A GIS ARCHAEOLOGICAL SITE ANALYSIS

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INTRODUCTION

The basic nature of archaeology is the study of spatial associations. "This spatial nature of archaeological phenomena can be put to effective use in automated computer environments by assembling and organizing information on the basis of spatial location (Kvamme 1989)."

When archaeologists define a "site," they are referring to the relationship of cultural materials relative to each other in terms of space. It cannot be assumed that just because this material occupies the same location it represents one time period. One would have to ask, were the remnants left behind manufactured at the same time? Upon close inspection, these artifacts might reveal more than one occupation.

Many studies have been done using ceramic assemblages for the dating of archaeological "sites". A ceramic assemblage is a set of ceramic artifacts, usually containing different types exhibiting varying frequencies. These ceramic types are defined by geographic location, temper, design, and stylistic components. These predefined ceramic assemblages are believed to represent different time periods. If one were to examine the frequency distributions of ceramics in conjunction with absolute dating techniques, and stratigraphic studies on an archaeological "site," one might be able to draw conclusions pertaining to the temporal component of a "site." A Geographic Information System lends itself to this kind of spatial analysis extremely well.

PURPOSE OF PROJECT

The purpose of this project was to infer the chronology of an archaeological site with the aid of a Geographic Information System (GIS). Within the particular study area there were three archaeological structures that appeared to be related to each other due to their proximity in space. We wanted to understand how these structures related to each other temporally. With the assistance of a GIS database the chronological relationship between these structures could be illustrated through time.

COMPUTER TECHNOLOGY

A Geographic Information System (GIS) is an organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, manipulate, analyze and display all forms of geographically referenced information. Because GIS has the spatial referent, it has great advantages over other relational database management systems. By utilizing the Technology Application Center's (TAC) GIS database system, ARC/INFO 5.0, we approached archaeological site analysis with extraordinary graphic detail. In conjunction with ARC/INFO 5.0, we conducted a ceramic analysis using the relational database Paradox 2.0. All of the digitizing needed was performed using AutoCADD Release 11.

DATA ACQUISITION

The Office of Contract Archeology at the University of New Mexico conducted a large scale archaeological project that produced sufficient data to allow for the creation of a GIS database. The Transwestern Mainline Expansion Project was the construction of a natural gas pipeline with a right-of-way measuring approximately 50-ft. It extended in six discontinuous segments from Farmington, NM, south to Gallup, NM and from Gallup west to Needles, CA. Over 99 archaeological sites have been completely excavated within this corridor and less than half of them underwent limited excavation outside of the right-of-way. Of these 99 archaeological sites, we took an extensive look at one in particular, Site 442-27.

GENERAL DESCRIPTION OF SITE 442-27

Site 442-27 lay on a low rise overlooking Dilkon, Arizona. The area is characterized by open grassland. Grass species include muhly, grama grass, and dropseed. Other fauna present in the site area are snakeweed and rabbit brush. The soil is loose and sandy, forming dunes on the rise. Extensive surface disturbance, including gas and water pipelines, as well as road construction, had exposed artifacts and rubble (Bradley 1992).

Site 442-27 was a small, but dense distribution of lithic, ceramic and ground stone artifacts associated with a possible rubble mound. An early P-III date was suggested by the presence of Walnut B/W and Holbrook B/W ceramic artifacts and the occurrence of a slab style metate. Site 442-27 appeared to be an Anasazi habitation site which may have been occupied on a permanent basis for some period of time.

One feature was visible on the surface (Feature 1). Feature 1 was a concentration of basalt cobbles and appeared to represent a collapsed structure (see Olsen below for description of the excavation of room block in the area of Feature 1).

During survey and testing operations, one 1 x 1 m unit, twelve auger holes, and one backhoe trench were excavated by personnel from the Office of Contract Archaeology to assess the site's integrity, subsurface extent, and research potential. The one unit was excavated in the center of the site, to a depth of 90 cm. Artifacts were recovered from this unit, primarily in the upper strata. The auger tests were sterile. The backhoe trench was excavated E-W along the r-o-w. At the base of the trench, a floor (with post holes) of a structure was uncovered (Feature 2).

Four different projects/organizations treated OCA Site 442-27 prior to OCA's investigations. (442-27 will be used in this report to refer to the site, the reader will note that the site has other designations under different site numbering systems). Site 442-27 was first recorded and excavated by Alan P. Olsen and given the site number NA 7806. Olsen's work was done under the auspices of a salvage archaeology project conducted for the Transwestern Pipeline Company (Olsen 1964). The construction for this pipeline occurred during the winter of 1959\1960. The site was most likely revisited by George Gumerman during a survey and excavation project in the Hopi Buttes area (Gumerman 1989). Comparison of the Olsen and Gumerman reports with respect to the location and description of sites in the area indicate that 442-27 may have been recorded twice. No permanent site markers were left on the site nor were exact locations provided by Olsen or Gumerman. Only their plots on topographic maps are provided. Therefore, based on these plots it appears that Gumerman may have re-recorded 442-27 and given it the number NA 9404.

Under the auspices of the Dilkon Expansion Project Linda Popelish (1979) also commented on the prehistory of the area and reviewed the work of Olsen and Gumerman. She restates an assertion (Popelish 1979:15) that Gumerman (1989:26) made, indicating that some of the sites he recorded were the same sites found by earlier pipeline surveys (Olsen 1964).

The fourth organization to treat the site is the Office of Contract Archaeology, University of New Mexico, hereafter OCA. OCAs efforts were in conjunction with a parallel pipe to the one constructed in 1959/1960 (Olsen 1964). The survey, testing, and Phase I aspects of OCAs initial treatment of the site occurred without knowledge of the previous organizations' work. Archival research completed by David Eck, L. Theodore Neff and Linda Stephen of OCA allowed the Phase II work at the site, as well as the preparation of this report, to be conducted with reference to the earlier work.

Summary of Olsen's (1964:48-57) Work

The site was designated NA 7806. Olsen describes the site as a small pueblo, showing very little building stone, found on the crest of a low sandy ridge. Two or three rooms were outlined. It is noted that sherds were scattered over a restricted area and that there were more painted sherds than corrugated and plain.

Excavation and description of the room block: "The building stones were basalt boulders brought from a nearby volcanic deposit more than a mile from the site. The rooms were outlined by boulders standing no more that two courses high. Specially prepared floors were not found. The sandy fill of the rooms was flecked with charcoal and this material stopped at the wall footing level. The fact that the ground was frozen well below the level of the floor at excavation, may have complicated the clearing. The blocks of soil were broken out, the floor level could be discerned as a thin, stained line. No features or artifacts were found."

Excavation and description of the kiva: "Some time after the excavation of the surface structure, the trenching for the pipe encountered a kiva just south of the rooms. The trench cut through the southern edge of the kiva, removing all but a small portion of the ventilator complex."

Description of the kiva fill: "The top member of the fill was a stabilized sand that is anchored by the vegetation on the ridge. Below this there was a thick band of trash which filled the remainder of the kiva nearly to the floor. This would suggest that the kiva had been abandoned and that dumping started immediately after the roof had collapsed, or perhaps even before, while the
roof still stood."

There was a disproportion of sherd counts from the various excavations between the kiva fill and the surface structures, possibly suggesting a longer occupation than would be postulated on the counts from the surface structures alone.

OCA Phase I and Phase II Excavations

The goal of the OCA excavations was to clear a 50 ft corridor for the construction of a pipeline located to the south and parallel to the one constructed in 1959/60. Investigation of this corridor was conducted via additional 1 x 1 m excavation units, backhoe trenches, augur holes, and a 100% collection of the surface artifacts in the 50 ft corridor. As was noted above, a testing backhoe trench encountered a portion of floor with post holes (Feature 2). Excavation was expanded here and a pit structure was defined. Other OCA probes located a kiva (Feature 5) and a trash-filled pit structure (Feature 7).

Following are brief descriptions of the features:

<u>Feature 2</u>

Feature 2 was a small pit structure. The structure was rectangular in shape and measures 2.8 m NW-SE by 2.5 m NE-SW. The depth of the fill in the structure was 1.0 m. A lined hearth (Feature 3), two sub-floor storage pots (Features 2 and 4), and ten post holes of varying sizes were recorded and excavated on the structure floor. The floor was plastered and exhibited charcoal staining. No formal walls were detected. Aeolian sand with faint charcoal flecking and occasional lenses of caliche ($CaCO_3$ deposits) characterize the fill of the structure. Numerous large sherds were found in close association with the floor (in the structure fill between the floor and 0.1 m above the floor). These artifacts were pedestaled, drawn in, and point provenienced. These floor associated artifacts are designated as Analytical Unit (AU) 3 (Analytical Units will be defined later in the report). Gradual filling with aeolian sand summarizes the remaining history of deposition at Feature 2.

The process of abandonment at the structure was one that left artifacts in association with the floor. No sealing of floor features or other architectural modifications indicative of multiple occupations were noted. The structure is interpreted as being the locus of one occupation. Thus, the floor associated
sherds should provide a date for the occupation.

<u>Feature 7</u>

Feature 7 was a sub-rectangular pit structure that measures 3.20 m NW-SE by 3.0m NE by SW. The structure contained 1.5 m of fill. A lined hearth, a storage pit, and 4 post holes were recorded and excavated in the floor of the structure. The floor exhibited a poor state of preservation and was made up of fragments of dark stained plaster. No formal wall elements were observed. Trash fill, containing lots of artifacts (in the 100s per 0.1 m level in a 1 x 2 m control unit), ash, and charcoal, made up the first 1.10 m of the structure fill. The remaining 0.4 m of structure fill were less artifact laden (in the 10s per 0.1 m level in a 1 x 2 m control unit) and represent less vigorous deposition.

The dual nature of the structure fill indicate two kinds of post habitation deposition. The first is a less vigorous and more gradual deposition as expressed by the final 0.4 m of structural fill. The artifacts contained in the final 0.4 m of structure fill were representative of the final occupation of the structure. This 0.4 m portion of the structure fill is designated as AU10. The second kind of deposition, expressed by the first 1.1 m of structure fill, denotes the use of the pit structure as a trash dumping locus. This second kind of deposition postdates the final occupation of the structure and may represent a later occupation at the site. This 1.1 m of structure fill is designated as AU9.

Feature 5

Feature 5 was a kiva. The main chamber was circular in shape and measured 3.60 m NW-SE by 3.60 m NE-SW. The southern recess was rectangular in shape and measured 1.5 m NW-SE by 2.25 m NE-SW. The main chamber of the kiva was encircled by a bench. The bench is 0.5 m wide and rises 0.8 m above the floor. The recess extends south from the main chamber at bench height. The recess contained a ventilator complex with a formal opening at floor level into the main chamber of the kiva. The ventilator opening outside of the kiva was either gone or was never formalized. The bench walls, the recess floor, and the main chamber floor were plastered. The bench surface was finished with plaster and shaped slabs. To the NW and the SE the bench contained pilasters that still contained fragments of wood posts. Only very ephemeral traces of kiva wall extended above bench height in the kiva main chamber. The SE wall of the recess consisted of plaster and basalt cobble masonry. A large juniper beam was also recovered. The beam was located in the vicinity of the opening to the recess and it is surmised that it once functioned as a lintel across the opening to the kiva main chamber. A hearth, sipapu, large pit, deflector, probable ladder depressions, slabs, and numerous post holes were recorded in the kiva floor.

The kiva contained 1.5 m of fill. The composition of the fill was similar to that of Feature 2. Until approximately the last 0.1 m above the main chamber floor and bench surface, the fill was predominately aeolian sand with light bands of charcoal flecking. Occasional lenses of more compact sand and an area of cave-in debris also occurred. The fill in the southern recess exhibited no division from top to floor. Numerous sherds, ground stone artifacts and fragments, as well as small pigment grinding stones were found in situ on the bench and main chamber surfaces. These artifacts are designated as AU7 and AU8. AU7 designates artifacts recovered in a 1x2 m control unit 0.1 m above the kiva main chamber floor. AU8 designates artifacts point provenienced on bench and floor surfaces as well as recovered in floor feature excavations.

The process of post occupation deposition was similar to Feature 2. At the cessation of habitation, artifacts were left on the structure surfaces. The structure was then gradually filled by predominately natural processes as evidenced by the aeolian sands.

DATA MANAGEMENT

GEOGRAPHICAL INFORMATION SYSTEM DATABASE

The GIS database was initially designed to perform spatial querying as well as descriptive data querying. Due to the lack of sufficient time on the GIS system, only the spatial querying was performed by ARC/INFO 5.0. The descriptive data was manipulated using Paradox 2.0. The following pages include a detailed description of how the tabular and geographical databases were designed.

FIELD SPECIMEN (FS) PROVENIENCING DATABASE SYSTEM

A majority of the tabular data originated from the FS System designed by OCA and tailored for the purposes of this specific project. It was organized to facilitate computer tracking of artifact and sample location information. Tracking refers to the use of the system to check artifacts into the laboratory while making sure that all of the bags are accounted for and that the information on the bags is correct. The tracking system extends through analysis. Artifacts subjected to analysis are cross referenced to locational information using just the site and FS number. With these two numbers (site and FS), the original provenience of any material recovered from a site can be retrieved.

Location is the other key ingredient of the FS system. The primary principle is this: AN FS NUMBER REFERS TO A MINIMAL UNIT OF SPACE. Each FS number designates an area on a site or a minimal unit of provenience.

The OCA FS system is essentially a database. Each of the fields is used to track artifact and sample provenience. During analysis, additional fields are added to the location information so that sets of individual attributes can be compared spatially. For analysis purposes FS numbers are combined to make an analytical unit (AU). Where an FS number represents a minimal unit of space, an AU represents a unit of analysis that combines FS numbers into a meaningful unit that aids in inferring cultural and/or individual behavior. With the aid of a GIS system, each AU is graphically represented as a mutually exclusive area within the study area boundaries.

Tables 1 and 2 in Appendix A explains the designing of the FS database that was used for this specific project using Paradox 2.0. Table 3 describes how the geographical data was organized. Table 4 defines the attributes used and Table 5 summarizes the formatting of the INFO files.

DATA INPUT AND DISPLAY

Each coverage was entered as a separate layer on AutoCADD Release 11, and then each layer was separated into individual files. Each of these files were converted into a DXF file on AutoCADD. Using the ARCDXF command each file was brought over into TAC's ARC/INFO 5.0 system. Once topology was created for each of the files, the Analytical Unit (AU) item was added onto each PAT file. Analytical Units 1, 3 - 10 all were identified as mutually exclusive polygons with separate User-IDs. Analytical Unit 2 failed to have much integrity due to prior mechanical disturbance on the site. The AU's were calculated for the specific User-IDs, thereby creating a link between the spatial data and the descriptive data. The time period item was then added to each PAT file. The time period results were obtained from a collaboration of ceramic analysis and archaeomagnetic dating results, both in conjunction with stratigraphic studies. The time period was then calculated for each analytical unit. In which case the analytical unit was represented graphically, as well as descriptively with a specific time period assigned to each. With this in mind, Time Period 1 geographic features were represented as one color, and the Time Period 2 geographic features were represented as another color.

In the INFO file FS.DAT, all of the analytical units were calculated using each specific logical expression. By performing a RELATE operation, all of the ceramic and locational descriptive data was tied into the analytical units (geographic coverage features).

DATA ANALYSIS AND INTERPRETATION

As was outlined above, the site excavations were divided into ten analytical units (AUs). The division of the excavations into AUs is done to provide a framework for querying and hypothesis testing. For example, AU 3 is defined as the floor association of Feature 2 (a pit structure). Artifacts associated with the floor of the structure are separated from artifacts contained in the rest of the structure fill. This separation is based on the premise that artifacts associated with the floor of the structure are representative of activities focused in and around the structure. The rest of the fill in the structure may be associated with activities that are not related to the structure in question and took place elsewhere on the site at a later time. Things are not always so simple. Human beings often engage in behavior that would render the above stated premise useless. However, the premise is a good place to start and redesignation of AUs is always an option.

Division of the excavations into AUs provides a framework through which the site may be viewed. Based on the AU divisions, ceramic data, and archaeomagnetic dates, a hypothesis will be presented concerning the occupational history of the site. Ceramic information for each AU and archaeomagnetic dates, when present, are presented in Tables 7 - 15 in Appendix A. A mean ceramic date, the number of ceramic artifacts used to calculate the date (n =), and archaeomagnetic date, when available, are provided for each AU. Following is an explanation of archaeomagnetic dating and the calculation of a mean ceramic date.

Archaeomagnetic dates are derived from an absolute dating technique. This technique involves the collection of material from archaeological deposits that were intensely burned, i.e. hearths. Sediments that are exposed to intense heat take on properties of the earth's magnetic field at the time of heat application. The earth's magnetic field changes through time. Thus, the magnetic signature that an intensely burned sediment displays is unique. Sediments burned earlier or later will display a different signature. A profile of magnetic signatures has been constructed back through time. Samples are analyzed and then compared to the known magnetic profile. A date for the burned deposit is then calculated based on comparison to the earth's reconstructed magnetic profile. Archaeomagnetic dates in Table 6 in Appendix A are presented in years since the birth of Christ (A.D.).

Ceramic mean dating is a method introduced to archaeology by Stanley South (1978) and applied to Southwestern ceramic analysis and archaeology by Barbara Mills (1988, 1990). Individual ceramic types have separate beginning and ending dates of manufacture. These beginning and ending dates are known through manufacturing records for historical ceramic artifacts, and through relative and absolute dating techniques for prehistoric ceramic artifacts. A specific type of ceramic may be assigned a date range that includes a begin date, an end date, and a median date (Mills 1992). Most archaeological sites and/or deposits contain more that one type of ceramic, thus numerous date ranges are possible. South's ceramic mean dating technique allows the archaeologist to calculate a mean date for a ceramic assemblage that weighs each ceramic type via its frequency. Ceramic assemblages from archaeological sites usually have more than one type of ceramic and their proportions with respect to one and other are usually different. South's method weighs these proportions in calculating a date. For example, if we are examining an assemblage that has two types of ceramic artifacts, one type making up 75 percent and the other 25 percent. A date calculated using the date ranges of the two ceramic types, as though they were equal, would be misleading. The proportionally greater ceramic type (75 percent) should influence the date more than the lesser type.

The ceramic mean date is calculated in the following manner: For each assemblage the median date for a ceramic type is multiplied by the frequency of that type. These products are then added together and divided by the total number of ceramic artifacts in the assemblage (Mills 1988:66). Please refer to Tables 7 - 15 in Appendix A for calculation of ceramic mean dates by AU. The reader is encouraged to consult South (1978) and Mills (1988, 1990) for a more in-depth discussion of ceramic mean dating, particularly with respect to assumptions that are operative concerning the dating technique. There is insufficient space to examine these issues in this report. The ceramic mean dates presented in tables 7 - 15 are in years since the birth of Christ (A.D.).

Stanley South comments that archaeologists "may find it(the ceramic mean date formula) useful in the interpretation of site occupation periods" (South 1978:75, parentheses mine). This is precisely what we wish to do in our GIS archaeological site analysis. The reader will have noted in Tables 7 - 15 that the ceramic mean dates, taken together, are not indicative of distinct periods of occupation at the site. The dates range from 1177.46 to 1186.98, only a ten year span (the AUs where "n" is less than 50 are not considered because of the small sample size). Ten years is the length of one generation at best. Taken together, our ceramic mean date analysis offers us no clear way to distinguish occupations. In spite of this fact, we would like to present a hypothesis concerning different periods of occupation even though these periods of occupation occur within a single generation.

Simply stated, our hypothesis is that the eastern pit structure (Feature 7) was occupied and then abandoned. This is time period 1. Subsequently the western pit structure (Feature 2) and the kiva (Feature 5) were occupied and dumped at least a portion of their trash into the aforementioned pit structure, Feature 7. Our hypothesis was prompted chiefly by stratigraphy. The eastern pit structure was filled primarily with trash while the kiva and the western pit structure were filled primarily with aeolian sands. We had hoped that our ceramic mean date analysis would provide evidence to support the hypothesis. This did not come to pass.

Two primary reasons or factors come to mind concerning the fact that our analysis turned out the way it did. The first reason has to do with the date ranges available for the ceramics. As prehistoric ceramic assemblages go, southwestern ceramic types are tightly controlled. Good preservation and techniques such as tree ring dating provide relatively tight chronological control. However, these factors are not as good as chronological controls available for historic ceramic types. Documentation, to the precise beginning and ending year of manufacture, is available for many historic ceramic types. At present we may not have the chronological resolution necessarily to discern, ceramically, sequential occupations during a relatively short period in prehistory. The second reason involves the fact that the structures we are looking at may have been occupied for a short time and our analysis is showing us exactly what we should see. It probably does not take all that long to fill up a pit structure with trash, ten or fifteen years would seem adequate. If this is the case then we would not be able to discern any change in ceramic types because none occurred. If we wish to posit two time periods within a generation, then the data in hand suggests no reasons for not doing so.

CONCLUSION

The archaeological data for this project was spatially linked both diachronically and synchronically. Each time period was represented in the GIS as an unit of analysis that aided in interpreting how the individuals on this particular archaeological site organized their living space. The GIS also displayed a model of a short term temporal and spatial process.

Our perception of two periods of occupation at the site and the use of this scenario in a GIS analysis is valid. As was mentioned above, there may be mitigating factors effecting our hypothesis, one of them being the fact that an insufficient amount of time had passed and we would be unable to "see" ceramic variability, no matter how high our resolution was. This GIS archaeological analysis has proven quite successful with respect to site 442-27. However, we feel that the techniques and analyses used in this study could be an important part of the presentation of archaeological data from any site. The combination of stratigraphic and artifact analysis with GIS can be an important tool for the archaeologist. This is particularly true of sites that were occupied for longer periods of time and display more complex depositional histories. With respect to more complex sites, the archaeologist could examine numerous hypotheses and engage in analyses and comparisons that would be enormously time consuming by conventional methods. While this report offers no earth shattering insights into the lives of the ancient inhabitants of site 442-27, it clearly demonstrates the utility of using GIS in archaeology.

Ideally this GIS database is just the beginning of a larger and more complex system. Using the analytical unit, the ceramic data, stratigraphy and the absolute dating results, we were able to identify temporal sequences within one occupation. Other files could be added, such as the lithic data, faunal data, architectural data etc.. With these added data sets the analytical unit could be used to interpret other spatial problems.

Although a GIS has the ability to analyze and display multiple variables, it does not solve the accompanying theoretical biases of defining appropriate analytical units for the interpretation of individual/cultural behavior over space. GIS can only work within the theoretical and methodological limitations that archaeological questions impose. Yet many of the spatial research questions can be addressed quicker and more accurately with the aid of a GIS. For instance, some of the following spatial questions can be addressed: How does one define activity areas? or archaeological sites? and/or cultural regions?

The other problem involves the question of whether or not human behavior can be explained within these spatial definitions. It is these spatial definitions that are translated by specific attributes that ultimately interpret human behavior. At this point in time it is necessary to have an analytical unit incorporated within the GIS database, thereby allowing the variability that is needed at the interpretive level to come to any valid hypotheses about human behavior.

APPENDIX A

Table 1

Tabular Database (FS Proviencing System)

Field Name	Field Abbreviation	Description of the Field Name
Field Specimen Number	FS	A number that defines a minimal unit of space. These numbers are assigned sequentially. The FS number is the relate item for the descriptive data.
Study Unit	SU	This is the assigned Study Unit number. Study Units are major culturally or arbitrary excavation units such as test pits, backhoe trenches, rooms, pit structure,extramural surfaces, etc. Each of these are described by the type of unit and a unit number for that unit type. These numbers run consecutively through the site with no duplicates.
Feature	FEAT	This is the assigned feature number. Features are often contained within Study Units. Examples of features are hearths, stains and chipping stations.
Northing	NGRID	This is the grid northing of the excavation unit. The number represents the x-coordinate of the southwest corner of any size unit within an arbitrary grid that is made up of one by one meter units that are set up to encompass the site.

Field Name	Field Abbreviation	Description of the Field Name
Easting	EGRID	This is the grid easting of the excavation unit. The number represents the y-coordinate of the southwest corner of any size unit within an arbitrary grid that is made up of one by one meter units that are set up to encompass the site.
Area Squared	AREA2	This is the area, in square meters, of the excavation or surface collection unit. Combined with beginning and ending elevation the area will provide the volume of excavated areas.
Starting Elevation	STARELEV	This is the beginning elevation for all excavation units. For surface or stratigraphic levels the highest corner elevation is used. For point plotted items (e.g., metates) the top of the plotted artifact is monitored.
Ending Elevation	ENDELEV	This is the ending elevation of the excavation unit from the master site datum. The lowest elevation is recorded for that particular Arbitrary Level. For point plotted items the bottom of the artifact is used.
Stratum	STRAT	This is the assigned Strata designation. Strata are designated with both letter and number codes to impart specific types of deposits. The capital letter designates the relative stratigraphic position of the deposit while the number designates the type of deposit. Letter designations begin with A (top strata)and continue consecutively through the

Field Name	Field Abbreviation	Description of the Field Name
		alphabet.
Level	ARBLEV	This is the arbitrary stratigraphic unit within each excavation unit. The numbers run consecutively from one through the bottom of the unit.
Ceramic Counts	CERM	This is the number that represents how many ceramic artifacts were collected from each FS number or minimal unit of space.
C14 Samples	C14	This number indicates the presence or absence of a carbon-14 dating sample from each FS number.
Other Samples 1	OSAMP1	This number is a code that represents how many special samples were collected from each FS number.
Other Samples 2	OSAMP2	This number is a code that represents how many special samples were collected from each FS number.
Analytical Unit	AU	A number that is a combination of FS numbers representing a unit of analysis that will eventually aid in the interpretation of individual/cultural behavior. The AU is also the relate item between the descriptive data and the geographic data. Geographically it represents a mutually exclusive geographic feature.
Time Period	TIMEPER	A code that represents one of two separate time periods.

Table 2

Ceramic Tabular Database

Field Name	Field Abbreviation	Description of Field Name
Temper	Temper	This code refers to the non-clastic materials that are added to pure clays to aid in the strengthening of the ceramic vessel walls. The materials used vary considerably for different ceramic production techniques.
Type	Type	This code refers to a formally named stylistic subdivision of a ceramic ware. The sub-set of a ware bearing a specified design style or range of styles. It is relatively restricted temporally - generally considered as a time slice of a ceramic ware.
Form	Form	This code refers to the general shape of the pottery vessel when complete.
Part	Part	This code refers to the actual part of the pottery vessel that the ceramic artifact originated from.

Table 3

Geographical Database

Coverage Number	Coverage Name	Feature Type	Feature Names	Attributes

Coverage Number	Coverage Name	Feature Type	Feature Names	Attributes
1	PUBWORKCOV	Arcs	Roads, Pipeline Location, Right-of-Way	
2	AUGHOLCOV	Points	Auger Hole Locations	
3	CONTROLCOV	Points	Datum, Tics	
4	SURFCOV	Polygons	Surface Collection	AU, Timeperiod
5	POLYSUBCOV	Polygons	Feature 1, Nonfeature Excavations, Archaeological Site Boundary, Feature 2 Fill, Backhoe Trenches	
6	GRIDCOV	Polygons	Arbitrary 1 x 1 m grid	
7	SURFGRIDCOV	Polygons	Separate Surface Collection Units	
8	POLYFEATCOV	Polygons	Feature 2 Floor, Feature 5 Vent Fill, Feature 5 Rooffall, Feature 5 Floor, Feature 7 Trash, Feature 7 Floor	AU, Timeperiod
9	FEAT4COV	Polygons	Feature 4	AU, Timeperiod

Coverage Number	Coverage Name	Feature Type	Feature Names	Attributes
10	FEAT9COV	Polygons	Feature 9	AU, Timperiod

Table 4

Attribute Values

Attribute	Value	Code	Logical Expression
AU #	1	Surface Collection	ARBLEV = 999 and FSNO >= 100
	2	Non-Feature OCA Excavations	ARBLEV ≠ 999 and FEAT = 0 and FSNO >= 100
	3	Floor Association in Feature 2	FEAT = 2 and STRAT = H35 and FEAT = 3, 6, 8 and FSNO = 187

Attribute	Value	Code	Logical Expression
	4	Pot/Pit on Floor of Feature 2	FEAT = 4
	5	Pot/Pit on Floor of Feature 2	FEAT = 9
	6	Trash in the Ventilator in Feature 5	STRAT = B64
	7	Roof fall in Feature 5	STRAT = C38
	8	Floor and Bench Association in Feature 5	FEAT = 5 and STRAT = H35, I36 and FEAT = 16, 17
	9	Trash Fill in Feature 7	NGRID = 103.5 and EGRID = 120.5 and ARBLEV = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
	10	Roof fall and Floor Association in Feature 7	NGRID = 103.50 and EGRID = 120.5 and ARBLEV = 13, 14, 15, 16, 17 and FEAT = 10, 11, 12, 13, 14, 15
Timeperiod	1		Occupation of Feature 7
	2		Occupation of Feature 2

Attribute	Value	Code	Logical Expression
			and Feature 5 and Dumping of Trash in Feature 7
Temper	1	Sherd	
	2	Sand	
	3	Trachyte	
	4	Sandstone	
	5	Limestone	
	6	Cinder	
	7	Crushed Rock	
	8	Tuff	
	9	Mica	
	10	Feldspar	
	11	Sanidine	
	12	Sherd/Sand	
	13	Sand/Sherd	
	14	Unid. WAF	
	15	Sand/WAF	

Attribute	Value	Code	Logical Expression
	16	Sand/WAF/Trahcyte	
	17	Andesite-Diorite	
	18	A-D Sand	
	19	Sand/Crushed Rock	
	20	Trachyte/Sand	
	21	Trachyte/Sandstone	
	22	Sherd/Trachyte	
	23	Fine Paste with unid. fragments - crushed rock, sand or sherd	
	24	A-D/WAF	
	25	Sand/Sandstone	
	26	Quartz/Augite Sand	
	27	Augite Sand	
	99	Unidentified	
Type	See Appendix B		
Form	1	Bowl (unid.)	
	2	Bowl Hemispherical	

Attribute	Value	Code	Logical Expression
	3	Bowl Straight-Sided	
	4	Bowl Flare-Rimmed	
	5	Ladle	
	6	Scoop	
	7	Jar (unid.)	
	8	Jar Restricted	
	9	Jar Semi-Restricted	
	10	Mug	
	11	Cylinder Jar	
	12	Effigy Jar	
	13	Kiva Jar	
	14	Canteen	
Part	1	Rim	
	2	Neck	
	3	Body	
	4	Base	
	5	Handle	

Attribute	Value	Code	Logical Expression
	9	Unknown	

Table 5

INFO Files

INFO File Name	Item Name	Item Width	Item Output	Item Type	Number of Decimals
CERM.DAT	FSNO	4	4	Integer	
	Temper	2	2	Integer	
	Type	4	4	Integer	

INFO File Name	Item Name	Item Width	Item Output	Item Type	Number of Decimals
	Form	2	2	Integer	
	Part	1	1	Integer	
FS.DAT	FSNO	4	4	Integer	
	SU	2	2	Integer	
	FEAT	3	3	Integer	
	NGRID	7	7	Number	2
	EGRID	7	7	Number	2
	AREA2	6	6	Number	2
	STARELEV	6	6	Number	2
	ENDELEV	6	6	Number	2
	STRAT	8	8	Character	
	ARBLEV	3	3	Integer	
	CERM	6	6	Integer	
	C14	2	2	Integer	
	OSAMP1	3	3	Character	
	OSAMP2	3	3	Character	
	AU#	2	2	Integer	

INFO File Name	Item Name	Item Width	Item Output	Item Type	Number of Decimals
	TIMEPER	1	1	Integer	
TEMPER.LUT	CODE	2	2	Integer	
	TEMPER	59	59	Character	
TYPE.LUT	CODE	4	4	Integer	
	TYPE	50	50	Character	
FORM.LUT	CODE	2	2	Integer	
	FORM	20	20	Character	
PART.LUT	CODE	1	1	Integer	
	PART	7	7	Character	

Table 6

Archaeomagnetic Dating Results

AU	N =	Mean Ceramic Date	Archaeo-magnecic date
1	159	1184.86	
2	7	1199	
3	12	1191.67	1185-1260 (1015-1080)
4	-	No diagnostic ceramic types	
5	1	1175	
6	7	1175	
7	2	1137.5	
8	62	1186.98	1015-1260
9	226	1177.46	
10	10	1182.50	1175-1240

Ceramic Data Results

Table 7

AU1

Ceramic Type	Type Median	(x_i) x_i - 1000	Sherd Count	Product

Flagstaff B\W	1193	193	1	193
Holbrook A B\W	1100	100	9	900
Holbrook B B\W	1100	100	1	100
Padre B\W	1175	175	29	5075
Walnut A B\W	1175	175	12	2100
Walnut B B\W	1225	225	46	10350
Walnut B\W Undif.	1175	175	61	10675

y = 29393 divided 159 + 1000 = **1184.9** n = 159 29393

Ceramic Data Results (continued)

Table 8

AU2

Ceramic Type (x_i) Sherd

Type	Median	x_i - 1000	Count	Product
Flagstaff B\W	1193	193	1	193
Walnut A B\W	1175	175	3	525
Walnut B B\W	1225	225	3	675

y = 1393 divided by 7 + 1000 = **1199**   n = 7   1393

Ceramic Data Results (continued)

Table 9

AU3

Ceramic Type	Type Median	(x_i) x_i - 1000	Sherd Count	Product
Walnut A B\W	1175	175	7	1225
Walnut B B\W	1225	225	4	900
Walnut B\W undif.	1175	175	1	175

y = 2300 divided by 12 + 1000 = **1191.7** n = 12 2300

Ceramic Data Results (continued)

Table 10

AU5

Ceramic Type	Type Median	(x_i) x_i - 1000	Sherd Count	Product
Walnut A B\W	1175	175	1	175

y = 175 divided by 1 + 1000 = **1175** n = 1 175

Table 11

AU6

Ceramic Type	Type Median	(x_i) x_i - 1000	Sherd Count	Product
Walnut A B\W	1175	175	7	1225

y = 1225 divided by 7 + 1000 = **1175** n = 7 1225

Ceramic Data Results (continued)

Table 12

AU7

Ceramic Type	Type Median	(x_i) x_i - 1000	Sherd Count	Product
Holbrook A B\W	1100	100	1	100
Walnut A B\W	1175	175	1	175

y = 275 divided by 2 + 1000 = **1137.5** n = 2 275

Ceramic Data Results (continued)

Table 13

AU8

Ceramic Type	Type Median	(x_i) x_i - 1000	Sherd Count	Product
Flagstaff B\W	1193	193	1	193
Tusayan B\W	1250	250	1	250
Leupp B\W	1225	225	1	225
Padre B\W	1175	175	1	175
Walnut A B\W	1175	175	39	6825
Walnut B B\W	1225	225	12	2700
Walnut B undif.	1175	175	7	1225

y = 11593 divided by 62 + 1000 = **1186.98** n = 62 11539

Ceramic Data Results (continued)

Table 14

AU9

Ceramic Type	Type Median	(x_i)	Sherd Count	Product
1Black Mesa B\W	988	988	2	1976
Dogoszhi B\W	1125	1125	1	1125
Flagstaff B\W	1193	1193	28	33404
Holbrook A B\W	1100	1100	4	4400
Holbrook B B\W	1100	1100	1	1100
Padre B\W	1175	1175	17	19975
Walnut A B\W	1175	1175	148	173900
Walnut B B\W	1225	1225	17	20825
Walnut B undif.	1175	1175	8	9400

y = 266105 divided by 226 = **1177.46** n = 226 266105

Ceramic Data Results (continued)

Table 15

AU10

Ceramic Type	Type Median	(x_i) x_i - 1000	Sherd Count	Product
Holbrook B B\W	1100	100	1	100
Walnut A B\W	1175	175	3	525
Walnut B B\W	1225	225	3	675
Walnut B\W undif.	1175	175	3	525

y = 1825 divided by 10 + 1000 = **1182.50** n = 10 1825

APPENDIX B

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