:67) includes with Valdez phase dates two dates from Kiva 2 at Pot Creek Pueblo: 1122vv and 1154vv. She includes Kiva 2 with Valdez phase sites and features because it was found beneath room block "Unit 2." Wetherington (1968) includes it with the Pot Creek-phase component of Pot Creek Pueblo, but Crown is suspicious that the tree-ring dates may indicate that it was an earlier structure. Wetherington's (1968:43-44) description of Kiva 2 shows that it had features not common to Valdez phase pithouses, including a stepped subfloor feature identified as a "floor drum" and small horizontal "postholes" in the walls thought to be shelf supports. Crown does not dispute its description as a kiva, but suggests that it may show that kivas were in use in the Valdez phase. Although the structure of Valdez phase communities and community integration is the subject of discussion and on-going research (Adler 1993; Boyer and Urban 1995), no Valdez phase structures with these kinds of features had been examined at the time Crown made her decision to include the Pot Creek Kiva 2 dates. However, recent but as yet unreported excavations at LA 53683 on Blueberry Hill west of Taos have revealed a large subterranean structure with three subfloor "floor drum" or "vault" features, a subfloor channel leading from the ventilator to the vicinity of a sipapu on the west side, and an elaborate hearth-ashpit complex. This structure seems to represent a Valdez phase dedicated kiva rather than a pithouse used as a part-time ceremonial structure. The implications of this structure for understanding Valdez phase communities are beyond the scope of this report. Nonetheless, the structure suggests that Crown's opinion that Kiva 2 at Pot Creek Pueblo might have been a Valdez phase structure may be warranted.

Kiva 2 was found beneath the Talpa phase surface rooms in room block "Unit 2." Besides its architectural features and its location beneath the later rooms, Wetherington (1968:45) points to its "ceramic associations" as evidence for a Pot Creek-phase date. By this, he apparently refers to the ceramic types and frequencies recovered from the structure's fill. His data (Wetherington 1968:49) show that 64.7 percent of the decorated sherds recovered from the fill were Taos Black-on-white and 24.2 percent were Santa Fe Black-on-white. Interestingly, 8.8 percent were Talpa Black-on-white, the hallmark of the later Talpa phase. Among the varieties of Taos Gray, plain sherds made up 59.3 percent, corrugated sherds made up 37.1 percent, and incised sherds made up 3.4 percent. These figures contrast sharply with those from the Talpa phase rooms, from which Talpa Black-on-white comprised 39.9 percent, Santa Fe Black-on-white made up 29.0 percent, Taos Black-on-white made up 27.1 percent, Taos Gray plain comprised 43.6 percent, Taos Gray corrugated made up 27.3 percent, and Taos Gray incised made up only 0.8 percent. They suggest that Kiva 2 was filled (if not used and abandoned) near the transition from the Pot Creek to the Talpa phase. If we compare the Kiva 2 ceramic assemblage with that from Pithouse A at Pot Creek Pueblo, a small structure found below one of the supposed Pot Creek phase rooms associated with Kiva 2, we see that the contrast is not as striking as between Kiva 2 and the Talpa phase rooms. The decorated assemblage from Pithouse A was made up of 75.0 percent Taos Black-on-white, 19.3 percent Santa Fe Black-on-white, and 5.3 percent Talpa Black-on-white, while the Taos Gray assemblage included 68.5 percent plain sherds, 28.5 percent corrugated sherds, and only 3.1 percent incised sherds. Nonetheless, Wetherington (1968:45) assigns Pithouse A to the Valdez phase, even though its ceramic assemblage resembles that from Kiva 2 by including both Santa Fe and Talpa Black-on-white sherds, relatively many Taos Gray corrugated sherds, and very few Taos Gray incised sherds. Pithouse A should, using the ceramic figures, have also been filled (if not used and abandoned) near the Pot Creek-Talpa phase transition. Although the distinction between the Pot Creek and Talpa phase assemblages is clear, the distinction between the Kiva 2 and Pithouse A assemblages is not. Consequently, the dates from Kiva 2 are not included in the list of Valdez phase tree-ring dates in this report.

Pot Creek Phase Sites

We can use tree-ring dates from Pot Creek phase sites to check possible end dates for the Valdez phase. Tree-ring dates are available from three Pot Creek phase sites: Pot Creek Pueblo, PC-58, and LA 1892 (Jeançon's Llano Pueblo). As noted above, Kiva 2 at Pot Creek Pueblo yielded two beams that dated 1122vv and 1154vv. Since these dates are earlier than those from PC-58 and LA 1892, Crown (1990) suggests that Kiva 2 was constructed and used during the Valdez phase. At least two factors could account for these dates without assigning the structure to the Valdez phase. First, since both dates are vv dates, we cannot know how many rings are missing and, therefore, how much older the vv dates are than actual cutting dates. If, as William Robinson suggested, the difference may be 70 to 100 years, then the older specimen may have been cut between about 1192 and 1222, while the younger may have been cut between about 1224 and 1254. While these dates would place the older specimen within the commonly accepted cross-dates for the Valdez phase, the younger specimen would fall within accepted cross-dates for the Pot Creek phase (A.D. 1200-1250 [Wetherington 1968]). Although we cannot rely on these reconstructions because of the uncertainty of the actual differences between the last ring dates and actual cutting dates, they point out the potential for error associated with accepting the vv dates at face value.

The second factor that could be involved is the possibility of reuse of one or both beams. If the beams were cut for use in one or more Valdez phase structures and salvaged when those structures were abandoned, as seems to have been a common practice (Boyer 1994a), then older beams will be found in younger structures. If, in fact, this practice was as common as present archaeological evidence suggests, it casts some doubt on the use of tree-ring specimens to date the Valdez phase structures in which they are found. It may, on the other hand, support the use of tree-ring dates to date the Valdez phase, since the dates provide a "no-earlier-than" threshold for the phase. That is, while the individual structures from which specimens are collected may actually be younger than the tree-ring dates, the specimens themselves were probably not used before the tree-ring dates, even if they are not cutting dates.

During the course of this project, Dr. Michael Adler, director of SMU's Fort Burgwin Research Center archaeological field school, provided us with three specimens from a recently excavated kiva beneath room block 6 at Pot Creek Pueblo. These were submitted for tree-ring dating. One, a large juniper support post fragment, yielded a date of 1209vv. The others, smaller pine pieces that were probably latilla fragments, yielded dates of 1254+r and 1277vv. Interestingly, the hearth from this kiva yielded an archaeomagnetic sample that intersected the archaeomagnetic curve at the following dates: 930-1015, 1315-1355, and 1385-1435 (OAS sample PC959; J. Cox, pers. comm. 1995). The first date is probably much too old, unless the structure showed evidence of considerable remodeling, which it did not (M. Adler, pers. comm. 1995). The last date is after the abandonment of the pueblo (Crown 1991). Consequently, the hearth was apparently used in the first half of the 1300s, immediately prior to site abandonment. This suggests either stockpiling or reuse of beams (Crown 1991), particularly in the case of the latilla that yielded a cutting date.

PC-58 was probably excavated (partially) in 1953 by the Taos Archaeological Society (Blumenschein 1956). Robinson and Cameron (1991:18) list 29 tree-ring dates from the site,

A.D.	
119	2
120	9 9
121	6 8 9 9
122	2 9
123	0 3 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 6

Figure 4. Pot Creek phase: stem-and-leaf diagram of tree-ring dates from PC-58. Numbers in the left-hand column represent decades (A.D.). Numbers to the right of each decade represent individual tree-ring samples dating to the specific year. Cutting dates are underlined.

A.D.	
120	7 8
121	
122	8 9
123	3 5 9 9

Figure 5. Pot Creek phase: stem-and-leaf diagram of tree-ring dates from LA 1892. Numbers in the left-had column represent decades (A.D.). Numbers to the right of each decade represent individual tree-ring samples dating to the specific year. Cutting dates are underlined.

ranging between 1209 and 1239. Robinson and Warren (1971:44) show that 17 of these are probable cutting dates. Figure 4 shows a stem-and-leaf diagram of the tree-ring dates from PC-58. The cutting dates include one each at 1209, 1216, 1219, 1233, and 1236, and 11 at 1234. Two scenarios may be suggested. In the first, logs that had been cut prior to 1220 were either stockpiled or salvaged from another structure. Most construction took place in 1234, at which time the older logs were incorporated into the structure. The 1236 date may represent a remodeling episode. This scenario is supported by the fact that 23 of 29 beams (75.8 percent) were cut after A.D. 1220 and 21 (72.4 percent) were cut after 1225. In the second scenario, PC-58 had two construction episodes, the first dating prior to 1220 and the second dating to 1234. This scenario has the support of Blumenschein's (1956:55-56) description of the site:

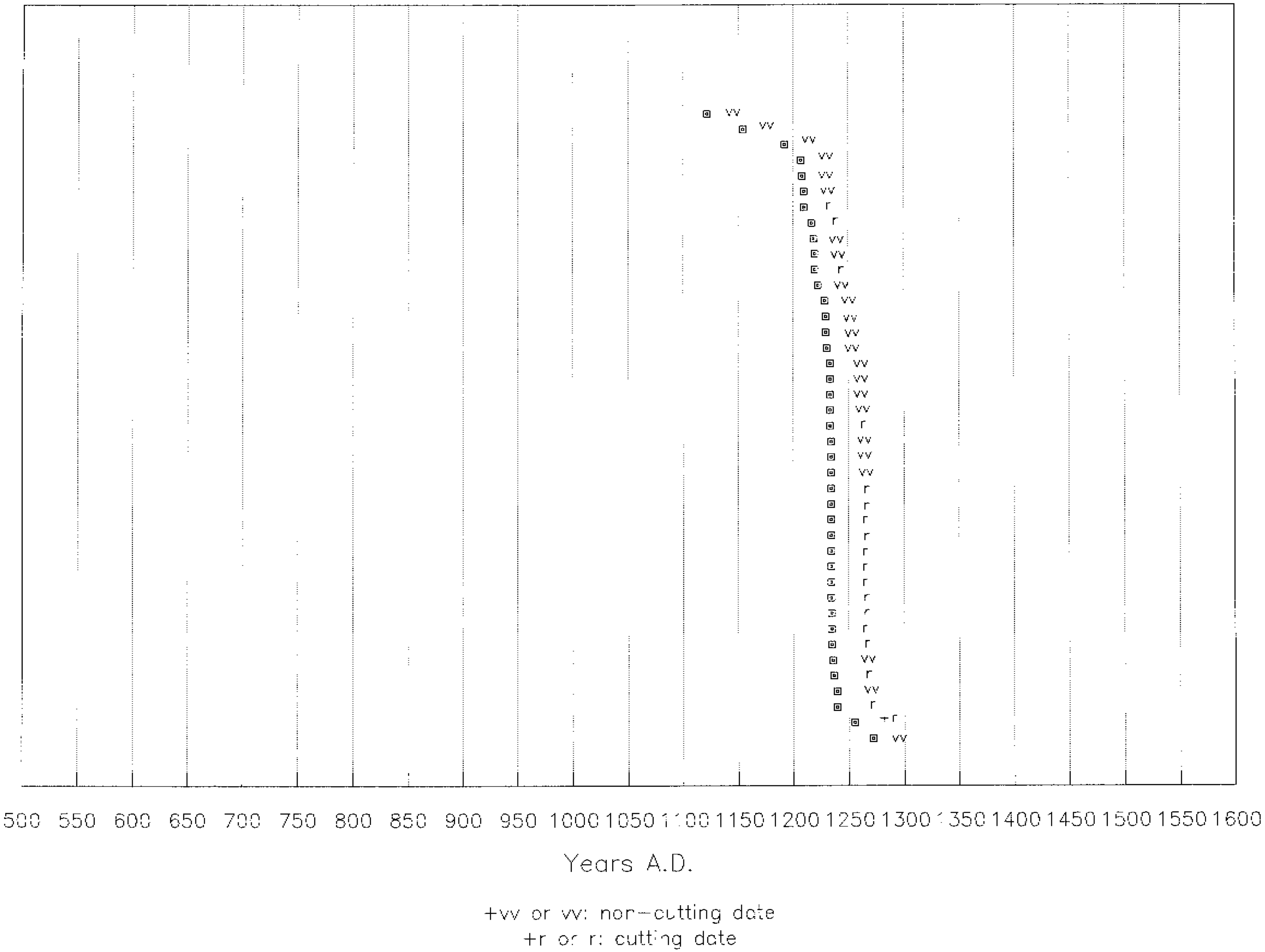
> One of these smaller units was trenched and partially excavated. Evidence pointed to a two story structure which had been burned, and a later two story structure built directly over it, not burned. Taos Black-on-white was the dominant pottery in the lower level, with Santa Fe Black-on-white showing an increasing percentage in the upper.

Her two "levels" may correspond to the two building episodes suggested by the tree-ring dates. If so, her pottery descriptions are interesting and may suggest that the site had a late Valdez phase occupation underlying a Pot Creek-phase component. In this case, the fact that 72 to 75 percent of the beams were cut after 1220 to 1225 may show that the earlier component was much smaller than the later or that it was less affected by excavations.

Smiley (1951) lists 18 tree-ring samples from LA 1892, from which he derived a date of 1194 to 1239. Smiley, Stubbs, and Bannister (1953) note, however, that there are duplicates in this number and that only eight dates are left after removing the duplicates. The dates include one each at 1207+, 1227, 1229, and 1235+, and two each at 1233 and 1239. Only one of the 1239 dates is a cutting date (Fig. 5). The dates might suggest building episodes in the late 1220s, about 1233, and in the late 1230s, episodes that appear to have come in five to six-year intervals. However, with only eight dates and only one cutting date, and without some correlation between collection locations and construction information, we cannot know how to interpret the construction of LA 1892. The possibilities of stockpiling and salvaging cannot be discounted. Jeançon's (1929:20-27) pottery descriptions, coming as they did before type names and descriptions were defined, are difficult to correlate with type descriptions, primarily because they do not include descriptions of paint type. However, he found incised, corrugated, and basket-impressed Taos Gray sherds and vessels and an examination of his photographs (Jeançon 1929:Plates 13-15) reveals what are probably both Taos and Santa Fe Black-on-white sherds and vessels. Together, these data indicate that the site falls in the Pot Creek phase.

Figure 6 shows the Pot Creek-phase tree-ring dates. With the exception of the two dates from Kiva 2 at Pot Creek Pueblo, the dates are concentrated between 1192 and 1274, with most falling between 1200 and 1250. Of 18 cutting dates, 17 (94.4 percent) are between 1200 and 1250 and the eighteenth is 1254. Fourteen of the 18 cutting dates (77.8 percent) are between 1225 and 1250. The pattern contrasts with Figure 3, which shows that the few tree-ring dates from Valdez phase sites fall before 1150. While the Pot Creek phase tree-ring dates come from only three sites, they indicate that the transition from the Valdez phase to the Pot Creek phase took place in the early 1200s.

Figure 6. Pot Creek Phase: Tree Ring Dates



Archaeomagnetic Dates

Unlike the paucity of tree-ring dates, archaeomagnetic samples have been collected and reported from 13 Valdez phase sites (Table 2). Most of these samples result from OAS investigations in the Taos Valley, as evidenced by the number of dates reported by Boyer and others (1994) and in this report. The samples first reported in this report with alpha-numeric sample numbers were collected during this project from sites previously excavated by the Taos Archaeological Society (LA 9201), the UNM field school (LA 9201, 9204, 9206, 9207, and 9208), and the SMU field school (TA-18). The samples first reported in this report with numeric sample numbers (161-168) were collected by Robert Dubois during excavation of the UNM field school sites in the 1960s. Loose (1974) reported one archaeomagnetic date from LA 9205, but no other dates have been reported from Dubois's samples, although Dubois apparently determined dates for two samples (Table 2). J. Cox has determined archaeomagnetic dates for four of Dubois's samples using OAS's Southwest Polar Curve. Dates are also reported from two other sites excavated by the SMU field school: TA-34 (Cordell 1978; Crown 1990) and the Cerrita site (Woosley 1986).

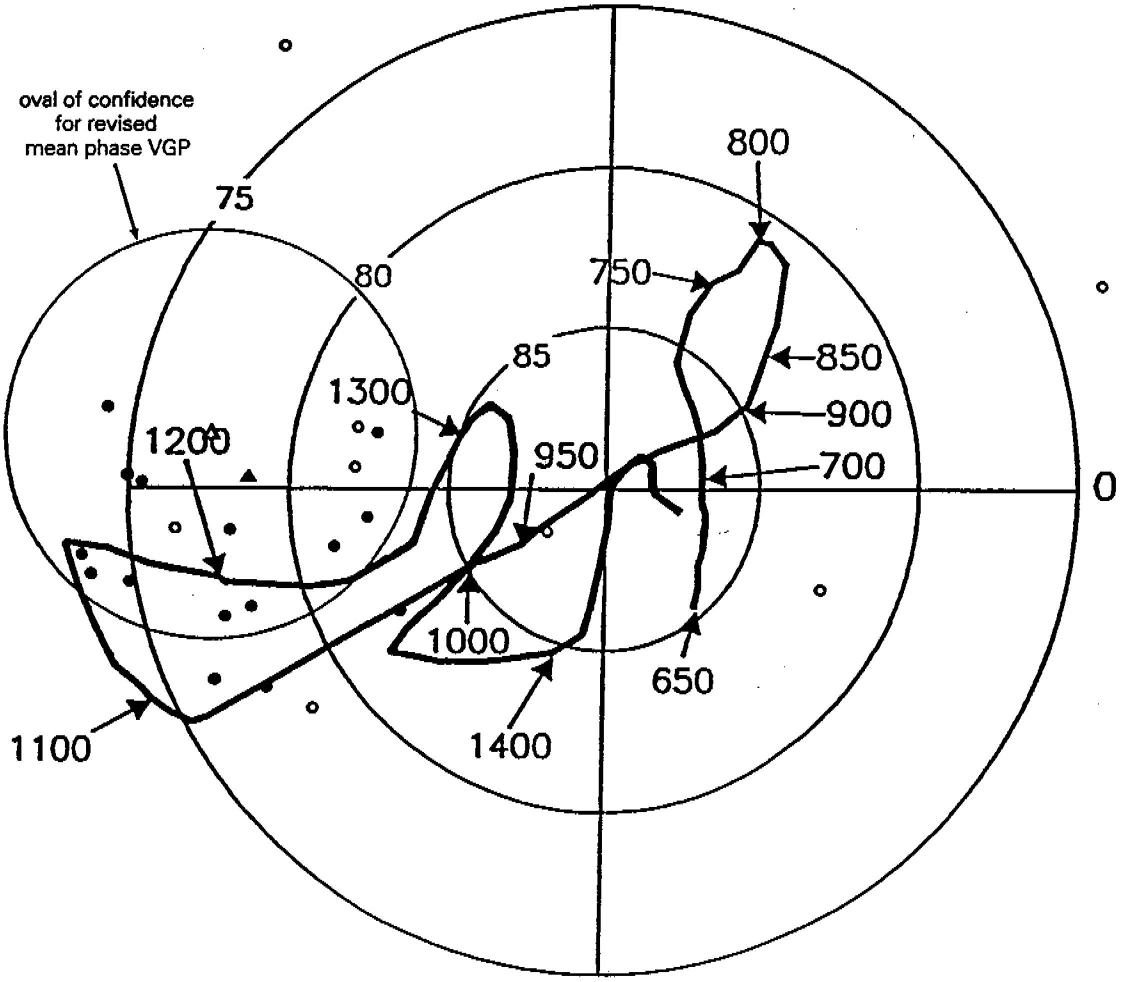
These samples have yielded 26 dates, spanning the years between A.D. 945 and 1410. Following Eighmy and McGuire (1988), the dates are combined into a "phase-group," from which mean archaeomagnetic dates for the Valdez phase can be derived by two methods: calculating a mean VGP (virtual geomagnetic pole) location and averaging the individual sample dates.

Mean VGP Location

Table 2 shows that VGP longitude and latitude values have been reported for 24 of the 26 samples. Mean longitude and latitude values for the 24 samples were calculated (Table 3), resulting in a mean VGP location for the Valdez phase samples. This location is plotted on Figure 7, which also shows the VGP locations of the other archaeomagnetic samples for which these data are available. This mean phase VGP location reflects the VGP values of all reported samples. However, Eighmy and McGuire (1988:20) assert that it is necessary to check for "locational outliers," samples whose VGP values diverge from the other samples "for reasons which do not reflect the ancient field at the time of firing." Inclusion of outliers can result in "a bad estimate" of the true mean VGP location. Outliers are samples that fall at least three standard deviations from the mean of the other phase samples. Eighmy and McGuire describe their method of defining outliers as follows:

> When a suspected outlier was encountered in a set of samples for a phase, it was tentatively removed from the set. A new mean and variance were calculated. If the suspected outlier fell three standard deviations or more away from the mean, then it was declared an outlier and removed from further consideration. (Eighmy and McGuire 1988:20)

Inspection of Figure 7 and Table 2 in light of Eighmy and McGuire's definition shows three samples that may be outliers: sample LC917 from site LA 9206, sample LC919 from LA 9207, and sample 163 from LA 9208. Table 4 shows the mean VGP locations and standard deviations after removing sample LC917 from the set. It also shows the ranges of values at three standard deviations from the mean. Comparison of LC917's VGP values with the three-standard-deviation ranges shows that the sample falls within three standard deviations and is not an outlier. Table 5 shows the means and standard deviations after removing sample LC919 from the set. Comparison with LC919's VGP values



Southwest Polar Curve A.D. 650 - ca. 1450
with the VGP's for Valdez Phase sites

● VGP for samples with acceptable α95 values and ovals of confidence

○ VGP for samples with unacceptable α95 values and no ovals of confidence

▲ mean phase VGP, all samples

△ revised mean phase VGP, samples with acceptable α95 values

Figure 7. Southwest polar curve with VGPs for Valdez phase sites.

Table 2. Valdez Phase: Archaeomagnetic Samples

SAMPLE NO.	SITE	FEATURE	INC.	DEC.	VGP LAT.	VGP LONG	α_{95}	δ_p	δ_m	N	DEM AG	EST. DATE (A.D.)	AM DATE (A.D.)	COL.	REFERENCE
VA1058	LA 9201.3	Pithouse 3, hearth	60.7	353.0	82.5	209.9	3.3	3.8	5.0	8/8	150	1100-1225	945-1065 1195-1295 1325-1410	JC	This report
EG920	TA-18	Pithouse C, hearth	58.1	351.1	82.5	186.6	2.6	2.8	3.8	8/8	300	1100-1225	965-1055 1215-1290 1330-1400	IT	This report
LC1023	LA 9208	Pithouse, hearth	63.2	348.0	77.7	210.1	0.7	0.9	1.1	8/7	200	1100-1225	1050-1075	JC	This report
163	LA 9208	Pithouse, hearth?	56.5	9.4	82.4	23.9	4.6	4.8	11.1	NA	150	900-1000	No date	RD	This report
168	LA 9208	Pithouse, hearth?	59.2	343.5	76.5	174.6	5.5	6.2	8.3	NA	150	950-1000	No date	RD	This report
167	LA 9206?	Pithouse, hearth?	63.2	345.3	76.1	154.0	2.8	3.4	4.4	NA	NRM	950-1050	1100 (Dubois) 1050-1130 (OAS) 1100-1250 (OAS)	RD	This report
LC1022	LA 9206	Pithouse, burnt floor, south side	60.3	339.6	73.5	187.3	0.8	0.9	1.1	8/8	300	1100-1225	1135-1175	DW, IT	This report
LC917	LA 9206	Pithouse, hearth	68.9	350.0	72.8	233.4	12.0	17.3	20.4	8/7	200	1100-1225	No date	JC, IT	This report
NA	Cerrita	Pithouse, lower hearth	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1050-1150	NA	Woosley 1986
166	LA 9205	Surface hearth	55.0	357.3	87.7	146.5	6.5	6.5	9.2	NA	NRM	NA	1095-1145	RD	Loose 1974
VA1055	LA 9201.1	Pithouse 1, hearth floor	61.2	341.8	74.8	192.1	2.7	3.2	4.2	8/8	50	1100-1225	1095-1220	IT, JC	This report
165	LA 9204?	Pithouse, hearth?	58.1	341.8	75.4	179.4	3.9	4.3	5.8	NA	NRM	975-1025	1140 (Dubois) 1100-1230 (OAS)	RD	This report
LC918	LA 9204	Pithouse, hearth	59.5	350.7	81.8	194.4	5.5	6.2	8.2	8/7	NRM	1100-1225	No date	JC, IT	This report
164	LA 9204	Pithouse, hearth?	61.3	351.3	80.9	150.4	7.2	8.6	11.1	NA	NRM	1050-?	No date	RD	This report
VA1056	LA 9201.5	Pithouse 5, hearth wall	58.1	341.3	75.0	178.8	3.5	3.8	5.2	8/8	200	1100-1225	1105-1220	IT	This report
161	LA? (Lobo Creek)	Pithouse, hearth?	55.9	340.4	74.2	170.8	4.1	4.2	5.9	NA	NRM	1000-1150	1115-1210 (OAS)	RD	This report
PC509	LA 70577	Pithouse, Feat. 5, hearth	NA	NA	73.7	189.3	1.2	1.4	1.9	9/8	400	1100-1225	1125-1190	DW	Boyer et al. 1994a

SAMPLE NO.	SITE	FEATURE	INC.	DEC.	VGP LAT.	VGP LONG	α_{95}	δ_p	δ_m	N	DEM AG	EST. DATE (A.D.)	AM DATE (A.D.)	COL.	REFERENCE
NA	TA-34	Pithouse, hearth?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1170-1210	NA	Cordell 1978 Crown 1990
PC537	LA 2742	Pithouse, Feat. 3, hearth 1	NA	NA	77.6	199.1	1.4	1.7	2.2	8/8	50	1100-1225	1170-1230	AM, VL	Boyer et al. 1994a
PC663	LA 2742	Pithouse, Feat. 3, hearth 2	NA	NA	78.1	185.8	1.5	1.7	2.2	8/7	200	1100-1225	1170-1230	AM, VL	Boyer et al. 1994a
PC609	LA 2742	Pithouse, Feat. 3, hearth 3	NA	NA	78.4	195.9	2.5	2.9	3.8	8/8	NRM	1100-1225	1175-1245	AM, VL	Boyer et al. 1994a
Avg. of PC537, PC663, PC609	LA 2742	Pithouse, Feat. 3, hearth	NA	NA	78.1	193.9	1.0	1.2	1.6	24/23	NA	1100-1225	1195-1210	AM, VL	Boyer et al. 1994a
PC510	LA 2742	Pithouse fill, stratum 5a	NA	NA	81.9	185.4	6.0	6.5	8.8	8/8	NRM	1100-1225	No date	AM, VL	Boyer et al. 1994a
VA1057	LA 9201.2	Pithouse 2, hearth	59.4	349.8	81.3	191.9	1.7	1.9	2.8	8/8	100	1100-1225	1205-1265	IT	This report
BL1068	LA 53678	Structure, Feat. 6, floor 1, hearth	55.8	350.6	82.5	166.7	3.6	3.7	5.2	7/7	500	1100-1225	1230-1355	JC	This report
LC919	LA 9207	Pithouse, hearth	56.4	16.4	76.9	337.6	13.9	14.5	20.0	5/5	NRM	1100-1225	No date	IT	This report

Table 3. Valdez Phase Archaeomagnetic Samples: Means and Standard Deviations of VGP Longitudes and Latitudes, All Reported Samples

	LONGITUDE	LATITUDE
No. of samples	24	24
Range of values	23.9-337.6	72.8-87.7
Mean	182.02	78.68
Standard deviation	50.48	3.89
Standard deviation range	131.54-232.50	74.79-82.57

Table 4. Valdez Phase Archaeomagnetic Samples: Means and Standard Deviations of VGP Longitudes and Latitudes, Excluding Sample LC917

	LONGITUDE	LATITUDE
Mean	179.78	78.94
Standard deviation	50.39	3.78
Three standard deviation range	28.61-330.95	67.60-90.28

Table 5. Valdez Phase Archaeomagnetic Samples: Means and Standard Deviations of VGP Longitudes and Latitudes, Excluding Sample LC919

	LONGITUDE	LATITUDE
Mean	175.25	78.76
Standard deviation	39.51	3.96
Three standard deviation range	56.72-293.78	66.88-90.64

Table 6. Valdez Phase Archaeomagnetic Samples: Means and Standard Deviations of VGP Longitudes and Latitudes, Excluding Sample 163

	LONGITUDE	LATITUDE
Mean	182.13	78.36
Standard deviation	23.31	3.78
Three standard deviation range	112.20-252.06	67.02-89.70

Table 7. Valdez Phase Archaeomagnetic Samples: Means and Standard Deviations of VGP Longitudes and Latitudes, Excluding Samples with alpha-95 Values Greater Than 5.0 and Probable Outliers

	LONGITUDE	LATITUDE
No. of samples	15	15
Range of values	154.0-210.1	73.5-82.5
Mean	186.51	77.55
Standard deviation	14.66	3.18
Standard deviation range	171.85-201.17	74.37-80.73
Two standard deviation range	157.19-215.83	71.19-83.91

shows that its longitude value exceeds the three-standard-deviation range. Using this method, LC919 is an outlier sample and is removed from further consideration. Table 6 shows the means and standard deviations after removing sample 163 from the set. Comparison of 163's VGP values shows that its longitude value is outside the three-standard-deviation range. Sample 163 is also an outlier and is removed from further consideration.

Recent examinations of outliers in statistical data have suggested that defining outliers is a process laden with assumptions (Rudy King, pers. comm. 1998). Among those are concepts of rejection, accommodation, and identification of "anomalous values" (see Barnett and Lewis [1994] for an exhaustive discussion of outliers and their appropriate treatment). In order to deal with statistical values that "appear" anonymous, a stronger approach involves the use of robust estimators that accommodate all data values. Among those are the sample median and values termed m-estimators (see Barnett and Lewis [1994] for definitions). Using the VGP latitude and longitude values in Table 2, Rudy King, Rocky Mountain Research Station biostatistician, calculated median and Huber's M-estimator values. The sample median for VGP latitude is 77.90, while the median for VGP longitude is 186.95. The similarities between the median and m-estimator values indicate that they have adequately adjusted for "outlier" values (Rudy King, pers. comm. 1998). Interestingly, the median and m-estimator values are also very similar to the mean values calculated by removing the outlier samples (Table 7). This indicates that the method of defining and removing outliers, while perhaps less than ideal in its robustness, yielded, in this case, results that are adequate for determining a mean VGP location for the Valdez phase samples (Rudy King, pers. comm. 1998). Consequently, I have elected not to discard or change the mean VGP values presented in Table 7.

In addition to its VGP location, a sample has another factor that is critical for deriving a date, its alpha-95 value. The alpha-95 value represents the degree of clustering of the directions of the cubes around the mean direction of the sample. Smaller values reflect tighter clustering about the mean. Samples with alpha-95 values greater than 5 cannot reliably yield chronometric dates because the dispersion of directional values is too great. This is seen in Table 2, in which samples with alpha-95 values greater than 5 do not have AM (archaeomagnetic) dates. Figure 7 shows the VGP locations of these samples represented by a different symbol than the samples with acceptable alpha-95 values (less than 5). Since the samples with unacceptable alpha-95 values will not yield accurate dates, they were also removed from the mean VGP data set. Table 7 shows the means and standard deviations of the VGP longitudes and latitudes after removing outlier samples and samples with unacceptable alpha-95 values. This revised mean phase VGP location is also plotted in Figure 7. Two-standard-deviation ranges for the mean longitude and latitude were calculated. Those ranges are shown in Figure 7 as a circle surrounding the revised mean phase VGP. The circle, which represents a 95-percent "oval" of confidence surrounding the mean, intersects the polar curve between about A.D. 1135 and 1250. If I use Dan Wolfman's method (J. Cox, pers. comm. 1995) of adjusting the circle's location so that the mean VGP location rests on the curve, the circle intersects the curve between about 1015 and 1265 and again between about 1355 and 1370. Thus, depending on the method by which we correlate the mean phase VGP and its surrounding "oval" (circle) of confidence with the polar curve, we obtain mean VGP dates for the phase of A.D. 1135 to 1260, 1015 to 1265, or 1355 to 1370. With regard to these dates, Eighmy and McGuire state:

> This method produces what we consider to be precise and accurate estimates of the mean phase locations, but caution should be used in extrapolating dates by visual inspection of the proximity of the mean location and the curve. Because of the vagaries in [definition of the polar curve], precise absolute dates for the means by visual inspection might be in error. (Eighmy and McGuire 1988:44)

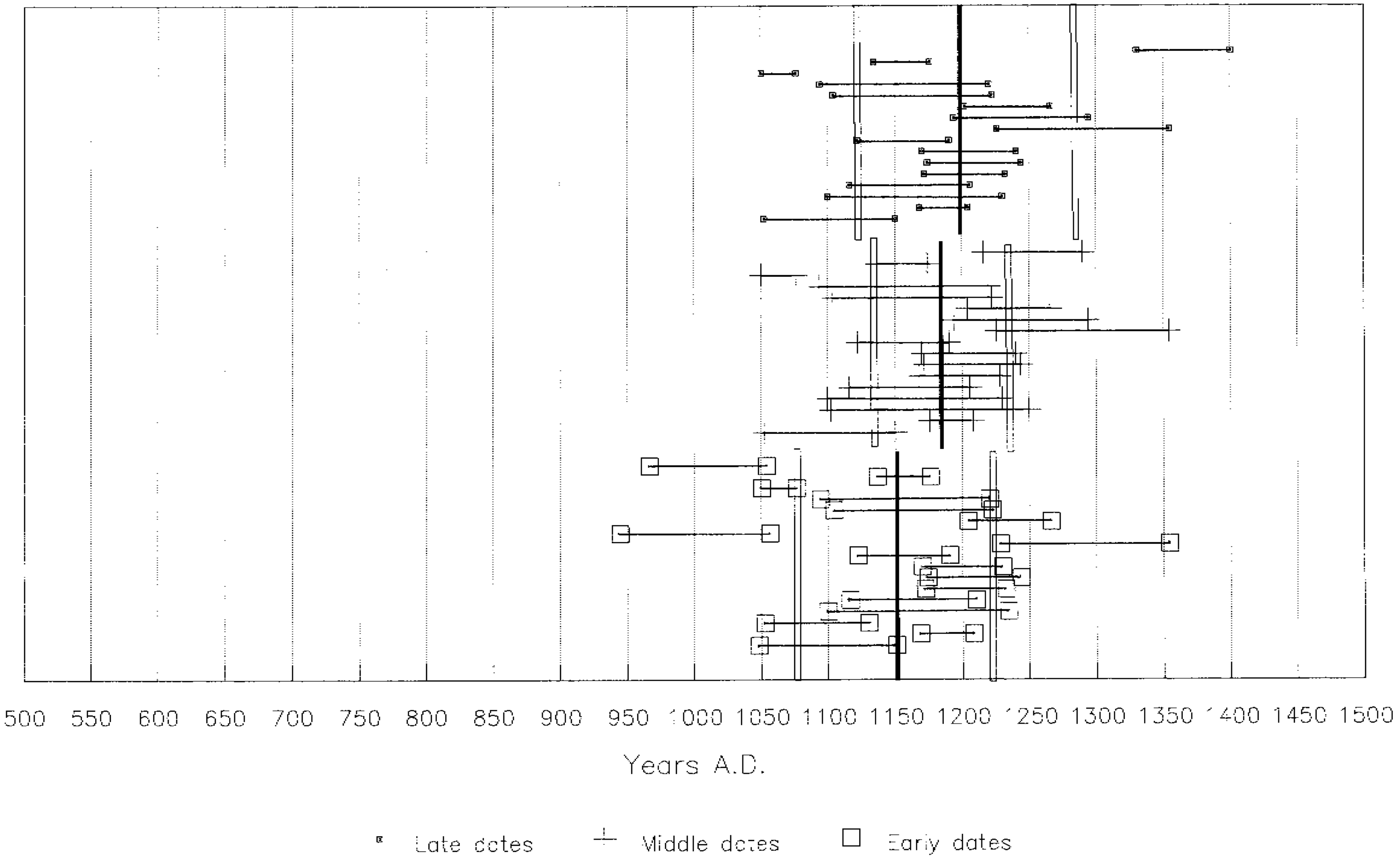
Individual Sample Dating

The imprecision of the mean VGP method to obtain actual dates may have led Eighmy and McGuire (1988:44) to use the second method: "The second dating method, dating each sample separately and then averaging the results for each phase and transition, should be able to average out variability in the calibration of the curve and to produce an accurate estimate of the phase mean age. . ."

They go on to observe that archaeomagnetic samples sometimes yield multiple dates. This happens when a sample's oval of confidence intersects the curve at one of the locations where the curve loops back on itself (Fig. 7). To deal with this, they calculated different means of the dates: "When two dating options existed, the option falling on the early side of the loop would be included in the early mean and those falling on the late side of the loop would be included in the late mean" (Eighmy and McGuire 1988:46-47). Single-option dates are included in both means. Inspection of Table 2 shows that three samples yielded multiple dates. Two yielded three dates (samples EG920 and VA1058) and one yielded two dates (sample 167). Following Eighmy and McGuire, we calculated three means: early dates, middle dates, and late dates. Table 8 shows the early, middle, and late mean dates and standard deviations. Figure 8 shows the distributions of individual sample dates about the group means and standard deviation ranges. It also shows that, for each group of dates, there are several outlier dates, dates that fall entirely outside the single-standard-deviation date ranges. In order to check the possible effects of these outliers on the means, they were removed from the data sets and the means and standard deviations were recalculated. The revised figures are shown in Table 9. The span of mean dates shown in Table 8 is A.D. 1076.41 to 1279.46; the three ranges overlap between 1118.36 and 1224.17. The span of revised mean dates in Table 9 is 1120.16 to 1260.91; the ranges overlap between 1132.67 and 1210.22. These results are expectable since removal of the outliers should serve to narrow the ranges of dates. None of the outliers fall outside two standard deviations from the means. Consequently, if I am to rely on a the highest level of confidence, I must use the dates shown in Table 8.

In their study, Eighmy and McGuire (1988:46, 48) recommend selecting "preferred" mean values in those instances where multiple sample dates produce multiple means. They do not, however, specify how the preferred values are selected. Using the tree-ring dates discussed above, the mean archaeomagnetic dates can be compared with the tree-ring dating conclusions that Valdez phase construction seems to have taken place after 1100 to 1120 and that the transition to the Pot Creek phase happened in the early 1200s. We see that the mean archaeomagnetic overlap range of 1118.36 to 1224.17 seems to best match the conclusions from the tree-ring dates. However, I must acknowledge that one sample, LC1023 from LA 9208 (Table 2) clearly dates before 1100 and has no other alternative dates. Taking that sample, which dates between 1050 and 1075, into account, the early mean date range, 1076.41 to 1224.17, seems to be the most appropriate mean archaeomagnetic date range for the Valdez phase. I must also note that sample BL1068, from site LA 53678, dates between 1230 and 1355 and is much younger than the "preferred" mean archaeomagnetic date range. (Note that this is also much younger than the date for the same sample presented by Bullock [1999]. The data presented in Table 2, including the sample date, were provided by Jeffrey Cox, who collected and analyzed the sample). Jeffrey Cox (pers. comm. 1996), director of OAS's Archaeomagnetic Dating Laboratory, states that the hearth from which the LA 53678 sample was collected was badly cracked prior to collection and probably prior to excavation. This could have resulted in shifting of parts of the hearth. During the demagnetization process, the alpha-95 value and the VGP location of the sample would not stabilize and the VGP location presented in Table 2 and Figure 7 is a "best guess" location. These data suggest that the sample date may not be reliable and is probably anomalous (J. Cox, pers. comm. 1996). Therefore, while I may select a preferred mean date range that accommodates the pre-1100 date from LA 9208, I am not obliged to accommodate the post-1225 date from LA 53678.

Figure 8. Valdez Phase Archaeomagnetic Dates: Distribution of sample dates about group means and standard deviations.



Solid vertical line: group mean
Open vertical line: 1 standard deviation

Table 8. Valdez Phase Archaeomagnetic Dates: Means and Standard Deviations

	EARLY DATES	MIDDLE DATES	LATE DATES
No. of dates	17	17	16
Mean date (A.D.)	1150.29	1183.68	1198.91
Standard deviation	73.88	53.93	80.55
Date range (A.D.)	1076.41-1224.17	1129.75-1237.61	1118.36-1279.46

Table 9. Valdez Phase Archaeomagnetic Dates: Revised Means and Standard Deviations

	EARLY DATES	MIDDLE DATES	LATE DATES
No. of dates	14	16	14
Mean date (A.D.)	1165.19	1191.25	1196.79
Standard deviation	45.03	45.99	64.12
Date range (A.D.)	1120.16-1210.22	1145.26-1237.24	1132.67-1260.91

Discussion

As noted earlier in Research Questions, I focus my attempts to derive chronometric dates for the Valdez phase on tree-ring and archaeomagnetic dates. One reason is that both radiocarbon and obsidian hydration dating techniques, which have also been used at Valdez phase sites, have produced mixed results. Consequently, radiocarbon and obsidian hydration dates are presented later in "Chronometric Discrepancies." Another reason is that, by focusing my attempts here on tree-ring and archaeomagnetic dates, I am better able to control for the context of the "event" being dated. That is, ideally at least, tree-ring dates should be associated with construction episodes and archaeomagnetic dates should be associated with the last firing of the feature from which the samples are collected. Obviously, there are potential problems with these techniques and their samples, such as stockpiling and reuse of wooden beams and alteration, and re-firing of hearths, that can skew their results. I have discussed some of the possible effects of those problems. Given those possible problems, the results of tree-ring and archaeomagnetic dating are relatively consistent. As I will discuss in Chronometric Discrepancies, inability to consistently and accurately associate radiocarbon and obsidian samples with the events we wish to date may be a significant cause of the mixed results obtained from these techniques.

Tree-ring dates from Valdez phase sites, although an admittedly small data set, point to pithouse (and kiva?) construction after A.D. 1100 and, for the most part, after 1120. Tree-ring dates from Pot Creek phase sites, although also a small data set, point to a transition to the Pot Creek phase in the early thirteenth century, perhaps by about 1225. Archaeomagnetic dates obtained from calculation of a mean phase VGP location are A.D. 1015 to 1265, 1135 to 1260, or 1355 to 1370. Eighmy and McGuire (1988) caution against relying on absolute dates obtained from this technique. However, it is interesting to note that the middle range, A.D. 1135 to 1260, resembles the tree-ring date range, although extending further into the thirteenth century. Finally, three ranges of archaeomagnetic dates obtained by averaging individual sample dates span the years between A.D. 1076 and 1279. Since I do not necessarily know which of the three ranges is most accurate, I could posit the period within which they overlap as the most likely years for the phase. That period is A.D. 1118 to 1224, a time span that is very similar to that obtained from tree-ring dating. Were I to rely on the available tree-ring dates and on mean archaeomagnetic phase dating, I could state that the Valdez phase dated between about A.D. 1120 and 1225. Tree-ring dates from Pot Creek phase sites indicate that extending the Valdez phase to the mid-thirteenth century, as indicated by the middle mean VGP range, is unwarranted and reflects the inaccuracy of that method.

As discussed earlier, I must acknowledge the presence of one archaeomagnetic sample with a clear pre-1100 date. While that date is included in the calculation of the early, middle, and late mean archaeomagnetic date ranges (Table 8), its presence is not reflected in the overlap period of those three ranges. Earlier, I argued that I must account for that date in selecting a preferred archaeomagnetic date range for the phase. Doing so, I selected the early mean range, A.D. 1076.41 to 1224.17, but did not assess the effect of this selection on the tree-ring dates. Use of a rounded version of this range, 1075 to 1225, can accommodate both the early archaeomagnetic date and the 1077vv tree-ring date. This seems a preferable alternative since, although I argued earlier that the 1077vv date could have come from a tree cut up to 100 years later, I do not actually know when the tree was cut, only that it was sometime after 1077. I should, then, take into account the possibility that the sample's cutting date could have been only a few years after 1077 and well before 1100.

Based on available tree-ring and archaeomagnetic dates and on the considerations taken here, I could argue that the best dates for the Valdez phase are A.D. 1075 to 1225. This period begins about 25 years later than the time postulated by Crown (1990) and about 25 years earlier than the time I postulated (Boyer 1994a). My (Boyer 1994a) beginning date of 1100 is clearly too late, based on the archaeomagnetic date from LA 9208. Crown's (1990) beginning date of 1050 is not too early, on the other hand, based on the same archaeomagnetic date. There is a 95 percent chance that the sample dates between 1050 and 1075 and, therefore, that it could date at 1075, the beginning of the date range obtained by averaging the individual early archaeomagnetic dates. If, on the other hand, the sample's actual date of last firing was earlier, 1075 is too late and Crown's 1050 date is more reasonable. Support for this argument is found in the site itself. The archaeomagnetic date reflects the last firing of the pithouse hearth at LA 9208. If that happened in the same year that the Valdez phase began, then the pithouse was occupied for a year or less. Loose's (1974) description of the site does not, however, suggest that this was the case. The pithouse at LA 9208, which was incompletely excavated in 1967, was rectangular and deep, about 2.9 m below modern ground surface. Excavation seems to have been limited to finding the walls and the hearth. Loose (1974:20) states that the pithouse was burned, a condition that our re-excavation for this project seemed to support. Although we did not record the stratigraphy of the unexcavated fill surrounding the center of the pithouse above the hearth, we observed lenses of ashy soil and encountered at least one burned beam fragment. Boyer (1995) has suggested that among excavated pithouses, those whose fill represents collapsed structural remains are relatively rare, are associated with different structural treatment during use and abandonment, and may have been "integrative" structures within communities. None of this can be confirmed at LA 9208 without further excavation, but if LA 9208 were such a site, then it would not likely have been occupied for a very short period of time. Therefore, even if the last firing of the hearth occurred in 1075, the pithouse was likely occupied for at least several years before that time. Since I cannot know exactly when during the A.D. 1050 to 1075 range the LA 9208 hearth was last fired, it seems reasonable to acknowledge the entire range of the LA 9208 date.

Taking all these factors into consideration, I suggest that the best dates for the Valdez phase, the period of initial Anasazi occupation of the Taos District, are A.D. 1050 to 1225. These dates are the same as those proposed by Crown (1990). Note that I am at this point willing to push the date earlier than 1075 on the basis of the LA 9208 date. There are no tree-ring or archaeomagnetic dates that support a beginning date earlier than 1050. This contradicts Wetherington's (1968) widely accepted beginning date of 1000, for which, I observed earlier, there was no obvious reason when he proposed the date. It contradicts Loose's (1974) argument that at least some of the Lobo Creek sites were occupied in the ninth and tenth centuries and Green's (1976) contention that the phase began in the early tenth century. Finally, it contradicts Woosley's (1986) assignment of Valdez phase sites to the early Developmental period, whether we use Wendorf and Reed's (1955; A.D. 600-1200) or Woosley's (1986; A.D. 750-1100) dates for that period. The ending date of the phase is subject to less contention, with the exception of Woosley (1986), whose unsupported dates are earlier than either previously accepted dates for the Developmental period and the Valdez phase or available tree-ring and archaeomagnetic dates.

Finally, I observe in the distribution of tree-ring and archaeomagnetic dates that, while I begin the phase at 1050, most of the dates are in the 1100s. Figure 9 shows the ranges of the early, middle, and late archaeomagnetic dates and the frequencies of individual date midpoints. What is clear is that whether I use the early, middle, or late dates, 76 to 88 percent of the date midpoints are after 1100 and 53 to 59 percent are between 1150 and 1200. Figure 10 shows the frequency of dated archaeomagnetic samples that could date to each 10-year period between A.D. 500 and 1500, expressed as a percent of the total number of dated samples. Only 25 percent of the samples could date before 1100 and less than 32 percent could date after 1220, while the largest frequency (56 percent) could date between 1120 and 1210. This peak in the twelfth century could support a post-1100 date for the phase, except for the small peak in the late 1000s. The small peak between A.D. 1050 and 1080 is largely the result of the LA 9208 date and probably reflects the earliest Anasazi occupation of the district, while the major peak between 1100 and 1220 points out that most of the sites date to the twelfth century. I argue that these figures show that the initial Anasazi movement into the district took place in the last half of the eleventh century and that the numerous twelfth century dates represent increased immigration, internal population growth, and significant population movement within the district during that century.

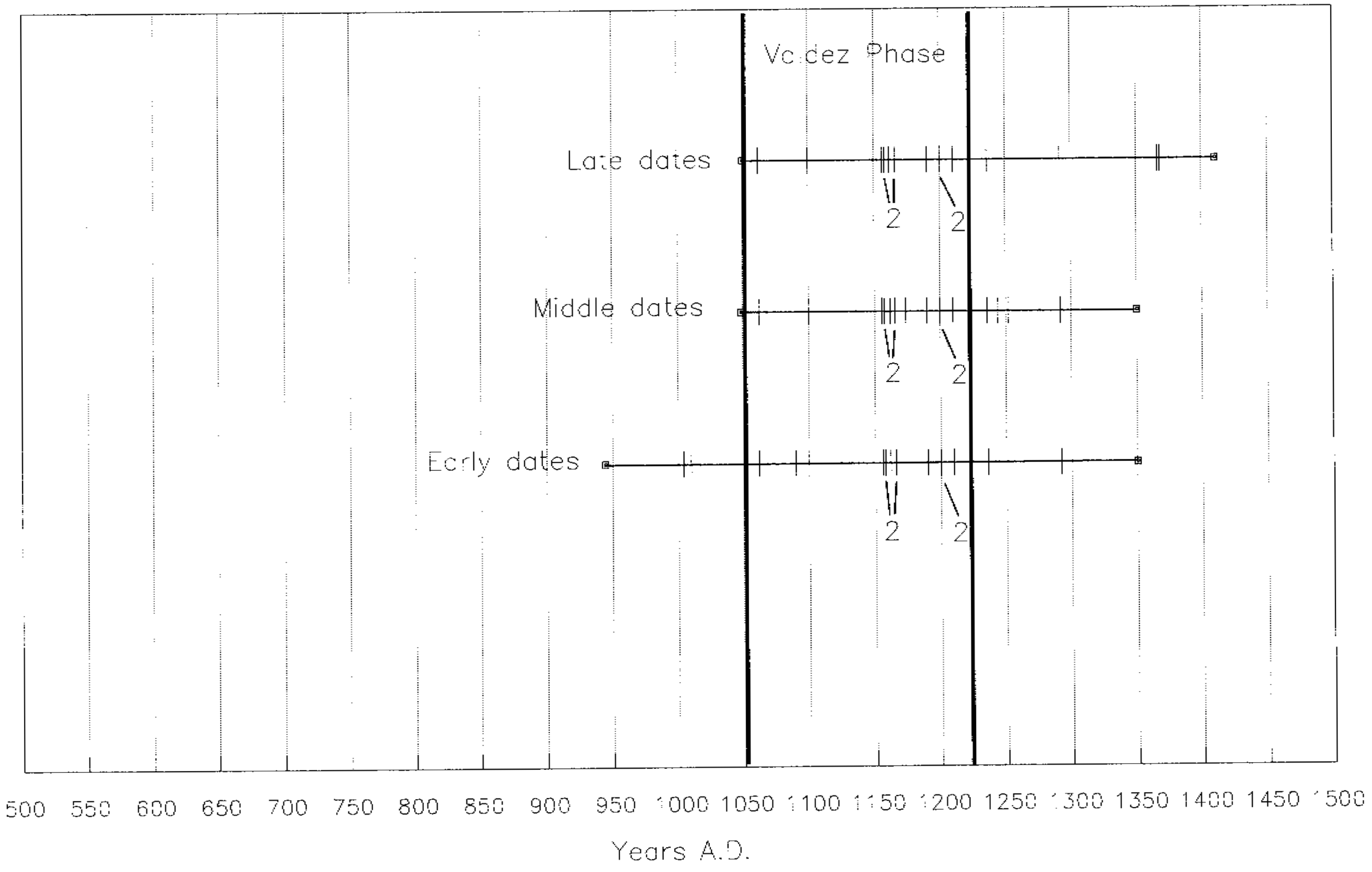
Several researchers have suggested that simple sites consisting of pithouses without associated surface structures were older than sites where pithouses were associated with small surface pueblos (see Wetherington 1968:79). For instance, Woosley states:

> Early Developmental period sites consist of pit house clusters and are followed at a slightly later date by small surface pueblos of less than 10 rooms with or without a kiva. While the pit house probably predates the surface room block as an architectural type, the latter does not supersede the former since both continue to exist side by side throughout the prehistoric sequence. (Woosley 1986:148)

Crown, Orcutt, and Kohler (1996:191) contend, "The Taos District is characterized by sedentary occupation by A.D. 1000 in dispersed pit house hamlets with one to four structures. Small circular kivas and above-ground storage structures appear around A.D. 1100."

I attempted to check this possibility by examining the sites with tree-ring and archaeomagnetic dates (Tables 1 and 2). Of the three sites listed in Table 1, only TA-47 includes a substantial surface pueblo (see Green 1976). TA-47 yielded the only cutting date, 1147r, as well as the 1077+vv date. Above, I suggested that the +vv date came from a specimen that was probably cut near or after 1100. The 1147 cutting date could point to construction in the mid-1100s, although I cannot know whether it relates to the construction of the "kiva" from which it was collected. The vv dates from LA 2742 and TA-18 suggest cutting and construction near or perhaps later than the dates from TA-47.

Figure 9. Valdez Phase Archaeomagnetic Dates: Ranges and midpoint frequencies.



Horizontal lines: total date ranges.
Vertical lines: date midpoints.
Numbers: multiple midpoints.

Figure 10. Valdez Phase Archaeomagnetic Dates: Percent of samples that could date to each 10-year period, A.D. 500-1500

Of the thirteen sites with archaeomagnetic dates listed in Table 2, five are described as having surface structures or possible structures associated with pithouses: LA 9204, LA 9206, LA 9208 (Loose 1974), LA 70577 (Boyer et al. 1994b), and Cerrita (Woosley 1980, 1986). Loose (1974) describes LA 9205, also listed in Table 2, as surface rooms with no associated pithouse. Field examination of these sites revealed that the possible structures at LA 9205 and LA 9208 may not be the remains of buildings but, rather, small cobble-lined garden plots; Loose's (1974) descriptions do not include internal features. The structural remains at LA 70577 consist of a line of cobbles that probably represent the base of a brush or jacal wall (Boyer et al. 1994b; see Herold [1968] for a similar structure at TA-32). This leaves us with LA 9204, LA 9206, and Cerrita as the sites with the most substantial surface structures. Table 2 lists the archaeomagnetic dates from these sites: A.D. 1100 to 1230 (LA 9204); 1135 to 1175 and 1050 to 1130 or 1100 to 1250 (LA 9206); 1050-1150 (Cerrita). The mean midpoints of these dates are 1135.83 (early; standard deviation = 32.54) or 1138.13 (late; standard deviation=32.78), creating ranges of 1103.29 to 1168.37 or 1105.35 to 1170.91. These dates are at the center of the phase date range derived from the total set of archaeomagnetic dates (1050 to 1225). Tree-ring and archaeomagnetic dates show no difference between the dates of Valdez phase sites with substantial surface structures and those of the whole group of dated sites. There is no chronometric evidence to suggest that "simple" sites predated more complex sites during the Valdez phase; there are "simple" sites that are both earlier and later than the sites with substantial surface pueblos. A more likely explanation of the complex sites with pithouses and surface pueblos is that they represent "community-center" locations involving community ritual, storage feature, and other functions (Adler 1993; Boyer 1995).

DATING THE VALDEZ PHASE COMMUNITIES

Introduction

A review of published data from excavated Valdez phase sites revealed several interesting patterns. While over 20 sites with over 30 pithouses dating to the Valdez phase have been excavated and reported, these sites are concentrated in two large groups (Fig. 11). One group is in the Arroyo Seco-Arroyo Hondo-Lobo Creek area north of the modern town of Taos. The other is in the Ranchos de Taos-Rio Grande del Rancho area south of Taos. These two groups of sites do not reflect the actual distribution of Valdez phase sites; rather, they largely reflect the activities of two university archaeological field schools: the University of New Mexico's 1965 and 1967 field school in the north and Southern Methodist University's Fort Burgwin field school in the south. A few other sites were excavated as salvage or contract projects and one as a research project. Nonetheless, given that the distribution of excavated sites reflects the choices of their excavators and, particularly, proximity to field school facilities, there are significant differences between the two groups of sites. These differences center on construction and features of pithouses and on artifact assemblages. The reader is referred to Boyer (1994a, 1994b, 1995) for discussions of the differences; they are summarized later in "Conclusions: Dating the Valdez Phase." Based on the patterns, I (Boyer 1994b, 1995) suggest that the two groups of sites represent two different communities of Valdez phase sites.

In "Valdez Phase Chronometric Dates," I established that tree-ring and archaeomagnetic dates fall between A.D. 1050 and 1225 and cluster between 1150 and 1200, relatively small time ranges. This suggests that there are not major differences in timing between the two communities. On the other hand, the earliest archaeomagnetic date came from a north community site. This fact, combined with purported Red Mesa Black-on-white sherds from some north community sites (Loose 1974) might suggest that the north community predated the south community. Resolving this issue is important for establishing baseline data for the study of Anasazi immigration onto the Taos frontier, for studying variety in community formation and structure, and for studying the transition from dispersed to aggregated communities. As I discuss later in "Conclusions: Dating the Valdez Phase," it also figures in Taos Pueblo origin stories.

North Community Dates

No tree-ring dates are available from sites in the north community. Table 10 lists the archaeomagnetic dates obtained from north community sites. Eleven dates are available from seven sites. Note that I include LA 53678 with the north community sites, although I (Boyer 1995) have suggested that the sites along the lower Arroyo Seco, of which LA 53678 is one, may be part of another community or communities. Dates from these sites are not presently available. LA 53678 is too far north to include with the southern sites and so I place it with the northern sites.

Table 11 shows early, middle, and late mean archaeomagnetic dates, standard deviations, and date ranges. The three ranges span the years between A.D. 1071.57 and 1271.41; they overlap between 1104.59 and 1220.71. Table 12 shows the results of t-test comparisons of the mean phase archaeomagnetic dates and the mean north community dates. Test results show that there are no significant differences between the phase and north community dates.

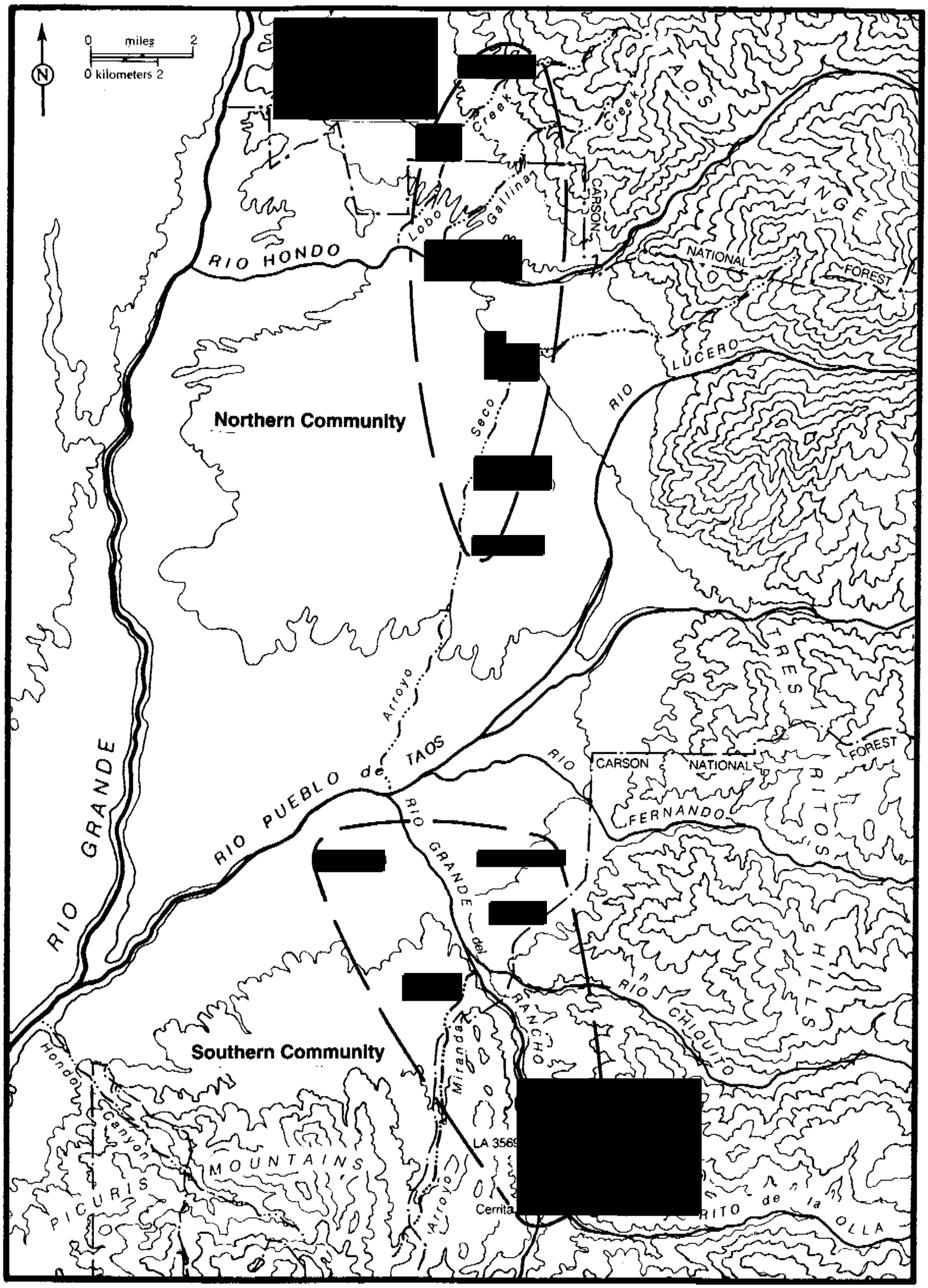


Figure 11. Excavated Valdez phase sites: northern and southern communities.

Table 10. Valdez Phase Archaeomagnetic Dates: North Community Sites

SAMPLE NO.	SITE	AM DATE (A.D.)
VA1058	LA 9201.3	945-1065 1195-1295 1325-1410
LC1023	LA 9208	1050-1075
167	LA 9206?	1050-1130 1100-1250
LC1022	LA 9206	1135-1175
166	LA 9205	1095-1145
VA1055	LA 9201.1	1095-1220
165	LA 9204?	1100-1230
VA1056	LA 9201.5	1105-1210
161	LA? (Lobo Creek)	1115-1210
VA1057	LA 9201.2	1205-1265
BL1068	LA 53678	1230-1355

Table 11. Valdez Phase Archaeomagnetic Dates: North Community Means and Standard Deviations

	EARLY DATES	MIDDLE DATES	LATE DATES
No. of dates	11	11	10
Mean date (A.D.)	1146.14	1160.34	1188.00
Standard deviation	74.57	69.04	83.41
Date range (A.D.)	1071.57-1220.71	1091.30-1229.38	1104.59-1271.41

Table 12. Valdez Phase Archaeomagnetic Dates: T-Test Comparison of Mean Phase Dates and North Community Mean Dates

	EARLY DATES	MIDDLE DATES	LATE DATES
Pooled standard deviation (Sp)	74.15	60.19	81.63
Pooled standard error (Se)	28.69	23.29	32.91
t	0.145	1.00	0.33
Degrees of freedom (df)	26	26	24
p	<0.5	$0.5<p<0.2$	<0.5

South Community Dates

The four tree-ring dates discussed in "Valdez Phase Chronometric Dates" are from south community sites. Therefore, the conclusions regarding phase dates drawn from the tree-ring dates apply equally to the south community sites.

Table 13 lists the archaeomagnetic dates obtained from south community sites. Seven dates are available from five sites. Table 14 shows early, middle, and late mean archaeomagnetic dates, standard deviations, and date ranges. The three ranges span the years between A.D. 1084.56 and 1278.00; they overlap between 1143.05 and 1220.44. Table 15 shows the results of t-test comparisons of the mean phase archaeomagnetic dates and the mean south community dates. Test results show that, as with the north community sites, there are no significant differences between the phase and south community dates.

Table 13. Valdez Phase Archaeomagnetic Dates: South Community Sites

SAMPLE NO.	SITE	AM DATE (A.D.)
EG9208	TA-18	965-1055 1215-1290 1330-1400
NA	Cerrita	1050-1150
PC509	LA 70577	1125-1190
NA	TA-34	1170-1210
PC537	LA 2742	1170-1230
PC663	LA 2742	1170-1230
PC609	LA 2742	1175-1245

Table 14. Valdez Phase Archaeomagnetic Dates: South Community Means and Standard Deviations

	EARLY DATES	MIDDLE DATES	LATE DATES
No. of dates	7	7	7
Mean date (A.D.)	1152.50	1187.14	1203.21
Standard deviation	67.94	44.09	74.79
Date range (A.D.)	1084.56-1220.44	1143.05-1231.23	1128.42-1278.00

Table 15. Valdez Phase Archaeomagnetic Dates: T-Test Comparison of Mean Phase Dates and South Community Mean Dates

	EARLY DATES	MIDDLE DATES	LATE DATES
Pooled standard deviation (Sp)	72.31	51.43	78.95
Pooled standard error (Se)	32.47	23.10	35.78
t	-0.068	-0.149	-0.120
Degrees of freedom (df)	22	22	21
p	<0.5	<0.5	<0.5

Table 16. Valdez Phase Archaeomagnetic Dates: T-Test Comparison of North Community Mean Dates and South Community Mean Dates

	EARLY DATES	MIDDLE DATES	LATE DATES
Pooled standard deviation (Sp)	72.16	60.89	80.07
Pooled standard error (Se)	34.89	29.44	38.71
t	-0.18	-0.91	-0.39
Degrees of freedom (df)	16	16	15
p	<0.5	0.5<p<0.2	<0.5

Discussion

Results of t-test comparisons of mean phase archaeomagnetic dates and mean north community and south community dates show that there are no significant differences. To check these results, a t-test comparison of the mean north community and mean south community dates was conducted. Table 16 shows that there are no significant differences between the mean archaeomagnetic dates of the two groups of sites. The conclusion I must draw from these data is that there was no significant difference in the timing of the formation of the two communities; that is, one community is not older than the other. This contradicts Bullock's (1999) interpretations based on ceramic type frequencies and architectural style. It is certainly true that the earliest Valdez phase archaeomagnetic date came from north community site (LA 9208). My review of Valdez phase tree-ring and archaeomagnetic dates suggests that pre-1100 sites are scarcer than post-1100 sites. Pre-1100 sites may represent the initial Anasazi movement into the Taos Valley, while post-1100 sites may reflect the establishment and development of frontier Anasazi communities. If so, then we should expect fewer pre-1100 sites. Since the LA 9208 date was obtained almost 30 years after the pithouse was partly excavated, it seems reasonable to suppose that other pre-1100 sites, although rare and potentially difficult to identify, are present in the district, in both the north and south communities, perhaps even among previously excavated sites.

CHRONOMETRIC DISCREPANCIES

Introduction

My review of Valdez phase radiocarbon and obsidian hydration dates shows that, while the dates obtained by these techniques seem to support the dates obtained by tree-ring and archaeomagnetic dating, there are discrepancies (Boyer 1994a) . Concerning radiocarbon dates, I observed that numerous dates had been obtained that were consistently earlier (older) than tree-ring and archaeomagnetic dates from the same and similar sites. In fact, radiocarbon dates from one site, LA 2742, were much older than the site's tree-ring and archaeomagnetic dates; the former do not overlap the latter. Additionally, analysis of several radiocarbon samples from a single site produced dates spanning 250 to 550 years. Obsidian hydration analysis yielded groups of dates that were more consistent with each other but whose absolute date values seemed to vary according to which of Ridings's (1991) effective hydration temperatures (EHTs) were used to calculate the dates. The inconsistencies in the results of these techniques, and discrepancies between results of different techniques, lessen the value of their results because of insecurity in assessing their accuracy.

Radiocarbon Dates

Table 17 lists the radiocarbon dates obtained from Valdez phase sites. Eighteen dates are available from six sites. Most of these dates (n = 12) are from two sites, LA 2742 and LA 70577, excavated by OAS during the Pot Creek data recovery project. In the table, I present each sample's measured C^{14} age, its conventional or adjusted age, its dendro-calibrated age, and the dates at which the sample intercepts the dendro-calibration curve. I was not able to obtain from Beta-Analytic the conventional ages of the samples from sites KC:TGP:1 (LA 33063), TA-34, or Cerrita. I was also not able to obtain the dendro-calibrated ages or intercept dates of the SMU samples from TA-34.

Measured dates (one-sigma) span the years between A.D. 730 and 1320 (590 years). Figure 12 shows only the measured dates of the SMU samples from TA-34 and the Beta samples from Cerrita. Conventional dates (one-sigma) span the years between A.D. 530 and 1130 (600 years; Fig. 12), a range that is about 200 years older than the corresponding measured date range. Dendro-calibrated dates run between A.D. 640 and 1385 (745 years). In all but two cases, one each from LA 2742 and LA 70577, the calibrated ages are closer to measured ages than to conventional ages. Seven samples from LA 2742 range from A.D. 760 to 1230 (measured age), 530 to 1070 (conventional age), or 640 to 1166 (calibrated age). These ranges are 470, 540, and 526 years long, respectively. Five samples from LA 70577 range from 950 to 1200 (measured age), 880 to 1100 (conventional age), or 980 to 1245 (calibrated age). These ranges are 250, 270, and 265 years long, respectively. Two samples from TA-34 range from 906 to 1215 (measured age), a span of 309 years. Two samples from Cerrita range from 1110 to 1320 (measured age) or 1220 to 1385 (calibrated age), ranges of 210 and 165 years.

These dates point out two serious problems with the radiocarbon dates from the Valdez phase. First, the range of dates revealed by radiocarbon dating, regardless of whether they are determined by measured, conventional, or calibrated ages, are considerably longer than the dates for the phase determined by tree-ring and archaeomagnetic dates. If we take the radiocarbon dates at face value, the Valdez phase was much longer, started much earlier, and, perhaps, ended much later than indicated by tree-ring and archaeomagnetic dates. Secondly, the ranges of radiocarbon dates obtained from each of the four sites

Figure 12. Valdez Phase: Radiocarbon Dates

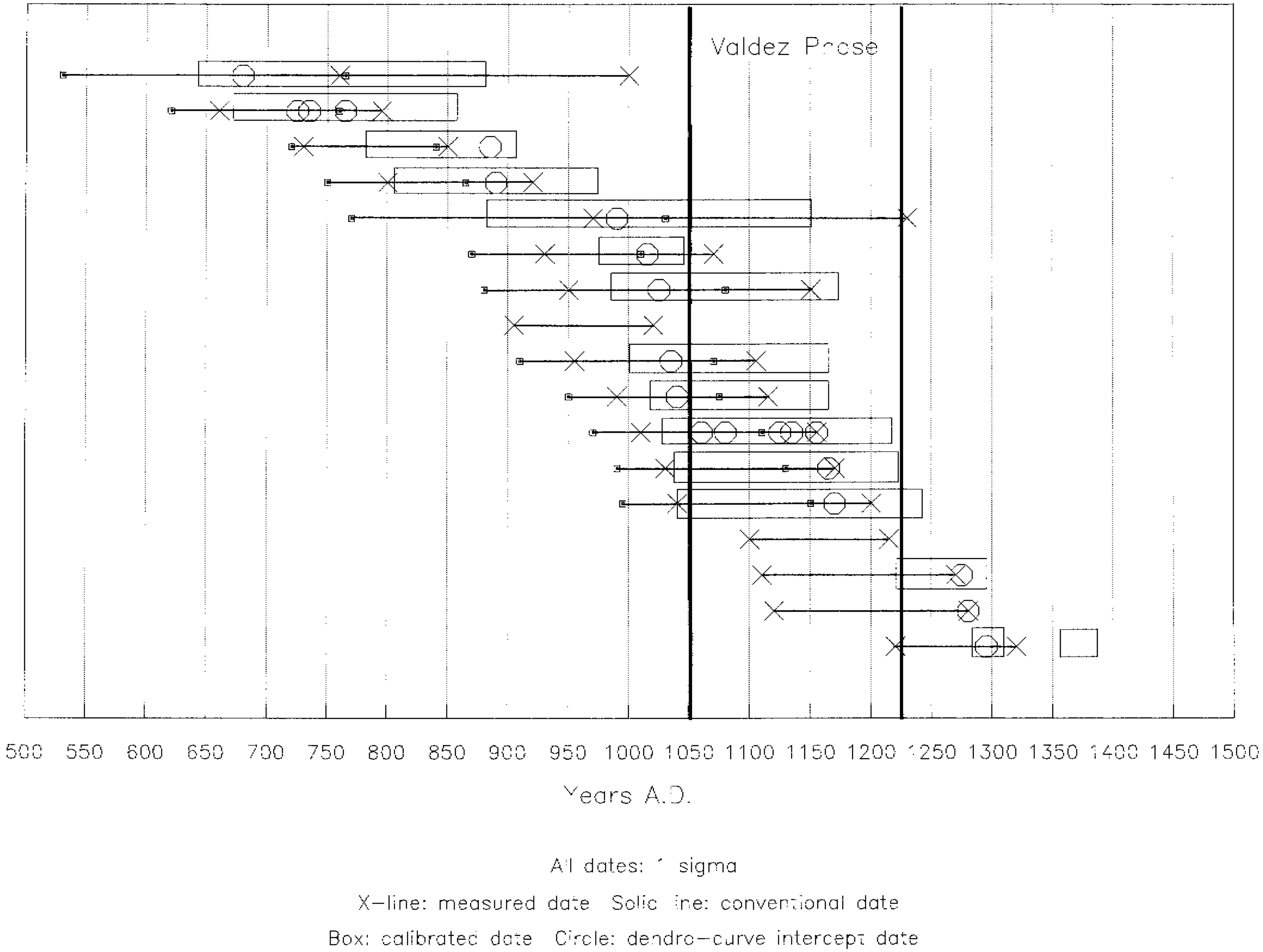


Table 17. Valdez Phase: Radiocarbon Dates (1 Sigma)

SITE	SAMPLE NO.	MEASURED AGE (A.D.)	CONVENTIONAL AGE (A.D.)	CALIBRATED AGE (A.D.)	INTERCEPT DATE(S) (A.D.)	REFERENCE
LA 2742	B-46596	760-1000	530-770	640-880	681	Boyer et al. 1994a
	B-46601	660-800	620-760	669-860	725, 735, 766	Boyer et al. 1994a
	B-47036	730-850	720-840	780-953	883	Boyer et al. 1994a
	B-46600	800-920	750-870	810-975	891	Boyer et al. 1994a
	B-46597	970-1230	770-1030	880-1153	991	Boyer et al. 1994a
	B-46595	930-1070	870-1010	974-1039	1015	Boyer et al. 1994a
	B-46599	950-1110	910-1070	999-1166	1030	Boyer et al. 1994a
LA 70577	B-46604	950-1150	880-1080	980-1170	1027	Boyer et al. 1994a
	B-46602	990-1110	950-1070	1018-1166	1039	Boyer et al. 1994a
	B-46606	1010-1150	970-1110	1024-1217	1058, 1078, 1125, 1136, 1156	Boyer et al. 1994a
	B-46603	1040-1200	990-1150	1030-1245	1166	Boyer et al. 1994a
	B-46605	1030-1170	990-1130	1030-1225	1163	Boyer et al. 1994a
KC:TGP:1	B-15478	1120-1280	-	1225-1300	1275	Moore 1986
TA-34	SMU-868	906-1018	-	-	-	Crown 1990
	SMU-867	1105-1215	-	-	-	Crown 1990
Cerrita	B-8578	1110-1270	-	1220-1295	1275	Woosley 1986
	B-8579	1220-1320	-	1285-1310, 1355-1385	1295	Woosley 1986

having more than one date (Table 17) could suggest that the sites were occupied for much longer periods of time than indicated by several studies of pithouse use-life (see discussion in "Descriptions of the Valdez Phase") and by the descriptions of the sites themselves. For instance, the radiocarbon dates from Cerrita leads Woosley (1986) to conclude that the site was occupied for 250 years. Clearly, the sources of these discrepancies must be identified if we are to assess the accuracy and reliability of the radiocarbon dates.

Calcium Carbonate Contamination

The wide ranges of radiocarbon dates from the sites, particularly including dates much older than associated tree-ring and archaeomagnetic dates, has prompted speculation on the causes of the early radiocarbon dates. Specifically, the earlier dates came from LA 2742 and LA 70577, both located near Pot Creek Pueblo on the east side of the Rio Grande del Rancho Valley (Figs. 2 and 11; Moore et al. 1994; Boyer et al. 1994b). In my review of Valdez phase dates, Boyer notes:

> One problem that may make radiocarbon dates earlier than dates obtained by other techniques is the presence of calcium carbonate in the soil. Although samples are routinely checked for the presence of calcium carbonate, a higher than normal presence may mean that some calcium

> carbonate remains in the sample during the dating procedure. This could result in an early date. (Boyer 1994a:398)

I then go on to say, "In the descriptions of both sites, we noted that the soil as deep as 3 m is very high in calcium carbonate, probably because of limestone beds in the mountains near both sites. This may explain the early radiocarbon dates from LA 2742 and LA 70577" (Boyer 1994a:398).

In order to test the possibility that contamination by calcium carbonate from limestone beds in the Tres Ritos Hills resulted in early radiocarbon dates, I undertook two investigations.

Acid/alkali wash pretreatment. Since the LA 2742 and LA 70577 samples were dated by Beta-Analytic, I approached the laboratory to assess whether pretreatment of the samples was adequate to remove contaminants. Beta-Analytic's pretreatment glossary, provided to clients with dating information, describes the process as follows:

> The sample was first gently crushed/dispersed in deionized water. It was then given hot HCl acid washes to eliminate carbonates and alkali washes (NaOH) to remove secondary organic acids. The alkali washes were followed by a final acid rinse to neutralize the solution prior to drying. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of the sample. Each chemical solution was neutralized prior to application of the next. During these serial rinses, mechanical contaminants such as associated sediments and rootlets were eliminated. This type of pretreatment is considered a "full pretreatment." (Beta-Analytic n.d.:1)

In consultation with Dr. Darden Hood, Beta-Analytic's General Manager, we determined that a sample portion from one of the Pot Creek data recovery project sites had been kept at Beta-Analytic's laboratory. The sample portion had been processed according to Beta-Analytic's full pretreatment procedures but the dating procedure had not been completed. Dr. Hood agreed to submit the sample to an additional acid wash to see if calcium carbonate remained in the sample. The sample was left in the acid wash for 24 hours; no evidence of remnant calcium carbonate was observed (D. Hood, pers. comm. 1995). Clearly, this does not assure us that Beta-Analytic's "full pretreatment" completely removed all calcium carbonate from all the LA 2742 and LA 70577 samples, although Dr. Hood (pers. comm. 1997) is adamant that the laboratory's stringent procedures remove the possibility of carbonate contamination. Therefore, laboratory processing probably did not contribute to early dates from the samples.

Pot Creek Pueblo Tree-Ring and Radiocarbon Dates. Pot Creek Pueblo (LA 260), a large site first occupied in the Valdez phase that reached its height in the early Classic period Talpa phase (ca. A.D. 1270 to 1340), is located in the foothills of the Tres Ritos Hills a short distance up the Rio Grande del Rancho from LA 2742 and LA 70577. Its geomorphological situation is very similar to that of the other two sites. Consequently, if radiocarbon samples from those sites are early because of soil chemistry, then the same chemistry should affect samples from Pot Creek Pueblo. As discussed in "Valdez Phase Chronometric Dates," three wood samples from Pot Creek Pueblo were submitted to the Laboratory of Tree-Ring Research for tree-ring dating. Outer-ring segments of two samples were then submitted to Beta-Analytic for radiocarbon dating. Table 18 compares the results of tree-ring and radiocarbon dating of those two samples, which are also shown in Figure 13. Sample PCP-385/B-77303 yielded a last-ring date of 1209vv,

Table 18. Comparison of Pot Creek Pueblo Tree-Ring and Radiocarbon Dates (1 Sigma)

TREE-RING SAMPLE NO.	INSIDE RING DATE (A.D.)	OUTSIDE RING DATE (A.D.)	RADIOCARBON SAMPLE NO.	MEASURED AGE (A.D.)	CONVENTIONAL AGE (A.D.)	CALIBRATED AGE (A.D.)	INTERCEPT DATE (A.D.)
PCP-385	1101	1209vv	B-77303	1200-1300	1190-1290	1275-1300	1290
PCP-387	1207p	1255+r	B-77304	1240-1360	1200-1320	1275-1310 1355-1385	1295

meaning that an unknown number of outer rings are missing. As discussed earlier, informal observations at the Laboratory of Tree-Ring Research suggest that a vv date is often 70 to 100 years older than the specimen's cutting date, although it is not clear why this should be the case. Nonetheless, if the 1209vv date is 70 to 100 years too old, then the cutting date was around 1280 to 1310, which matches the sample's calibrated age, including its intercept date, and the later end of its measured and conventional ages. This suggests consistency in the radiocarbon dates and the possibility that the tree-ring date could correspond to the radiocarbon date. On the other hand, if the vv date is considerably less than 70 years older than the sample's cutting date, then the tree-ring date is older than the calibrated radiocarbon age but does fit well within the measured and conventional date ranges.

Sample PCP-385/B-77304 yielded a tree-ring date of A.D. 1255+r, meaning that a portion of the outermost ring appears to be present; the sample's date may be a cutting date. The radiocarbon measured and conventional ranges are 15 to 55 years older and 55 to 65 years younger than the tree-ring date. The calibrated dates are 20 to 55 and 100 to 130 years younger than the tree-ring, while the intercept date is 40 years younger. The "+" symbol with the date means that one or more rings near the end of the ring series may be missing. If so, then the r date may not actually be a cutting date and may be older than the real cutting date, although we could expect that the difference in years would be less than with a vv date, since the analysts felt they could record an outer ring. In such a case, the tree-ring and calibrated dates, including the intercept date, would be closer than seen in the table and the figure. In any case, however, the tree-ring date falls within both the measured and conventional radiocarbon date ranges.

Two samples cannot constitute a definitive test of the correspondence between tree-ring and radiocarbon dates. Still, the results of tree-ring and radiocarbon dating of the two Pot Creek Pueblo samples show that soil chemistry--in this case, the presence of calcium carbonate from nearby limestone beds--did not result in radiocarbon dates significantly younger than associated tree-ring dates. Assuming that these results likely hold for the radiocarbon samples from nearby Valdez phase sites, then we must look for another reason or reasons for radiocarbon dates that are much earlier than dates obtained by other techniques.

Pooled Radiocarbon Dates

Shott observes that one of the most significant sources of error in radiocarbon samples is:

> the intrinsic variation--associated with site occupation span and arising from the likelihood that the precise date of each cultural event producing datable material varies at random or in some other manner within the range given by the occupation span. Strictly speaking, that is, no two samples are likely to be of precisely the same age. (Shott 1992:203)

Given this situation, Shott maintains:

> It is no surprise, therefore, that such series are likely to span a considerable chronological range no matter how short the period during which the dated materials were deposited. (Shott 1992:203)

In fact, "It would be truly astonishing if such variation or dispersion were not found. . ." He goes on to say,

> The simple presentation of such results, in addition to being "unacceptable" and "statistically wasteful," fails to measure the central tendency of the series and to consider the possibility that all samples have the same or nearly the same true age. Therefore, the absolute range of results is not necessarily an accurate or valid measure of the length of time spanning the cultural events that deposited the samples. The probabilistic nature of radiocarbon dating means that the dispersion of results may overestimate site occupation span by a considerable margin. (Shott 1992:211)

Given this conclusion, I could dismiss the ranges of radiocarbon dates obtained from Valdez phase sites as representing the "intrinsic variation" that "overestimate[s] site occupation span[s] by a considerable margin." However, Shott argues that it is worthwhile to evaluate the possibilities that either long ranges of radiocarbon dates obtained from a site represent the actual span of site occupation or that they actually represent a shorter span of years, "to measure the homogeneity or, conversely, the dispersion of the series of dates" (Shott 1992:212).

Following Shott, I evaluated the radiocarbon dates from the four Valdez phase sites yielding multiple dates, LA 2742, LA 70577, TA-34 and Cerrita, using pooled mean dates to test the null hypothesis that the true ages of a site's samples are the same or nearly so. For each site, the pooled mean radiocarbon date is calculated using the formula:

$$A_p = \frac{\left(\sum \frac{A_i}{S_i^2}\right)}{\left(\sum \frac{1}{S_i^2}\right)}$$

where A_p is the pooled mean of radiocarbon dates in years B.P., A_i is the uncalibrated radiocarbon date of sample i, and S_i is the sum of the square of the assay's standard deviation (E_i^2) and the square of the standard deviation of the calibration error (F_i^2). For assays younger than 2,700 B.P., F_i^2 is 50^2 (Shott 1992:214). Having determined the pooled mean date, I calculate a T' value for the samples, using the formula:

$$T' = \sum \frac{(A_i - A_p)^2}{S_i^2}$$

The T' value has a X^2 distribution with n-1 degrees of freedom and is evaluated using a table of X^2 critical values. For my test, if the T' value is significant ($p \geq .05$), the samples making up the pooled mean cannot be from the same underlying distribution around a single true age; that is, the null hypothesis is rejected. When the null hypothesis is accepted--the samples have the same or nearly the same true age--I determine the variance about the calculated mean using the formula

$$V(A_p) = \sqrt{(\sum 1/S_i^2)^{-1}}$$

by which I determined mean radiocarbon ages for the samples from each site.

Tables 19 and 20 show the pooled mean radiocarbon date (A_p) and T' value for the samples from LA 2742. Table 19 values are calculated using measured radiocarbon dates, while Table 20 values use conventional dates, since Shott (1992:214) states that the A_p formula uses uncalibrated dates but does not specify whether he uses measured or conventional dates. Using the measured date values, the null hypothesis is accepted although the T' value is very close to the level of rejection. Note, however, that only three of the seven samples intercept the pooled mean age (A_p). Using the conventional date values, the null hypothesis is also accepted. However, none of the samples actually intercept the pooled mean age. I should probably reject the conventional values on this basis.

Although the T' values of the LA 2742 dates approach the level of rejection, I must accept the hypothesis and assume the true ages are the same or nearly so. The radiocarbon ages are at least 250 to 310 years older than the site's archaeomagnetic dates. Since the pithouse at LA 2742 was not likely occupied for two-and-a-half to three centuries (Moore et al. 1994; Boyer 1994a; see "Descriptions of the Valdez Phase"), and since the T' values suggest that the radiocarbon true ages are the same or nearly the same, I could propose that the radiocarbon samples represent the use of a single, old source of wood. Table 21 shows that this is not the case. Three different materials and proveniences are represented: juniper from pithouse architectural posts, ponderosa pine from cooking/heating and disposal contexts, and burned corn cobs from pithouse fill. Table 22 shows T' values for the LA 2742 samples by material. In each case, the null hypothesis must be accepted (the true ages are the same or nearly so), although the juniper and pine samples are close to the level of rejection. Table 23 lists LA 2742 pooled mean radiocarbon ages by material. It shows that the juniper samples are the oldest. While the two samples came from separate posts, the idea that their ages are so similar is reasonable if we assume that the pithouse builders would have selected trees of similar sizes (and, therefore, ages) for the upright roof-support posts. The pine samples are somewhat younger, while the corn samples are the youngest, and closest to the probable dates of the site, if I use the measured radiocarbon ages. Reasons for the discrepancy between the measured and conventional ages of the corn samples are not known. The differences between the ages of the three material groups probably account for the fact that less than half of the measured ages and none of the conventional ages intercept their respective pooled mean ages. Thus, we see that differences in the ages of the different materials are significant factors in producing the wide range of radiocarbon dates from LA 2742.

Tables 24 and 25 show the pooled mean radiocarbon date (A_p) and T' value for the samples from LA 70577, calculated using measured and conventional ages, respectively. In both cases, the null hypothesis is accepted by overwhelming margins and, in both cases, all five samples intercept the pooled mean age. Again, I could suggest, with more support than from LA 2742, that the LA 70577 samples represent a single source. However, like LA 2742, this is not the case, since three (or four?) materials and proveniences are represented: juniper from the pithouse floor, ponderosa and piñon pine from a pithouse posthole, piñon and undetermined conifer from the pithouse hearth and ashpit, and oak from the ashpit (Table 26). Table 27 shows T' values for the conifer samples, not including the single juniper sample. The null hypothesis is accepted by a large margin--the ages of the samples are the same or nearly so.

Table 19. LA 2742: Pooled Mean Radiocarbon Ages, Using Measured Ages, B.P.*

SAMPLE	A_i	E_i	F_i	S_i	A_i/S_i^2	$1/S_i^2$	A_p	$(A_i-A_p)^2$	$(A_i-A_p)^2/S_i^2$	$V(A_p)$
B-46601	1220	70	50	86.02^2	.165	.000135		157.88^2	3.37	
B-47036	1160	60	50	78.10^2	.190	.000164		97.88^2	1.57	
B-46596	1070	120	50	130.00^2	.063	.000059		7.88^2	.00367	
B-46600	1090	60	50	78.10^2	.179	.000164		27.88^2	.127	
B-46595	950	70	50	86.02^2	.128	.000135		-112.12^2	1.70	
B-46599	920	80	50	94.34^2	.103	.000112		-142.12^2	2.27	
B-46597	850	130	50	139.28^2	.044	.000052		-212.12^2	2.32	
							872.20		T'=11.361 (p=.082)	34.90

*A_i: measured radiocarbon age, B.P.; E_i: 1-sigma standard deviation; F_i: a constant; $S_i=E_i^2+F_i^2$; A_p: pooled mean radiocarbon age, B.P.; T': $\sum(A_i-Ap)^2/S_i^2$; $V(A_p)$: 1-sigma variance of the pooled mean age.

Table 20. LA 2742: Pooled Mean Radiocarbon Ages, Using Conventional Ages, B.P.*

SAMPLE	A_i	E_i	F_i	S_i	A_i/S_i^2	$1/S_i^2$	A_p	$(A_i-A_p)^2$	$(A_i-A_p)^2/S_i^2$	$V(A_p)$
B-46601	1260	70	50	86.02^2	.107	.000135		134.54^2	2.45	
B-47036	1170	60	50	78.10^2	.192	.000164		44.54^2	.325	
B-46596	1300	120	50	130.00^2	.077	.000059		174.54^2	1.80	
B-46600	1140	60	50	78.10^2	.187	.000164		14.54^2	.035	
B-46595	1010	70	50	86.02^2	.136	.000135		-115.46^2	1.80	
B-46599	960	80	50	94.34^2	.108	.000112		-165.46^2	3.08	
B-46597	1050	130	50	139.28^2	.054	.000052		-75.46^2	.294	
							1125.46		T'=9.784 (p=.146)	34.90

*A_i: conventional radiocarbon age, B.P.; E_i: 1-sigma standard deviation; F_i: a constant; $S_i=E_i^2+F_i^2$; A_p: pooled mean radiocarbon age, B.P.; T': $\Sigma(A_i-Ap)^2/S_i^2$; $V(A_p)$: 1-sigma variance of the pooled mean age.

Table 21. LA 2742 Radiocarbon Samples: Material and Provenience

SAMPLE NO.	MATERIAL	PROVENIENCE
B-46595	Ponderosa pine	Midden fill
B-46596	Corn cob	Pithouse fill
B-46597	Corn cob	Pithouse fill
B-46599	Ponderosa pine	Pithouse, ash pit
B-46600	Juniper	Pithouse, post hole
B-46601	Juniper	Pithouse, upright post
B-47036	Ponderosa pine	Pithouse, hearth

Table 22. LA 2742 Radiocarbon Samples: T' Values by Material

	MEASURED AGES	CONVENTIONAL AGES
Juniper Samples		
T'	3.497	2.485
p	0.065	0.121
Pine Samples		
T'	5.54	5.205
p	0.066	0.078
Corn Cob Samples		
T'	2.324	2.094
p	0.136	0.157

Table 23. LA 2742 Radiocarbon Ages: Pooled Ages and Variance by Material

	A_p	$V(A_p)$	AGE RANGE (A.D.)
Juniper Samples			
Measured ages	1150.50	57.83	741.67-857.33
Conventional ages	1193.98	57.83	698.37-814.03
Pine Samples			
Measured ages	1024.33	49.33	876.34-975.00
Conventional ages	1060.83	49.33	839.84-938.50
Corn Samples			
Measured ages	963.96	94.92	891.12-1080.96
Conventional ages	1180.18	94.92	674.90-864.74

Table 24. LA 70577: Pooled Mean Radiocarbon Ages, Using Measured Radiocarbon Ages, B.P.*

SAMPLE	A_i	E_i	F_i	S_i	A_i/S_i^2	$1/S_i^2$	A_p	$(A_i-A_p)^2$	$(A_i-A_p)^2/S_i^2$	$V(A_p)$
B-46604	900	100	50	111.8^2	.072	.00008		27.8^2	.062	
B-46602	900	60	50	78.10^2	.148	.000164		27.8^2	.127	
B-46606	870	70	50	86.02^2	.118	.000135		-2.2^2	.000654	
B-46603	830	80	50	94.34^2	.093	.000112		-42.2^2	.2	
B-46605	850	70	50	86.02^2	.115	.000135		-22.2^2	.067	
							872.20		$T' = .457$ $(p = .977)$	39.97

*A_i: measured radiocarbon age, B.P.; E_i: 1-sigma standard deviation; F_i: a constant; $S_i = E_i^2 + F_i^2$; A_p: pooled mean radiocarbon age, B.P.; T': $\Sigma(A_i-A_p)^2/S_i^2$; $V(A_p)$: 1-sigma variance of the pooled mean age.

Table 25. LA 70577: Pooled Mean Radiocarbon Ages, Using Conventional Radiocarbon Ages, B.P.*

SAMPLE	A_i	E_i	F_i	S_i	A_i/S_i^2	$1/S_i^2$	A_p	$(A_i-A_p)^2$	$(A_i-A_p)^2/S_i^2$	$V(A_p)$
B-46604	970	100^2	50^2	111.8^2	.078	.00008		53.07^2	.225	
B-46602	940	60	50	78.10^2	.154	.000164		23.07^2	.087	
B-46606	910	70	50	86.02^2	.123	.000135		-6.93^2	.00649	
B-46603	880	80	50	94.34^2	.099	.000112		-36.93^2	.153	
B-46605	890	70	50	86.02^2	.120	.000135		-26.93	.098	
							916.93		T'=.569 (p=.981)	39.97

*A_i: conventional radiocarbon age, B.P.; E_i: 1-sigma standard deviation; F_i: a constant; $S_i=E_i^2+F_i^2$; A_p: pooled mean radiocarbon age, B.P.; T': $\Sigma(A_i-A_p)^2/S_i^2$; $V(A_p)$: 1-sigma variance of the pooled mean age.

Table 26. LA 70577 Radiocarbon Samples: Material and Provenience

SAMPLE NO.	MATERIAL	PROVENIENCE
B-46602	Juniper	Pithouse, floor
B-46603	Ponderosa pine and piñon	Pithouse, post hole
B-46604	Piñon and undetermined conifer	Pithouse, hearth
B-46605	Undetermined conifer	Pithouse, ash pit
B-46606	Oak	Pithouse, ash pit

Table 27. LA 70577 Radiocarbon Samples: T' Values of Conifer Samples (Excluding Juniper)

	MEASURED AGES	CONVENTIONAL AGES
T'	0.329	0.476
p	>0.5	>0.5

Table 28. LA 70577 Radiocarbon Ages: Pooled Ages and Variance of Conifer Samples (Excluding Juniper)

	A_p	$V(A_p)$	AGE RANGE (A.D.)
Measured ages	856.27	55.30	1038.43-1149.03
Conventional ages	908.27	55.30	986.43-1097.03

Table 28 shows the pooled mean ages of the conifer samples. If I compare the dates in Table 28 with those in Table 17, I see that the juniper sample from the pithouse floor is slightly older than the other conifer samples while the oak sample is approximately contemporaneous. The pooled mean measured radiocarbon age of the LA 70577 samples (A.D. 1037.83-1117.77) approaches but does not overlap the site's archaeomagnetic date (A.D. 1125-1190). However, the pooled mean measured conifer date (1038.43-1149.03) does overlap the archaeomagnetic date, as does the measured oak sample date (1010-1150). This shows that the juniper sample, which is older, is responsible for creating a radiocarbon age for the site that is not supported by the site's archaeomagnetic date. Without the juniper date, I see that the radiocarbon dates from LA 70577 are essentially contemporaneous with the archaeomagnetic date.

Table 29 shows the pooled mean radiocarbon date (A_p) and T' values for samples from the Cerrita site. The values are calculated using only measured ages, which were supplied for this project by Beta-Analytic. The null hypothesis is rejected (the samples' true ages are not the same), although the T' value is very close to the level of acceptance. This is important since both samples intercept the A_p value. Based on these circumstances, the hypothesis should probably be accepted and the samples seen as having the same or nearly the same true ages. This conclusion seems to be supported by the overlap of the samples' calibrated dates and the fact that the samples' intercept dates are only 20 years apart. Consequently, I have calculated a pooled mean radiocarbon age for the site (Table 29). Unlike LA 2742 and LA 70577, the mean pooled radiocarbon age of the Cerrita samples is younger than the site's archaeomagnetic date (A.D. 1050-1150). The only reason for this discrepancy discernible from Woosley's (1986:153) discussion of the site is that the archaeomagnetic date is from "a hearth in the earliest pit house level" while the radiocarbon samples are from "other pit house contexts." Woosley (1986:153) concludes, on the basis of these dates, "The entire occupation probably does not extend much beyond 250 years, or from about A.D. 1050 to 1300." Apparently, the pithouse at Cerrita was remodeled, since it consisted of "two pit house levels" (Woosley 1986:153). Given the differences in dating contexts mentioned by Woosley, we might conclude that the archaeomagnetic sample came from the original pithouse hearth while the radiocarbon samples came from a feature or the fill of the later, remodeled structure. If so, then the dating differences may point to the original structure and to the remodeled structure. Alternatively, if the radiocarbon samples came from pithouse fill, they may have nothing to do with the structure itself or even the human occupation of the site. Without a clearer understanding of the context(s) of those samples, we cannot assume that their dates are associated with the human use of the site.

Since Valdez phase pithouses were not likely occupied for more than a few decades, even with substantial remodeling (see "Descriptions of the Valdez Phase"), Woosley's contention that the Cerrita site was occupied for 250 years requires considerable support. Her argument is based on the total span of years represented in the archaeomagnetic and radiocarbon dates. This is contrary to Shott's (1992:211) assertion that the total range of radiocarbon dates "is not necessarily an accurate or valid measure of the length of time spanning the cultural events that deposited the samples." Relying on the "simple presentation" of the dates is "unacceptable" and "statistically wasteful" because "the dispersion of results may overestimate site occupation span by a considerable margin." Shott's statements apply to radiocarbon dates; we must be even more cautious concerning the span of years represented by dates obtained by more than one technique. In this case, I have shown that the radiocarbon samples probably have the same or nearly the same ages and thus do not present sequential dates, negating an *a priori* conclusion of a long date range. We have also seen that the archaeomagnetic and radiocarbon dates may reflect different construction and remodeling episodes at the Cerrita pithouse, although I cannot specify the actual dates of those episodes or the basis of those dates. In fact, without evidence to the contrary, I cannot unconditionally accept the radiocarbon dates as dates for the site. Together, these data deny a conclusion that the site saw a continuous, multicentury occupation.

Table 29. Cerrita: Pooled Mean Radiocarbon Ages, Using Measured Radiocarbon Ages, B.P.*

SAMPLE	A_i	E_i	F_i	S_i	A_i/S_i^2	$1/S_i^2$	A_p	$(A_i-A_p)^2$	$(A_i-A_p)^2/S_i^2$	$V(A_p)$
B-8578	760	80	50	94.34^2	.085	.000112		-51.67^2	.3	
B-8579	680	50	50	70.71^2	.136	.0002		-28.33^2	.161	
							708.33		T'=.461 (p=.498)	56.61

*A_i: measured radiocarbon age, B.P.; E_i: 1-sigma standard deviation; F_i: a constant; $S_i=E_i^2+F_i^2$; A_p: pooled mean radiocarbon age, B.P.; T': $\Sigma(A_i-A_p)^2/S_i^2$; $V(A_p)$: 1-sigma variance of the pooled mean age.

Table 30. TA-34: Pooled Mean Radiocarbon Ages, Using Measured Radiocarbon Ages, B.P.*

SAMPLE	A_i	E_i	F_i	S_i	A_i/S_i^2	$1/S_i^2$	A_p	$(A_i-A_p)^2$	$(A_i-A_p)^2/S_i^2$	$V(A_p)$
SMU-867	790	55	50	74.33^2	.143	.000181		-98.27^2	1.75	
SMU-868	988	56	50	75.07^2	.175	.000177		99.73	1.76	
							888.27		T'=3.51 (p=.065)	52.85

*A_i: measured radiocarbon age, B.P.; E_i: 1-sigma standard deviation; F_i: a constant; $S_i=E_i^2+F_i^2$; A_p: pooled mean radiocarbon age, B.P.; T': $\Sigma(A_i-A_p)^2/S_i^2$; $V(A_p)$: 1-sigma variance of the pooled mean age.

Table 31. Valdez Phase: Pooled Mean Radiocarbon Ages

SITE	POOLED MEAN AGE, B.P. (A_p)	VARIANCE ($V[A_P]$)	AGE RANGE (A.D.)
LA 2742, measured ages	1062.12	34.90	852.98-922.78
LA 2742, conventional ages	1125.46	34.90	789.64-859.44
LA 70577, measured ages	872.20	39.97	1037.83-1117.77
LA 70577, conventional ages	916.93	39.97	993.10-1073.04
TA-34, measured ages	888.27	52.85	1008.88-1114.58
Cerrita, measured ages	708.33	56.61	1185.06-1298.28

Table 30 shows the pooled mean radiocarbon date (A_p) and T' value for samples from site TA-34. The values are calculated using only what are assumed to be measured ages, since Cordell (1978) and Crown (1990) do not specify whether the dates are measured or conventional. The null hypothesis is accepted although the T' value is very close to the level of rejection. This is important since neither sample actually intercepts the A_p value. Therefore, I cannot accept the notion that the true ages are the same or nearly so with confidence and I argue that the hypothesis should probably be rejected. Nonetheless, I do present a pooled mean radiocarbon age in Table 30. No published information is available on the excavation of TA-34, and I cannot assess the archaeological or collection context of the radiocarbon samples.

Discussion. Analysis of the "central tendency" (Shott's term) of series of radiocarbon dates from four

Valdez phase sites suggests several conclusions. First is the apparent utility of pooling or averaging series of dates to assess the central tendency of the dates, the degree to which the samples, regardless of their apparent dispersion, may or may not actually have the same or nearly the same ages. We have seen that, in the case of the LA 70577 samples, pooling the dates revealed that they are very similar to and may be contemporaneous with the site's archaeomagnetic date, despite the apparent wide range of the radiocarbon dates. In the case of the Cerrita samples, pooling the dates revealed that the samples probably have the same or nearly the same ages, despite their apparent dispersion, that they are younger than the site's archaeomagnetic date, and that the dates may be indicative of different episodes in the site's history. With the TA-34 samples, on the other hand, we see that the two samples probably do not have the same or nearly the same ages, although I cannot assess the context(s) of the samples.

The second conclusion has to do with the effects of different materials in producing the range of dates obtained from a series of samples. This is most clearly seen with the LA 2742 samples. The three material groups yielded different pooled mean ages, allowing us to assess the effects of different materials on the site's wide range of radiocarbon dates and on the pooled mean radiocarbon dates.

In addition to materials, the contexts from which radiocarbon samples are collected are critical for defining the reliability of their dates. I will assess this in more detail in the next section. At this point, I can say that by defining the collection context(s) of the dated samples (archaeomagnetic and radiocarbon) from Cerrita, I am better able to assess the significance of their different dates and interpretations of the site's occupational history. Shott (1992:212) notes Schiffer's concerns that averaging and other measures of central tendency may miss bias in a series of dates. He counters that careful sample selection in the field and the laboratory can obviate problems with averaging. This follows Smiley's (1985) assessment of material and context quality, which I will check for the Valdez phase samples in the next section.

Finally, I suggest that Valdez phase radiocarbon dates support Shott's (1992) contention that the probabilistic nature of radiocarbon dating means that individual dates and pooled ages should not be used alone to date a site, feature, or other context. Although the process of assessment and interpretation I have undertaken here allows me to refine the radiocarbon dates, there are still discrepancies with dates obtained by other techniques and the pooled mean ages often have sufficient variance to produce lengthy date ranges (see Shott 1992:226). Shott (1992:226) notes that numerous radiocarbon dates from components and sites are necessary for the use of statistical techniques to refine chronologies. This is borne out by my analyses of Valdez phase radiocarbon dates. Our ability to assess the effects of multiple materials and archaeological context and the degree of correspondence between radiocarbon and other dates is greatest at sites with the greatest number of dates, LA 2742 and LA 70577. Conversely, assessment of materials and contexts is limited at those sites with fewer dates, Cerrita and TA-34.

Radiocarbon Sample Context and Material Quality

In the previous section, we observed the importance of materials and context for assessing radiocarbon dates. Smiley (1985:66) states, "the consideration of sample suitability is a function of the nature and reliability of the perceived association with human activity and the physical character of the sample material." The need for evaluating radiocarbon samples lies in the differences or "temporal disparities" between the "dated event," the "referenced event," and the "target event" (Smiley 1985:59-60). The dated event is the event actually dated by the material, as opposed to the target event, a hypothetical cultural event that we wish to date. The referenced event is the actual death date of the plant, usually a tree, from which the sample is derived. These dates may not, and probably are not, the same in most archaeological situations because of a variety of factors (Smiley 1985:38-45, 60-62).

To facilitate the process of evaluating radiocarbon samples, Smiley (1985:66-74) proposes a set of criteria for "screening" the context quality and material quality of each sample. Three categories involve the quality of sample context:

1. Primary: the sample was collected from an undisturbed primary use or activity location such as the floor or roof-fall of a structure or the fill of a hearth;

2. Secondary: the sample was not collected from a primary use or activity location, in which case the sample may have been disturbed or contaminated by cultural or post-cultural factors. Examples include structural fill and mixed, disturbed, or arbitrarily defined deposits or levels;

3. Unknown: the sample's context is undocumented or poorly recorded or cannot be evaluated because of contamination.

Seven categories describe the quality of the material comprising the sample. They involve the integration of sample integrity, articulation with human activity, and quantity. The categories are:

1. annual material associated with human subsistence;

2. architectural structural elements whose outer rings are present or the number of missing outer rings is known;

3. sticks, twigs, and small branches, because of the small number of rings;

4. large cross sections of architectural or fuel wood without outer rings;

5. charcoal from contexts such as hearth or ashpit fill;

6. scattered charcoal from excavation levels;

7. undocumented or poorly documented samples.

Smiley argues that these criteria should be applied to samples prior to submission for processing in order to minimize potential interpretive problems with resultant dates. For this project, I will apply the criteria to radiocarbon samples from Valdez phase sites when adequate documentation is available. Application of the criteria involves assigning a context quality category number and a material quality category number to the sample. The sum of the category numbers provides a "rank" for the sample. The lower the sum of context quality (1-3) and material quality (1-7), the closer the sample's dated event is to the target event. Conversely, the greater the sum, the more disparity there is likely to be between the sample's dated event and the target event. Smiley (1985:74) cautions that "common sense" be used and that archaeologists avoid rigidly adhering to the criteria in comparing samples to each other, but argues that the criteria can provide a credible means of assessing a sample's chronological value.

Table 32 lists the Valdez phase radiocarbon dates and their ranking according to Smiley's context and material quality criteria. The LA 2742 samples rank between 5 and 8; five of the seven samples rank higher than 6, the midpoint of the range of rank sums (2-10). The overall quality of the samples is generally low. Note, however, that context quality for four of the seven samples is 1 (highest) and the remaining three are 2, showing that samples were collected from appropriately high quality locations. In

Table 32. Valdez Phase: Radiocarbon Sample Context and Material Quality

SITE	SAMPLE	CONTEXT QUALITY	MATERIAL QUALITY	QUALITY SUM
LA 2742	B-46596	2	6	8
	B-46601	1	4	5
	B-47036	1	5	6
	B-46600	1	4	5
	B-46597	2	6	8
	B-46595	2	5	7
	B-46599	1	5	6
LA 70577	B-46604	1	5	6
	B-46602	2	5	7
	B-46606	1	5	6
	B-46603	1	4	5
	B-46605	1	5	6
KC:TGP:1	B-15478	2	6	8
TA-34	SMU-868	Not determined from published reference		
	SMU-867	Not determined from published reference		
Cerrita	B-8578	Not determined from published reference		
	B-8579	Not determined from published reference		

contrast, material quality ranges between 4 and 6. Thus, we see that material quality is primarily responsible for the low overall quality of the samples. If I look at the different materials submitted for dating (Table 21), I see that the juniper samples were collected from high-quality locations (both are upright roof-support posts found *in situ*). Material quality in both cases is 4 because outer rings were missing (B-46601 yielded a tree-ring date of 1122vv for the same reason). These samples, with sums of 5, have the highest quality of the seven LA 2742 samples. The pine samples are the next highest in overall quality. Two of the three samples are from high-quality locations: one is from the pithouse hearth and the other is from the pithouse ashpit. However, their material quality, coming from these contexts, is not good (5, in both cases). This accounts for the overall low quality of the samples. The third pine sample is from the site's shallow midden and consequently is of low quality. The corn samples, which we could expect to provide high-quality dates because they are from annual plants (Smiley 1985:70-71), are medium quality (2) in context and low quality (6) in material because they were collected from pithouse fill, which resulted from post-abandonment deterioration of the pithouse superstructure and consequent filling of the pithouse (Moore et al. 1994). Earlier, I observed that the pooled mean corn radiocarbon dates are closer to the site's archaeomagnetic date than are the juniper and pine dates. While we might expect this, since the corn samples are from annual plants, we must remember Smiley's cautionary statement regarding low contextual or material sample quality:

> If, by chance, the sample is dated close to [the target event], then either an error in the laboratory processing or an event of very low probability has occurred due to the vagaries of counting. Either way, the resulting chronometric data will not reflect reality. (Smiley 1985:62)

In other words, if a low quality sample returns a date close to the target event, it may be because of chance or error and cannot be used to assign or corroborate dates for the target event. This is applicable to the corn samples since I cannot define the samples' original depositional contexts. Although it does not explain the discrepancies between the individual dates of the two corn samples, particularly the early date for sample B-46596, it does caution us not to use the corn results to date the context from which they were collected. In fact, I must apply the same caution to the other LA 2742 radiocarbon samples. The overall low quality of the samples, resulting primarily from low material quality, results in radiocarbon dates that are unreliable, particularly in regard to dating the contexts from which the samples were collected.

The LA 70577 samples rank between 5 and 7, with three samples at 6, the midpoint of the range (Table 32). The quality of these samples is generally mediocre. Like the LA 2742 samples, this is conditioned primarily by material quality: four of the five LA 70577 samples have material quality values of 5 while one has a value of 4. In contrast, four of the five samples have context quality values of 1 and the fifth has a value of 2, showing that the context quality of the samples is high. Of the three conifer samples (not including the juniper sample), all were collected from high-quality locations: one is from a pithouse posthole, one is from the pithouse hearth, and the third is from the pithouse ashpit. Material quality of the posthole sample is 4, since the specimen's outer rings are not present. Material quality of the other samples is 5. The juniper sample is of low overall quality, as is the oak sample.

Given the overall low quality of the radiocarbon samples from LA 70577, resulting primarily from material quality, I must be cautious in arguing that the radiocarbon dates are contemporaneous with the site's archaeomagnetic date. If Smiley's contention about quality is correct, the apparent correlation between the dates may be the result of chance or error and I cannot assume that the dates are actually contemporaneous.

The only other site for which available information allows us to assess radiocarbon sample quality is KC:TGP:1 (LA 33063; Table 32). The charcoal sample, whose material was not recorded, was collected from a shallow midden deposit during a testing program (Moore 1986). Based on this information, the sample's overall quality is very low. Consequently, I cannot rely on the sample's date to indicate the time of the site's occupation.

Discussion. Assessment of Valdez phase radiocarbon samples reveals that the samples suffer from generally low quality. In particular, the samples are characterized by low material quality, although context quality is usually high. This suggests that samples were usually collected from appropriate contexts, but that materials available from those locations were limited in quality. We have seen that the overall low quality of the radiocarbon samples results in unreliable dates obtained from those samples. Analyzing the "central tendency" of the samples from each site revealed underlying structure in the samples that is obscured by the total range of dates. However, using radiocarbon dates to date a site or its components requires that we be assured of the integrity and quality of the samples.

Table 33. Valdez Phase: Obsidian Hydration Dates. Dates in Each Column Are Calculated Using the Effective Hydration Temperature (EHT) Determined by Ridings (1991) at Those Sites or from Air Temperature

SITE	SAMPLE NO.	DATES (A.D.)				REFERENCE
		Pot Creek	Sagebrush EHT	Cerrita EHT	Air EHT	
LA 2742	91-519	1080-1216	869-1035	-	-	Boyer et al. 1994a
	91-520	1304-1354	1190-1322	-	-	Boyer et al. 1994a
	91-521	1065-1199	909-1065	-	-	Boyer et al. 1994a
LA 70577	91-522	790-948	507-703	-	-	Boyer et al. 1994a
	91-523	742-902	447-647	-	-	Boyer et al. 1994a
	91-524	1225-1349	1049-1203	-	-	Boyer et al. 1994a
	91-525	1238-1360	1064-1216	-	-	Boyer et al. 1994a
	91-526	790-948	507-703	-	-	Boyer et al. 1994a
	91-527	1244-1366	1072-1224	-	-	Boyer et al. 1994a
	91-528	774-932	488-684	-	-	Boyer et al. 1994a
Cerrita[1]	22-518[2]	1284	1117	941	1097-1173	Ridings 1991
	22-518[3]	1312	1144	963	1128-1200	Ridings 1991
	11-510-1[2]	1318	1159	992	1043-1211	Ridings 1991
	11-510-1[3]	1345	1184	1011	1076-1238	Ridings 1991

[1] Both artifacts were recovered from pithouse fill. Ridings (1991:182) states: "As an estimate, the artifact should not be younger than the date given, which is the upper end of the range assuming a recovery depth of 75 cm."

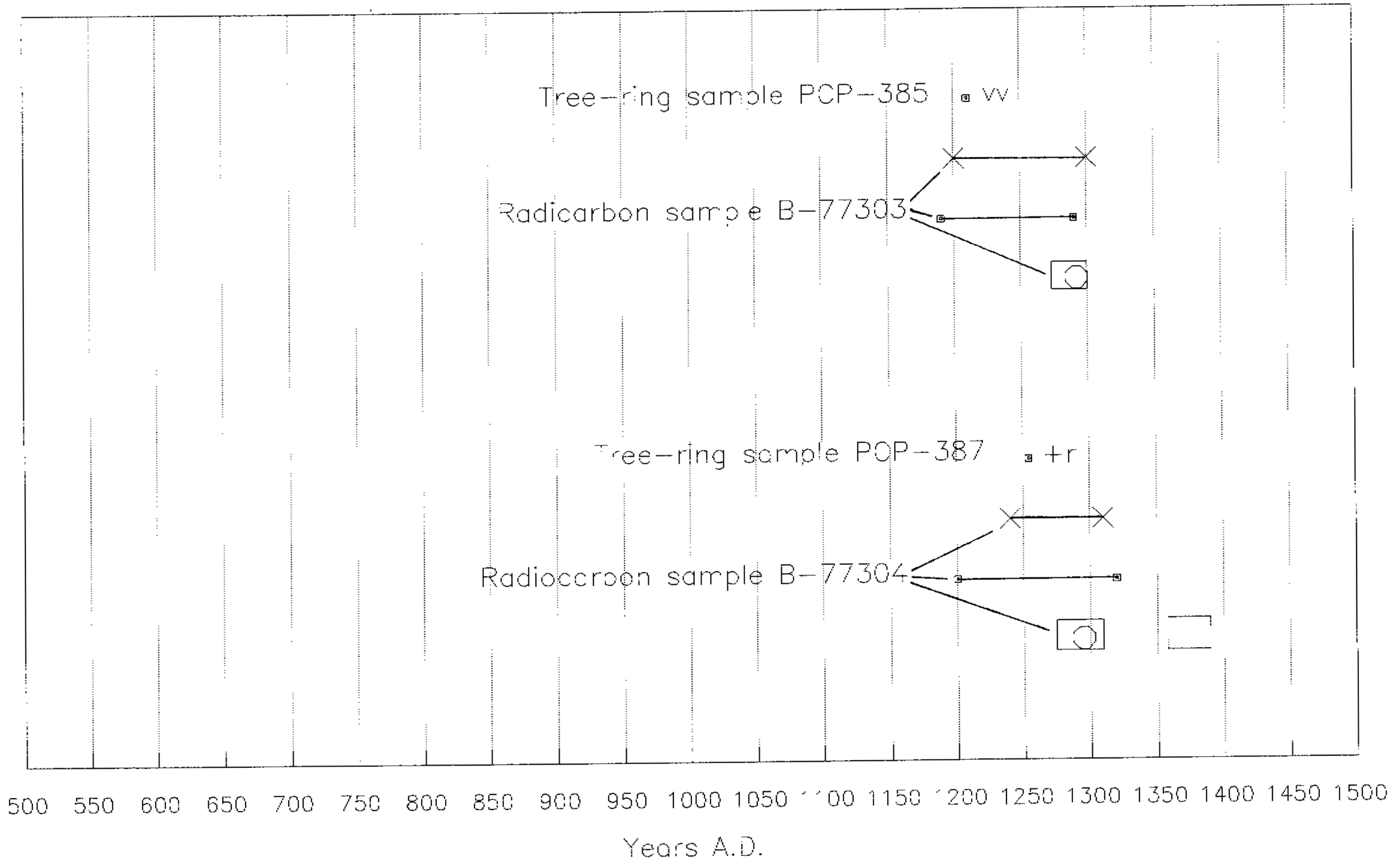
[2] Dates calculated using MOHLAB constants (Ridings 1991).

[3] Dates calculated using Archaeological and Historical Consultants, Inc. constants (Ridings 1991).

Obsidian Hydration Dates

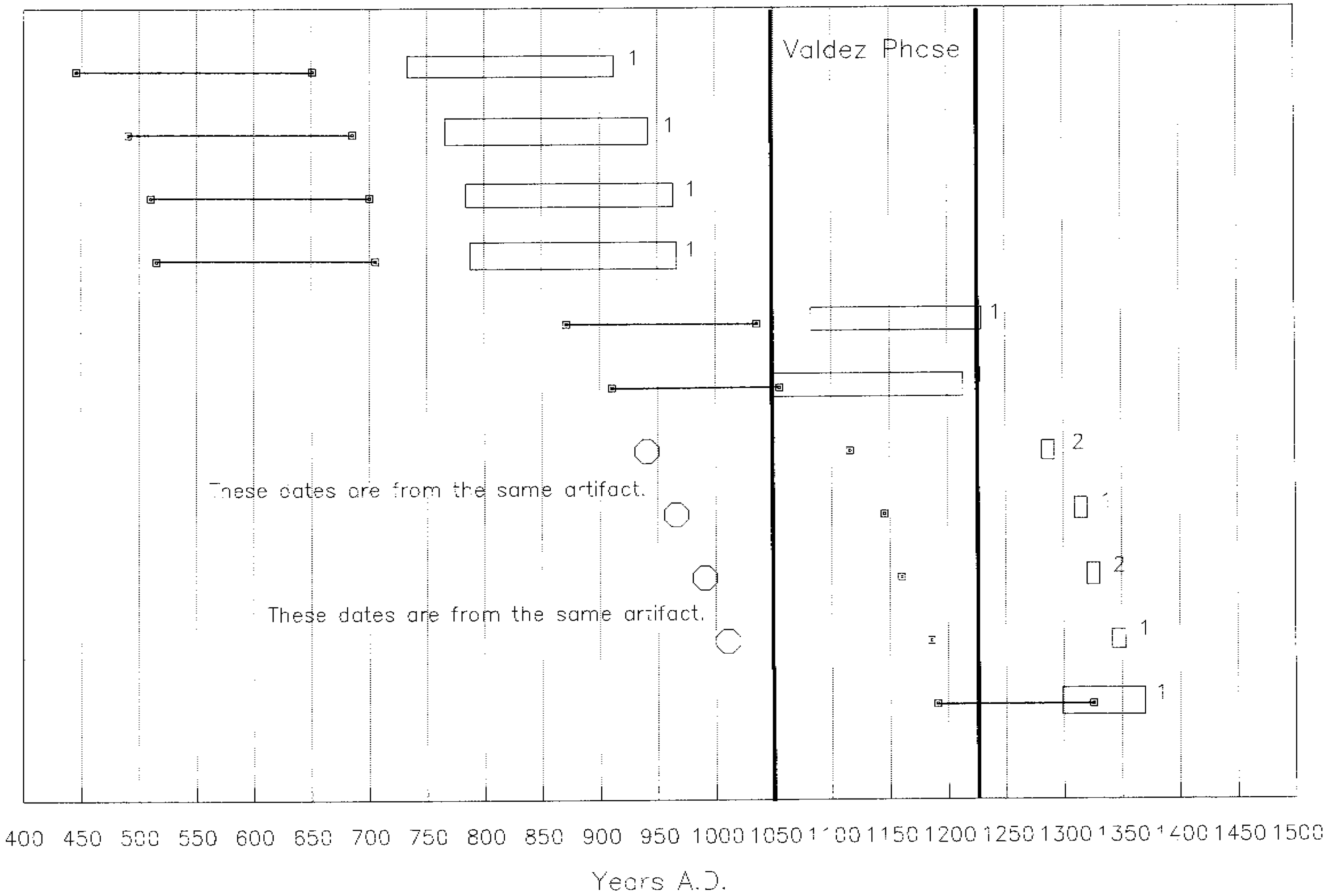
Table 33 lists the obsidian hydration dates obtained from Valdez phase sites. Most are from LA 2742 and LA 70577, excavated by OAS (Boyer et al. 1994a), while two samples from the Cerrita site were dated. Two dates are presented for each sample from LA 2742 and LA 70577. The dates are calculated using effective hydration temperatures (EHTs) determined by Ridings (1991) for Pot Creek Pueblo and Sagebrush Pueblo, both of which are near LA 2742 and LA 70577. The calculations included a hydration rate constant for Polvadera obsidian determined through induced hydration experiments by Archaeological and Historical Consultants (later Archaeological Services Consultants [ASC]).

Figure 13. Comparison of Pot Creek Pueblo Tree-Ring and Radiocarbon Dates



All dates: 1 sigma
X-line: measured date Solid line: conventional date
Box: calibrated date Circle: dendro-curve intercept date

Figure 14. Valdez Phase: Obsidian Hydration Dates



Box: Ridings Pot Creek EHT date
Solid line: Ridings Sagebrush EHT date
Circle: Ridings Cerrita EHT date

1: Dates calculated with ASC constants.
2: Dates calculated with MOHLAB constants.

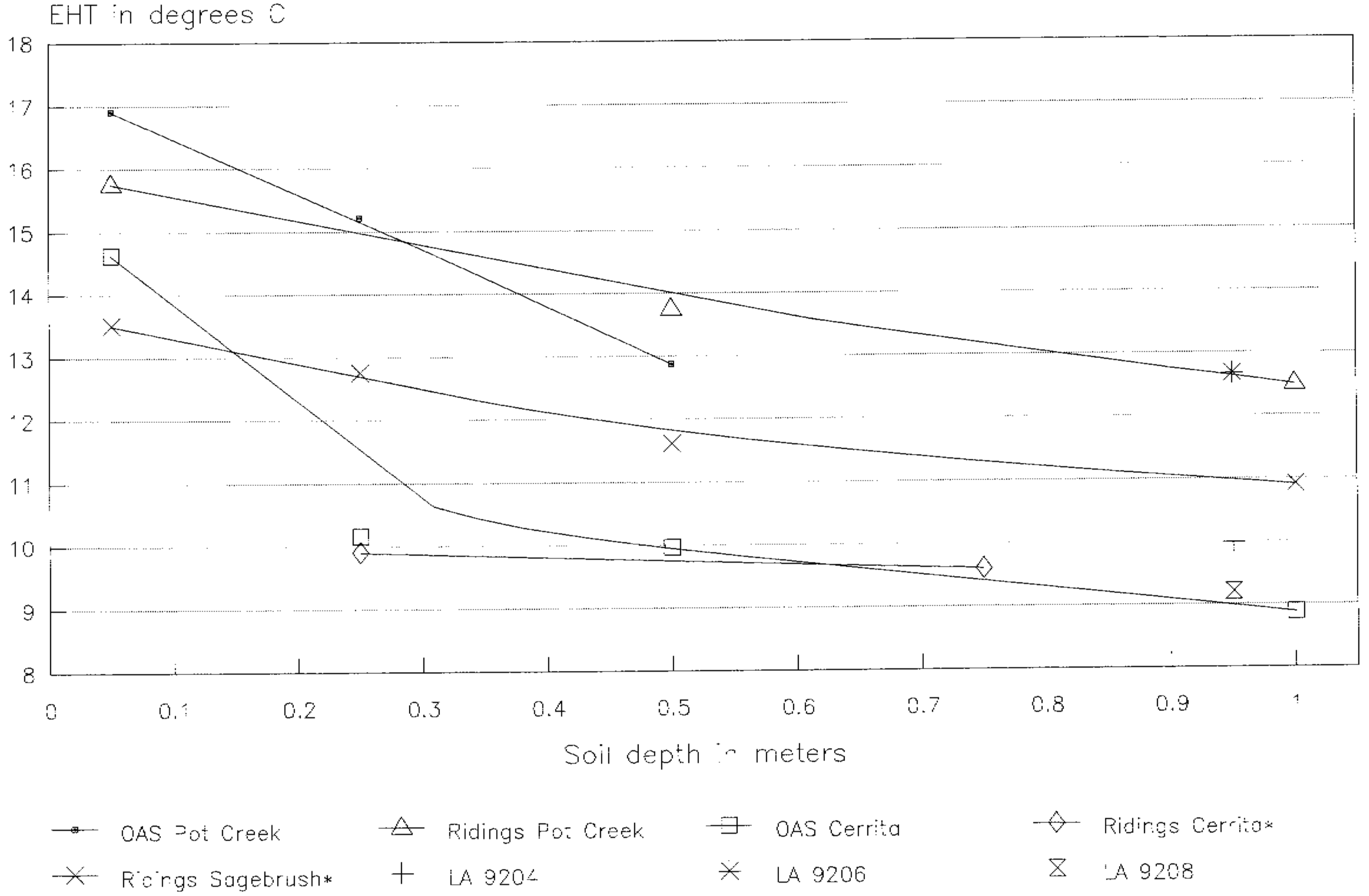


Figure 15. Effective Hydration Temperatures (EHTs)

*Points for Ridings' Cerrita and
Sagebrush EHTs are averages of her wet
and dry cell temperatures at each depth.

Eight dates are presented for the two samples from the Cerrita site. Ridings (1991) calculated the dates using her Pot Creek Pueblo, Sagebrush Pueblo, and Cerrita EHTs, as well as an EHT determined by air temperature in the Pot Creek region of the Rio Grande del Rancho Valley. In addition, she used two hydration rate constants for Polvadera obsidian, determined through induced hydration experiments by Mohlab and by ASC (Ridings 1991:80). For dates calculated using the air temperature EHT, Ridings provides ranges of years (Table 32). For dates calculated using the Pot Creek Pueblo, Sagebrush Pueblo, and Cerrita EHTs, she provides only one year. Concerning those one-year dates, Ridings (1991:82) states, "As an estimate, the artifact should not be younger than the date given, which is the upper end of the range assuming a recovery depth of 75 cm." That is, the date should be the latest or youngest age of the artifact.

Figure 14 shows that, like the radiocarbon dates, obsidian hydration dates span a wide range of years. Dates calculated with Ridings's Sagebrush EHT range from A.D. 447 to 1322, while those calculated with the Pot Creek EHT range from A.D. 742 to 1366. Further, Table 32 and Figure 15 show that there is little or no correspondence between dates obtained from the same artifact using the different EHTs.

Variability in Effective Hydration Temperature

Ridings's (1991) experiment focused on determining the variation in soil temperature and, thereby, in EHT at different depths at the same location and at different, but nearby sites:

> It seems logical, therefore, that in sites where obsidian artifacts are recovered in the top few meters of a cultural deposit, fluctuations in ground temperatures will have some effect on obsidian hydration rates, although the effect should decrease with depth. (Ridings 1991:78)

She goes on to state that, "a change of 1°C in the EHT has been shown to alter an obsidian hydration date by approximately 10%" (Ridings 1991:78).

In order to assess the potential variation of EHTs in the vicinity of Pot Creek Pueblo, Ridings buried pairs of "wet cells," thermal cells immersed in distilled water, at depths of 5 cm, 50 cm, and 1 m below modern ground surface at Pot Creek Pueblo. Since the wet cells would not provide a measure of soil humidity, she then buried pairs of wet cells and "dry cells," thermal cells not immersed in water, at depths of 5 cm, 25 cm, 50 cm, and 1 m at Sagebrush Pueblo, and 25 cm and 75 cm at Cerrita. Differences in cell weight gain represented the amount of soil humidity. EHTs calculated from these cells are adjusted for soil humidity, while the Pot Creek EHT is not adjusted for humidity.

Ridings's results (1991:81) are shown in Figure 15. They indicate considerable variation in EHTs at the three sites. Variation is greatest near modern ground surface and lessens with depth. At 5 cm below ground surface, there is an approximate 2.4-degree difference between the Pot Creek EHT and the average of the Sagebrush EHTs and a 3.4-degree difference between the Sagebrush average and the projected average of the Cerrita EHTs. These figures would result in 24 percent and 34 percent differences in dates. At 1 m below surface, the differences are approximately 1.6 and 1.45 degrees, resulting in 16 and 14.5 percent differences in dates. Differences in soil temperature are apparently largely due to natural factors:

> . . . fluctuations in soil temperature can be affected by variables that include amount of vegetation and the amount of shade it provides, air circulation near the ground, slope aspect, and slope gradient. The difference in EHTs recorded at Pot Creek and Cerrita illustrate the effects

> of some of these sources of soil temperature variability. Cerrita, for example, is on a northeast-facing slope with a relatively steep ridge rising behind it and, therefore, receives less afternoon sun in the summer than does Pot Creek. Pot Creek has only sagebrush and Rocky Mountain bee weed to provide shade, whereas Cerrita is located in a wooded area. (Ridings 1991:82)

The EHT differences are reflected in the dates Ridings (1991:82) presents for obsidian artifacts from the three sites. Based on these results, Ridings (1991:81, 83) concludes:

> This demonstrates the effects of using a cell EHT from one site in the calculation of dates for artifacts from another site. The Cerrita site is located at a distance of only about 1 km from Pot Creek Pueblo, but when the Cerrita cell EHTs were used in the calculation of an age estimate for Pot Creek artifact number 62-141, the means of those two estimates were about 500 years apart.
>
> . . .the largest dating error we could have made would have come from using the Pot Creek thermal cell EHTs to calculate dates for the Cerrita artifacts. The gap between the age estimate range based on the Pot Creek EHT and that based on the Cerrita EHT at the same depth for each of the Cerrita artifacts averages 338 years, although these gaps might be smaller if precise depth information were available.

Consequently, she asserts (Ridings 1991:81):

> As an alternative to using an air temperature EHT, it might seem logical to use a cell EHT from a nearby site instead. Our experiments suggest, however, that such a step could lead to misdating as well.

Not only do Ridings's data point out differences between even nearby sites, they also indicate significant differences associated with depth. Differences in EHTs from 5 cm to 1 m below ground surface are 3.2 degrees at Pot Creek and 2.45 degrees at Sagebrush. The Cerrita figures show the least difference with depth: 0.3 degree between 25 cm and 75 cm and a projected 0.5 degree between 5 cm and 1 m.

During this project we attempted to replicate, at least in part, Ridings's experiment and results. At Pot Creek Pueblo and at Cerrita, we buried pairs of wet and dry (temperature and humidity) cells at 5 cm, 25 cm, 50 cm, and 1 m below modern ground surface. The cells were left in the soil for one year, after which they were retrieved and returned to Christopher Stevens at Archaeological Services Consultants for processing. The results are shown in Table 34 and Figure 15. While our figures are not identical to Ridings's, there are important similarities. Our Pot Creek EHTs are much the same as Ridings's although our deepest cells at Pot Creek did not yield temperature or humidity data. Also, our Cerrita EHTS below 25 cm are very similar to Ridings's, although I cannot know if her experiment would have shown an increase in temperature in the topsoil. In any case, the differences between our Pot Creek and Cerrita EHTs are similar to Ridings's figures and support her conclusions that differences in EHTs between sites can be significant and can result in significant differences in hydration dates. They also show changes in EHTs with depth and support Ridings's (1991:84) contention that "exact depth provenience" must be controlled, both when determining EHTs and when calculating hydration dates.

Table 34. Effective Hydration Temperatures and Relative Soil Humidities: Pot Creek Pueblo, Cerrita, LA 9204, LA 9206, and LA 9208. (Temperatures are in degrees C. Relative humidities (rH) are in percent.)

CELL NO.	CELL TYPE	DEPTH BELOW MODERN GROUND SURFACE (cm)	TEMPERATURE OR RELATIVE HUMIDITY
Pot Creek Pueblo			
92-10	Temp	5	16.91
92-8	rH	5	90
92-16	Temp	25	15.21
92-25	rH	25	91
92-17	Temp	50	12.87
92-4	rH	50	NA
92-2	Temp	100	NA
92-12	rH	100	NA
Cerrita			
92-11	Temp	5	14.62
92-7	rH	5	97
92-3	Temp	25	10.16
92-19	rH	25	NA
92-1	Temp	50	9.96
92-13	rH	50	94
92-21	Temp	100	8.88
92-5	rH	100	95
LA 9204			
93-1	Temp	90-95	9.98
93-12	rH	90-95	95
LA 9206			
93-5	Temp	90-95	12.66
93-6	rH	90-95	96
LA 9208			
93-3	Temp	90-95	9.20
93-2	rH	90-95	96

In addition to this attempt to replicate Ridings's results, in order to determine whether EHT variability is indeed high between closely spaced sites, we buried pairs of cells at three sites in the northern community, LA 9204, LA 9206, and LA 9208. At LA 9204 and LA 9206, the cells were buried 90 to 95 cm below modern ground surface. At LA 9208, the cells were buried 90 to 95 cm below the backfill level within the partially excavated pithouse. At the northern sites, we did not bury cells at depths above 1 m because we were primarily concerned with documenting EHT variability at 1 m, a depth below the level at which soil temperatures fluctuate with daily fluctuations in air temperature, soil moisture, slope, vegetation, and other factors (Ridings 1991:78). At 1 m, soil temperatures change with long-term seasonal fluctuations rather than short-term daily fluctuations.

Like the Pot Creek and Cerrita cells, the northern site cells were left in the ground for one year. The results are shown in Table 34 and Figure 15. They resemble the results from Pot Creek and Cerrita in showing considerable differences in EHTs. Interestingly, the LA 9204 and LA 9208 EHTs are only 0.78 degrees different, while they are about 3 degrees lower than the LA 9206 EHTs. These differences may be conditioned by seasonal factors, such as amount and distribution of precipitation, vegetative shade, slope, and direction (Ridings 1991:78). In the case of the three northern sites, all are in essentially the same topographic situation. However, the locations at which cells were buried at LA 9204 and LA 9208 were beneath piñon-juniper tree-cover, while the LA 9206 location was in an opening in the trees surrounding the site's pithouse. Thus, the LA 9206 location was rarely in the shade and probably held snow-cover for shorter periods of time than the LA 9204 and LA 9208 locations, which were under nearly constant shade and would have held snow longer. In this situation, I would expect the LA 9204 and LA 9208 1 m EHTs to be lower than the LA 9206 1 m EHT, as is seen in the differences between Pot Creek Pueblo and Cerrita. Table 34 shows this to be the case. The differences in the LA 9204 and LA 9208 EHTs would result in minimal differences in dates, but the much higher EHT from LA 9206 would produce dates that could be younger by about 28 to 35 percent if used in place of the EHTs from the other sites.

These data support Ridings's (1991:84) contention that, "Since the factors that affect soil temperature fluctuation can vary over a relatively small space, using a cell EHT from a nearby site also has the potential for producing misleading results." Our data show that differences between the Pot Creek and Cerrita EHTs and the LA 9204, LA 9206, and LA 9208 EHTs would result in significantly different hydration dates if artifacts from one site were dated with EHTs from another nearby site. The exceptions to this are the EHTs from LA 9204 and LA 9208, which are similar and would yield dates within 10 percent of each other.

The data suggest another cautionary note. Factors like shade and ground cover and consequent distributions of precipitation can vary across a site in the same ways that they can vary between sites. Consequently, we might expect that EHTs defined from one area within a site may not represent soil temperatures and their effects on hydration rates across the site, even at the same depth. For instance, had our cell location at LA 9206 been beneath tree cover rather than in the open, the 1-m EHT might have been lower in degrees, closer to the EHTs from LA 9204 and LA 9208. The converse would be expected had the cell locations at LA 9204 and LA 9208 been in open areas rather than under tree cover.

Sample Context

In addition to the apparently highly variable effects of soil temperature on hydration dates, Ridings points out the problem of sample context in assessing the reliability of dates:

> . . .I did not have precise information on the depth at which all of the artifacts were recovered. For example, both of the Cerrita artifacts were found in the fill of a pithouse that was more than 3.5 m deep. Field records show that the upper 55 cm of the deposit was topsoil and modern overburden, and that the pithouse had been used as a trash dump by later prehistoric occupants of the site. Therefore, it is likely that these two obsidian artifacts postdate the pithouse occupation. (Ridings 1991:80)

She goes on to say:

> Finally, all of these artifacts represent isolated finds, which are not particularly good choices for obsidian hydration dating. To what are we actually assigning an age in such cases? The depositional history of an isolated flake and its relationship to the feature from which it was recovered are usually difficult to ascertain. A more secure date can be obtained only by examining several pieces from a collection or cache of obsidian artifacts excavated from a context such as a toolmaking area or a burial. (Ridings 1991:80-81)

Ridings then points out an underlying supposition in hydration dating:

> The manner in which obsidian hydration dates are calculated assumes that an artifact has always been at the depth at which is was found, and, therefore, was only ever exposed to the temperature at that depth. In most cases, we can be reasonably sure that these assumptions are not true. (Ridings 1991:83)

The effect of this supposition is that the hydration rim or rind thickness accurately reflects the hydration process as determined by the EHT at the depth the artifact was found. However, "We have found that artifacts recovered from the same depth can have widely varying hydration rim thicknesses. If they are all proven to be from the same source, the rim thicknesses indicate varying thermal histories" (Ridings 1991:83).

Thus, the dates Ridings obtained for the two Cerrita artifacts cannot reliably be associated with the pithouse from which they were recovered. Ridings (1991:80) is forced to define an excavation context for the artifacts for which she has no supporting evidence. She arbitrarily assumes that the artifacts were recovered from a depth of 75 cm below modern ground surface. Since the field excavation notes state that the pithouse fill below 55 cm was trash from a later occupation of the site, assigning the artifacts to a depth below 55 cm places them in a cultural deposit post-dating the pithouse but within the years of the site's occupation. I might, then, be able to conclude that the artifacts were directly deposited in the trash. If I were to apply Smiley's (1985) contextual criteria for radiocarbon samples to the Cerrita obsidian samples, a midden deposit in the abandoned pithouse would be a secondary context, a less-than-ideal situation for a dating sample. Still, if Ridings is correct in this assignment, the artifact dates could be associated with a post-pithouse occupation of the site.

However, since Ridings is clear that she made an arbitrary choice to assume the artifacts came from more than 55 cm below ground surface, it seems just as possible that the artifacts came from less than 55 cm below surface. If so, then the artifacts were probably deposited in the pithouse depression by natural processes that also deposited topsoil and "modern overburden," in which case it is impossible to associate their hydration dates with cultural features or events. This would certainly qualify as a secondary context and, since Ridings apparently does not really know the depth proveniences of the artifacts, I could assert that the artifacts came from an unknown context. I cannot know how long they may have been on the site surface or in some other context prior to redeposition in the pithouse fill. To use Ridings's terms, I cannot know their "thermal histories." I am, then, left with the same contextual problems for the Cerrita obsidian hydration dates that characterize the Cerrita radiocarbon dates. Not knowing the pre-depositional and depositional histories of the samples, I am precluded from placing faith in their dates.

Given the situation with the Cerrita obsidian artifacts, it is reasonable to check the contexts of the obsidian artifacts from LA 2742 and LA 70577 in order to assess their dates. Five obsidian flakes from LA 2742 were submitted to Archaeological Services Consultants for hydration dating (Moore 1991). Three were visually identified as coming from the Polvadera source, while two were identified as coming from one of the Jemez sources. Because accurate identification of the source is critical for determining hydration rates, only the Polvadera obsidian artifacts were dated, since Polvadera obsidian is distinctive in its visual characteristics (see Ridings [1991:80] for a similar discussion). The dates are reported in Table 33. Sample 91-519 is from approximately 1.5 m below modern ground surface (level 15) within the pithouse, a secondary deposit context. Samples 91-520 and 91-521 are from the fill of a shallow midden north of the pithouse, also a secondary deposit context. Thus, the collection contexts of the LA 2742 artifacts are less than ideal if I wish to obtain dates that I can associate with site features or on-site activities.

Twelve obsidian artifacts from LA 70577 were also submitted for dating (Moore 1991). Five were from one of the Jemez sources, while seven were visually identified as coming from the Polvadera source. Only those seven were dated; the results are reported in Table 33. Of the seven artifacts, five were collected from strata within the site's pithouse: sample 91-522 from a thin ash lens and samples 91-523 through 91-926 from stratum 3, a thick stratum of loose colluvial soil comprising the lower half of the fill of the 2.9 m deep pithouse (Boyer et al. 1994a). These strata are secondary deposit contexts. Since the pithouse at LA 70577 filled by natural colluvial processes, artifacts found in the fill, including the obsidian flakes, were redeposited from other contexts on or near the surface of the site around the pithouse. Sample 91-527 was collected from Feature 7, the pithouse ventilator chamber, showing that it, like the artifacts from the structure fill, was redeposited. Sample 91-528 was collected from Feature 6, the pithouse ash pit. The ash pit was also probably not a use or activity location for obsidian tools. Although it may have been a disposal feature for chipped-stone debris generated by activities around the hearth and ash pit features, that possibility cannot be demonstrated. Consequently, I must assume that the artifact came from a secondary deposit context because I cannot define the processes by which it was deposited in the ash pit. Like the LA 2742 dated obsidian artifacts, the LA 70577 artifacts were collected from secondary contexts and I cannot associate the dates obtained with site features or on-site activities.

Discussion

Assessment of Valdez phase obsidian hydration samples shows that a number of factors affect the reliability of the dates. My data support Ridings's (1991) conclusions that effective hydration temperatures (EHTs) can vary significantly with soil depth and between sites. The conditions affecting that variability could also occur across a single site, suggesting that EHT variation might be expected to be inconsistent across a site. Since a 1-degree change in EHT can result in a 10 percent difference in dates, variability in EHTs within and between sites can have significant effects on resultant dates. Ridings's cautionary statements that use of an EHT from one site to calculate hydration dates from another site, even nearby, can produce misleading results are warranted, and should be applied within sites, as well.

Further, the integrity or quality of the context from which an artifact is collected must be considered. Examination of depositional contexts of dated obsidian artifacts from Cerrita, LA 2742, and LA 70577 reveals that the artifacts were collected from secondary deposit contexts and were likely redeposited from their original post-use locations. Consequently, we cannot be sure of the "thermal histories" of the artifacts (the conditions under which their hydration rims formed) or of any clear association between the artifacts and site features, on-site activities, or activity locations.

Considering these conditions, what interpretations can we draw from the Valdez phase obsidian hydration dates? Hydration dates for the Cerrita artifacts vary according to which EHT and which rate constant are used by Ridings (1991). Ridings presents the youngest or latest date obtained using her Pot Creek, Sagebrush, and Cerrita EHTs and date ranges obtained using the air EHT (Table 33). Comparison of the hydration dates with the phase dates defined using tree-ring and archaeomagnetic dates shows that the hydration dates calculated using the Sagebrush and air EHTs most closely resemble the phase dates. The Pot Creek EHT dates seem to be too young, while the Cerrita EHT dates seem too old. However, since it seems clear that hydration dates must be calculated using an EHT from the collection site, we should disregard the hydration dates calculated with the Pot Creek, Sagebrush, and air EHTs. The Cerrita EHT dates are in the tenth and early eleventh centuries, considerably older than the phase dates, and older than the archaeomagnetic date from the earliest pithouse hearth. The dates suggest that the obsidian artifacts are actually older than the site from which they were collected. Two explanations are possible: the site may have an older component or the artifacts may have been collected from an older site by the Anasazi occupants of the Cerrita site. Given the lack of available information on the site, I cannot securely identify one or the other possible alternative as the most likely explanation for the older hydration dates. However, Woosley's (1986) description of the site, although brief and relatively nonspecific, provides no evidence for a component older than the earliest pithouse. This would suggest that the second possibility is more likely, that the site's Anasazi occupants collected obsidian artifacts from an older site or sites.

Ridings's Pot Creek and Sagebrush EHTs were used to calculate hydration dates for the artifacts from LA 2742 (Table 33). Of the three Pot Creek EHT dates, two correspond to the site's Valdez phase occupation (though they are much longer ranges than the site's archaeomagnetic date), while one is much younger. These dates might suggest that the site was visited during the early fourteenth century, well after it was abandoned by its Valdez phase occupants. Of the three Sagebrush EHT dates for the same artifact, two are older than the site's dates, while one more closely resembles the archaeomagnetic dates. These dates might suggest that the site had a component older than the pithouse or that the site's occupants collected obsidian artifacts from an older site or sites. Since Moore and others (1994) provide a detailed site description, I can evaluate these alternatives, although I cannot determine the accuracy of the dates since they were not calculated with an EHT from LA 2742. While the pithouse was remodeled during its lifetime, and so may have been occupied longer than most pithouses, Moore and others (1994:109-111) have no evidence for an older component or for a younger, fourteenth-century component. Ceramic and chronometric dates point to a single Valdez phase component represented by the pithouse and associated midden. If I eliminate the alternatives of older and younger components, I am left with the possibility that the site occupants collected artifacts from an older site or sites.

Like the LA 2742 artifacts, hydration dates for obsidian artifacts from LA 70577 were calculated using Ridings's Pot Creek and Sagebrush EHTs (Table 33). Regardless of the EHT used, the seven dates cluster in two groups. Of the seven Pot Creek EHT dates, four fall in the late eighth, ninth, and early tenth centuries, while three fall in the thirteenth and fourteenth centuries. The first group is much older than the site's archaeomagnetic date, while the second group is much younger. These dates could suggest components older and younger than the site's pithouse. Of the seven Sagebrush EHT dates, four fall in the late fifth, sixth, and seventh centuries, while three fall in the late eleventh, twelfth, and early thirteenth centuries. The first group is much older than the site's archaeomagnetic date, while the second group corresponds to the site's Valdez phase occupation, although, like the LA 2742 artifacts, the hydration dates are much longer ranges than the archaeomagnetic date range. Like the LA 2742 dates, these LA 70577 date groups could suggest that the site had an older component or that the site occupants collected artifacts from an older site or sites. Excavations at LA 70577 revealed no evidence for components either pre-dating or post-dating the site's Vàldez phase pithouse component (Boyer et al. 1994b). Ceramic and archaeomagnetic dates point to a single, relatively short-lived, Valdez phase component represented by the pithouse and external surface structure. The pithouse was not remodeled and was undoubtedly occupied for a shorter time than LA 2742. Once abandoned, the site was not reoccupied. Thus, I can eliminate the possibilities of earlier and later components, and am left with the alternative that the site occupants collected obsidian artifacts from an older site or sites.

Because of the ambiguities resulting from variability in EHTs between sites and from the deposition and collection contexts of the artifacts, I can have little confidence in the dates obtained from the artifacts, with the possible exception of the Cerrita dates calculated with the Cerrita EHT. The Cerrita dates are older than the site's occupation and point to artifact collection by the site's occupants. Some of the LA 2742 and LA 70577 dates also seem to be much older than the sites' occupations, while other dates seem to be approximately contemporaneous with the sites' occupations. Together, a review of Valdez phase obsidian hydration dates suggests that the Anasazi occupants of the sites collected and used obsidian artifacts from older sites and that this may have been a common activity.

The possibility that Valdez phase Anasazi were collecting obsidian artifacts from older sites provokes interesting questions about procurement and use of nonlocal chipped stone materials. Was the collection and use of artifacts from other sites a common practice among the Anasazi? Was the practice more common during early Anasazi phases than during later phases? How were the collected artifacts used by the Anasazi and how did those uses differ from their previous, older functions? Was this practice limited to "exotic," nonlocal materials or did it also apply to local materials? Answering these questions could be an important test of the notion of an Anasazi frontier, particularly as it conditioned economic interactions between frontier and core-area populations. For instance, we might expect that the use of collected obsidian artifacts was more common during the earlier years of frontier settlement (the Valdez phase), when the settlers experienced decreased sociocultural complexity and relative isolation from core-area populations and resources (Boyer 1994c) than in later years, after the frontier population was established and relationships with the core area were less attenuated. In this situation, while obsidian was a nonlocal material to the residents of the Taos Valley, the presence of obsidian on older sites made it a sort of local material in the sense that it could be collected locally rather than coming into the area through exchange networks or long-distance procurement trips. If so, then we might expect that, as social and economic interactions between frontier settlers and core-area populations became less attenuated, less evidence of artifact collection and reuse and more evidence of nonlocal materials being brought directly into the communities will be found. It is not the point of this project to present a set of frontier research guidelines. However, this discussion serves to illustrate a point: while obsidian hydration dating may not be useful for dating Anasazi sites, both because of the ambiguities of the technique and the size of the date ranges that often result, the technique may be useful for examining patterns of obsidian procurement and use by the Anasazi.

ACCURACY AND PRECISION

Accuracy

We have seen that definitions of the Valdez phase as 200 to 300 years long (Wetherington 1968; Loose 1974; Green 1976; see also Woosley 1986) are inaccurate, as are those suggesting a time frame of about 100 years (Peckham and Reed 1963; Wolfman et al. 1965; Boyer 1994b; see also Dick 1965; Dick et al. 1966). The most accurate dates for the Valdez phase, based on available chronometric data, are A.D. 1050 to 1225. I have established these dates using tree-ring and, particularly, archaeomagnetic dates. My analyses of archaeomagnetic dates produced a best mean phase date of 1075 to 1225; I push the early date back to 1050 to accommodate the only clearly pre-1100 date obtained so far. Having established these dates, we can compare other dates against them to assess the accuracy of the new dates. I compared the archaeomagnetic date from LA 53678 to the phase dates and found it to be younger. To determine the significance of this situation, I examined the context and condition of the sample and found that the date is probably unreliable. This information shows that the LA 53678 date is probably inaccurate.

I also compared radiocarbon and obsidian hydration dates from Valdez phase sites with the phase dates. When I found significant discrepancies, I assessed their potential sources. Concerning the radiocarbon dates, I examined the possibility of sample contamination, whether the radiocarbon samples from each site represented a single set of samples with the same or nearly the same ages, whether material variation affected the dates, and the effects of context quality. I found that considerable variability is present in the radiocarbon dates and that definition of that variability is necessary if we are to assess the accuracy of the dates. Generally, the radiocarbon dates are not accurate in their correlation with phase dates or with archaeomagnetic dates from the individual sites. An exception may be the dates from LA 70577, which may be contemporaneous with the site's archaeomagnetic date and with the phase dates. Consideration of sample quality shows that most of the samples submitted for dating suffer from relatively low quality, primarily low material quality. This results in unreliable dates, so that even in the cases in which the central tendency of the samples is strong, the accuracy of the dates may be more apparent than real.

Concerning obsidian hydration dates, I observed the necessity of controlling for variability in soil temperature within and between sites. Because I cannot calculate hydration dates using site-specific effective hydration temperatures (EHTs) for LA 2742 and LA 70577, I cannot determine whether the dates from these sites are accurate in terms of their correspondence to site or phase dates. In the case of the Cerrita dates, I can determine that those calculated with the Cerrita EHT are probably the best dates. They do not, however, correspond to the site's dates or to the phase dates. Those dates, and several from LA 2742 and LA 70577, do suggest that the sites' occupants collected and used obsidian artifacts from older sites. Thus, the dates may, if calculated using appropriate EHTs, accurately reflect the ages of other sites and events, although not the sites on which they were found.

Precision

In "Research Questions," I suggested that tree-ring and archaeomagnetic dates will provide the greatest precision because they should yield the smallest ranges of time within which a sample could date. Ideally, tree-ring dates would not be seen as yielding date ranges, since the results of dating are presented as a single-year inner and outer ring date, of which the outer ring is relevant to dating events associated with a site or its features. When the outer-ring date is a cutting date, a more immediate association with events involving a site or its features is potentially presented. However, when the outer-ring date is not a cutting date, that association is obscured by the loss of an unknown number of years represented by missing rings. In that case, a date range results. As an experiment to determine how long that range might be, I calculated the mean difference in years between tree-ring noncutting dates and the nearest younger cutting date. To determine the differences, I subtracted from a cutting date the noncutting dates between it and the next older cutting date and averaged the differences. Because we have only four Valdez phase tree-ring dates, I also calculated the differences for the two Pot Creek phase sites with tree-ring dates, PC-58 and LA 1892 (Figs. 4 and 5), from which I determined a Pot Creek phase mean, and for Pot Creek Pueblo, the only excavated Talpa phase site (Crown 1991). The results are shown in Table 35. The mean difference among the Valdez phase dates is 33.3 years, while the mean difference among the Pot Creek phase dates is 6.5 years. Among the Pot Creek Pueblo dates, the mean difference is 8.0 years. Clearly, I cannot argue that these figures represent the actual average date ranges between noncutting dates and outer rings of the dated specimens, since it is not possible to know the outer-ring dates of samples that yield only noncutting dates. As Table 35 also shows, the ranges of differences are sizeable, up to 98 years at Pot Creek Pueblo. However, that 98-year difference is unique and, if it is disregarded, the range of differences among the Pot Creek Pueblo dates is 1 to 38 years and the mean difference is 7.0 years. Given that situation, I can suggest that the differences between noncutting and cutting dates may generally be relatively minimal and that tree-ring dating, even when it involves noncutting dates, can be relatively precise.

Table 35. Valdez, Pot Creek, and Talpa Phase Tree-Ring Dates: Mean Differences in Years Between Noncutting Dates and Nearest Younger Cutting Dates

	PHASES				
	Valdez	*Pot Creek*			*Talpa*
		PC-58	LA 1892	Phase	Pot Creek Pueblo
Mean	33.3	2.8	6.5	6.5	8.0
Range	5-70	0-17	0-32	0-32	1-99

In many ways, this conclusion seems obvious. Most field archaeologists would prefer to use tree-ring dates to attach absolute time to their sites, primarily because tree-ring dates are single-year dates. They present the appearance of the maximum precision one could reasonable hope for: a single year and, perhaps, under the right conditions, a season during which a tree or tree-limb was cut. However, Crown's (1991) study of Pot Creek Pueblo tree-ring dates points out complexity inherent in tree-ring dates that can preclude simplicity in interpretation:

> Tree-ring dates alone are not sufficient for deciphering a complex sequence of room use, remodeling, and abandonment. The construction sequence . . . combines wall-abutment information, tree-ring dates, and stratigraphy. These data indicate that rooms with multiple cutting dates either underwent repair/remodeling at intervals, or were built using stockpiled/recycled roofing beams. (Crown 1991:310)

Clearly, the study and interpretation of 213 tree-ring dates from a large, multistructure, multiroom site such as Pot Creek Pueblo (Crown 1991) is a more complex undertaking than evaluating one tree-ring date from a Valdez phase pithouse. As I (Boyer 1994a:404-407) point out, however, most excavated pithouses show evidence of salvaging architectural features (i.e., roof beams and roof-support systems) by the absence of these features. That is, most excavated pithouses do not contain roof beams or upright support posts and their postholes were opened during site abandonment to remove the upright posts. We also know that some pithouses were remodeled and that remodeling sometimes involved replacement of posts and beams (Peckham and Reed 1963; Moore et al. 1994; Boyer 1994a). This suggests that recycling large wooden architectural elements from one pithouse to another was a very common practice during the Valdez phase. If so, we must suspect and perhaps assume that wooden beams and posts may not be original features in the structures in which they are found. Consequently, dates from these beams and posts, both cutting and noncutting, provide strong evidence for construction timing during the Valdez phase (see "Valdez Phase Chronometric Dates") but probably not specifically for the pithouses in which they are found. With this in mind, I conclude that tree-ring dates from Valdez phase sites must be evaluated in light of other dates, particularly archaeomagnetic dates from the same structures, in order to assess their accuracy, precision, and association with the structures from which they are recovered.

Table 36. Valdez Phase Archaeomagnetic, Radiocarbon, and Obsidian Hydration Dates: Comparison of Lengths in Years of Date Ranges

	DATING TECHNIQUE					
	Archaeomagnetic (2-sigma)	*Radiocarbon (1-sigma)*		*Obsidian Hydration (1-sigma)*		
		Measured/ Conventional	Calibrated	Pot Creek EHT	Sagebrush EHT	Air EHT
Mean	79.56	151.88	151.57	140.02	144.49	148.11
Range	29.63	43.17	59.25	54.03	51.76	58.77

The other chronometric techniques discussed in this report yield sample ages expressed as ranges of dates. In order to assess the precision of the date ranges, I calculated the mean length of those ranges for each technique, using the dates obtained from Valdez phase sites. The results, which are striking, are shown in Table 36. Archaeomagnetic date ranges, expressed to two standard deviations (two-sigma), are about half as long as one-sigma radiocarbon and obsidian hydration date ranges. Two-sigma Valdez phase archaeomagnetic date ranges average 79.56 years in length, while one-sigma radiocarbon ranges average over 150 years and obsidian hydration ranges average over 140 years. These data show that archaeomagnetic dates are the most precise (have the shortest date ranges). This is certainly convenient, since they are also most clearly associated with actual site features (usually hearths) and events (the last firing of the feature). The relative imprecision of radiocarbon and hydration dating is related to ambiguities inherent in the techniques, the samples, and the dates that are discussed in "Chronometric Discrepancies." The average lengths of radiocarbon and hydration date ranges are critical in this regard, because at 140+ to 150+ years, they can tell us little about a site's date except, at best, it was occupied during the Valdez phase. Since we often can learn as much by looking at the site's surface ceramic assemblage, chronometric dates that are as long as, nearly as long as, or longer than a phase are less than useful. Further, I have observed that we must be able to determine and assess the depositional and material integrity of the samples before we can interpret the dates. Radiocarbon and hydration dates can reveal important information on the procurement and uses of various materials, even though their relative lack of precision and potential for contextual ambiguity may preclude their use to date sites or site features.

CONCLUSIONS: DATING THE VALDEZ PHASE

Summarizing the Project Results

I begin my conclusions by summarizing the project's results in reference to the questions posed in "Research Questions."

1. What are the dates of the Valdez phase?

Tree-ring dates from Valdez phase sites, while a small sample, show construction of sites after A.D. 1100 and, for the most part, after 1120. Because so few dates are available, they do not clearly point to an ending date for the phase. However, a larger body of tree-ring dates from Pot Creek phase sites shows that the transition to small, aggregated, surface-structure villages took place in the early 1200s.

Re-excavation of several Valdez phase sites provided us with a larger body of archaeomagnetic samples than were available before this project. Analyses of those samples and their resultant dates provide a mean phase date of A.D. 1075 to 1225. The necessity of accommodating one clearly pre-1100 date results in dates for the phase of 1050 to 1225.

Like the tree-ring dates, archaeomagnetic dates are most frequent in the 1100s. Only one-quarter of the samples could date before 1100 and less than 13 percent could date before 1050, while less than one-third could date after 1220. The largest percent could date between 1130 and 1210. I argue that these figures and the tree-ring dates show that the initial Anasazi movement into the Taos district took place in the last half of the eleventh century and that the numerous twelfth century dates represent increased immigration, internal population growth, and significant internal population movement during that century. There is no evidence to suggest that there was an "evolution" from simple pithouse sites to more complex sites with pithouses (or kivas) and surface structures during the course of the phase.

2. Are there significant differences in the timing of the formation of the northern and southern "communities" (was one formed earlier than the other)?

Analyses of archaeomagnetic dates reveal no significant differences between north community dates and phase dates, between south community dates and phase dates, or between north community and south community dates. I conclude from these results that one group of sites was not significantly older than the other. Although the earliest date came from a site in the northern community, there is no chronometric evidence that the northern community is older than the southern community. I argue that the two groups of sites are contemporaneous.

3. Can we isolate the cause(s) of chronometric discrepancies between techniques, which is critical for assessing the significance of dates obtained by different techniques?

a. Why has radiocarbon dating often yielded dates that are significantly older than dates obtained by other chronometric techniques?

Comparative radiocarbon and tree-ring dating of log samples from Pot Creek Pueblo show that contamination by calcium carbonate from the soil in the Pot Creek area probably was not a factor in producing radiocarbon dates from nearby sites that are older than associated tree-ring and archaeomagnetic dates.

Analysis of the central tendency of four series of Valdez phase radiocarbon dates suggests several conclusions. First, pooling or averaging dates is useful for determining whether dates that appear to be widely dispersed may actually have the same or nearly the same ages and may actually be contemporaneous with other associated dates. However, it is important to assess the effect of variation in materials within the sample group, since my analysis shows that material variation is an important source of date dispersion.

Examination of Valdez phase radiocarbon sample context and material quality reveals that the samples suffer from generally low quality. In particular, the samples are characterized by low material quality, although context quality is usually high. This suggests that samples were usually collected from appropriate contexts, but that materials available from those locations were limited in quality, resulting in unreliable radiocarbon dates. I argue that low sample quality is the primary cause of radiocarbon dates that are older than other associated dates. This information requires that we be assured of the integrity and quality of the samples, particularly the material quality.

b. How much variation in ground temperature is present at sites throughout the region and how are obsidian hydration dates affected by this variation?

In an attempt to replicate Ridings's (1991) experimental results, we buried temperature and humidity cells at Pot Creek Pueblo and the Cerrita site. Resulting effective hydration temperature (EHT) and soil humidity values are very similar to Ridings's and support her conclusions that EHT can vary significantly between sites and within sites at different depths. Since EHT variation can result in a change in calculated hydration date of 10 percent for each degree of EHT difference, the 1 to 3 degree differences observed by Ridings and replicated by this experiment can be expected to produce significant variation in hydration dates. This is seen in Ridings's dates for artifacts from Pot Creek Pueblo, Sagebrush Pueblo, and Cerrita. It is also shown in dates from LA 2742 and LA 70577, which were not calculated with the benefit of EHTs from those sites.

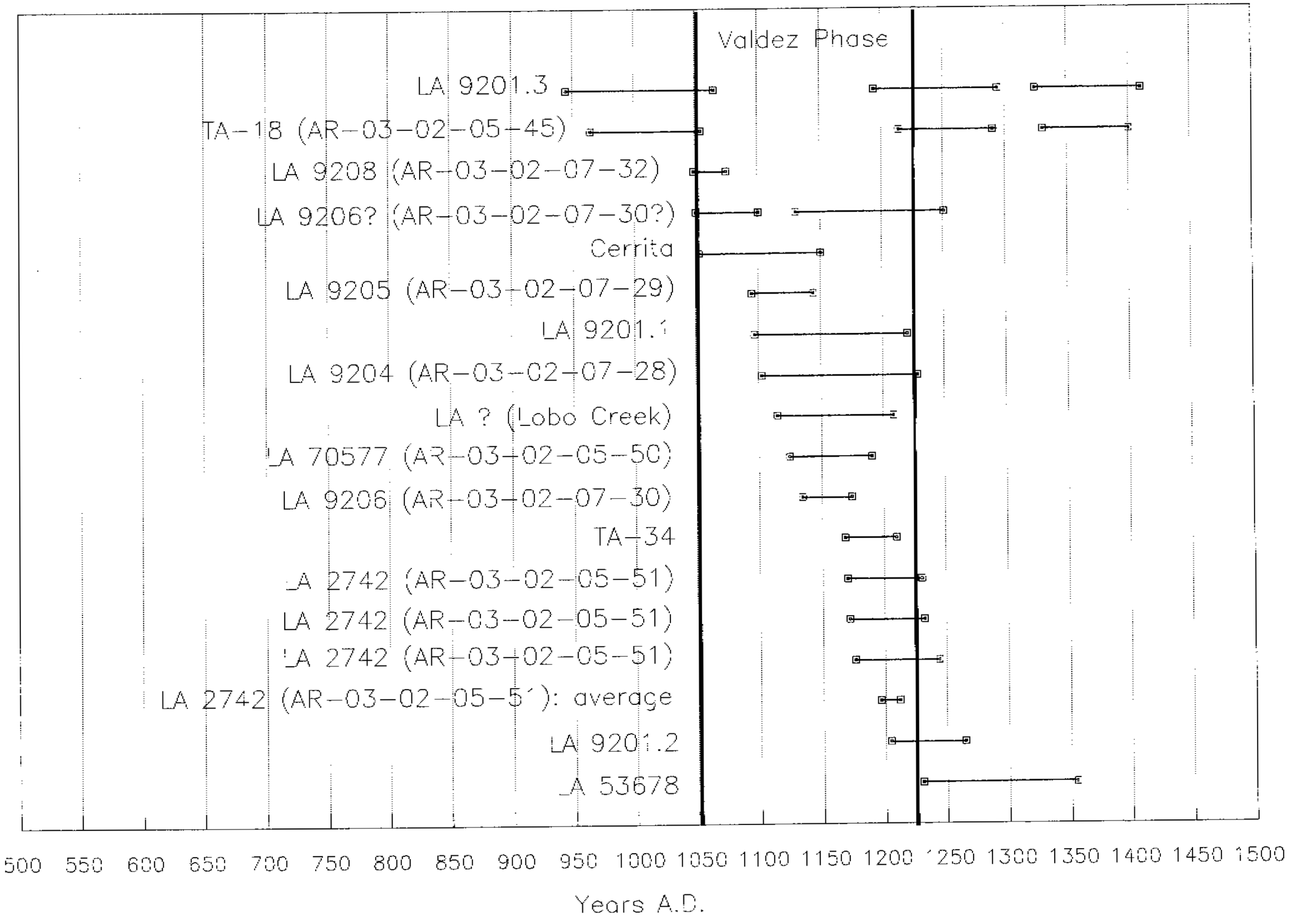
In order to determine whether EHT variability can indeed be high between closely spaced sites, we also buried cells at three sites in the northern community. The results show differences from nearly 1 degree to 3 degrees, apparently depending on the degree of shade cover at the cell burial location. Those differences could result in dates differing from less than 10 to about 30 percent. These data support the variability documented among the Pot Creek area sites. They also suggest that the same degree of variability in EHTs, hydration rates, and resultant dates is potentially present within sites, depending on on-site topography and vegetation.

In addition to soil temperature and humidity, examination of Valdez phase obsidian hydration samples shows that sample depositional context is critical for assessing the reliability of the hydration dates and the association of those dates with site features, activities, or activity locations.

Given the considerable variability inherent in the conditions that produce and affect the hydration rim and resultant dates, obsidian hydration dating requires stringent sample collection and selection procedures in order to obtain dates that can be associated with site features or activities. However, I am able to show that, even when I could not be sure of the accuracy and association of dates, I could see examples of Anasazi collection and use of obsidian artifacts from older sites. This raises a number of questions about procurement and use of nonlocal resources during the Valdez and subsequent phases.

4. Which of the chronometric techniques provide the greatest accuracy and precision for dating sites and intrasite features and deposits?

Figure 16. Valdez Phase: Archaeomagnetic Dates



My examination of Valdez phase chronometric dates suggests several conclusions. Tree-ring dates can be both accurate and precise, but are not necessarily so. Their accuracy is affected by one's ability to securely associate the dated specimen to the context from which it is collected and to the context one would like to date: the construction of the pithouse. In the case of Valdez phase sites, given the relative paucity of construction materials found in excavated sites, one must be concerned about material salvaging and the probability that even a cutting date may not reflect construction of the structure in which the specimen is found. Thus, the date may not accurately represent the age of the collection context. The precision of tree-ring dates relates to noncutting dates and the number of years (rings) missing from the specimen. Informal observations by analysts at the Laboratory of Tree-Ring Research suggest there might be some consistency, on the order of 70 to 100 years, while my examination of differences between cutting and noncutting dates in the Taos District suggests fewer years. However, the loss of outer rings is clearly due to a number of possible factors, cultural and natural, and we cannot know with any certainty how much time is lost with missing rings in any particular case.

Archaeomagnetic dates appear to be the most consistently accurate and precise, although considerable variation is evident in the archaeomagnetic dates from Valdez phase sites. The dates can be clearly associated with site features, usually hearths but also including the burned pithouse floor at LA 9206, and events, the last burning of the feature. Consequently, we can accurately associate the date with both collection context and the context we wish to date--the last use or abandonment of the pithouse. When I compare the precision of archaeomagnetic dates with that of radiocarbon and obsidian hydration dates, I see that two-sigma archaeomagnetic dates are only about half as long, on average, as one-sigma radiocarbon and obsidian hydration dates. It is for this reason that I use archaeomagnetic dates to define the dates of the Valdez phase.

The relative precision of archaeomagnetic dates also allows me, in some cases, to date some sites within the Valdez phase. Figure 16 shows the dates from Table 2. With the exceptions of dates from LA 9201.3, TA-18, and LA 53678, all the dates fall within the phase dates I have proposed in this study, and the LA 9201.3 and TA-18 dates overlap the proposed phase dates. The LA 53678 dates, as I discussed in "Valdez Phase Chronometric Dates," are probably unreliable due to the condition of the hearth at the time of excavation. Among the dates that fall within the proposed phase dates, Figure 16 shows a trend from earlier sites to later sites. Based on these dates, some sites are clearly older than others within the phase. For instance, LA 9208, the first pithouse at Cerrita, and LA 9205 date during the first half of the phase, LA 70577 and LA 9206 during the approximate middle of the phase, and TA-34 and LA 2742 date late in the phase. Other samples, such as those from LA 9206(?), LA 9201.1, LA 9204, and an unidentified Lobo Creek site are less exact but obviously date later in the phase than the earliest sites.

In comparison, radiocarbon and obsidian hydration dates are less accurate and precise. Lower accuracy is related to the problems involved in unambiguously associating the date with the collection context and, particularly, with the context we wish to date. In the case of Valdez phase radiocarbon dates, context and especially material quality problems lead to unreliable dates, with discrepancies between the dated events and the target events. Similarly, examination of the collection contexts of dated obsidian artifacts shows that we cannot assume an association between the dates and site features, activities, or activity locations. On the other hand, the dates do point to collection and use of obsidian artifacts from older sites. Although the locations of those sites remains unknown, I can suggest that the dates are accurate with regard to the ages of the sites from which the artifacts were first collected. Comparison of the lengths of radiocarbon and hydration date ranges shows that they are much longer and, thus, much less precise than archaeomagnetic date ranges. The lengths of the date ranges render radiocarbon and obsidian hydration dates less than useful for dating the sites, since, at best, they can show site use during the region's Anasazi occupation; at worst, they are unrelated to the site occupation.

Discussion: The Big Picture

Dating the Valdez phase is a relatively academic endeavor in that the archaeological record is easily divorced from its human origins and subjects. However, since we are investigating the entrance into the Taos Valley of at least some of the ancestors of the historic and modern Taos Indians, we are justified in asking how the Valdez phase data compare with other "models" involving the northern Tiwa-speakers. It is well beyond the scope of this project to address the wide range of linguistic, regional archaeological, and oral historical information available and relevant to the origins of the Tiwa-speakers of Taos. Still, a brief examination of these data realms reveals several interesting patterns and questions.

Glottochronology and Regional Archaeology

One of the first to postulate a time-frame for the origin of the historic Tiwa dialects, one of which is spoken at Taos Pueblo, was Davis (1959:75), who says, "Assuming little or no intimate contact between the northern and southern Tiwas, this means that a period of about six hundred years has elapsed since there was a unified Tiwa language." In other words, Davis sees the separation of northern and southern Tiwa dialects occurring in the early to middle 1300s. Although it is possible that the divergence occurred much earlier and that the late date suggested by the number of cognate words reflects considerable contact between northern and southern Tiwa speakers, Davis is unconvinced. He also feels that the northern Tiwa-speakers, who finally settled at Taos and Picuris, migrated north: "The fact that the language most clearly related to Tiwa is that of the Piro, who occupied the area south of Isleta, supports the theory that it was the northern Tiwa group which broke off and migrated northward" (Davis 1959:81) .

Trager (1963, 1967) sees the differentiation occurring between about 1050 and 1150. He also sees the Tanoan-speakers--Tiwa, Tewa, and Towa--moving into the Rio Grande Valley from the north through the San Luís and Taos Valleys:

> By 1100, the remaining ones--the Tiwa--arrived in the Taos valley, built pithouses, etc., and also Pot Creek Pueblo. In the 1100s some took off for the South, passed the already settled Tewa--their linguistic relations possibly prevented conquest--and ended up north and south of Albuquerque--the Southern Tiwa. Between 1250 and 1300, the Northern Tiwa split. Part went to Picuris, the others moved north a little--to Taos." (Trager 1963:4; emphases his)

Trager's model, but not his dates, are supported by Wetherington (1968:84-85), who proposes that the people who would become the southern Tiwa-speakers moved south from the Taos Valley around 1350. In this, he matches Davis's dates with the abandonment of Pot Creek Pueblo. Trager's dates find support from Ford, Schroeder, and Peckham (1972:36; who seem to find little else on which to agree):

> Turning to the Tiwa, Trager states that the Tewas and Tiwas separated about 1050-1150 and the Tiwa were differentiated "not much later" (Trager 1967:340). If "not much later" means less than a century, then again Trager's date fits the archaeological picture much better than Davis' date, but Trager's evidence for the causes of the linguistic differences is unacceptable.

What is unacceptable to them is that none of the three agree with Trager's northern origin and migration route for the different Tanoan speakers. All three agree that "the Tiwa developed in situ in the Rio Grande valley" (Ford et al. 1972:30). Ford and Schroeder feel that the Tiwa, who occupied the central Rio Grande Valley and made Red Mesa Black-on-white pottery, were split by movement into the valley of Tewa speakers from the upper San Juan Basin before 1000. "This movement forced the norther Tiwa into the Taos area about A.D. 950. . ." (Ford et al. 1972:30). Peckham sees the northern-southern Tiwa divergence resulting from *in situ* differentiation of Tewa-speakers from the Tiwa, splitting those folks who held onto their Tiwa tongue into northern and southern groups. Although their reconstructions force the northern Tiwa into the Taos Valley one to two centuries before Trager's linguistic-divergence date, they still feel his date fits the archaeological record better than Davis's date. As I have shown, however, there are no chronometric data that support a pre-1050 entry into the Taos Valley, so we must question the timing of the Ford-Schroeder (and Peckham?) reconstruction, at least as it applies to movement of Tiwa-speakers into the valley.

An assumption implicit in these reconstructions, whether linguistic or archaeological, is well-articulated by Greiser and others (1990:41): "Anthropologists generally agree that Tiwa-speakers were the indigenous puebloan people of the Taos Valley." However, because artifacts do not speak and any link between language and the archaeological record is tenuous at best (as shown clearly by Ford et al. [1972] in their attempts to correlate archaeological assemblages with linguistic groups; see Cordell 1995), this assumption may obscure rather than illuminate reality. For instance, Ford, Peckham, and Schroeder appear to deny the validity of Davis's date for the Tiwa split (ca. 1300-1350) because they know that earlier Anasazi sites are present in the Taos Valley. On the same apparent basis, they choose to support Trager's date (ca. 1050-1150) since it is closer to dates from the archaeological record. And, indeed, I must agree that Valdez phase chronometric dates match Trager's date more closely than Davis's date. If the earliest Puebloan people to enter the Taos Valley spoke Tiwa, then Trager's date is more accurate. However, we must also note Crown's (1991:307) contention that Pot Creek Pueblo saw an immigration of new people to the pueblo in the early 1300s, immediately prior to site abandonment. This immigration appears to have coincided with significant changes in site structure, including construction of more rooms throughout the pueblo, construction of a new room block, Unit 4, that effectively enclosed the central plaza, and construction of a great kiva that was probably not used prior to abandonment. These changes exemplify Cordell's argument for recognizing immigration:

> This is the kind of reorganization that we should see as one result of immigration when incoming groups join ongoing communities. The evidence of immigration on a regional level is not site unit intrusion, it is a social reorganization that is reflected in changes in community makeup and alliances. (Cordell 1995:209-210)

The timing of this immigration at Pot Creek Pueblo corresponds closely to Davis's Tiwa-split date in the early 1300s. Could Crown's early 1300s immigration at Pot Creek Pueblo reflect the effect, at one site, of the immigration of Tiwa speakers into the Taos Valley? Perhaps, if we do not assume that Tiwa was the indigenous language of the Taos Valley Anasazi. Interestingly, Wendorf (1954) argues that the Tiwa moved north after that beginning of the Classic period (A.D. 1325-1600), while Wendorf and Reed (1955:162) contend that "the idea of having the northern Tiwa move up from the main Tiwa-speaking district around Albuquerque only after A.D. 1300 is not a satisfactory solution" to the problem that the two northern Tiwa dialects, Taos and Picuris, are "comparatively highly differentiated" from each other. That is, the distinctions between the Taos and Picuris dialects suggest to Wendorf and Reed that a single migration or a small series of migrations of Tiwa speakers could not account for the divergence between the dialects. Parsons (1936:12) notes that the dialects are different and that her Taos informants claimed they were nearly mutually unintelligible. She also observed that this was not actually the case in practice. Parsons (1936), Bodine (1979), and Brown (1979) mention the historical enmity between Taos and Picuris Pueblos. Given that situation, it seems possible that claims of mutual linguistic unintelligibility may be related to social conditions rather than significant linguistic difference. In any case, the degree of divergence (and the time frame involved) is not clear. Thus, while Trager's and Wetherington's contentions that the southern Tiwa Speakers migrated south from the Taos Valley in the 1300s seem to be unsupported by archaeological evidence, the possibility that Davis's early-1300s date for the Tiwa split corresponds to a possible immigration into the Taos Valley cannot yet be discounted. If this were the case, then Tiwa was not the indigenous language of the Taos Valley Puebloan peoples.

Taos Oral History

The assumption that the original Puebloan peoples in the Taos Valley, whose occupation we call the Valdez phase, were Tiwa speakers is also linked to an assumption of homogeneity within the Anasazi population that would become Taos Pueblo. For the linguists, this seems to have resulted from the fact of the historical and modern exclusivity of Tiwa at Taos and Picuris Pueblos. For the archaeologists, it seems to have resulted from apparent homogeneity in the archaeological record and an assumption of historical continuity like that observed at other pueblos. However, Bodine contends:

> It is apparent that Taos differs considerably from the rest [of the pueblos], which is not to deny the cultural similarities with the other Tanoan, Keresan, Zuni, and Hopi towns. The uniqueness of Taos requires a consideration of those elements that have shaped and molded Taos culture. (Bodine 1979:256-257)

One of those elements is that the aggregate population that became known as Taos Pueblo is formed from a number of groups of people who migrated, independently according to tribal traditions, into the valley over a period of time. Those groups had different histories and their descendents have different views of their consolidation into a single village:

> One important caution to keep in mind when reviewing migration stories is that the story will change depending on which kiva group's or society's story is being told. At Taos, this is because various groups of Taos people entered the valley at different times and each has a somewhat different story. (Greiser et al. 1990:42)

I will not attempt a complete correlation of the various Taos migration stories, but will focus on specific aspects that may inform on the appearance of early Anasazi groups in the Taos Valley.

There are two common themes among the available migration accounts. First is the emergence of the people from a lake north or northwest of the Taos Valley. The earliest published account has them emerging from a lake in the "Don Juan" Valley (Gaschet 1892:191). Ellis (1974:33-34) assumes this to mean the San Juan Valley, and more specifically the Mesa Verde area north of the San Juan River. Other accounts point to a location in the San Luís Valley near Mt. Blanca (Grant 1925; Curtis 1925; Espinosa 1936; Parsons 1936; Miller [1898:42-43] mentions only a lake in southern Colorado). Ellis (1974:36) correlates the lake with "a very black and maladorous lake about 100 yards across to the west of a group of dunes within one day's trip of Alamosa" that is apparently also identified as a Tewa emergence location.

The people emerged from the lake one group at a time. "The people came up with their kiva groups, `just as they are now. With their names,' as they are, they all came up. They brought with them different ways of speaking'" (Parsons 1936:112). Each group came with their own names (Espinosa 1936:123). We see here the recognition that the Taos people are made up of groups of people that originally had different identities and languages. This is confirmed by the accounts of the post-emergence travels of those groups. For instance, some people were led east to the Plains, where they lived near the Arkansas River before crossing back over the mountains to the Rio Grande Valley (Curtis 1925; see also Parsons 1936). Others traveled through the Rio Chama and Rio Ojo Caliente valleys and then south to the Black Mountains (could this be a reference to a Mogollon connection?). After being struck by disease, they started northward, building a pueblo south of the Taos Valley. One group broke off and settled at Picuris while the others moved on to the Taos Valley (Grant 1925).

The second common theme has to do with the identification of the earliest Puebloan immigrants into the valley. Espinosa's account seems to be the most detailed, although I disagree with Greiser and others (1990:43), who describe it as the "most complete." As Parsons (1936) and Bodine (1979) both note, aspects of Taos life that are considered to be of real sociocultural-"religious" significance are tightly guarded and full disclosure has never been obtained and may never be forthcoming. According to the Espinosa account, the first group to emerge was the Feather People (Fiadiana), who moved into the Taos Valley and settled in the southern valley in the Rio Grande del Rancho area. They are identified with LA 1892, Jeançon's (1929) Llano site, a pueblo referred to as "the place where the Feather People lived" and considered directly ancestral to the Feather People kiva at Taos Pueblo. The Feather People raised deer as pets, but did not eat them; I take this to mean they were probably farmers rather than hunters.

The second group to emerge was the Shell People (Holdaina), who also moved into the Taos Valley, but settled near the Colorado River. This is usually interpreted to mean the Red River (Rio Colorado). A correlation is made with Gaschet's (1892) account of people building a village along the Red River, the ruins of which were extant in 1887 (Greiser et al. 1990:43, 46) and may be the "pueblito" site located near or beneath the Questa cemetery. This is Ellis's (1974:105) site 43, which she identifies as ancestral to the Day People kiva at Taos Pueblo; thus, there seems to be a connection between the Shell People and the Day People: "The Shell people . . . were one of the original groups within the Sun, or Day, kiva" (Greiser et al. 1990:48). The Shell People were hunters rather than farmers, whose settlement area shifted from the Red River to the area north of the Rio Lucero following an attack by "giants" (Greiser et al. [1990:44] suggest an unknown Plains Indian group as the "giants"; I would suggest, simply, indigenous hunter-gatherers opposing the immigration of another group of people). These may be the same people whose migration account is recorded by Miller (1898:42-43). At some point, the Shell People and the Feather People began to live together. The Feather People apparently were convinced to eat deet meat and the Shell People, presumably, began to eat plant foods (Parsons 1936:113; Ellis 1974:37; Greiser et al.1990:43).

The next group to emerge was the Water People (Badaina or Pataina), who emerged from the lake as fish and swam down mountain streams to the Santa Fe River. From there, they swam back up the Rio Grande to its junction with the Rio Grande del Rancho, which they followed to the settlement of the Feather People. According to Greiser and others (1990:45), during their travels, the Water People moved as far south as the Sandia Mountains, then north through the Galisteo Basin to the Santa Fe area, to a location near Picuris. After moving into the Taos Valley, they made several stops. This account bears resemblance to Grant's (1925), in that the people moved down river valleys far to the south before turning north again. Like the Greiser account, the people in the Grant account stopped south of Taos and there is a reference to Picuris, with some people moving north into the Taos Valley. It is possible that the Grant account refers to the Water People. Once arrived in the Taos Valley, the Water People were made into humans and lived with the Feather People for a period of time before moving to other locations. Their residence with the Feather People may have been before or after the Feather People joined with the Shell People (Greiser et al. 1990:43, 45). During the course of their migrations, the Water People are specifically described as having lived in underground houses (pithouses) (Greiser et al. 1990:46), a fact that Greiser and others consider significant for explaining the presence of "late" pithouses in the Taos Valley.

Apparently after the advent of the Water People, the Big Earring, Dagger or Knife, and Day or Sun Peoples moved into the Taos Valley, as did the Old Axe People. However, with the possible exception of the connection between the Day and Shell Peoples mentioned earlier, published migration accounts do not include specific histories of these later groups. However, available accounts do discuss the combination of these groups of people into two larger groups (see Greiser et al. 1990:45-49). The Winter, Ice, or Cold People were hunters who lived north of the Rio Hondo. They probably included the Shell People; whether other identified groups were included in the early years is not clear. In the southern valley were several "clans" of the Summer People, farmers who included the Feather People and, perhaps, the Water People after they moved into the valley. The amalgamation of the various groups into six (or seven) kiva groups with inter- and intra-kiva societies was a complex process that worked to facilitate unity within the aggregated village (Greiser et al. 1990:46-47).

Concerning the Valdez phase, we see that Taos oral history specifically differentiates the first Puebloan residents of the Taos Valley into two groups of people. The Feather People were farmers who lived in the southern valley near the Rio Grande del Rancho, while the Shell People were hunters who lived, at first, north of the Rio Hondo but spread south to the vicinity of the Rio Lucero. Greiser and others (1990:48-49) correlate these differences with archaeological patterns observed in Valdez phase sites. The oral-historical differences specifically point to economic differences between the two groups of people. My (Boyer 1994a) review of Valdez phase sites confirms economic differences between sites in the northern and southern parts of the valley:

> **Chipped stone artifacts.** Northern assemblages include an average 32.6 projectile points, 18.8 scrapers, 10.7 knives, and 1.8 drills. Southern assemblages include an average 2.9 projectile points, 5.1 scrapers, 1.0 knife, and 0.9 drill.
>
> **Ground stone artifacts.** Northern assemblages include between 1 and 25 manos and mano fragments and between 1 and 8 metates and metate fragments. Southern assemblages include between 4.3 and 63 manos and mano fragments and between 0.3 and 44 metates and metate fragments.
>
> **Pithouse food-related features.** Internal pithouse storage and food preparation features are not common in either area, but are more frequent in southern group sites.

In addition, a number of other differences are discernable between the two groups of sites:

> **Pithouse shape.** Of 16 excavated pithouses in the northern group, 81.3 percent are square or subrectangular, while 18.8 percent are circular. Of 18 excavated pithouses in the southern group, 83.3 percent are circular and 11.1 percent are square or subrectangular.
>
> **Pithouse size.** Northern subrectangular pithouses are twice as large, on average, as southern subrectangular pithouses. Northern circular pithouses average 0.6 m wider in diameter than their

southern counterparts.

Pithouse walls. The walls of 56.3 percent of excavated northern pithouses are natural soil, presumably once plastered, while only 18.8 percent are coursed adobe. In the southern group, no excavated pithouses have natural soil walls, while 88.9 percent have coursed adobe walls.

Pithouse post-abandonment use. Southern pithouses are over twice as likely to have multiple human burials on the floor and 1.7 times more likely to have human burials in the fill as northern pithouses.

Pithouse hearths. Northern circular hearths average 10 cm wider in diameter and northern rectangular hearths average about three times larger than similar hearths in southern pithouses. These differences are, undoubtedly, related to the larger sizes of northern pithouses.

Ceramic artifacts. The same pottery types are recorded for both site groups. However, northern assemblages are comprised of an average of 4.3 percent white ware sherds, 73.5 percent Taos Gray plain sherds, and 22.5 percent Taos Gray incised, corrugated, neckbanded, and other sherds. In contrast, southern assemblages are comprised of an average of 27.2 white ware sherds, 60.2 Taos Gray plain sherds, and 12.7 percent Taos Gray incised, corrugated, neckbanded, and other sherds.

Given these patterns, I concur with Greiser and others (1990:48), and identify my "south community" sites with the Feather or Summer People (possibly including the Water People) and the "north community" sites with the Shell or Winter People. Although Taos migration stories have the Feather People (south community) entering the valley before the Shell People (north community), my review of Valdez phase chronometric dates shows no significant differences in dates between the two groups of sites. I must, therefore, conclude that differences in timing of the migrations of the two groups of people were minimal.

I do not concur with the suggestion by Greiser and others (1990:49) that the arrival of the Water People coincided with the introduction of Santa Fe Black-on-white pottery and the beginning of the Pot Creek phase. My disagreement is based solely on the account that the Water People, throughout their travels, lived in pithouses. While the beginning of the Pot Creek phase, with attendant new pottery types (Santa Fe Black-on-white, Taos Gray corrugated), seems to be associated with a settlement shift to small "unit pueblos," I do not see the appearance of a new group or groups of pithouse sites in the 1200s, and I am able to discount as unreliable any post-1225 chronometric dates from Valdez phase (i.e., pithouse) sites. The changes in architecture, ceramic types, and presumably other aspects of the archaeological record do seem to signal changes in relationships between the Taos Valley Anasazi and residents of the central Rio Grande Valley and may be clear evidence for immigration into the Taos Valley at this time (see Cordell's [1995] comments about social reorganization and migrations). However, there were several other groups of people who also moved into the valley and were finally incorporated into the Taos Pueblo community. Rather, I suspect that the immigration of the Water People is obscured by their association with the Feather People. Further, we do not know how Valdez phase sites in the central, open portion of the Taos Valley may resemble or differ from contemporaneous sites in the northern and southern communities, and so we cannot yet assess, archaeologically, the possibilities that sites in the central valley may represent additional communities, the blending of the northern and southern communities, or both (Boyer 1995).

As to which group of people were the original Tiwa speakers, Greiser and others (1990:46, 48) argue that the Feather People, the first immigrants, brought the Tiwa language that eventually spread to the other groups. This possibility is perhaps supported by Trager's dates for the northern-southern Tiwa divergence. Earlier, I noted that I could not discount the possibility that the Tiwa presence in the valley corresponds to a migration into Pot Creek Pueblo in the early 1300s, potentially matching Davis's dates for the divergence of the Tiwa dialects. A third possibility is presented by Taos oral history. As discussed above, one group of Taos ancestors, perhaps the Water People, moved into the Taos Valley from the south. One account mentions the vicinity of the Sandia Mountains, the area of the southern Tiwa pueblos of Isleta and Sandia. On their way north, these people stopped near the location of Picuris Pueblo, the other northern Tiwa pueblo; some of them may have settled at Picuris while the others moved to the Taos Valley. Given the conclusions of Ford and others (1972) that the Tiwa moved north from the Central Rio Grande Valley, this scenario from Taos oral history may present the Tiwa migration into the valley. If so, we could postulate that the Water People brought the Tiwa language with them during the Valdez phase. This might also be supported by Trager's dates. These possibilities reveal the difficulty, perhaps the impossibility, of determining which of the early migrant groups was responsible for bringing with them the Tiwa dialect that became the language of the different groups that became Taos Pueblo:

> One problem for archaeologists then is that traditional histories may not be used as an unambiguous guide to sort out those who had migrated from those to whose communities they moved. (Cordell 1995:205)

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