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GRADUATE COLLEGE

ICONOGRAPHY AND GROUP FORMATION DURING THE LATE PITHOUSE AND CLASSIC PERIODS OF THE MIMBRES SOCIETY, A.D. 970-1140

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

VALLI SUE POWELL

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2000

ICONOGRAPHY AND GROUP FORMATION DURING THE LATE PITHOUSE AND CLASSIC PERIODS OF THE MIMBRES SOCIETY, A.D. 970-1140

A DISSERTATION
APPROVED FOR THE DEPARTMENT OF ANTHROPOLOGY

BY

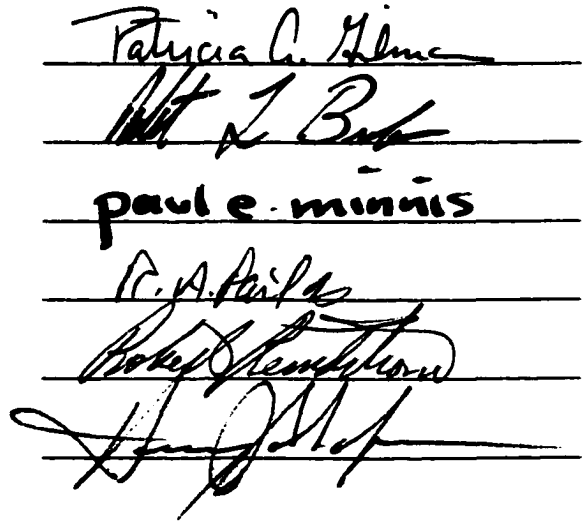

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TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS iv

LIST OF FIGURES x

LIST OF TABLES xi

CHAPTER

I. INTRODUCTION TO THE RESEARCH 1
Summary of the Chapters 14

II. ICONOGRAPHY, GROUP FORMATION, AND EXPLANATORY FRAMEWORKS 16
Cultural Ecology 19
Cultural Ecological Theory: Mimbres Studies 21
Stylistic Frameworks 23
Culture-Historical Use of Style 24
New Archaeology and Uses of Style 25
Learning interaction theory/ceramic sociology 25
Information exchange theory 28
Roles of Style 31
Active style 32
Emblematic style 35
Mimbres Icons and Group Formation: Formulating a Model 38
Icons, Iconography, and Iconology: Analytic and Synthetic Interpretations 41
Icon 41
Iconography 43
Iconology 44
Dyadic Relationships 44
Functions and Meanings: Ideology, Symbols, and Icons 45
Ideology 45
Symbols 47

Icons 48
Model Evaluation 48

III. ARCHAEOLOGICAL BACKGROUND: MIMBRES MATERIAL CULTURE 50
Mimbres Society from A.D. 200 to A.D. 1200 51
Settlement patterns 54
Subsistence 57
Architecture 63
Ceramics 69
Burials 77
Features 81
Observations Related to Mimbres Material Patterns 83

IV. MIMBRES ENVIRONMENT, FARMING, AND POPULATION 85
Environmental 86
Environmental Reconstruction of the Mimbres Valley and Surrounding Uplands 87
Farming Strategies 965
Irrigation 95
Terraces 96
Frost 97
Timing 97
Stream Flow 98
Other Variables 98
Dietary Sufficiency 99
Population 100
Population Estimates and Growth Rates 100
Population Variability: Environmental Zones 101
Summary and Preliminary Inferences 104
Summary 104
Environment 104
Farming strategies 104
Dietary Sufficiency 105
Population 105
Preliminary Inferences 106

V: COMPOSITIONAL ANALYSIS OF THE MIMBRES BLACK-ON-WHITE CERAMICS 109
Methodological Approaches to Compositional Analyses 109
Mineralogic Analyses 110
Petrographic analysis 110

Other mineralogic analyses 111
Chemical Analyses 112
X-ray fluorescence 113
Electron microprobe 113
Optical emission spectroscopy 114
Instrumental neutron activation analysis 115
Compositional Analytic Methodology 117
Chemical Analysis 117
Sites 120
Ceramic Sample 123
Temporal Variability 124
Iconography 124
Compositional Data 125
Calculations 125
Chemical Cluster Assignments 127
Temporal Assignment of the Compositional Sample 127
Chemical Cluster and Production Locale Assignments 129
Temporal Separation within the Clusters 130
II/III-Early III style sherds 130
Middle III style sherds 131
Late III style sherds 135
Data Synthesis and Preliminary Inferences 136
Exchange Patterns for II/III-Early III Ceramics 136
Exchange Patterns for Middle III Ceramics 140
Exchange Patterns for Late III Ceramics 141
Summary of the Compositional Data 141
Preliminary Inferences from the Instrumental Neutron Activation Analytic Data 142

VI. ICONOGRAPHIC ANALYSIS 144
Analytic Methodologies Applied to Stylistic Designs 145
Attribute Analysis 145
Symmetry Analysis 148
Comparative Analysis 148
Background for Analysis of Mimbres Black-on-white Designs 152
Iconographic Design Analytic Methodology 155
Design Analytic Sample 156
Sites 156
Iconography 156
Sample size and selection 157
Analytic variables 157
Iconographic categories 157
Temporal categories 158

Iconographic Data 158
Temporal Assignment of the Designs 158
Iconographic Assignment of the Designs 159
Iconographic-Temporal Integration 167
II/III-Early III style icons 167
Middle III style icons 167
Late III style icons 168
Data Synthesis and Preliminary Inferences 168
Late Late Pithouse and Early Classic Period Trends 168
Middle Classic Period Trends 168
Late Classic Period Trends 169
Preliminary Inferences 170

VIII. CONCLUSION 174
Review of Study 174
The Study Questions 178
Quantitative Data 179
Qualitative Data 179
Review and Syntheses of the Data Sets 180
Review of the Compositional Analysis 180
Review of the Iconographic Analysis 182
Synthesis of the Ceramic Data 185
A.D. 970 to 1080 ceramic data 185
A.D. 1060 to 1110 ceramic data 187
A.D. 1110 to 1130 ceramic data 187
Review of Material Patterns 187
Review of Economic Factors 191
Environment 192
Farming strategies 194
Population 194
Environment, Farming Strategies, and Demographic Synthesis 195
Responses to Subsistence Stress 196
Iconography, Stress, and Group Responses 199
Iconographic Bowls, Exchange, and Distribution 201
Conclusions 207

REFERENCES CITED 210

APPENDICES

A. SAMPLES SUBMITTED FOR INSTRUMENTAL ACTIVATION ANALYSIS 233

DENDROGRAM 240

B. DATA VARIABLES: KEY TO THE ICONOGRAPHIC DATA CODING 242

LIST OF FIGURES

Figure Page

1. Mimbres Black-on-white Iconographic Bowls 4
2. Mimbres Black-on-white Designs Showing Positive-Negative Imagery 6
3. Mimbres Black-on-white Story Bowls 6
4. Map of the Study Area and Study Sites 11
5. Mimbres Black-on-white Styles I, II, III 75
6. Mimbres Black-on-white Microstyles, Style I, Early Style II, Late Style II, Style II/III, Early Style III, Middle Style III, and Late Style III 76
7. Precipitation, Crop Success, and Estimated Food Stress for the Study Period 92
8. Plot of Mimbres Black-on-white Chemical Composition Analysis Showing Trace Chemical Dissimilarities 126
9. Bivariate Plot Showing Clustering of the Sherds 128
10. Exchange Percentages and Directions During the II/III-EIII Time Frame 137
11. Exchange Percentages and Directions During the MIII Time Frame 138
12. Exchange Percentages and Directions during the LIII Time Frame 139
13. Shared Icons During the II/III-EIII Time Frame 171
14. Shared Icons During the MIII Time Frame 172
15. Shared Icons During the LIII Time Frame 173
16. Iconographic Designs Showing Uniqueness of Each Design 176

LIST OF TABLES

Table Page

1. Exchange Percentages 132

2. Percentages of Icon Type of Site Total, Temporal Total, and Temporal Type 160

CHAPTER I

INTRODUCTION TO THE RESEARCH

One of the aspirations of North American archaeologists is to infer functional and behavioral aspects of societies from patterns and variability in the enduring material culture, the surviving things that people of these societies used. The assumption is that things are associated with specific activities and, therefore, that these activities should be reflected in the objects and their contexts. Connecting inferred activities to causes or possible motivators requires the researcher to consider influential or systemic parts of the society and assess whether the patterns are only the result of activity or whether they functioned in initiating certain behaviors. Did the objects implement activity or were they more primary in activating behavior for the participants of the society, the users of the "things?" Artifacts may serve as active motivators of behavior or as passive implementors of activity, as well as reflective archaeological research tools.

Researchers have suggested that a relationship exists between iconography, or symbols, and social group formation (Braun 1989; Braun and Plog 1982; Conkey and Hastorf 1990; Crown 1991; DeBoer 1990; Earle 1990; Hegmon 1990; Hodder 1977, 1979, 1982, 1991a; Lintz and Reese-Taylor 1997; Macdonald 1990; Nassany and Sassaman 1995; Pauketat and Emerson 1991; Plog 1995; Rautman 1993; Sackett 1990;

Sterner 1989; Upham 1982; Wallace 1988; Wiessner 1983, 1984, 1990). Therefore, because human behavior is patterned, the distribution of the symbols should be patterned, and the patterning thus would allow group membership, or the groups involved in the behavior, to be identified. Researchers also have suggested that symbols may actively function in mediating and maintaining group relationships (Earle 1990; Hodder 1982; Macdonald 1990; Rice 1987; Upham 1982; Wiessner 1983, 1984, 1990). Symbols carry social messages which may demarcate boundaries, delimit socially permissible behavior, transmit cosmological information, and/or stimulate various individual or group behavioral responses. This study uses patterning of Mimbres ceramic iconographic symbols to identify groups formed by interaction or alliance between two or more villages within Mimbres society. The iconographic ceramic data are also viewed within the context of the Mimbres society and its economic base to examine the active mediating role of Mimbres ceramic iconography in group formation.

Understanding the patterns of group formation as they change through time provides significant data for the reconstruction of social organization. Ethnographic and archaeological studies note that group membership changes in response to tensions set up by institutional conflict or in response to stress situations within the context of changing environmental and/or demographic conditions (Bernardini 1996; Braun 1989; Cancian 1972, 1980; Collier 1975; Halstead and O'Shea 1989; Hames 1990; Johnson 1982, 1983; Rice 1987; Sampson 1988; Vayda and McCay 1975; Wiessner 1988, 1990). For example, Cancian (1972) has shown that as food shortages increase among the Tzotzil of Chiapas, kin groups coalesce to share food, but if pressures increase, then a point is

reached where kin sharing fails and groups disperse. Thus, the processes of kin interaction as groups come to gather and disperse through time are one important aspect of reconstructing the overall social organization of the Tzotzil.

This research will provide pertinent data concerning group responses to economic uncertainty and the role of ceramic iconography in the Mimbres society by examining the temporal and spatial distribution of Mimbres bowls with iconographic designs in relationship to economic variability in the Classic Mimbres society (A.D. 970-1140). It will also evaluate the methodological use of the temporal and spatial distribution of symbols in demonstrating the presence of groups.

In terms of the iconography, the designs on Mimbres pottery are highly visible representations of animals, people, anthropomorphic figures, stories, and geometrics (Figure 1). Technically, the art work is very sophisticated, and the designs' visual effects are dramatic and enduring. Although Mimbres black-on-white designs most frequently occur as geometric designs, perhaps as many as 75 percent (based the Mimbres black-on-white bowl sample from Galaz for all time periods; Powell 2000), the geometric designs are also extremely well painted, distinctive, and intricate consisting of combinations of various geometric elements, such as lines, curves, and triangles. However, geometric designs are more accurately analyzed in terms of grammars than as iconic ecapsulations of group ideologic information (see, for example, geometric design grammar analysis by Hegmon 1990). This study, however, focuses on the most emblematic of the black-on-white ceramics, the naturalistic, or life-form, designs.

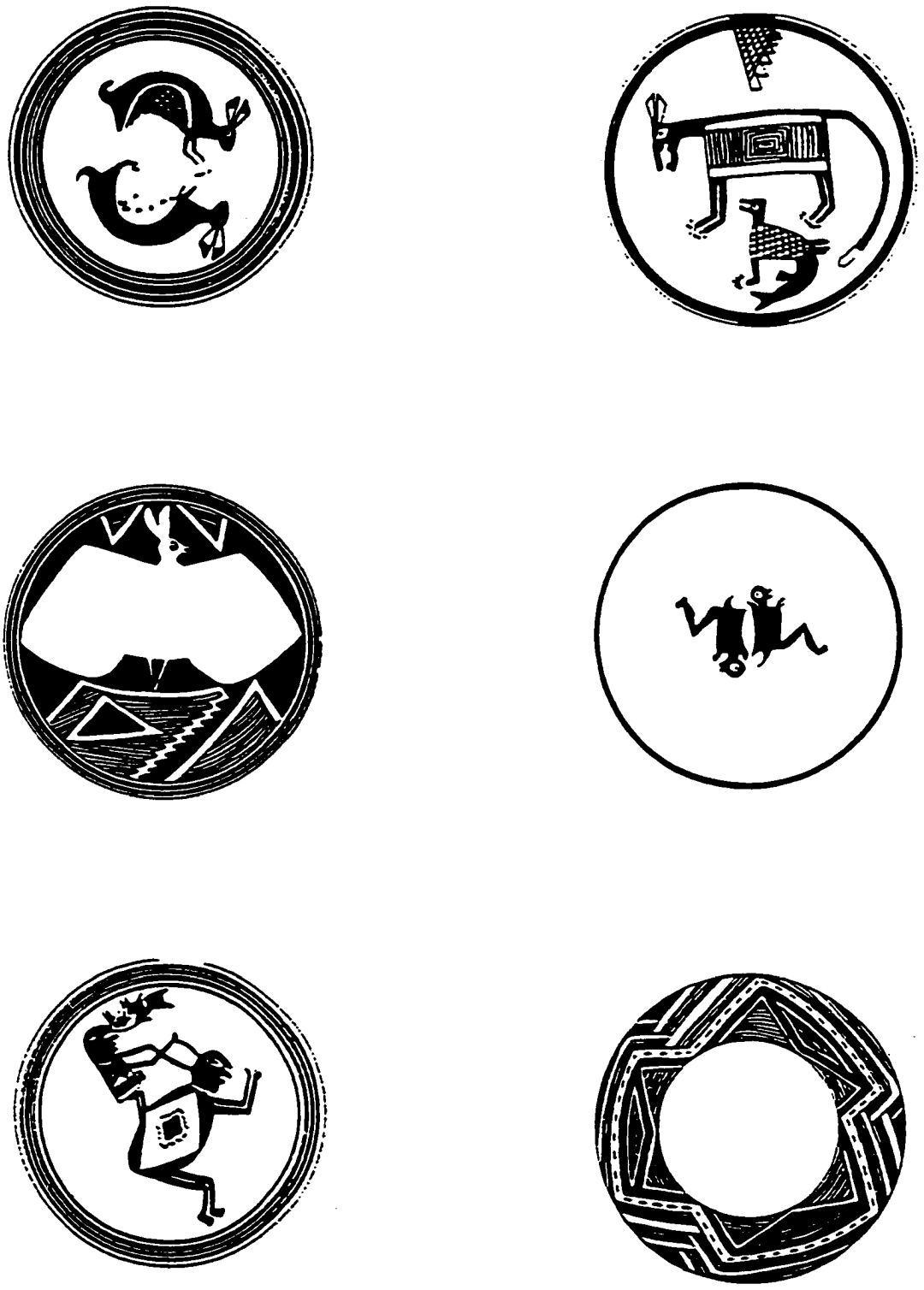


Figure 1. Mimbres black-on-white bowls.

The Mimbres black-on-white iconographic designs are pictures or figures painted near the center of a bowl's interior showing the subject in positive-negative imagery (Figure 2). Figurative life-forms on Mimbres bowls include humans, several types of mammals (i.e; antelopes, badgers, bats, bears, cats, cottontail rabbits, deer, jackrabbits, mountain sheep), birds (i.e; hummingbirds, parrots, quail, swallows, turkeys), fish (i.e; catfish, gar, minnows, perch), insects (i.e; bees, hornets, mites, vinagaroons, wasps, weevils) and reptiles (i.e; lizards, snakes, turtles). In the later designs, the central icon is normally framed by one, two, or multiple unattached framing bands which are painted at or near the bowl rim. Usually the figure is presented in profile, full-face, or from above with a single representation at the bowl center, but iconographic designs also may consist of two, three, or more life forms (Brody 1977). Multiple figures sometimes occur as mirror images, but may be different animals, humans and animals, fantastic combinations, or two or more different types of life figures, such as a person with a bird head or bear feet or a rabbit with a fish tail. A frequent embellishment to the figures is the addition of geometric patterns at the central area of the body. Framing bands may also be elaborated with geometric elements.

Besides the figurative icons, narrative or story iconography occurs (Figure 3). These may or may not include humans, but more than one life form is painted so that the association between or among them suggests an action or episode, such as tracking a deer, or training a parrot, giving birth, or trapping birds. Characteristically, minimal contextual details are presented. There may be only deer tracks in addition to several humans armed with bows and arrows positioned in a curved line suggesting a trail. Or, a

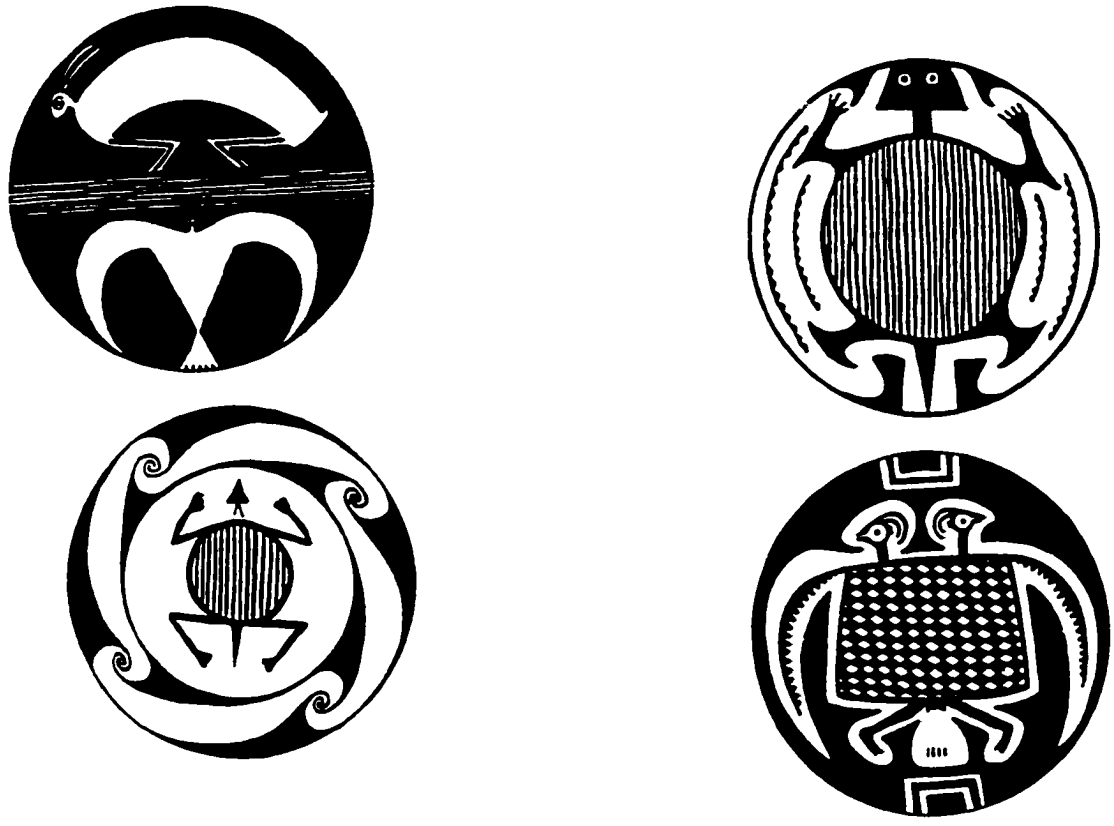


Figure 2. Mimbres black-on-white designs showing positive-negative imagery.

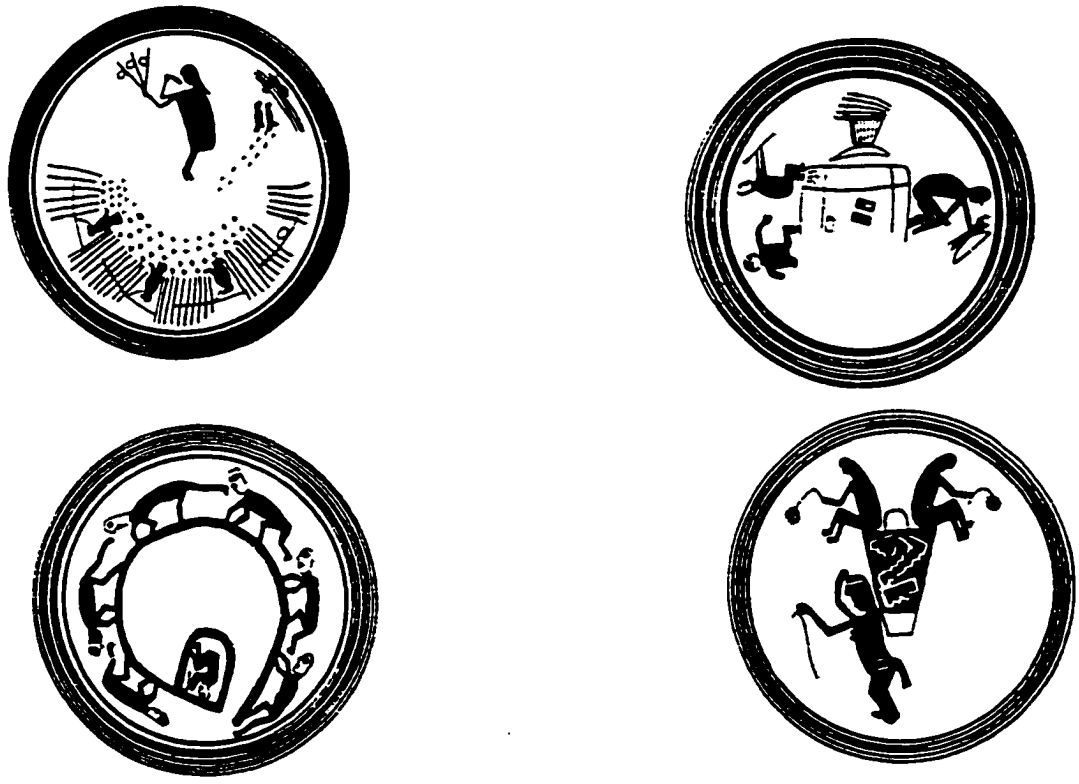


Figure 3. Mimbres black-on-white story bowls.

few chevrons may appear representing stylized grass in a bird trapping narrative. Story bowl designs without humans often depict one type of animal eating another, such as a bird pecking at a rabbit which is shown as partially whole and furred while the other portion is skeletoned.

The function of this distinctive iconography in Mimbres society has long been the subject of conjecture as well as untested hypotheses among southwestern archaeologists (Gilman 1989), but the hypotheses concerning the mitigating role of the iconography put forth in this study will quantitatively test the functionality of the naturalistic designs by evaluating their role in group formation. It also will illuminate the usefulness of tracking spatial and temporal iconological patterns as a tool for identifying group formation. On a more general level, the relationship between iconography and group formation in one of the earliest aggregated, agricultural societies of the Southwest will aid researchers interested in social evolution, particularly organizational changes in response to economic variations in sedentary, non-stratified societies.

The study will also provide previously undocumented data on the production and distribution of Mimbres black-on-white iconographic ceramics. Mimbres black-on-white pottery is understudied in that only a few quantitative studies have been done. One pilot study in the 1970s (C. LeBlanc 1977) systematically attempted to document motif distribution. Chemical analysis done by Gilman et al. (1994) examined a limited number of Mimbres black-on-white sherds from a cross-section of large Classic sites. Three site-specific chemical analyses (Brewington 1992; Creel et al. 1995; James et al. 1995) were done on sherds from Old Town, NAN Ranch, and West Fork ruins.

Hypothetically, if production/exchange chemical composition and iconographic design patterns of Mimbres black-on-white ceramics occur which show a high percentage of shared icons at two or more Mimbres villages then these villages may have been members of a group because of their high level of ceramic interaction. If these exchange and iconographic patterns change through time, then it is possible that group memberships have changed. Further, if the group membership patterns change through time and the temporal patterns correlate with economically stressful periods, then it possible that Mimbres iconography actively functioned in the formation, identification, and maintenance of groups.

In order to test the idea that the temporal and spatial patterns of Mimbres black-on-white iconography delineated as well as mediated group memberships, three aspects need to be considered: 1) the production and distribution patterns of naturalistic ceramics over time, 2) the temporal and spatial distribution of the iconography, and 3) the social and environmental contexts within which the iconography occurred. The first quantitative test which compares chemicals in the ceramic compositional materials by instrumental neutron activation analysis contrasts patterns of ceramic distribution and manufacturing origin. Vessel production loci are determined through the compositional analysis and identification of trace chemicals occurring in the ceramics. The data from these tests should identify vessels made from like pastes indicating a common origin of production. This analysis will document if vessel movement occurred, and if it did, then it can be reasoned that people interacted in exchanging ceramics. Therefore, comparison of production and distribution loci will demonstrate whether two or more villages with

high percentages of like icons were interacting as a group or did not interact but painted like icons, perhaps reflective of broader, less interactive culturally shared ideas (Crown 1991; Hagstrum 1995; Lintz and Reese-Taylor 1997; Mills and Crown 1995).

The second analysis tests stylistic patterns of the iconography which may reflect group memberships if the spatial distribution of some iconographic designs occurs in high percentages at two or more villages, thus suggesting that distinct groups existed. If temporal distribution of these high percentage icons changes, and if the changes correlates with the exchange data, then group re-formation may be demonstrated. The data for quantifying the spatial and temporal frequency of the icons are obtained from microserational and iconographic analyses of naturalistic vessel designs.

Third, a social background and an environmental reconstruction will provide comparative frameworks for correlating iconographic changes with economically related tensions. If environmental, demographic, and to a lesser degree, material culture changes co-occur, or slightly pre-date, iconographic changes, then it may be inferred that iconography is functionally associated with group responses to significant economic impacts. An overview of Mimbres material culture patterns should corroborate that social change occurred concomitantly with shifting climatic patterns and iconographic distributions. General Mimbres material culture patterns are drawn from the literature with study site details coming from site reports, interim reports, and personal communications. Environmental data come mainly from Minnis' 1985 research and are augmented by other more recent contributions, additional tree-ring dates from the Mimbres Valley, and evidence from prehistoric farming strategies.

The results of the study will document the presence or absence of both a reflective, passive and an active, functional relationship between iconography and group formation and thus make an important contribution toward understanding processes involved in social organization and evolution. It will also map production and distribution loci of the Mimbres black-on-white naturalistic ceramics. Group membership data from this study will contribute significantly to reconstructing Mimbres social history which previously has been addressed by only a few scholars (Gilman 1989, 1990; Ham 1989; Nisengard 1995; Shafer 1995), and Mimbres scholars will benefit from a large production and distribution data base based on chemical analyses.

This research focuses on the Mimbres branch of the Mogollon region of the North American Southwest, and, in particular, on the Mimbres Valley of southwestern New Mexico (Figure 4), an area which has often been cited as the heartland of Mimbres society (Brody and Swenzell 1996; LeBlanc 1983; Shafer 1985, 1995). During the A.D. 900s, the inhabitants of the Mimbres Valley lived in rectangular pit houses, practiced at least part-time agriculture and met for ceremonies in Great Kivas (Anyon and LeBlanc 1980, 1984; Gilman 1987). Rainfall was variable, including some years of below average moisture (Minnis1985). Poor crop yields or failures were probably supplemented with wild plants and game from the rugged, surrounding mountains.

By the A.D. 1000s, subsistence was focused on farming including agricultural technologies such as irrigation and check dams that had not been used previously (Herrington 1979; Minnis 1985). All available arable land in the valley was used for crops, and evidence exists to suggest that farming was practiced in surrounding upland

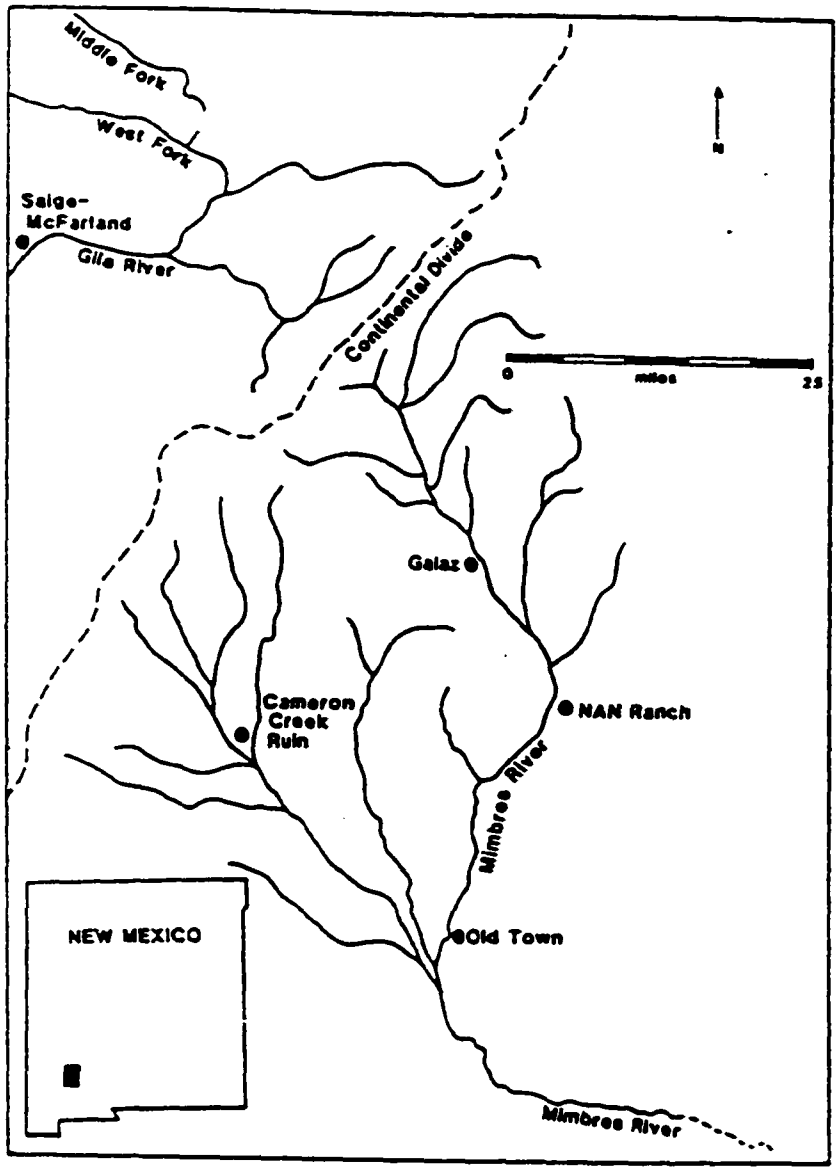


Figure 4. Map of the study area and study sites.

areas (Anyon and LeBlanc 1984; Blake et al. 1986; Minnis 1985). The period from A.D. 1000 to A.D. 1089 was an unusually favorable time both in amounts and consistency of precipitation (Minnis 1985). These conditions may have encouraged immigrants from the Gila Valley (Lekson 1990; Nelson and Anyon 1996) and contributed to better health and *in situ* population increase. Large, underground kivas were replaced by communal areas in village plazas which probably served as daily work areas and burial grounds (Anyon and LeBlanc 1980). Small kivas associated with room blocks and probably kin-related groups also characterize the Classic period.

During the eleventh century, population reached it maximum size. Ominously, however, beginning around A.D. 1090 and lasting into the A.D. 1140s, fluctuations in rainfall amounts and consistency increased in the valley and surrounding region. There were more dry years before A.D. 1000-1090, more severe drops in precipitation amounts, and less flooding to replenish the fertility of the valley (Minnis 1985). Gradually, and perhaps imperceptibly at first, subsistence stress increased. Possibly even before the effects of environmental variability were felt, population pressures may have begun to stress the system. Considering the economically related environmental-demographic conditions of the Classic period, changing group memberships are not unexpected (Lipe 1994). Hodder (1978) and others (Cancian 1972, 1980; Collier 1975; Halstead and O'Shea 1989; Minnis 1985; Wiessner 1988, 1990) suggest that group members may change through time as environmental and demographic contexts vary, especially if economic tension exists.

Groups may respond to food stress by becoming more diversified or more sedentary. Mobile foragers may use a wider variety, including less desirable types, of foods, and/or they may enlarge or change their gathering territory (Halstead and O'Shea 1989; Minnis 1996). Nomadic or semi-sedentary people may become sedentary and dependent on horticulture. In the latter case, agriculture necessitates surplus so that food is available between harvests. Surplus and storage also allow exchange, and agriculture, surplus, and storage are often associated with aggregation (Halstead and O'Shea 1989). Increased dependence on agriculture and aggregation may also signal group formation as a means of protecting land-use rights (Adler 1996).

Another mechanism for mitigating against food stress used in sedentary, horticultural groups is ceremonialism (Hegmon 1995; Pauketat and Emerson 1991). Rites of intensification serve to integrate nested groups such as families, clans, and villages (Braun 1991; Pauketat and Emerson 1991). And, as well, ceremonies reinforce ideologic concepts and perpetuate cosmologically oriented buffering strategies through acts of propitiation for fertility/crop success, and they provide a stress release event for the people (Hegmon 1995; Pauketat and Emerson 1991). As population grows and communal density increases, decisions about economic success become more important. Group integration insuring cooperative behavior is more critical for reducing the risks involved in a narrowly focused economic base such as agriculture. Thus, Mimbres group formation and re-formation may have been a response aimed at relieving economic tension or reducing subsistence risks because groups may have combined to cooperate in crop production, and/or to define and protect land-use rights, and/or to participate in rites

of intensification. Uses of the iconographic vessels within the context of these possibilities is discussed in the study's conclusion.

Summary of the Chapters

Chapter II presents the model into which the compositional and iconographic ceramic data as well as material and environmental patterns are juxtaposed. From this contextual examination, inferred outcomes will be made in the concluding chapter concerning group formation as identified and mediated by icons and as related to environmentally impacted economic conditions. Because environmental conditions were especially constricting to prehistoric horticulturists who lacked the technology to overcome many environmental variations negatively affecting agricultural success, ecological explanations concerning group responses are discussed. And, as well, theories of ceramic style which have long been used in southwestern archaeology to explain change are summarized, and current explanations focused on stylistic messaging are reviewed and evaluated. The basis for typing Mimbres naturalistic ceramic designs as iconographic is presented, and this element of the formula is placed within the model. Symbols, icons, iconography, and iconology are defined and the operative definitions of icons and iconography used in this study are given.

Chapter III gives an archaeological overview of Mimbres settlement, subsistence, architecture, and other material items covering time periods both prior to and after the study focus in order that change may be made more visible. Chapter IV summarizes the paleoenvironmental data for the Mimbres region and considers farming strategies which may have reduced environmental impacts on agriculture success.

Additionally, Mimbres population estimates are discussed in order to evaluate the impact of population fluctuations on Mimbres subsistence.

Chapter V details the methodology used in the ceramic compositional analysis, after which the spatial and temporal quantitative distribution data obtained from the analysis of the compositional sample are presented. The chapter concludes with preliminary observations regarding the production and exchange data. A similar presentation of methods, data, and patterns is given in Chapter VI for the iconographic analysis of Mimbres black-on-white naturalistic designs ceramic.

The concluding chapter, Chapter VII, presents a review of the study questions, background material, and outcomes of the data analyses. This is followed by a discussion of the results, including inferences and implications.

CHAPTER II

ICONOGRAPHY, GROUP FORMATION, AND EXPLANATORY FRAMEWORKS

This study examines the relationship between group formation/village alliances and icons. It is proposed that ceramic iconographic distribution in the Mimbres region of southwestern New Mexico changed during the late pre-Classic and Classic periods, A.D. 970-1140, and that these changes were tied to the formation and re-formation of social groups. It is further hypothesized that if changes in the iconographic patterning closely paralleled environmental changes that were likely economically detrimental, then group formation and re-formation may have been linked to socially perceived risk reduction strategies. The hypotheses imply an active role for the icons in Mimbres society.

The ability to address such questions results from a fruitful historical development and use of theoretical applications to Southwest and Mimbres prehistory. The explanatory framework used in this study builds on and connects theoretical constructs in cultural ecology and stylistic interaction and information exchange. They are used to create a model of the relationship between icons and group formation within the context of the Mimbres society.

Stylistic expression and environment both suggest possible motivations for social

change, such as village alliance formation and re-formation, because style may signal interaction as well as carry messages and because environment affects all societies. Societies are impacted by environmental conditions in greater and lesser degrees depending on the severity of variability and on ameliorating technological capabilities (Watson et al. 1971). Ancient societies such as the Mimbres relied directly on domestic and wild resources, and although Mimbres' technology in the form of water conservation/diversion and niche utilization was impressive, it likely was not adequate to buffer against or overcome severe resource depletions. Negative environmental impacts occurred and posed a major threat to Mimbres economy during the study period.

Stylistic explanations that suggest interaction and/or messaging as social boundary markers and as communicative vehicles of change also apply to questions asked in this study. Icons are a form of style, as will be discussed below. In a passive role, style may demarcate societal and group boundaries for archaeologists, and thus it allows the presence or absence of village alliances to be documented (Conkey and Hastdorf 1990; Wiessner 1990). In its active capacity, style may carry messages to societal members eliciting various types and intensities of responses (Ball and Dagger 1990; Kertzer 1988; Wiessner 1990). Iconographic messages on Mimbres bowls may identify group members for both group participants and for outsiders, and more importantly, perhaps, icons may carry powerful messages which initiate and perpetuate groups . In historical times, icons often represent political and/or religious ideals to achieve or maintain and provide a rallying banner for these ideals through social action (Ball and Dagger 1990; Kertzer 1988). For example, consider the socially activating power of the multi-level meanings

embodied in the Madonna-child icon, or that of the stylized fish for people of the Christian religion. Likewise, pictures of political figures such as Mao Tse Tung enhanced and displayed on huge banners stir up and perpetuate political fervor and endorse a set of socio-political ideals. Icons call for action that aims toward creating or perpetuating group ideologies.

Icons function in much the same way as other symbols, but have an added aspect of life, or energy, because icons are specifically figurative representations as opposed to abstracted renderings of objects. With such focused, dynamic power, Mimbres icons would have been an extremely effective vehicle for messaging about social action or social responses.

The role of icons, however, is greater than that of a functional conveyer of social response messages. Because icons encapsulate societal and/or group ideology, as will be discussed below, they act as a pivot between action and other aspects of the cultural-environmental system. Individual and group perceptions of the world/system as well as the range of optional responses are filtered through ideologic constructs. Ideology is, in fact, a monitoring or defining framework for the whole of society. Thus, an effective explanatory model for understanding the role of Mimbres icons in relation to the formation and re-formation of village alliances from A.D. 970 to 1140 is one which is set within a diachronic context in which icons as the embodiment of social and group ideologies interface between the systemic components of environment-social organization-economy and group action.

Cultural Ecology

In anthropology and archaeology during the first half of the twentieth century, a great deal of emphasis and research was put into amassing data and establishing chronologies for both ancient and living groups. Causal explanations, such as diffusionist and direct historical approaches, regarding why groups of people behaved or changed as they did later proved unsatisfactory because rates of diffusion did not always correlate with change, and ancestral data about prehistory w not necessarily accurate and/or available. In reaction to the lack of satisfactory explanation, the anthropologist Leslie White began to re-examine evolutionary ideas that had been proposed in the nineteenth century, and to consider the possibility of varied evolutionary trajectories. Just prior to World War II, scathing attacks concerning the current state and problems of archaeology were put forth by Clyde Kluckhohn (1940) in a paper on Mayan archaeology and more fully elaborated by his student, Walter Taylor, who denounced archaeology's focus on establishing chronologies and thereby ordering cultural development (Longacre personal communication, 1994; Willey and Sabloff 1980). Taylor called for a conjunctive approach and for functional explanations (Taylor 1948; Willey and Sabloff 1980).

Concurrently with the growing dissatisfaction expressed by White, Kluckhohn, and Taylor concerning archaeology's and anthropology's inabilities to adequately explain cultural change, Julian Steward, drawing on his observation of the Shoshoni and their adaptations within the arid lands of Nevada, proposed an approach which focused on the interaction of the physical environment with aspects of culture (Fiedel 1987; Harris 1988; Steward 1955). This approach came to be called cultural ecology. It presented a broad

theoretical framework as well as a methodology and espoused the idea that the relationship between the physical-biological environment and human society underlies culture change (Fagan 1996; Netting 1977; Steward 1955; Watson et al. 1971).

From Steward's ideas, three new areas of focus arose in American archaeology: 1) multi-linear evolution and cross-cultural comparisons; 2) settlement patterns; and 3) cultural ecology (Willey and Sabloff 1980). New awareness of methodological and theoretical problems along with Steward's ideas resulted in innovative research. After consulting with Steward in the late 1940s, Gordon Willey began research in the Viru Valley of Peru where he focused on settlement patterns through time (over 1500 years) and changing climatic patterns (Renfrew and Bahn 1991; Longacre personal communication, 1994; Willey and Sabloff 1980). Thereafter, Flannery's work in the Valley of Oaxaca viewed adaptive changes within the contextual and interactive whole of the ecosystem (Flannery 1972).

Steward's cultural ecology has remained an important approach in American archaeology as eco-models have contributed to and been refined by new ideas introduced in the 1960s and 1970s by the New Archaeology movement of Binford and his colleagues (Renfrew and Bahn 1991; Crown 1994). Systems and processes approaches, new quantitative techniques, the introduction of multi-disciplinary research data and techniques, and above all, a new emphasis on *scientific* methodology enhanced an archaeological research framework based on the interaction and interdependence of culture and environment. In turn, cultural ecology encouraged the examination of non-artifactual evidence, such as seeds and animal bones.

Cultural ecological models have been deemed especially appropriate in the North American Southwest where ancient societies were generally non-hierarchical and based on subsistence systems that included technologies incapable of mitigating against extreme detrimental impacts from the environment. Most areas of the Southwest are arid or semi-arid with unpredictable rainfall, and these conditions create a marginal environment for both foraging and/or agriculturally based groups. In such a context, environment must be considered as a formative agent of the system.

In the Mimbres area, semi-arid conditions, relatively narrow valleys, and thin upland soils limit domestic and wild resource productivity. Although, changes can be made within a limited range to improve the soil depth and water retention of small gardening plots, the underlying nature of the uplands constitutes an area of low carrying capacity for supporting agricultural populations (Sandor 1983). Flood plain soils in the Mimbres Valley provide deeper moister soils, but as in the uplands, limited area and desert conditions configure carrying capacity.

Changing conditions of the environment along with topographic limitations were elements with which the Mimbres people of necessity maintained a working relationship for at least five centuries. This relationship may not explain why group formation expressed as village alliance was one optional social response to negative environmental impacts, but the potentially life-threatening environmental aspects likely triggered social reactions, and, therefore, must be taken into consideration in this study.

Cultural Ecological Theory: Mimbres Studies

Most modern interpretations of Mimbres prehistory have been based on ecological theory

in which environmental and demographic conditions are posited as instrumental in organizational change (Anyon and LeBlanc 1984; Barker and Bayer 1996; Cosgrove and Cosgrove 1932; Creel 1996; Dean 1996; Diehl 1992; Gilman 1983, 1989, 1990; Ham, 1989; Hegmon et al. 1998; C. LeBlanc 1977; McCluney 1968; Minnis 1985, 1996; Nisengard 1995; Powell 1992; Shafer 1982, 1985, 1995; Stokes 1994; Stokes and Roth 1997). These studies address questions about subsistence, settlement patterns, and social organization. Many of the ecological reconstruction studies use temporal and spatial changes in style as material culture evidence for modeling organizational evolution within the environmental context. The presence and intensity of trade and craft specialization also have been explored in organizational change, but researchers suggest that craft specialization and inter-regional trade was minimal in the Mimbres area, especially during the Classic period (Anyon and LeBlanc 1984; LeBlanc and Whalen 1980; Minnis 1985; Vargas 1995).

Although possibly less directly related to the environment than subsistence or settlement studies, social reconstructions also stress ecological conditions by demonstrating the co-occurrence of agricultural intensification and population increase with ideologic and ceremonial changes, or with the presence/absence of social differentiation (Gilman 1989, 1990; Nisengard 1995; Shafer 1995). As noted above, these studies rely heavily on stylistic similarities of material culture as supportive evidence. The use of stylistic supportive evidence is not denied; however, it is suggested that inferences about group identification and social organization need independent measures that validate the links between stylistic change and hypothesized social

processes. Inferences about structural organization must be supported by *evidence* of behavioral change, group membership, or interaction. Style must be demonstrated to be a part of these behaviors through evidence of material culture exchange. High levels of symbolic or architectural design similarity may indicate imitative behavior rather than group interaction (Neff 1993). Compositional analysis of ceramics is a strong independent measure for correlating interaction and stylistic distribution. The compositional analysis in this study is essential for supporting the interaction and information-exchange theories of style from which stylistically defined groups are confirmed as interactive groups.

Stylistic Frameworks

In this study, a descriptive and critical discussion of stylistic theories is appropriate because style is used to document and/or explore aspects of temporality, boundaries, interaction, and messaging. Additionally, active and passive uses of style as well as various types of style are addressed as they also are relevant to the possible functions of icons in this research and in establishing the iconic landscapes from A.D. 970 to 1140. Temporal placement based on stylistic attributes is important in determining change in icon distribution over time while the spatial distribution of icons as a type of style is essential for identifying group boundaries. The icons themselves are presented in such a dramatic form that a message of identity and/or other symbolic meaning(s) is proclaimed. Because style in this study is both a reflective, archaeological tool and hypothetically an active mediator of group formation, discussion and definition of active and passive style are needed. Since group formation and re-formation is an integral part of the hypotheses

in this study, iconic style must be shown to be associated with groups. This will be evaluated in a discussion of analytic approaches to active styles which address referent specificity and criteria. Both the active-passive and referent aspects address the iconographic or more surficial function of the icons. Active style is appropriate for exploring the deeper iconological meanings that the icons may have transmitted to the Mimbres people concerning perceived environmental impacts and allowable responses configured by Mimbres ideology and encoded in the icons.

Culture-Historical Use of Style

Style has been defined as the elements of an object which are not necessary to its technological function (Binford 1962; Braun 1989; Hegmon 1991). Ceramics and the decorations on them are basic archaeological research tools because of their durability, ubiquity, and temporal sensitivity.

The study of ceramic stylistic or decorative aspects in North American archaeology began in the late nineteenth century. While at Zuni, Cushing (1886) used ceramics in an attempt to trace the evolution of ceramic traits, especially in relation to cooking processes. In Hopi land, Fewkes (1900) hoped ceramic stylistic research would help resolve conflicting oral traditions about Hopi migrations. He hypothesized that designs on sherds and whole vessels represented clan symbols. At Pecos in the 1920s, Kidder (1924) used ceramic stylistic traits to identify cultural units and reconstruct a cultural sequence based on seriation. Ceramic style was mainly a tool for establishing chronologies and cultural spatial boundaries in the first half of the twentieth century (Shepard 1957). In these early days of archaeology, the methodological uses of style

supplied broad temporal and spatial frameworks and foundational data for later studies. The use of style to establish chronologies and boundaries is a passive methodological tool employed by archaeologists. Questions concerning the active role of stylistic patterns were not asked by early researchers (Arnold 1985; Wiessner 1990).

In spite of changing theoretical approaches in the rest of anthropology during the 1930s and early 1940s, archaeologists continued to ignore the structural-functionalism of Ratcliffe-Brown, and ecological approaches being espoused by Steward (Harris 1988). When archaeologists were finally jolted out of their culture-historical, normative thinking by Kluckhohn (1940), and into action by Taylor (1948), new questions concerning the parts and articulation of parts that made up a "culture" were asked of the archaeological record (Longacre 1991). The use of style as an indicator of interaction played a significant methodological and theoretical role in this new era.

New Archaeology and Uses of Style

Learning interaction theory/ceramic sociology. In the beginning of the New Archaeology during the late 1950s and 1960s, archaeologists initiated problem-based research to make sense of data. Even though stylistic qualities were used to interpret social organization and behavior, a separation between style and function was maintained. Early ceramic sociology viewed style as a passive reflector of the maker and held that styles changed through diffusion or drift (Hegmon 1991; Sinopoli 1991).

In the early 1960s, stylistically oriented studies adopted a theoretical approach, known at first as ceramic sociology, in which learning-interaction was the focus. Along with assumptions about learning and kinship derived from modern pueblo societies, inter-

and intra-community boundaries were sought using design similarities and differences. Style as a way of reconstructing social interaction was used in archaeological studies by Longacre (1964), Martin, Longacre and Hill (1967), and Martin and F. Plog (1973). In 1957, Shepard's *Ceramics for the Archaeologist* was published. It heralded new theoretical approaches of the early 1960s archaeology, including a detailed description of the technological information carried by ceramics and ceramic designs.

Interaction theory explains cultural change and cultural behavior by emphasizing "stylistic variation through space . . ." (Plog 1980:1) at a given moment in time. An inherent assumption of this explanation is that homogeneity and diversity of style are directly proportional to the amount of interaction by defined social groups (Deetz 1965; Hill 1970; Longacre 1964, 1970; Martin and Plog 1973; Plog 1980; Rice 1987). Although the assumptions on which these studies were based (i.e, daughters learn from mothers; similar motifs reflect kinship) have been challenged, sometimes even by the original researcher (e.g., Longacre 1970), the application of interaction theory did refine the use of style by focusing on greater detail in variation and in searching for sources of differences and change. This was a more sophisticated used of style than that of previous studies which used generalized types and norms for defining broad cultural areas.

In spite of refinements, style was perceived as reflective and passive, not functional and active. Interaction theory as it was originally conceived was a synchronic, reflective use of style to infer group contact, and it has been criticized because it ignores contextual variables such as environment or ideology (Braun and Plog 1982; Plog 1990; Rice 1987; Sackett 1990; Wiessner 1983, 1990). Interaction theory targets the source of

style, not what style in and of itself may do, nor why style. Early learning-interaction approaches, like culture-historical uses of style, emphasized materialism and thus continued to separate style from what its original intended use and meaning might have been (Conkey and Hastorf 1990). Instead the mechanical processes that allow stylistic variation (e.g., motor skills, age cohorts, distance between learning groups) are the focus of these explanations.

Interaction approaches continue to be used by some archaeologists, but with refinements, fewer assumptions about how style is learned, and caution concerning interpretations based on the distribution of style. For example, in a detailed analysis of design attributes on sherds from three prehistoric villages in west-central New Mexico, Kintigh (1985) demonstrated greater social interaction and shared learning between two of the villages which were three kilometers apart than between two that were only about 500 meters apart. Further, stylistic similarities and differences with those villages supported a refined use of stylistic interaction theory for delimiting smaller groups. And, lastly, stylistic attribute comparisons at two of the villages which were multi-component suggested continuity through time at each village and therefore group autonomy for each village during all occupations.

Ethnographic studies have made important contributions to interaction theory by testing its assumptions in living societies. In the Philippines, Graves (1985) studied the effects of distance, time, vessel morphology, kin groups, and work groups on stylistic variability. He observed that Kalinga pot designs correlated in part with distance and time, exhibited greater variation between rather than within villages, and importantly,

variation and time correlate most when time is defined as age differences between potters. Graves found that age cohorts shared more stylistic likenesses than potters from other generations, possibly because they were in the same learning groups. Although later more sophisticated learning-interaction studies such as Graves' have contributed pertinent insights, they have not considered aspects of identity and boundary formation in relation to the active functions of style.

Information exchange theory. Limitations of interaction theory motivated the testing of other models of style. In the 1970s and early 1980s with the works of Braithwaite (1982), DeBoer and Moore (1982), Hodder (1982), Sackett (1973, 1977), Wiessner (1983), and Wobst (1977), style as an active, functional element of systems was demonstrated. In addition to the passive, reflective role of style, it was now seen as a way of information exchange and as a mediator of social organization and change.

Wobst (1977) introduced information exchange theory, called attention to the idea that style could have meaning, and that it was more than a general or specific typological tool. Wobst (1977:317) noted that "[to date] most stylistic analysis proceeds without a clear notion of what is being measured and what this may be sensitive to (sic). Style is commonly treated as if it neither articulated with other cultural variables nor bestowed any adaptive advantages on human populations." He especially criticized learning theory's use of style as reflective, unattached to the functional aspects of the artifacts they decorated and unrelated to any dynamic of change in which the host artifact might play a part. Instead, Wobst suggested that style might articulate with the use of the artifact on which it appeared. He asserted that style was symbol and, as such, an adaptive

mechanism available to humans in maintaining their social system. Style was a way to exchange information as part of system maintenance and survival in response to external pressures.

Wobst brought the functional possibilities of style to our attention. He put forth many useful ideas for consideration, such as: What are the types of messages conveyed by style (later defined as referent)? Who was sending the messages and to whom? Who was the target group? and What were the degrees of the message's usefulness, including aspects of distance, visibility, relationship of sender/receiver, and decodability? Wobst (1977:327) maintained that most "functions of stylistic behavior should relate to processes of social integration and social differentiation . . ." which sounds suspiciously like identifying groups through interaction (or lack of interaction). Yet, he went on to elaborate this to include aspects of group identity in ameliorating fear and/or conflict between unknowns (inter- or intra-group members). Wobst's innovative ideas suggested that style not only had function, but that stylistic form was determined by multiple variables.

Many of Wobst's claims about how style functioned in information exchange and his suggested cross-cultural generalities have been challenged. General human behavioral correlates between style and group identity may hold, but specifics tend to break down. For example, Hodder (1982a, 1991) demonstrated that groups exhibiting a high degree of social interaction may continue to maintain stylistic separateness as do the Baringo of Kenya. Baringo groups are interactive, and all Baringo women use calabashes for milk containers; however, only the Ilchamus Baringo decorate their calabashes.

Additionally, initial acceptance of the efficiency of style in information exchange is not necessarily correct in all situations. For example, stylistically carried information may be most effective in reducing uncertainty among socially *distant* people who come together in integrative functions such as rituals or ceremonies (Hegmon 1991). Nevertheless, the information exchange theory was widely adopted by many archaeologists during the 1980s and 1990s.

Information exchange has been applied in understanding how style is used as opposed to how style is learned. Information exchange or messaging focuses on the functional role of style, whereas learning-interaction theory targets the source of style, not what style in and of itself can do, nor why style, but what are the mechanical processes that allow stylistic variation (e.g., motor skills, age cohorts, distance between learning groups). Information theory acknowledges that style is more than a passive marker of the passage of time and space in that style may function as a messenger between and within social groups conveying information about external circumstances. "Social groups" in these studies are two-dimensional components of a system that may send coded messages to other "groups" or to their "group;" they are not composed of decision-making, collectively influential members of a society.

The open-ended nature of the information exchange theory, that style is a medium of information, allows the fitting of this framework around almost any archaeological problem involving stylistic variation. Information exchange is effective when exploring uses of style as opposed to how style is learned, but it does not address *why* a particular style is used, under what conditions style is used, or how style configures and is

configured by mental constructs.

Roles of Style

As noted above, by 1980, style was recognized as more than a tool for defining spatial and temporal boundaries, or a way for understanding technological learning. Reflective of the new approach to ceramic decoration in archaeological interpretation and the recognition of multiple purposes for style, Braun's *Pots as Tools* was published in 1983. Although cognizant of the many roles of style as seen in his evolutionary explorations of stylistic diversity and its causes, Braun saw no uniformitarian principles underlying the origins of ceramic decoration. He questioned the cross-cultural and predictive value of general laws of ceramic style. Rather, each situation is specific, based on a unique set of variables including "construction practices, decorative practices, residential practices, and the physical use of objects" (Braun 1989:362). Discussions about the meanings of style, or the why of style, began to appear in journals in the late 1970s and 1980s, flowering into the passive-active debates between Sackett (1977, 1982, 1985, 1986) and Wiessner (1983, 1984, 1985).

What could be learned from style if it carried an active and functional role that could be either individual or group generated as well as being a passive, reflective tool? Wobst (1977) had suggested convincingly with his hats-clothing examples that style carries a message. The information-bearing potential of style created many questions about previously considered "non-essential" additions to technologically functional objects. Did the creator of the design consciously wish to send a message, and if so, who was the intended audience, and what was the referent? As researchers began to consider

the functional roles of style, even more specific questions were asked: How was stylistic messaging culturally constrained? Did stylistic messages have to be active or could they be passively or unconsciously rendered by the artist? Were stylistic messages perceived directly or indirectly? Who was the target audience for stylistic messaging?

Active style. Dfferent views concerning the exact nature of active style exist among archaeologists (i.e., DeBoer 1990; Sackett 1985, 1990; Wiessner 1990). For example, Sackett (1990) contends that, for both the artist and the consumer, most style is passive because production choices and viewer interpretations are unconscious. It appears that active-passive correlates with conscious-unconscious for Sackett. Wiessner (1990) differentiates active and passive style according to degrees of intention concerning stylistic significance. Passive style functions at the habituated, culturally expected and rarely noted level, while active style is purposefully and consciously done. On the other hand, Hodder (1990) and DeBoer (1990) do not differentiate style by active-passive roles, but rather imply that all style is actively functional, and for Hodder style is simultaneously active in a number of social domains.

The distinction between active and passive styles when applied to producer as well as user perception is difficult to define in much the same way that the division between style and function is troublesome. Sackett (1990) and Wiessner (1990) both have valid points in claiming that some style is more intentional than others, and that some style is unconscious or habituated. The problem is that Wiessner's suggested definition is based on degree or scale which includes a large grey area: How does one measure intentional as opposed to unintentional style? The same quantitative issue arises

with Sackett's criteria in determining whether style was created consciously or not. Is active-passive determined in reference to the stylist or the audience? Perhaps the only way of determining functional level is in reference to research focus and by viewing style's relationships within the whole social context. What social effect does style invoke as evidenced in material culture?

Current researchers using learning and/or information-exchange theories suggest that style plays an active role in the cultural system and that style may be used strategically by those who make and use it (Hegmon 1992). Certainly from a research perspective the Mimbres icons appear active in that they are so dramatic and apparently stylistically isolated from other Mimbres material culture.

In this study, active style refers to the effect that icons have on an audience regardless of the conscious or unconscious intention of the stylist. Audience refers to the stylist's social group as well as any other contemporaneous groups encountering the style. Conversely, passive style is the researcher's reflective use of style as a tool for delineating material patterns. Active style may be conscious or unconscious because the precursor of stylistic expression, cognition, although functional and active, may contain elements of unconscious, or as Sackett (1990) would label it, isochrestic choices. Likewise, style may be actively functional in its effect on the viewer whether the receiver is aware of its impact or not. In Sackett's (1990:37) words, there is "style which informs upon ethnicity [as an] etic perception . . . and that style which mediates ethnicity as an emic phenomenon involving the operation of symbolic behavior upon the products of isochrestic choice." In other words, active style may be the product of either conscious or of automatic

(unconscious) choices, have an etic function of defining boundaries both for groups and for the archaeologist, and also have conscious or unconscious effects on behavioral choices. In the case of Mimbres iconography and group formation, the original and/or primary intent of the icon may or may not have been to mediate group formation. Perhaps, it was a different type of identifier, such as a clan marker, a particular potter's "signature," or a specific aspect of Mimbres belief system. Selective interaction among people/groups could still be signified and cemented through the use of previously created symbols with multiple and/or emergent meanings (Earle 1990; Hodder 1990).

Iconic style strongly associates the design referent with the audience (Sackett 1990; Wiessner 1990). The icon refers to an expected group action, and as well is an identity marker for group members (Earle 1990; Hodder 1990; Macdonald 1990; Wiessner 1990). In this sense, active style is functionally co-dominant with cognition in its relationship with audience (group) behavior, creating a bridge between the two (Hodder 1990; Macdonal 1990; Wiessner 1990). In this role, active style may generate sub-groups as well as maintain them.

The expression of world view including acceptable behavioral responses can effectively create groups in that the symbolic expression of ideology carries information about behavioral options and/or boundaries to certain people. Active style is "the communicational aspect of form . . . [c]ommunication is a relationship, a context, not a thing" (DeBoer 1990:82), and as such active style can be a very formidable bond between people.

Emblematic style. Other criteria for evaluating the communicative function of style have been proposed (i.e., Macdonald 1990; Sackett 1990; Wiessner 1990). Macdonald (1990) suggests that style may be expressed at the individual (panache) or group (protocol) levels and concurs with Wiessner (1985, 1988; 1990) that these stylistic variables are elicited by different conditions. Wiessner (1990) focuses on referents of stylistic expression. She contends that some style is emblematic and refers to a specific social object and/or idea while other referents are vaguely associated with social concepts. The former function she calls assertive style. Like Sackett's isochrestic choices, DeBoer (1990) sees a limited number of unconscious options which express "Shipibo-Conibo"-ness in his studies of stylistic learning. In the same study, DeBoer (1990) has observed that beyond the learning constrained unconscious options, individuals exercise conscious stylistic creativity and freedom. In most stylistic studies of the last twenty years, processes of learning and the information-bearing functions of style are explored from individual-group, passive-active, intention, and/or referent approaches.

Emblematic style needs to be as unambiguously stated as possible and highly visible to the intended audience with a distinct referent (Wiessner 1990). "Specificity of referent can and often does change as styles are used in new contexts and take on new meanings" (Wiessner 1990:108). Mimbres iconographic designs are emblematic style because the strikingly displayed black-on-white life forms are easily recognized, and they likely target specific groups.

Groups identified by emblematic style need to be carefully evaluated within their contextual milieu to substantiate the emblems', or icons,' function as membership

markers. Hodder (1977, 1978, 1979, 1982) has shown with the Baringo of Kenya that style may not always serve to identify group membership, but frequently does when stress is present. Stanislawski (1977, 1978) working among the Hopi, as well as DeBoer and Moore (1982), have also documented cases in which style may not serve as group signifiers. However, if it can be substantiated that emblematic style was exchanged and occurred in statistically significant numbers in some villages but not in others, and if other variables such as environmental-economic changes and historical context are viewed together, a strong evaluation of the role of iconography as a mediator of group formation may be made.

In summary, style in its association with group boundaries and formation has special characteristics definable in functional, communicative terms and identifiable in the archaeological record. Recognition is dependent on design analysis as well as upon historical and contextual aspects. Style as mediator in group formation should be active and emblematic. If it can be demonstrated that icons are emblematic and that iconographic clusters and distributions show patterns that closely parallel environmental changes, then the style is considered active because it is associated with fluctuating economic conditions that intrinsically entail social coping responses.

The various explanatory frameworks focusing on style indicate that recognition of its role in social organizational definition and change, whether active or passive, increased from the early cultural area studies through the various applications of interaction, learning, and information exchange theories. Current researchers frequently present style as both functional and decorative, active and passive, within the same

context/social setting (e.g., Hodder's [1991a] interpretation of calabash style). Over the years, stylistic approaches to defining borders (generally ceramic design style) have evolved from a view of style as purely decorative and reflective to including style as an active, functional aspect of social behavior. This change in emphasis has also included a blurring of the division between style as decoration and style as function. It can essentially be argued that style from any perspective is functional. Even purely aesthetic, culturally mandated style may serve a number of possible purposes. These may be unintentional by the artist and unconsciously received by the audience or not.

The argument for functionality at all levels as mentioned above is likely too inclusive; however, this does not negate the fact that there has been a trend toward emphasizing the functional aspect of style. This trend has been extended to the role of style as a cementer of alliances (Hegmon 1991) and perpetuator of religious ideologies (Plog 1990). For the most part, these studies have focused on the external variables which influence or create the need for alliances or boundaries. Style as a functional associate of individual and/or group cognition and as a mediator of behavior as mandated by internal beliefs, ideas, and ideals has received less attention. The approach advocated here is that style, especially ceramic designs, has an active, emblematic role as a mediator of group and individual perceptions and behavioral response decisions in group formation. This does not deny the causal role of external environmental and/or demographic variables, but it includes these variables as part of the internal, mental data that both form and are formed by individual and societal world views. Style as a mediating aspect of group boundary creation focuses on the uniqueness of each society

and change within that society.

Mimbres Icons and Group Formation: Formulating a Model

The broad purpose of this research is to understand the function and possibly something about the meaning of Mimbres icons. The icons on Mimbres bowls stand in stark and startling contrast to their white backgrounds, and as well in contrast to the rest of Mimbres material culture, such as the architecture, chipped and ground stone tools, and brown ware ceramics. The contrast is so extreme that a claim of emic importance and focus cannot be denied. The time, energy, skill, and dramatic rendering of the icons all make likely their importance in Mimbres society, an importance that has come down through the ages even if exact meanings have been lost. Nothing else in Mimbres material culture draws attention like these icons. How can we begin to interpret the "why" of Mimbres iconic designs?

Initially, inquiries were made to determine other significant aspects of Mimbres society that were spatially and temporally coincident with the icons. Mimbres society from A. D. 970 to 1140 was agricultural, supplemented by foraging (Minnis 1985); and they were non-hierarchically organized with hamlets and villages spatially bounded and linked by similar material culture, and by inference from the material culture, they shared ideology. Economics were inadequate for overcoming severe environmental impacts, and like any small-scale agriculturally based society Mimbres subsistence was subject to environmental conditions. Thus, in addition to the pottery, a second obviously significant aspect of Mimbres society was their physical environment.

Any change that affects the economic base of a society entails a consequent social

response. For example, in the case of agrarian based, non-stratified groups who live "close to the land," periods of beneficial climatic conditions may allow surplus harvest and a social response to this might entail an increase in storage facilities, trade, and/or emergent managers of surplus and distribution. Conversely, the same type of society may react to adverse conditions by strategically utilizing a greater variety of niches for planting, by increasing family, clan, intervillage, or extraregional ties, and/or by increasing communal intensification rites. Social responses vary probably as much as the particularistic combinations of environmental variables in different places and at different times. The point is that people respond to variability; change begets change. The environmental conditions that affected Mimbres economy most were environmental variability such as precipitation and temperature. Ethnographic studies suggest that economic/subsistence threats in non-stratified agrarian societies elicit group responses (Cancian 1972; Collier 1975; Halstead and O'Shea 1989; Hames 1990; Minnis 1985). Thus, we have a third significant aspect of Mimbres society, varied behavior as a response to environmental fluctuations and or other systemic changes.

Like symbols, the Mimbres icons encode some element of group ideology (Hodder 1990; Pauketat and Emerson 1991; Wiessner 1990). And, as with most group directed symbols, the emblematic message is straight-forward and even appears simple, but likely carried multiple meanings. Different life-forms on Mimbres bowls may represent separate aspects of Mimbres ideology and/or may carry messages related to group membership(s) within the larger society, such as families, clans, sodalities, or moieties. Ideologic concepts are discussed in greater detail below.

A model for examining the role of Mimbres icons incorporates the three significant aspects of icons, environment, and behavior and the observation that the icons are focal in some manner in Mimbres social organization. As stated above, it is hardly presumptuous to assume a central role for the icons for guiding social behavior given their extreme contextual visibility. On either side of the icons stand environment and behavior. The model is refined by substituting ideology for icons, physical environmental variability for environment and group responses for behavior.

ENVIRONMENT >>>>>>>>>>> <<<<<<<<<<< ICONS <<<<<<<<< >>>>>>>>> BEHAVIOR

Physical environment >>>>> >>>>> <<<<<<<<<< *Ideology* <<<<<<<<<< >>>>>>>>>> *Group Responses*

It can be argued based on the tested reliability of cultural ecological explanations, sociological research, and stylistic information exchange that the model elements given above influence and are influenced by each other (see above discussions of theoretical issues and developments). Looping and feedback systemic ecological models have too often become overly complex to yield clear explanations about social patterns and change (Fiedel 1987). Therefore, in the model developed for this study, mutual influence is admitted, but because the icons are so visually dominant in Mimbres society and because ideology is central to all groups, a bi-directional linear relationship is proposed for explanatory purposes. This reflects the apparent importance given to icons/ideology by the Mimbres people. Icons are placed between environment and behavior as an ideologic

interface that filters perceptions of environmental conditions and impacts, as well as delimits group response options.

The model frames an explanation created through a combination of the effects of ecological relationships and information exchanged via symbols to interpret the *function* of the icons. Additionally, the historical context preceding and subsequent to the situation under investigation should be examined for similarities and differences in order to substantiate or deny the relevance of the relationships suggested by the model, such as the temporal and spatial scale of environmental variability and icon presence.

Icons, Iconography, and Iconology: Analytic and Synthetic Interpretations

Icon

None of the specific or implied definitions of icon encountered in a literature search for this study completely agree on what an icon is or is not, nor how it may be different from a symbol. Webster defines icon as a "pictoral representation: image," and secondly as "a conventional religious image. . . . (Webster Ninth Collegiate Dictionary 1988:596). Interpretations of what icon refers to frequently are linked to specific disciplines. For example, in the visual arts an icon can be any work of art (Panofsky 1955); in christology an icon is a painted image that follows ancient color and line rules as well as liturgical demands in order to guide an introspective observation of the glories of God and the mysteries of life (Nouwen 1987; Schonborn 1994); and, in semiotic studies Peirce designates an icon as a particular type of sign, an object, with a particular quality so that the sign is in some way reflective or similar to its object (Andrews 1990; Cobley and Jansz 1998; Liszka 1996; Zeman 1988). In her archaeological study of Salado

polychrome designs, Crown (1994:134) defines icons as "any signs with formal similarities to a referent." Initially, icon is defined in this study as a figurative representation which carries symbolic meaning (Levy and Guenhall 1985).

A further refinement here is that 'figurative representation' refers to a life-form as opposed to abstractions or inanimate objects because the definition chosen for this study attempts to limit the subject and stylistic range of icons in order to isolate them as a particular type of symbol rather than interpreting icon as synonymous with symbol. In contrast, christological icons also focus on life images, while in linguistic semiology the term is more inclusive in that the sign or representation need only resemble the associated object and the object need not be a life entity. Art history is even less restrictive in that not only can the representation be animate or inanimate but abstractions are permissible.

Another aspect of icons such as those often used with political movements is that the presentation of subject matter is bold with few distracting embellishments (Ball and Dagger 1990). The bold presentation of Mimbres icons is similar to political iconographic style, but it is less like Christian iconography whose symbolic elaborations and predominance of beatified and sanctified humans as focal conveys a more subtle, individualistic internal message (Nouwen 1987). Political and religious aspects of non-hierarchical societies are likely inextricably interwoven within the social fabric (Cobb 1993; Fagan 1996), and, therefore, simplicity of presentation along with certain subtle embellishments on Mimbres black-on-white icons like such as the geometric inclusions on animals' bodies likely reflect religious and political ideology. For this study an icon is defined as a figurative representation of a life-form that carries symbolic meaning and is

rendered in such a style as to present a bold, even dramatic, image intended to activate a group or groups to external action.

Iconography

The word iconography combines icon, which has already been defined and discussed above, with the suffix "graphy." This suffix according to Webster is "writing or representation in a (specified) manner or by a (specified) means or of a (specified) object . . .or on a (specified) subject or in a (specified) field" (Webster Ninth Collegiate Dictionary 1988:533). Panofsky (1955:26), one of the foremost visual art historians of the twentieth century states that "[i]conography is that branch of the history of art which concerns itself with the subject matter or meaning of works of art, as opposed to their form." He clarifies this by limiting "the subject matter or meaning" to its primary meaning. That is, iconography deals with the object represented by the icon such as a person, bird, or fish. It is not the ideologic multi-layered symbolic meanings that the icon may convey to people of a particular society or group in a specific time and place. Rice (1987:271) defines iconography as "specific motifs . . . painted or incised . . . because they represent deities or are symbols of concepts and beliefs widely recognized in the society." Her interpretation encompasses aspects of this study's definitions of icon, iconography, and iconology.

Panofsky's definition applies without change to Mimbres icons and this study in that Mimbres iconography is the life-form representations and their associations with the objects in nature to which they refer. The analysis of Mimbres iconography then allows the icons to be placed in motif or life-form categories. It is at this level that the icons can

be classified and quantified within spatial and temporal dimensions. Because icons can be quantified and because they are material culture which results from patterned human behavior, then the temporal and spatial graphics of the icons can likely be associated with other cultural patterns of material culture, and therefore a functional interpretation is possible.

Iconology

Iconology, on the other hand, is the study of the secondary meanings of icons (Panofsky 1955). It is a study that necessitates the inclusion of as much cultural context as possible because secondary meaning consists of culturally configured images, emotions, ideas, and behavior that are elicited by the primary meaning (Panofsky 1955). Iconology interprets the quantifiable, classifiable icons by synthesizing them with other cultural information while iconography is studied through analyses (Panofsky 1955). Iconology then relies on ideologically determined associations and relationships between various data sets functioning within the cultural-ecological whole and temporally and spatially relevant icons.

Dyadic Relationships

Two parts are included in the definition of icon: 1) 'figurative representation of life-forms,' and 2) 'symbolic meaning.' These parallel the research methods suggested by the definitions and discussion of iconography and iconology. This bipartite division can be taken further: 1) The *analysis* of the Mimbres icons at the primary level and within the context of the whole social and environmental milieu may yield a functional purpose as group markers for the icons. The functionality may be determined from the temporal and

spatial distributions of icon types associated with ecological and cultural patterns and associated group responses. 2) A *synthetic* approach incorporating interwoven systemic patterns with the iconographic analytic data may enable an interpretation of a narrow range of responses elicited by the effects of the icons. In other words, a synthetic look at Mimbres society, environment, and icons may illuminate one bit of information regarding the effect of Mimbres ideology: a particular allowable group response related to one perceived set of environmental conditions.

Functions and Meanings: Ideology, Symbols, and Icons

It was stated above that icons are a particular type of symbol that are imbued with special characteristics. Icons in this study are representations of life-forms in bold, highly visual presentation with symbolic meaning. Energy associated with life-forms empowers the icon's effective message. It was also noted that all groups have ideologies which, whether consciously or unconsciously, order the world in which group members live. Given that icons are symbols and symbols represent aspects of group ideology, a definition of ideology and what its active functions are is essential to this study.

Ideology. Ideology, in general, is a set of ideas held by a group of people that structures the relationships and associations among objects of the world; it is a system of ordering the world about us. Ideologies make sense out of chaos and are particularistic as to group, time, and space. According to Pauketat and Emerson (1991:920), "[i]deologies are seen as systems of discursive knowledge, beliefs, and values . . . which legitimize the social status quo through an appropriation of traditional and cosmological referents. . . . [They] articulate the cultural tradition with the consciousness of individuals." In some

instances, the word ideology has evolved from Locke's original argument that we organize our world based on a set of ideas acquired through sensory experiences to a more current meaning that ideology is a set of political ideas and beliefs which are used to maintain or direct social change (Ball and Dagger 1990). At the extreme, it has come to mean a system of ideals which are used to justify, legitimize and mask social domination and exploitation. This latter, special meaning of the word has come from its application to Marxist ideology and theory and applies principally to complex social chiefdom-state (Ball and Dagger 1990; Kertzer 1988).

In this study, the term ideology is used in the broad sense of a system of mental concepts that make sense of the world both for individuals and for groups in that similarity of the majority of the ideologic components are shared by members of a group. Ball and Dagger (1990:8) suggest that ideology has four purposes: "(1) explanatory, (2) evaluative, (3) orientative, and (4) programmatic. . . ." In other words, a group's world view explains why things are as they are, what members of the group should think about these things, who they (the groups) are and where they belong in the world, and what to do and how to do it.

Political ideologies especially focus on the programmatic function in trying to activate groups to change things in the world, particularly change for "better" according to the political ideological definition of what constitutes "better" (Ball and Dagger 1990). The persuasive power of political ideologies is evidenced in modern times by the hundreds of wars fought to bring about change. Conditions of war or other instability indicate conflicting ideologies or an unacceptable political ideology of legitimacy

(Kertzer 1988). Conversely, stability in societies throughout time also attests to the power of ideologies.

In reality, any group movement involves all of these functions of ideology as the filter through which appropriate (programmatic) action is determined. The evaluative aspect provides a complex of values of which one or several may suggest an area of society which needs change (programmatic action; Ball and Dagger 1990; Miller 1985). For example, individual values coupled with ideologically appropriate options of action may result in a special interest group that has selected from its ideologically acceptable options to campaign against abortion peacefully or in a militant fashion, or to protest famine with a hunger strike.

Additionally, as can be inferred from the above example, there can be ideologies within ideologies (Hodder 1990; Pauketat and Emerson 1991; Wiessner 1990). That is, within a larger group, sub-groups with interest-focused ideologic frameworks can exist and overlap with other sub-groups and their ideologies. There is a predominant ideology of the society, culture, or nation under which exists specialized ideologies focused on making sense of a segment of the larger world.

Symbols. Because ideology is a belief system encompassing all of a group's world, reference to the guiding principles are necessarily condensed. Evaluation and action would be excessively slow if a detailed mental reading of the whole ideology were taken (Kertzer 1988). Thus, humans are able to utilize their world view by encoding chunks of it into symbolic bits. The symbols are usually arbitrary, as with language, but may be iconic in bearing a similarity with the object represented by the symbol. Icons are

in effect a style of symbolizing. An icon presents a recognizable image of something in the real world. The real world object in turn carries symbolic significance. Because symbols represent a chunk of ideology and because ideologies, in order to perform their functions, identify relationships and associations, symbols are multi-layered as to content and intensity associated with various meanings. Symbols thus serve to encode world view and make its functions and data practically useful.

Icons. Why are icons different from other symbols? As noted above, they are different in presentation and object representation. Presentation style suggests an intention of creating high visibility and thus of conveying an especially important bit of ideology. Ideally, object representation of life-forms brings emotive, positive values of energy, life, and power to mind. In style and object representation, Mimbres icons suggest an ideal shared by the society that made and used the pottery. As noted in the introductory chapter, the different categories of life forms rendered in like-style suggest sub-groups that subscribed to the "big" ideology, but that have also tailored the ideology in some aspects for the sub-group's particular beliefs, values, identity, and/or action. The symbolic function of Mimbres icons suggests 1) small groups within the Mimbres society; 2) positive, powerful external action; 3) conveyance of an exceptionally precise ideologic concept; 4) importance of the ideologic message; and, 5) action (Ball and Dagger 1990; Giammattei and Reichert 1975; Kertzer 1988; Miller 1985).

Model Evaluation

In order to evaluate the model which suggests that Mimbres icons functioned as an interface between perceived environmental variations and behavioral responses to those

variations, the following chapters will provide temporal and spatial data regarding the background of Mimbres archaeology, environment, population sizes, and icongraphic distribution. An evaluation of co-occurring changes may help support a meaningful relationship between the Mimbres icons and group formation from A.D. 970 to A.D. 1140.

CHAPTER III

ARCHAEOLOGICAL BACKGROUND: MIMBRES MATERIAL CULTURE

This research tests the ideas that the temporal and spatial patterns of Mimbres black-on-white ceramic iconography delineate group membership and, when correlated with economic fluctuations, indicate an active, mediating role for the icons. This chapter describes the historical, contextual milieu of Mimbres society in general to determine if material culture and organizational patterns reflect the presence of stress during the study period. A comprehensive view of the Mimbres society provides a comparative framework for correlating a functional association between icons and group formation related to economic tensions because material variability may correlate with iconographic and environmental fluctuations and, thus, support the presence of stress and/or group formation.

Material characteristics at some study sites may differ from the general Mimbres ones while correlating with other study villages that are integrated through ceramic iconographic exchange. If chemical element and iconographic distributions suggest that certain villages were allied through interaction and these same villages exhibit one or more similar patterns, then additional support for group formation between those villages is demonstrated. Also, site specific and general Mimbres material culture patterns may

mirror changes in environment, population size, and agriculture, further supporting stressful periods.

Mimbres Society from A.D. 200 to A.D. 1200

This study focuses on the heartland of the Mimbres branch of the Mogollon region. The Mimbres core area lies along the Mimbres River valley and surrounding uplands in present-day southwestern New Mexico. Regional boundaries for the Mimbres branch are more difficult to delimit than those for the heartland area because architecture and diagnostic ceramics exhibit spatial and temporal variability outside of the Mimbres Valley (see Lekson 1997 for a discussion of Mimbres boundaries). M. Nelson (1999) suggests one viable definition for Mimbres boundaries that correlates with sites primarily characterized by Mimbres ceramics and architecture.

The study sites include three large villages in the heartland, the Mimbres Valley, as well as two sites outside of the valley. Sites in the valley include the Galaz ruin in the upper valley, the NAN Ranch ruin in the middle valley, and the Old Town ruin in the southern valley, Cameron Creek ruin in a drainage just west of the Mimbres Valley, and Saige-McFarland is much farther to the west-northwest in another major drainage, the Gila River valley. The outlier sites both evidence architecture and ceramics that place them within the Mimbres branch and also indicate they are comparable in temporal occupations to the valley sites.

Excavations at each of the sites reflect different archaeological approaches to investigation which need to be kept in mind when assessing possible differences and similarities in patterns among the sites. For example, early archaeological excavations

which occurred at Cameron Creek and partially at the Galaz site did not include screening room fill, and thus it is likely that many small objects such as lithic, floral, and faunal fragments were not recovered. Additionally, technological and theoretical advances in archaeology have shown that many artifacts, features, and ecofacts that in the early days of southwestern archaeology were not thought to yield relevant information do, in fact, provide data for reconstructing the past Methodological precision in the field and laboratory have also increased over the years resulting in more fine-grained interpretations of archaeological patterns.

The Galaz ruin data represent methods and research goals of both the earlier 1920s and 1930s as well as those of later processual archaeology of the 1970s. Most Classic ruins at Galaz were excavated during the earlier periods, while the Mimbres Foundation's salvage efforts of the latter time focused on investigation of pit structures. Detailed and scrupulous analysis and re-analysis of the Galaz artifacts and field notes from all explorations have yielded the most extensive account yet produced of a large Mimbres site, synthesized and published as one volume (Anyon and LeBlanc 1984).

The NAN Ranch site represents a long-term excavation done in recent years using the most advanced field technologies and current theoretical constructs. The fortunate circumstances surrounding the site, including a willing and cooperative land owner, funding for 11 seasons of excavation, and for the Mimbres region, a relatively undisturbed context, have allowed for the most comprehensive and fine-grained study of a large Mimbres village to date. It will likely retain this status as few if any other large sites with Late Pithouse and/or Classic period components have survived the heavy hands

of unmitigated relic hunting and/or industrial enterprises.

Excavation, analysis, and interpretation of the Old Town ruin have benefitted from current methodologies and goals, but the challenge to gain information from this site has been monumental. Destruction of the site by amateurs and treasure hunters is very extensive. In spite of this, much has been learned from this village in the southern reaches of the Mimbres Valley, about adaptations in arid environments, about integration of cultural and natural impacts upon archaeological sites, and about the Postclassic continuation of Mimbres society.

The Cameron Creek site represents a large village that was entirely excavated and reported in the early days of professional, scientific archaeology in the Southwest. Wesley Bradfield's (1929) investigation and report of the site is extraordinary in detail and scientific professionalism for its time. It is unfortunate that his untimely death precluded further articles and reports of specific classes of material culture from Cameron Creek village.

The Saige-McFarland site has suffered from impacts by road and building constructions. Two different episodes of excavation by Fitting in 1971 and 1972 went unreported and largely unanalyzed except for a preliminary report after the first season (Lekson 1990). In 1986, Lekson (1990) assembled field notes, maps, photographs, and artifacts in order to organize and process the materials for museum curation, to reconstruct the excavation sequences, and to map locations of pit structures and room blocks with a view toward producing a comprehensive report of the site. Because of Lekson's efforts, knowledge about a large village with pre-Classic and Classic

components within the Mimbres branch but in an entirely different major river valley has been considerably increased. The report allows comparative data between the material cultures of the two valleys as well as a temporal overview of the subsistence and demographic fluctuations of large villages in geographically distant sections of the region.

In spite of excavation times and approaches, consistent patterns of material culture are apparent at the sites, some of which follow the general Mimbres patterns while others contrast with them. These patterns will be discussed in the conclusion and the observations will be integrated with environmental, demographic, farming strategy, and ceramic data in the final chapter of the study.

Settlement Patterns

Settlement patterns can reflect land-use, subsistence changes, and population densities and are relevant to this study because changes through time in proximity of villages could suggest changing group memberships. Also, village location and size may reflect increased dependence on domesticated foods if villages are situated and/or aggregated so that they use as little arable land as possible. Villages located in marginal areas also may indicate a need to produce maximum crops due either to increased dependence on agriculture and/or growing population. Therefore, it is important to examine settlement patterns in order to determine if village location and/or population densities reflect a greater reliance on agriculture as well as group memberships, both of which may have necessitated a group response to food stress.

Clusters of semi-subterranean pit houses numbering from one to 80 structures are

characteristic of Mimbres villages from A.D. 1 to A.D. 1000 (Gilman 1989; LeBlanc and Whalen 1986; Minnis 1985). During the Early Pithouse period of the Mimbres society from A.D. 200 to A.D. 550, villages were located on ridges, isolated knolls, or high mesa edges above river valleys and arable lands (Anyon and LeBlanc 1986; LeBlanc and Whalen 1986; Minnis 1985; Wills 1989). Access to villages was characteristically limited by natural topography and/or by rock walls blocking entry paths (Minnis 1985; Wills 1989). This may have been defensive, or, less likely, because early varieties of maize in high desert areas required elevations of 1770 to 2100 m in order to germinate and mature (Minnis 1985; Wills 1989).

In the Late Pithouse period (A.D. 550), pit house village locations shifted from ridges, isolated knolls, or high mesa edges to first terraces above major rivers where villages were fairly equally spaced along the benches (Anyon and LeBlanc 1980; LeBlanc and Whalen 1986; Minnis 1985). Sites were larger and in general more numerous than during the prior Early Pithouse period (Minnis 1985). Houses may have been loosely centered around a Great Kiva in some cases (Lekson 1996), but generally village planning was lacking.

By the Classic period, A.D. 1000, large aggregated pueblo villages, such as Galaz, NAN, and Old Town, were formed, many of which were built over pit house villages (Anyon and LeBlanc 1980, 1984; LeBlanc and Whalen 1986; Minnis 1985). In general, the largest villages continued along the first terrace above the Mimbres River (Minnis 1985). Smaller villages increased in number and often were situated in more marginal areas such as tributary drainages (Anyon and LeBlanc 1980). In the uplands, check dams

and other water conservation and diversion systems, often with small one to four room pueblos close by, were also characteristic of this period (Herrington 1979; Minnis 1985).

Villages during the Classic period consisted of above ground structures with aggregated rooms forming blocks. Room blocks or clusters grew by accretion without planning, and as villages grew, room blocks tended to form around a large open area. Sometimes smaller open plazas were formed by room configurations within a single room block (e.g., Cameron Creek, Galaz, Mattocks, NAN Ranch, Swarts).

During the Postclassic, some rooms at the large Classic villages, such as Old Town, continued to be occupied, but most villages were located elsewhere, particularly in the Black Range Mountains to the east and to the south and southeast in the desert during the latter two-thirds of the twelfth century (Creel 1998; Lekson 1996; Plog 1997; M. Nelson 1999). M. Nelson (1999) suggests that small Classic pueblos in the Black Range likely had been earlier agricultural field houses that were remodeled into residential structures by Postclassic Mimbres people. Some Black Range villages were as large as 80 rooms, but in general, most sites in the Postclassic Eastern Mimbres are of medium size, ranging from 11 to 35 rooms, and settlements were dispersed and located near arable land and drainages with dependable water flow (M. Nelson 1999). Postclassic villages in the Black Range and in the Mimbres Valley during the Animas and Salado periods probably were not occupied continuously but were repeatedly used, possibly as part of an annual residential mobility mechanism (Nelson and Anyon 1996; M. Nelson 1999). Southern and southeastern areas of Postclassic occupation were in the desert and consisted of larger villages of 25 to 40 rooms with room blocks situated

around a plaza and small, internal plazas within room blocks (Lekson 1996).

Some scholars suggest a general trend during the period from A.D. 200 to A.D. 1200 of shifting settlement patterns from one large drainage or resource area to another (Lekson 1992; M. Nelson 1999; Nelson and Anyon 1996). During the early and middle Late Pithouse period, population concentrations in the Mimbres region may have centered in the Gila River drainage, followed by intensive settlement of the Mimbres River valley and uplands, and subsequent re-settlement to the east and south/southeast into drainages of the Rio Grande. By the late twelfth and early thirteenth centuries a renewed trend toward village aggregation occurred in the Eastern Mimbres (M. Nelson 1999).

Subsistence

As noted above regarding settlement patterns, subsistence is relative to the study because increased reliance on agriculture over time correlates with growing subsistence risks. Dependence on one food source in a horticultural society magnifies the chance of subsistence failure because that source may be damaged or ruined by negative climatic conditions, disease, insects, or animals. If failure occurs, alternative food sources may not be available because knowledge about wild resources has been lost, mobility is not an alternative, and/or exchange is not a possibility (Cashdan 1990; Halstead and O'Shea 1989; Minnis 1985).

Mimbres people were both farmers and foragers (Minnis 1985). Lekson (1992) points out that the Mimbres branch extends over a relative large area which lies between two ecozones: the northern pinyon-juniper zone and the Chihuahuan-Sonoran desert oak-agave biosphere. Natural resources may have been fewer and less densely packed here

than in other branches of the Mogollon, suggesting that higher foraging risks may have prompted an earlier experimentation and subsequent dependence on agriculture in the Mimbres branch than in other areas of the Mogollon (Lekson 1992). Over time, there likely was a shift to greater dependence on domesticated maize, although even by middle Classic times an estimated fifty percent of the diet was composed of wild resources (Minnis 1985). Based on settlement patterns and architectural features, Gilman (1983) suggests that Early Pithouse dwellers likely used a seasonal mobility strategy in which pit houses were occupied only in winter and maize crops were planted before the residents left to migrate through the landscape harvesting various ripening plant products and migratory fauna. A seasonal mobility pattern is consistent with other archaeological evidence suggesting that agriculture was gradually incorporated into Mimbres economy. Maize remains from the Early Pithouse period compared with Classic period remains also support the idea that agriculture increased through time (Minnis 1985).

Analyses of plant remains from Mimbres Foundation flotation samples show that maize was the predominant cultivated plant through all Mimbres time periods, but based on presence/absence of plant remains, that it increased from the Early Pithouse through the Postclassic periods, although it must be noted that the Early Pithouse period samples are underrepresented in the Mimbres Foundation work (Minnis 1985). Increased dependence on agriculture is also supported by low ubiquity percentages of other taxa including a small representation of cultivated beans in the Late Pithouse, Animas, and Salado periods (3 percent, 4 percent, and 4 percent, respectively; Minnis 1985). Maize kernel remains increased from 9 percent of Late Pithouse sample to 17 percent of Classic

period flotations, to 36 percent and 33 percent kernel presence in the Postclassic Animas and Salado periods, respectively. Although maize kernels are not present in the Early Pithouse flotation samples, cob presence ranged from 64 percent in the Early Pithouse to 57 percent in the Classic to 84 percent and 77 percent for the Animas and Salado periods (Minnis 1985).

The most common wild plants remains were chenopodium-amaranth, purslane, and juniper, but sunflowers and cacti also were present in all periods (Minnis 1985). In the Early Pithouse period, the goosefoot member of the chenopodium-amaranth group was more frequently present (68 percent of the sample) than maize cobs and kernels (20 percent, while chenopodium-amaranth and maize were equally represented in the Late Pithouse samples (73 percent). By Classic times maize remains (cobs=57 percent and kernels=17 percent) were present in 74 percent of the samples while goosefoot occurred in only 60 percent (Minnis 1985). From flotation analyses, frequency of occurrence and types of plants used by the Mimbres people was quite consistent from the Late Pithouse through the Postclassic periods, but an increase in maize frequency occurred showing that dependence on agriculture increased over time.

Meat apparently was obtained only from wild animals as no faunal remains or other associated evidence such as pens indicate the presence of domesticated animals. Mammal remains at Mimbres Foundation excavations included many small rodents such as rabbits, squirrels, gophers, medium sized species such as beaver, coyote, and badger, and larger types like deer, pronghorn, mountain sheep, and mountain lion (Minnis 1985). No doubt birds, turtles, and fish were harvested also. Analysis at NAN indicated that at

that site, flaked tool variety, except for decreased size of projectile points, did not change throughout the site's occupation suggesting constancy of faunal exploitation (Dockell

In the Postclassic Eastern Mimbres, at least during the latter half of the twelfth century, farms were small, and floral and faunal remains from six villages in the Eastern Mimbres support conservative use of the environment (Nelson and Diehl 1999). Botanical remains of non-domesticates indicate that locally available species, such as Chenopodium-amaranth, purslane, dropseed, and juniper, were gathered, and that native plants in fertile river/stream ecozones were not depleted. Faunal densities from the six sites were low, locally occurring species dominated, and processing methods (i.e, bone fragmenting/smashing) suggested that the Postclassic Eastern Mimbres people's subsistence was moderated toward preserving resource sufficiency (Nelson and Diehl 1999). In general, the Postclassic Eastern Mimbres inhabitants likely were primarily mobile cultivators who supplemented their maize diet with non-domesticates but did not over-use resources.

Ground stone is an indicator of subsistence in that shape, size, and construction materials, especially of manos and metates, are associated with various types and emphases on food processing procedures. Manos and metates in the Mimbres Valley area were usually made from sandstone, basalt, vesicular basalt, or rhyolite (Anyon and LeBlanc 1984; Lancaster 1983). Generally, two classes of grinding stones occurred: two-handed manos and trough or through-trough metates for grinding maize and one-handed manos and slab or basin metates for grinding a variety of resources (Lancaster 1984). Of 289 complete manos from the Mimbres Foundation's collection in the valley,

side drainages, and some upland areas. 29 were deemed "one-handed" based on length (approximate range 8.7 to 15.0 cm) and width (approximate range 7.5 to 11.5 cm; Lancaster 1983). When striation patterns could be determined, most were circular indicating that these one-handed manos were used in rotational grinding patterns (Lancaster 1983).

Conversely, the more rectangular, two-handed manos, which ranged in length from approximately 15.0 to 37.0 cm and in width from 8.0 to 17.0 cm, with most falling between 19.0 to 26 cm and 9.5 to 11.0 cm, showed more parallel striations and, unlike the one-handed manos, were frequently convex in cross-section. Slightly over 45 percent were made from vesicular basalt, while less than four percent of the one-handed manos were made of this material. Shape, size, and striations as well as material type suggest that one-handed manos were used for small amounts of relatively hard materials while the two-handed ones were suited for larger quantities of soft material with large grains such as maize (Lancaster 1984).

Four types of metates were found including basin, trough, through-trough, and slab, and their size differences, striation patterns, and material types paralleled mano differences. Most of the Mimbres slab and basin metates were made from smooth basalt or rhyolite, while trough types were predominantly vesicular basalt. Slab and basin metates exhibited random grinding scars, generally had smaller grinding lengths, and had less total grinding area than through types which had parallel striations, and were significantly larger in all measurements (Lancaster 1984). Trough type metates which were used more than any other types in the Early Pithouse period experienced about equal

popularity mid-way between the Late Pithouse and Classic periods, although through metates decreased throughout all time periods (Lancaster 1983). Through-trough metates were modified to add more grinding area, especially prior to the Postclassic period, and increased in grinding surface and frequency from the Early Pithouse period through the Postclassic Cliff phase, suggesting that technological efficiency in maize grinding became more and more important. An emphasis on the ability to grind more maize in less time also suggests greater dependence on that crop and/or an increase in other time-consuming activities.

Chipped stone tools from the upper and middle Mimbres Valley generally support a greater focus on large mammals in the Classic period than did the middle valley. M. Nelson (1984) compared debitage, expedient, and formally chipped stone materials from the Early Pithouse period of the McAnally site, from the Late Pithouse period at Galaz and Mattocks in the middle valley as well as from Beauregard in the upper valley, from the Classic components of Mitchell and Montezuma in the upper valley, from Mattocks and Galaz in the middle valley, and the Postclassic Cliff and Salado phases of Disert and Stailey in the middle valley. Formally shaped tools represented about three to five percent of the upper and middle valley sample, while expediently used flakes constituted approximately 15 percent. Because formally prepared bifaces are more often associated with large mammal predation than with smaller animals or plants, these percentages may suggest there was less overall emphasis on large animal hunting than on small game harvesting in the middle and upper valley (M. Nelson 1984).

Material type, flake size, and edge angle, at least at Galaz, support an emphasis on

plant processing. During the Classic period, flake size was larger than before and edge angles increased, both of which extend tool use life. Coarse grained crystallines were preferred in the Classic period, possibly because the edges produced on crystalline materials are more durable than on other materials. Plants possess large amount of silica which would dull stone knife edges quickly, and thus, larger more durable blades likely correlate with greater use of plants.

The majority of most so-called hoes in the Mimbres were found in caches and show no use-wear or hafting preparation, although Bradfield (1929) noted that most hoes from Cameron Creek village evidenced use (Anyon and LeBlanc 1984; Bradfield 1929 1929; Dockall 1991). In spite of the use-wear on some hoes, in general, Mimbres "hoes" are quite thin for effective or enduring use in breaking up ground, and therefore, may not be associated with agricultural activities (Anyon and LeBlanc 1984; Dockall 1991).

Architecture

Architectural styles and changes may reflect degree of sedentism because structures that require greater cost investment in time, materials, and maintenance correlate with increased residential stability. Aggregated villages consisting of room blocks likely housed extended families or even more than one family that used living, storage, and activity rooms, shared plazas and communal structures, and probably were closely identified with their village. Recognition of village membership by people makes a group response more likely than with individuals who are only loosely associated, such as those at small, unplanned pithouse villages. Ethnographers have also reported that kin often coalesce in sharing strategies during times of stress. Aggregation also may be a

strategy for maximum use of arable land and for land-use rights protection. Therefore, it is important to note architectures indicating group closeness and, therefore, the likelihood of group responses.

In the Early Pithouse period, domestic architecture consisted of semi-subterranean houses that were round, oval, or D-shaped and had lateral entries which sloped from the surface to the pit floor (Anyon and LeBlanc 1980; LeBlanc and Whalen 1986; Minnis 1985). Early pit house roofs were peaked and supported by a center post, or cribbed with side/wall posts and smaller posts extending from the walls to the center post or between lateral posts. Over these, smaller sticks were laid, and finally the entire roof structure was covered with mud.

A few early pit houses were larger than average, and these may represent communally used structures (Anyon and LeBlanc 1980, 1984). Some of these larger pit structures had "lobes" which consisted of small earthen mounds on either side of the entry ramp near its juncture with the pit, giving the structure an overall kidney-shaped appearance (Anyon and LeBlanc 1980). The interiors of the large structures were starkly lacking in features such as hearths, sipapus, or benches (Anyon and LeBlanc 1980).

During the Late Pithouse period domestic structures continued to be semi-subterranean and for the first 100 years they remained round or oval (Anyon and LeBlanc 1980; Shafer 1990). Pithouses changed to rectangular with somewhat rounded sides and sometimes cobbled walls during the second century of the Late Pithouse period (Anyon and LeBlanc 1980; Minnis 1985). By A.D. 750, pit houses were square or rectangular, and some had masonry walls (Anyon and LeBlanc 1980). For example, some portions of

walls at Galaz were cobble and adobe masonry while one room had all masonry construction (Anyon and LeBlanc 1984). A few pit structures evidenced features characteristic of both late Late Pithouse and Classic period architecture. At NAN, some transitional pithouses had vents, blocked ramps, roof entries, partially cobbled walls, and circular, adobe-lined hearths with cobble deflectors (Shafer 1980, 1981, 1982, 1990, 1991b, 1991c, 1991d; Shafer et al. 1979; Shafer and Taylor 1986). At Old Town, even Late Pithouse structures in the northeast area of the site had cobble and/or slab masonry walls, two of the structures also had flat roofs, and, most unique for the early time period, some walls were puddled adobe (Creel 1993, 1995, 1997a). Three were built so that the entries faced inward to form a "U," effectively creating a small courtyard (Creel 1991, 1993; Lucas 1996). At Cameron Creek, Late Pithouse period domestic structures had rock walls, at least on the above ground portion and rectangular, slab-lined hearths (Bradfield 1929). The latest Three Circle phase pithouses at Cameron Creek were built with slab stones below the ground surface, river cobbles above surface level, and roof entries (Bradfield 1929). Like the pithouses at Old Town, the later pit structures at Cameron Creek were intentionally placed in groups facing inward to form courtyards (Bradfield 1929; Creel 1991, 1993).

During the Georgetown phase of the Late Pithouse period, A.D. 550-650, communal structures were easily distinguishable from habitation ones because they were noticeably larger, ranging between 34 and 44 m^2 in floor space. Lobing was nearly universal, but there still were few internal features to differentiate communal from domestic structures (Anyon and LeBlanc 1980). From A.D. 650-750, the San Francisco

phase of the Late Pithouse period, communal pit structures continued to be round or oval, but increased in size (Anyon and LeBlanc 1980). Lobing changed to a stylized form and in some structures was replaced by posts or rocks on either side of the entry (Anyon and LeBlanc 1980).

During the last phase of the Late Pithouse period, the Three Circle phase, communal architecture continued to be semi-subterranean, but the structures were rectangular rather than oval or round (Anyon and LeBlanc 1980). Some, often referred to as Great Kivas, were quite large, 100 m^2 or more. Correlation of village population with the size of communal structures during the Three Circle resulted in a wide range of sizes for communal buildings (Anyon and LeBlanc 1980). Earthen lobes were replaced by a small post on either side of entry ramps (Anyon and LeBlanc 1980). Interior features proliferated in the Three Circle phase, including sipapus, niches, and portable materials which were probably ritualistic (Anyon and LeBlanc 1980). Late Three Circle communal structures evidenced floor and hearth replasterings, and Anyon and LeBlanc (1980) claim a seriational sequence is visible during the Three Circle in the wall construction of communal structures which progressed from adobe to single course to double course masonry. In a comparison of communal structures at five Three Circle phase villages, Anyon and LeBlanc (1980) found that three communal structures had single course or no masonry walls and had burned, and two, neither of which was burned at abandonment, had double masonry walls, floor and hearth replasterings, and inset floor rocks. Usually there was a large, open area in front of the Great Kiva at the major Late Pithouse villages (Creel 1989a).

In a radical change from the 800-year semi-subterranean habitation pits, the use of contiguous above ground rooms with ceiling entrances occurred just prior to the Classic period during the A.D. 900s (Gilman 1989; Shafer 1995). Many of the above ground structures were built over trash-filled pit houses. Initial core room groups were added onto by accretion as more families, probably kin, added living quarters and/or as older rooms were abandoned. Additions were adjacent to existing rooms and bonded to or abutted against existing walls (LeBlanc and Whalen 1986). Room blocks resulted, sometimes consisting of up to 50 rooms (LeBlanc and Whalen1986). Primary living rooms were relatively large while associated storage rooms had poorer quality floor leveling and plastering (Shafer 1995). Classic period walls were built with round river cobbles and mortared together with adobe (Lekson 1993). Flat roofs served as activity areas for drying, grinding, and cooking foods, and for manufacturing stone tools and jewelry (Shafer and Judkins 1997). Roof hatchways served the dual purpose of room entry and smoke hole for the interior hearth.

At NAN, rhyolite slabs were inlaid into floors occasionally, replaced wall cobbles, and in a few instances, slabs were part of roof venting or drainage systems (Shafer 1980, 1981, 1990, 1991a, 1991b; Shafer et al. 1979; Shafer and Taylor 1986). At Cameron Creek, some room interiors evidence rows of small posts that probably supported shelving or other types of furniture (Bradfield 1929). Classic architecture at Saige-McFarland appeared unusually uniform in that the front row in each room block had similarly sized domestic rooms plus one larger subdivided or partitioned room and one smaller room with a center post and no features (Lekson 1990). The back rows of rooms

were small storage or special use rooms (Lekson 1990).

Village-wide communal structures in some cases probably shifted from large subterranean kivas to large open plazas during the Classic period (Anyon and LeBlanc 1980; LeBlanc 1986), although it seems likely that the Great Kivas at Cameron Creek and Galaz villages were used during the Classic period (Nisengard 1995). The Great Kiva (Room 42A) at Galaz, which was built in the Three Circle phase and used into the Classic period, was the largest known communal structure in the Mimbres area (Anyon and LeBlanc 1984). Old Town evidenced unusual communal architecture with its platform and associated nearby road and large communal pit structures (Creel 1991, 1999). At two of these large communal structures, the upper and lower floor adobe was reddish while the middle floor was grey adobe (Creel 1997a, 1999). Excavation evidence from these rooms suggests a pattern of large post removal before abandonment and pre-planned, systematic destruction (Creel 1997a, 1999). One Classic communal room at Cameron Creek had grey-red wall plaster (Bradfield 1929).

It also appears that small communal rooms associated with a segment of the village population were constructed or existing rooms or pit structures were remodeled for communal use, although these rooms have not been found at NAN (Anyon and LeBlanc 1980; Minnis 1985; Shafer personal communication, 2000). The interior of remodeled pit rooms usually had cobbles and adobe covering the pre-existing pit walls, support posts recessed into room walls, and a ventilator shaft which entered near the hearth (Anyon and LeBlanc 1980). The old ramp way was destroyed and the entry sealed over during remodeling; the new entry was through the roof (Anyon and LeBlanc

1980).

Additionally, during the Classic period, smaller walled plazas within individual room blocks as well as some larger than average surface rooms may have served segments of the population larger than family. Small plazas are recorded at Mattocks, NAN, Red Rock Village, and Swarts (Anyon and LeBlanc 1980; Cosgrove and Cosgrove 1932; Shafer 1991d). Evidence that larger surface rooms were communal is based solely on their size which generally was more than twice that of domestic rooms (Anyon and LeBlanc 1980).

Postclassic architecture used adobe rather than cobbles and mortar for wall construction (Lekson 1996). At Old Town in the southern section of the site, Black Mountain phase structures had masonry lower walls, black adobe mortar and flooring, and were not burned after abandonment as rooms had been in the Classic period (Creel 1995, 1997a). In the Eastern Mimbres, field houses were remodeled by shoring up walls and roofs with added support posts, including indoor hearths and mealing areas, enclosing open sides on ramada rooms, and building new rooms (M. Nelson 1999). No communal structures at the study sites were noted for the Postclassic period. This fits with M. Nelson's (1999) findings for the Eastern Mimbres Postclassic hamlets and Lekson's (1996) statement that there were no kivas in the El Paso phase.

Ceramics

Ceramic quantities, types, styles, designs, and composition may indicate such things as subsistence, population densities, exchange, social complexity, and boundaries, while changes in ceramic signatures can reflect new directions in these social aspects. Different

types of ceramic vessels may be used for various tasks such as long, slow cooking, sealed storage, or water containers. Function along with proportional density can reflect subsistence focus or changes. For example, increased storage container sizes and quantities may parallel increased sedentism, greater reliance on agriculture, and/or population size. Ceramic style and designs are stylistically group specific because technology and style are generationally learned and passed on. Style as well as composition can identify the presence of exchange between groups by indicating non-local ceramics. In Mimbres villages, changes in vessel types, use, and quantity may reflect increased dependence on agriculture while style, composition, and design distribution may show the presence of smaller groups within the greater society.

Ceramics during the Early Pithouse period consisted of a plain brown cooking or everyday ware which Haury (1936) called Alma Plain. Alma Plain as well as subsequent cooking and decorated wares had a grey core bracketed by brown nearer the surfaces and all were made using the coil and scrape method (Haury 1936). Early vessel shapes include jars usually with vertical necks, bowls, and seed jars (Anyon and LeBlanc 1984; Haury 1936). Jars out-numbered other shapes of Alma Plain wares throughout the Early and Late Pithouse periods (Haury 1936).

Women probably made and decorated the pottery. Shafer (1985, 1991a) found one female's grave at the NAN Ranch ruin that contained polishing stones, worked sherds, a vessel containing pigment, and unfired black-on-white vessels, suggesting she was a potter. Plog (1997) claims a few other similar burials have been found in the Southwest. Additionally, a female potter tradition is observed in most pueblo groups of

the Southwest today.

Some time after Alma Plain was in production, a small percentage of vessels were finished with a thin red slip or wash, and sometime later, toward the end of the Early Pithouse period, around A.D. 550, some of these had a thicker polished slip (Anyon and LeBlanc 1980; Haury 1936; Gilman 1980, 1989; LeBlanc and Whalen 1986). During the Late Pithouse period, a small percentage of red slipped bowls, called San Francisco Red, were highly polished, had red on both the exterior and interior, and often the exterior was finger dimpled. The red wares with thinner, unpolished slips or washes mentioned above precede, co-occur, and follow San Francisco Red.

Following the Early Pithouse period, brown wares evidenced various decorating techniques, such as incising, scoring, and punctating (Anyon and LeBlanc 1984). Alma Neck Banded appeared during the transition from the Georgetown to the San Francisco phase increasing in quantity and becoming a diagnostic by the middle of the latter phase (Anyon and LeBlanc 1984; Haury 1936). The Neck Banded vessels were eared pitchers with flattened, overlapping thick coils around the neck (Anyon and LeBlanc 1984; Wasley 1960). The quantity of small pitchers with handles produced at this time strongly associates them with the Three Circle phase (Anyon and LeBlanc 1984). During the Three Circle phase, Neck Banded evolved into a Neck Corrugated type with thinner coils that generally covered the upper one-third of the vessel (Anyon and LeBlanc 1984; Haury 1936). Jars gradually developed from gourd-shapes to rounder bodied (Anyon and LeBlanc 1984).

Beginning near the middle of the Late Pithouse period, some bowl interiors and

exteriors of jars were slipped with a thin brown wash over which red geometric shapes were painted. Haury (1936) designated this painted ware as Mogollon Red-on-brown. Most design layouts were based on a quadrant division, and motif elements primarily were linear or various angular combinations of lines (Haury 1936; Powell 1991). Exteriors were usually red slipped, and like the San Francisco Red wares, finger dimpling sometimes was imprinted on the exteriors. Tempers were prepared by crushing rock or pot sherds allowing a smooth surface for polishing and design painting. At Saige-McFarland, Mogollon Red-on-brown occurred in percentages that were higher than for most Mimbres sites, and although Mogollon Red-on-brown decreased somewhat through time at Saige-McFarland, it remained much higher than in other areas of the Mimbres (Lekson 1990). Haury (1936) noted that the two color slip (red exterior and light brown interior on bowls) appeared much earlier in the Mimbres and San Francisco drainages than in the rest of the Southwest. Mogollon Red-on-brown was short-lived, probably being produced and used less than 80 years (Powell 1991, 1996).

About A.D. 750-800, Mogollon Red-on-brown evolved into a decorated ware called Three Circle Red-on-white, demarcating the beginning of the Mimbres white-slipped ceramic tradition. Red designs were painted onto a thick cream colored, well-polished slip. Bowl exteriors were brown slipped or unslipped and lightly polished (Haury 1936). Design execution and polish reflected the finely ground tempers used during this time. Motifs contained more solids, usually triangles, than the previous red-on-brown designs and thick curvilinear scrolls occasionally occurred. Three Circle Red-on-white probably was produced and used for about 50 years (Shafer and Anyon,

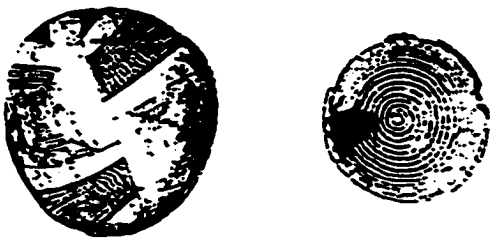
personal communication 2000), and some have questioned its as a separate ware from the subsequent black-on-white type (Anyon and LeBlanc 1980, 1984; Gilman, 1989).

Towards the end of the Late Pithouse period, designs used on the red-on-white vessels evolved into slightly more complex motifs with finer line work reflecting a greater time investment and perhaps increased painting skills. Design paint changed from red to predominantly black, although some vessels of the black-on-white series were fired at varying oxidization levels resulting in a range of colors, including reds, red-blacks, and blacks. The first black-on-white pottery appeared prior to A.D. 900, possibly as early as A.D. 750 (Shafer and Brewington 1995). It was initially called Boldface black-on-white by the Cosgroves (1932) and later Style I by the Mimbres Foundation (Anyon and LeBlanc 1984; Figure 5). Boldface Style I designs covered the entire interior of bowls, usually extending to the rim edge, and lack of polishing produced a much sharper design image than before (Cosgrove and Cosgrove 1932; Haury 1936). Lines were thick and bold, frequently with large scrolls. A three-pronged F and wavy-line hachuring were also characteristic (Anyon and LeBlanc 1984). Exteriors were not slipped as with some vessels in the earlier painted types. A very small number of these early black-on-white bowls had designs consisting of life-forms, but they were crudely rendered compared to subsequent naturalistically painted designs.

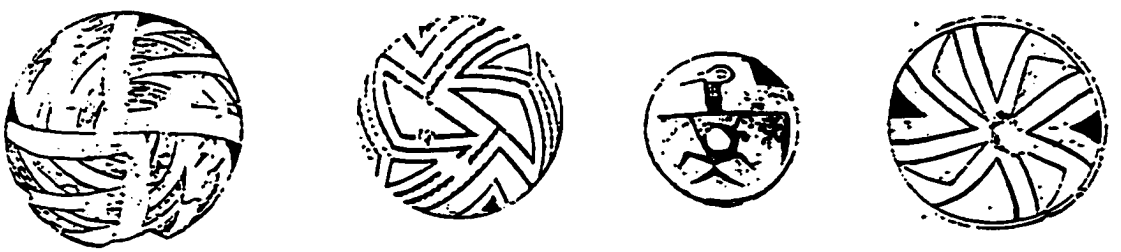
Following Boldface, black-on-white designs during the A.D. 900s and early A.D. 1000s changed in that hatchuring lines were straight, all lining was much finer and more precisely rendered, thin lines were bordered by thick lines, large scrolls interlocked, and although some designs still continued to the bowl edge, some stopped short of it. Vessels

with this style of design were called Transitional or Style II (Anyon and LeBlanc 1984; Shafer and Brewington 1995; Figure 5). Anyon and LeBlanc (1984) as well as Shafer and Brewington (1995) noted a refinement in this type between the earlier and later Transitional, or Style II, designs. The late Style II designs have small differences from the earlier Style II designs such as finer bordering lines and occasional broad framing lines from which the designs were suspended (Anyon and LeBlanc 1984; Shafer and Brewington 1995). These stylistic differences have been formally designated as Early Style II and Late Style II by Shafer and Brewington (1995). Naturalistic designs, many of which were embedded within negative geometric designs, increased during this time (Shafer and Brewington 1995). Mimbres black-on-white Style II vessels were not predominant in the stratigraphic sequences at Galaz or Saige-McFarland (Anyon and LeBlanc 1984; Lekson 1990).

During the Classic period, the black-on-white design series was perfected into a highly sophisticated art form (Brody and Swentzell 1996). In general, thin lines were bordered by thin lines, hatchuring was thin-line, there were multiple suspended framing lines and the number of exquisitely rendered naturalistic designs increased dramatically (Anyon and LeBlanc 1984; Powell 1999; Shafer and Brewington 1995). Style III, or Mimbres Classic Black-on-white, designs were divided into three micro-styles by Shafer and Brewington (1995; Figure 6). The small differentiating characteristics include such traits as prominent eyes on Early Style III life forms, paired, opposing life figures encircled by a geometric frame in Middle III designs and increased blank space in the bowl center and frequent absence of framing lines in Late III times (Shafer and



STYLE I



STYLE II

STYLE III

Figure 5. Mimbres black-on-white Styles I, II, III.

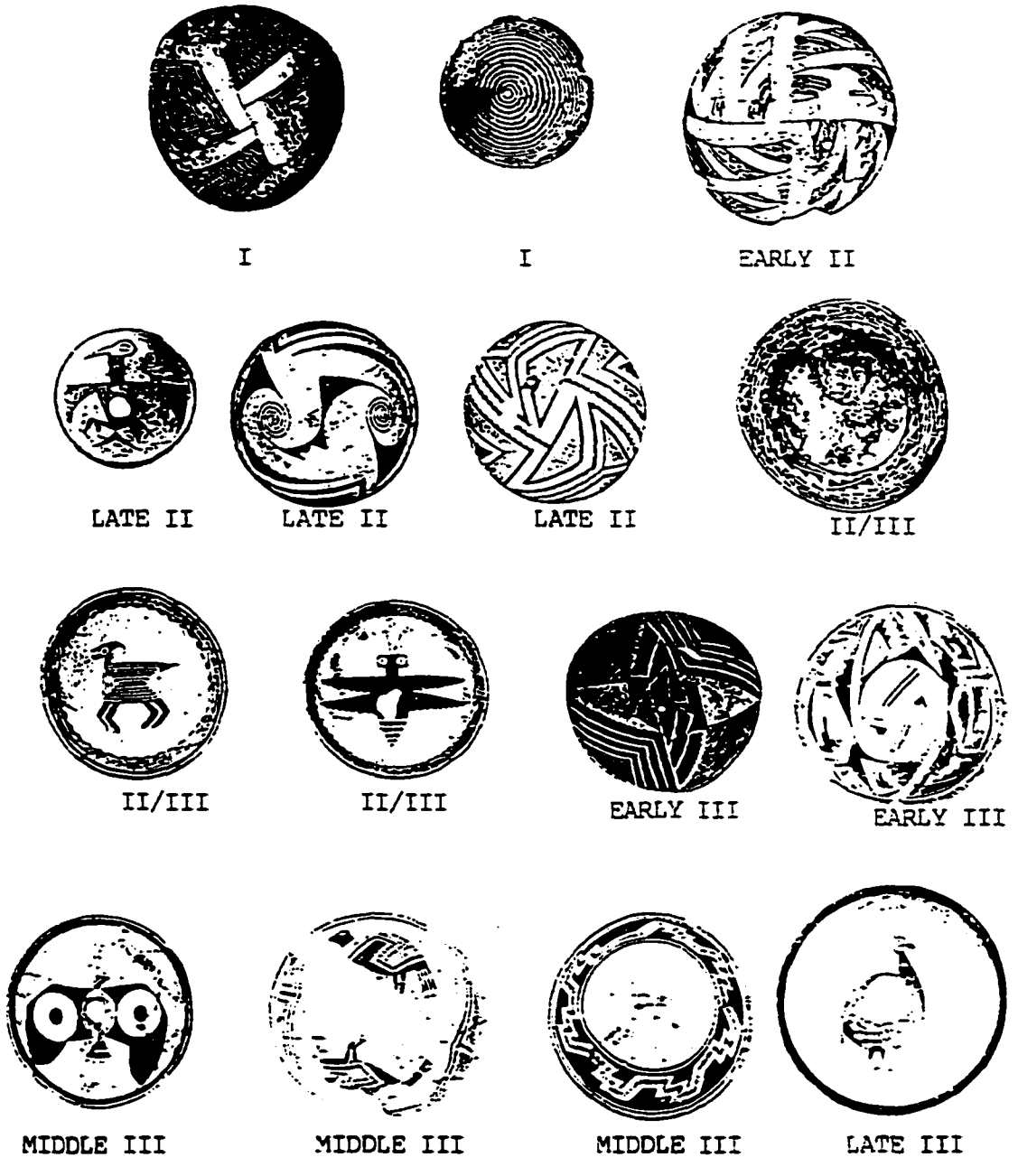


Figure 6. Mimbres black-on-white microstyles, Style I, Early Style II, Late Style II, Style II/III, Early Style III, Middle Style III, and Late Style III.

Brewington 1995).

Polychrome designs also occurred during the Classic period in which a third color, usually tan or yellowish, was added to the design (Anyon and LeBlanc 1984; Shafer and Brewington 1995). The tan color was substituted for or included with fine-line hachures, or was used as a filler in naturalistic designs (Anyon and Le Blanc 1984; Shafer and Brewington 1995).

The majority of Classic painted vessels were bowls, although jars and flower-pot shaped bowls occurred as well as rare painted effigy jars (Anyon and LeBlanc 1984). Even though some Mimbres decorated pottery became quite artistically sophisticated later in time, there is no documented evidence to suggest specialization above the household level (Gilman 1989; Powell 1992).

Burials

Questions regarding status are often assessed using mortuary data. These same data may also be used to identify the presence of groups within the Mimbres society. In general, there is little patterning in amounts or types of grave goods among Mimbres burials that would suggest status differentiation based on age, sex, or inheritance (Gilman 1990). However, recent work based on excavations at several of the large Classic sites and re-evaluation of some of the early materials, have allowed attempts at assessing questions concerning differentiation among the Classic Mimbres people. Gilman (1990) found differences in numbers of grave goods associated with certain rooms at the Mattocks site as did Shafer (1987) at the NAN Ranch site, and Hill (1995) noted that greater numbers of painted vessels accompanied burials in rooms with formal hearths at the Swarts ruin.

Shafer (1985, 1991a) recorded one adult female burial at NAN Ranch that was accompanied by artifacts suggesting that she was a potter in life, and one adult male buried with artifacts indicative of a shaman's tool kit. Gilman (1990) also noted that most Classic sites outside the Mimbres heartland have fewer whole vessels per burial than site in the Mimbres River Valley. These analyses suggest that differentiation and small group identification is possible to detect from the Mimbres mortuary data.

Funerary practices of the Early Pithouse period are not known, probably due to limited excavation of Early Pithouse sites, and/or the use of extramural burial grounds (Creel 1989; Gilman, personal communication 1999). No burials were found at two Early Pithouse villages sampled in the Mimbres Valley and one adjacent to the Gila River (Anyon and LeBlanc 1984).

Early Late Pithouse period burials primarily were located in the trash-fill of abandoned houses, although a few sub-floor interments have been noted (Anyon and LeBlanc 1984). Sub-floor room burials increased throughout the period and during the late Late Pithouse period the quantity of grave good per burial increased (Anyon and LeBlanc 1984).

From the late Late Pithouse period onward throughout the Classic period, most Mimbres burials were placed beneath room floors or were interred in open areas adjacent to room clusters (Anyon and LeBlanc 1984). The majority were flexed or semi-flexed, placed in a pit of minimally adequate dimensions, and accompanied by one or a few grave goods (Anyon and LeBlanc 1984; Creel 1989a; Gilman 1990). The practice of placing a "killed" bowl, or bowl with a hole punched in the bottom, over the skull of the

deceased was initiated at the end of the Late Pithouse period (Anyon and LeBlanc 1984; Plog 1997).

Other types of artifacts besides painted ceramics were found in graves, including bracelets, turquoise pendants, beads, plain and neck banded or corrugated vessels, paint palettes, shell, projectile points, ground stone, occasional worked bone, and, rarely, copper bells (Anyon and LeBlanc 1984; Gilman 1990; Hill 1995). Galaz had more vessels per burial than did NAN and as well Galaz inhabitants evidenced a preference for shell-turquoise and ceramic-jewelry combinations in graves in all time periods (Anyon and LeBlanc 1984). At NAN, male only interments with no grave goods and a low percentage of cranial deformations were documented in the Southeast midden, burials in the South room Block had more grave goods than the East Room Block, and two rooms in the South Room Block had the most and richest burials for the entire site (Ham 1989). Also at NAN, ceramics, pigment, and polishing stone grave goods probably represented a female potter and grave goods such as crystals accompanied a male shaman (Shafer 1985, 1991a; Ham 1989). One child buried at Galaz had an extremely large quantity of grave goods, including 20 ceramic vessels and one adult burial at Saige-McFarland had 21 associated ceramic vessels (Anyon and LeBlanc 1984; Lekson 1990). Similar to NAN's Southeast Midden burials, no associated ceramic grave goods were found with midden burials at Cameron Creek (Bradfield 1929).

Fewer than 200 cremations have been found and most of these were secondary with the ashes usually contained in a covered ceramic vessel (Creel 1989a; Shafer and Judkins 1997). At NAN, fourteen cremations were found in the east Plaza and one

primary cremation in the Southeast midden at NAN (Creel 1989a; Shafer and Judkins 1997). These usually were "in special rooms and special areas . . . more often than were inhumations," and grave goods consisted of a higher occurrence per burial of projectile points than with inhumations (Creel 1989a:1). Creel (1989a) suggested these cremations may be associated with type of death or ranked status.

Unusual burial practices included one at Old Town in a communal structure which was an infant with only post-cranial elements present as well as an intentionally disarticulated adult associated with the platform mound (Creel 1997a, 1999). Twenty interments at Galaz had no skulls, and five others had no post-cranial material (Anyon and LeBlanc 1984). Of these 25, only three could definitely be assigned to the Classic period and one to Postclassic times (Anyon and LeBlanc 1984).

Non-human burials also occurred. Twenty-one bird and two canid burials were documented at NAN and one bird and one canid at Old Town (Creel 1994, personal communication 1999; Shaffer 1991). Eleven macaw and parrot burials were found at Galaz, as well as three macaws and parrots at Cameron Creek (Anyon and LeBlanc 1984; Bradfield 1929).

During Postclassic times from A.D. 1150 to A.D. 1350, cremations exceeded inhumations, although cremations (n=3) made up a larger portion of the small burial sample from Saige-McFarland prior to the Postclassic than did interments. From A.D. 1350 to A.D. 1450 cremation was the exclusive burial practice (Creel 1989a). No pattern in location or grave goods categories was noted with Postclassic cremations (Creel 1989a).

Features

Features include those material culture remains that are not architecture and are not portable. The most numerous features in the Mimbres area were hearths, postholes, and to a lesser degree storage facilities. Postholes were integral to and often determined wall and roof construction, and therefore are discussed, when relevant, in the architecture section. Hearths may relate to subsistence because they may contain plant and/or animal remains in the ashes, boiling rocks, or large numbers of cracked rocks from roasting ovens. As noted above (Hill 1995), hearth size and design may be associated with certain groups of people. Storage facility size and type may reflect what is being preserved as well as quantity of surplus. For example, storage pits beneath floors may indicate conservation of storage space within small family residences such as pithouses and thus may be associated with greater mobility, less reliance on domestic crops, and loosely integrated villages. Pithouse sub-floor storage also may be a strategy to protect against animal marauding while the residence is seasonally unoccupied. Portable ceramic storage containers may be associated with greater sedentism, small kin groups, less fear of animal break-in, low surplus needs, and/or less dependence on agriculture. Separate rooms for food processing and storage correspond with sedentism, extended families or large groups, and/or increased potential for subsistence failure and, thus the need for more surplus. Rooms provide a large and substantial work area and greater space to stock surplus against increased risk potential as subsistence bases become more focused on one resource and/or population increases.

Hearths were not present in all Early Pithouses, and when present they were not

formally constructed, but were ash pits or lenses in shallow depressions. During the Late Pithouse period hearths gradually became less ephemeral, reflecting planning and some standardization (Anyon and LeBlanc 1984). Hearths were generally rectangular and located between the ramp and center of the domestic structures in late Late Pithouse architecture (Anyon and LeBlanc 1984).

By Classic times, circular and rectangular slab lined, adobe lined, and single and double formally constructed hearths were standard (Anyon and LeBlanc 1984; Hill 1995). Some Classic hearths also had an associated ash bin nearby. Hill (1995) noted that at the Swarts site Classic formal hearths were in rooms with more burials than rooms without formal hearths, that room sizes varied according to hearth type, and that rooms with circular hearths had fewer painted ceramics and other grave goods than those with rectangular hearths. Rooms with rectangular double-compartment hearths had the greatest number of painted ceramics with burials, while both single and double rectangular hearths in rooms with burials had similar numbers of other types of grave goods (Hill 1995).

In the Early Pithouse period, one or more storage pits beneath room floors was common, but this practice became less common during the Late Pithouse period. Ceramic storage containers may have replaced sub-floor storage. During the Classic period, small rooms which were probably used for storage were constructed adjacent to the larger living room. Floors in these rooms were sometimes not leveled or plastered as thoroughly as living rooms (Anyon and LeBlanc 1984).

Observations Related to Mimbres Material Patterns

Mimbres characteristics reflect a number of changing patterns such as village locations, architecture, ceramics, burial practices, ground stone, and floral and faunal remains that are associated with increases in agricultural dependence, sedentism, and population. Overall, major changes in material expression of Mimbres culture paralled each other in development through time. Scattered villages of loosely clustered pit structures were located on ridges, knolls, and high mesas in the Early Pithouse period. The residents likely were semi-sedentary, practiced part-time agriculture and followed migratory game and maturing plants during part of the year.

Village locations were moved to river terraces in the Late pithouse period. Residences during this time were more tightly clustered indicating greater closer association between village people and increased use of arable land in the flood plains (Adler 1996). Architecture changed from round to rectangular structures. By the end of the Late Pithouse and into the Classic period, villages became even more aggregated and population settlement in side drainages of the Mimbres River valley as well as the many large valley villages reflect population growth. Above ground, contiguous rooms in the Classic period also associate with land space conservation and/or land-use rights, and size of the room blocks in the large valley villages supports population estimates that more than ten times as many people were present in the Classic period than before.

Plant remains, ground stone, and chipped stone suggest an increased emphasis on plants, especially maize. The evolution of ceramic forms, quantities, and decorations are all reflective of agriculture dependence, large population, and sedentism. Burials indicate

a large Classic population that characteristic of a sedentary life had many material things. Grave good patterns indicate that small groups based on age, sex, possibly occupation (i.e, potter, shaman), perhaps exogamy (midden burials at NAN may represent in-marrying males; Ham 1989), and wealth (graves goods in the better constructed South Room Block at NAN were richer than those in the East Room Block) existed during the Classic period.

Material patterns also suggest that aggregation was not only in response to limited arable land, but that people coalesced into large villages to control assess to agricultural lands (Adler 1996). Population increase and greater dependence on agriculture created a need to use all available land and farming strategies to insure food sufficiency. As well, population and land limitations necessitated corporate decision making processes for land and water use and likely organization and management of other risk reducing strategies such as surplus distribution and rites of intensification.

CHAPTER IV

MIMBRES ENVIRONMENT, FARMING, AND POPULATION

In this study, variability in the physical conditions is of particular interest because these fluctuations directly impacted Mimbres economic conditions and thus affected social decisions aimed at maximizing well-being (Baksh and Johnson 1990; Braun and Plog 1982; Cashdan 1990; Dean 1996; Dean et al. 1994; Gummerman 1994; Halstead and O'Shea 1989; Kelly 1991; Minnis 1985, 1996; Rautman 1993, 1994; Winterhalder 1990; Winterhalder and Goland 1997). Changing conditions in rainfall, groundwater supplies, soil fertility, and temperatures and their subsequent impact on plants and animals, created variation that had to be met through economic and social adaptations in order to survive.

Fluctuation in the environment are central to farming; precipitation and temperature are primary constraining factors in economic success in the Southwest (Creel 1996; Dean et al. 1985; Minnis 1985; Schlanger and Wilshusen 1993). Negative environmental impacts and/or an accelerated population growth rate in many situations would mitigate against agricultural success and, as noted above, social strategies probably would be initiated to overcome these effects (Betancourt and Van Deveder 1981; Braun and Plog 1982; Dean 1996; Kelly 1991; Lipe 1994; Vayda and McCay 1975;

Winterhaulder and Goland 1997). This chapter details the physical and demographic conditions at the end of the Late Pithouse period and during the Classic period of the Mimbres people in order to provide data from which patterns of estimated crop success and population growth can be compared in the final chapter with variability in the temporal and spatial distribution of ceramic exchange and iconography. Temporal contrasts or parallels between food sufficiency and iconographic distribution from A.D. 970 to 1130 should demonstrate that group formation and re-formation occurred. If the ceramic evidence confirming group formations co-occurs with economic variability then it can be inferred that group formation was an economic stress response initiated at least in part by encoded ideologic messages in the Mimbres black-on-white icons.

Environment

In general, typical southwestern climatic conditions of today are similar to those that occurred during the Mimbres Late Pithouse and Classic periods. This claim is substantiated by tree-ring samples both from the Mimbres Valley and by extrapolation from dendrochronological data from the Reserve area of southwestern New Mexico (Minnis 1985). Fifty percent of the rainfall comes during July, August, and September as thunderstorms. Winter rain is less abundant, but gentler and more reliable (Parham et al. 1983). Annual precipitation varies from a mean of 44 cm in the northern valley at the Mimbres Ranger Station to 29 to 31 cm at the Faywood station near the Old Town site. Just south of Old Town, Deming receives only 23 cm (Gabin and Lesperance 1977). Summer rains begin near July 4th, or approximately two months after maize has been planted. In a semi-arid environment, the factor most impacting crop success is water

availability. In the Mimbres area of southwestern New Mexico, usability of the summer precipitation due to run-off and flooding is exacerbated by an evapotranspiration rate which exceeds rainfall (Anyon and LeBlanc 1984).

During the A.D. 900s to 1130s, the center of the Mimbres population was in the Mimbres Valley. The upper valley includes the river flood plain, adjacent terraces, and rugged mountains rising from the valley, while the lower, or southern valley is flood plain and semi-desert. In the mountains, small, scattered springs provided perennial water on which farmers probably depended for some upland agriculture (Anyon and LeBlanc 1984; Herrington 1982; Minnis 1985; Shafer, personal communication 2000). In the southern part of the valley, elevations range from 1219 m to 1676 m, while in the northern half of the valley uplands may reach 2438 m ((Parham et al. 1983). Frost-free days vary between the lower and upper valley as well as between the valley floor and surrounding higher elevations. For example, the lower valley has from 180 to 220 frost-free days as compared with approximately 150 to 180 for the upper valley, while in the mountains there may be as few as 100 frost-free days (Minnis 1985; Parham et al. 1983). As elevation increases, temperatures and precipitation also vary. Moisture increases and average temperatures decrease.

Environmental Reconstruction of the Mimbres Valley and Surrounding Uplands

The Classic Mimbres people were farmers, and thus a paleoenvironmental reconstruction is integral to establish independent variables against which the dependent social variables are viewed. The most detailed and complete paleoenvironmental reconstruction for the Mimbres Valley was done in the 1980s by Minnis. His environmental data allowed him

to estimate resource availability, both wild and domestic, for the inhabitants of the Mimbres Valley area during the Early Pithouse through the Postclassic Salado periods. Precipitation data were based on Dean and Robinson's (1978) tree-ring record from the Reserve area, a similar river valley about 106 km north-northwest of the Mimbres Valley. Minnis's reconstruction also used Mimbres Foundation survey and excavation data which were mainly from the upper, more mesic portion of the Mimbres Valley (Creel 1996; Minnis 1985).

The reason for using the Reserve data was two-fold: 1) annual environmental data from tree-rings were very limited for the Mimbres Valley at the time of Minnis' study; and 2) the Mimbres Valley dendrochronological data did not cover as long a time sequence as the Reserve data. Minnis demonstrated the usefulness of the Reserve data for the Mimbres Valley by correlating segments of Mimbres and Reserve tree-ring indices and figuring their coefficients. From the coefficients, he determined that the similarity between the existing well-documented Mimbres Valley indices and the larger numbers of Reserve data from the same time period were sufficient (i.e, .80 and .75) to confidently use the Reserve index as a predictor for environmental conditions throughout the Mimbres Valley and surrounding uplands (Minnis 1985).

Tree-ring widths were then used to estimate summer/winter precipitation levels and stream flow for the Mimbres River. From the tree-ring sequences, Minnis was able to infer intervals of high, low, and average precipitation for the prehistoric Mimbres Valley. Of particular relevance to this study were periods of low precipitation noted during the A.D. 970s, A.D. 1030-1045s, A.D. 1090-1120s, and A.D. 1130-1140s.

Updated data from the Laboratory of Tree-Ring Research (1998) as well as research done by Creel (1996), confirmed these low moisture intervals as do muskrat, reed, cattail pollen, and bulrush seed remains from the same time periods. The biotic remains are types that thrive in ponded environments which form when a stream slows and meanders during times of low precipitation and/or decreased ground water (Allen 1982).

The two primary limiting factors affecting floral and faunal resources in Minnis' reconstruction are: 1) amount and usability of water, and 2) the amount and fertility of available farm land. Minnis' reconstruction suggested that 50 percent of the Mimbre's diet was supplied by flood plain agriculture and supplementary upland, dry farming. However, in the Mimbres area, rainfall, whether upland or valley, rarely provides the required amount of moisture needed for corn, beans, and/or squash to mature (Sandor 1983). The fertile, well-watered flood plain was the most desirable land, but it was spatially limited. As population grew, upland farming became more important (Brady 1974).

By subtracting non-arable sections (the Mimbres River and estimated ponded areas), Minnis (1985) calculated that approximately 1512 hectares of farm land were available to the Mimbres people. Based on ethnographic evidence that farmers with similar flood plain fields use 0.4 hectares per person for crop production during average precipitation years, and adding 0.2 hectares to compensate for below average years and fallow fields, Minnis (1985) estimated that the valley could have supported 2525 people if one-half of their diet was from local crops.

The Mimbres flood plain soil is deeper and more fertile than in the uplands where

soils generally are thin and gravelly, lacking certain essential minerals for crop production (Herrington 1979, 1982; Sandor 1982, 1995; Sandor and Gersper 1988; Sandor et al. 1986a, 1986b, 1986c, 1990). There are, however, limited, upland areas where deep soils have collected that are profitable for planting maize (Anyon and LeBlanc 1984; Herrington 1982; Minnis 1985). Information regarding prehistoric agricultural practices is limited in that little is known about crop rotation or fertilization practices. If farming plots were not wisely managed, soil fertility of both the valley and uplands may have been depleted through time, thus creating an additional influencing variable to hectare productivity.

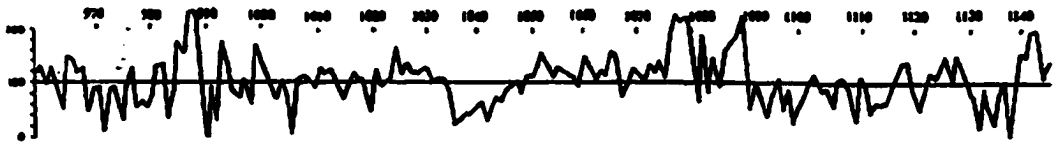
A study by Sandor (1983) near the Mimbres Valley showed that prehistoric soil fertility decreased through time, but he could not demonstrate whether the degree of depletion was significant to affect crop production. Nitrogen loss has been estimated at about 40 percent for corn crops over a 50 year period in the historic Midwest (Muenchrath and Salvador 1995; Sandor et al. 1990); however, this figure may not be accurate for the Mimbres fields as soil replenishing strategies such as interplanting, rotation of nitrogen-fixing plants, or soil entrapment from run-off may have been in place prehistorically. For example, the Hopi preserve soil fertility using a sort of micro-crop rotation. The same fields are used over and over, but plants are spaced widely and the next year planting is not in the same exact place. Ethnographic evidence also documents that historic native peoples often interplanted maize and beans so that the nitrogen-fixing property of legumes mitigated, in part, nitrogen depletion (Brandt 1995; Herhann 1995; Honeycutt 1995; Hurt 1987). Upland terracing in the Mimbres region slowed run-off and

may also have aided in replacing soil fertility by trapping soil suspended in run-off waters (Herrington 1982; Sandor, 1983; Sandor and Gersper 1988; Sandor et al. 1986a, 1986b, 1986c, 1990).

Consistent, adequate moisture is necessary for optimal maize development (Muenchrath and Salvador 1995). During the first half of the Mimbres Classic period when precipitation was average or above, upland dry farming probably produced a crop three out of four years, but in the uplands production per hectare yield is substantially lower than flood plain yields (Minnis 1985). Yields on first benches above the river, not even in the mountains, average one-third to one-fourth less than flood plain harvests today.

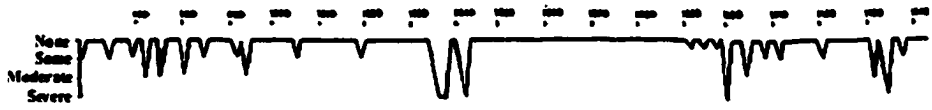
Minnis (1985) based food availability and dietary needs of the Classic period valley population on an assumption that farms in the valley were irrigated. Effective irrigation for the valley would entail cooperative efforts, implying a group organization which has not been demonstrated convincingly for the Mimbres society (Gilman 1990; Minnis 1985). Even if a cooperative irrigation strategy existed, years of below average precipitation would decrease stream flow below an effective level (Creel 1996; Minnis 1985). Years when irrigation cannot overcome low stream flow and fields are dry in the Mimbres Valley are historically documented (Minnis 1985).

The seventy years prior to the study period, A. D. 900 to 970, was a time of variable rainfall, but highs and lows in annual precipitation were interspersed so that no sequential years of below 10 cm rain occurred and thus, food stress was mild to nearly none for this early time (Figure 7). In A.D. 970, a decade of inadequate rainfall (i.e, less



Tree-ring sequence, A.D. 970-1140

Estimated Farming Success for the Study Area



Estimated Food Stress, A.D. 970-1140

Figure 7. Graphs showing precipitation, crop success, and estimated food stress for the study period. Reproduced from Minnis 1985.

than 10 cm per year) occurred with an average annual precipitation of approximately 6 cm, but this average does not adequately represent the variability from year to year in that no sequent years of extremely low moisture were recorded in the tree-rings for this decade (Figure 7). Crop success was fairly evenly dispersed during this decade and probably less than one-half of these years resulted in actual food stress (Minnis 1985).

During the 50 years from A.D. 980 to 1030, average annual precipitation was about 11 cm, but years of below average rainfall were relatively evenly spaced among years having 10 cm to 20 cm and sometimes more precipitation (Figures 7). The last decade of the 50 years, A.D. 1020 to 1030, was particularly constant, with all years having from 10 cm to 17 cm of rain (Minnis 1985). Crop success was interspersed with years of average/above average and below average/failure, resulting in only about ten to 11 years of little/ moderate food stress. Many consecutive years from A.D. 980 to 1030 had no food stress associated with them (Figure 7; Minnis 1985).

Precipitation amounts during the next 15 years, A.D. 1030 to 1045, produced a mild drought during which moderate to severe food stress likely was experienced, especially from A.D. 1035 to 1037/38 and A.D. 1041 to 1043, although between these two periods and from A.D. 1030-1035, no stress occurred. Average annual precipitation was only 6 to 7 cm, and less than 10 cm fell every year. Although, food stress occurred only for two or three years twice in this period because of variability in rainfall highs and lows from year to year, overall low precipitation may have increased stress or anticipated short-fall among Mimbres farmers.

The years between A.D. 1045 and A.D. 1090 covering the transition from the late

Late Pithouse period to the early Classic period had favorable precipitation levels with an average annual rainfall of 14 cm (Figure 7). There were no years of food stress (Minnis 1985) and likely no perceived or anticipated threats to crop failures by the farmers. In contrast, the last 20 years of the early Classic, A.D. 1090 to 1110, averaged only 7 cm of rain per year with none of these years having over 11 cm. Although Minnis (1985) estimated that less than one-third of these 20 years resulted in actual food stress, two decades of precipitation which was 3 cm below average represents a long stretch and anticipated short-fall no doubt caused increasing stress for the Mimbres farmers.

From A.D. 1110 to 1117 the average annual precipitation was only slightly higher than the preceding years, averaging 7 to 8 cm and resulting in two years of food stress (Figure 7; Minnis 1985). A brief recovery period occurred from A.D. 1117 to 1130 during which annual average precipitation was 12 cm with only one to two years of food stress indicated. The decade from A.D. 1130 to 1140 experienced an average of 5 to 6 cm of rain per year with only the last year or two receiving over 10 cm of precipitation. Three years at the beginning, middle, and end of the A.D. 1130 to 1140 years had adequate food while other years were severely affected by food shortages (Figure 7).

The precipitation data and food stress estimates indicate that in general droughts were experienced less frequently and for shorter lengths of time during the late Late Pithouse and early Classic periods than later in the Classic period. One ten year period, A.D. 970 to 980, had low but variable rainfall during which food stress no greater than moderate was present about 40 percent of the time. Minnis's (1985) data suggest that no food stress occurred again until A.D. 1035. Fifty-five years elapsed before the second,

more severe drought occurred in A.D. 1034 and lasting until A.D. 1045. Average annual precipitation was high and no food shortages were noted from A.D. 1045 to 1090. However, the period from A.D. 1090 to 1110 averaged 7 cm of rain and included at least five years of mild stress and one of severe stress. This latter twenty years of consistently low precipitation certainly created stress related to crop success. The years from A.D. 1110 to 1117 were consistently low in precipitation amounts, and by A.D. 1117, the Mimbres people had experienced 27 years of low rainfall, which undoubtedly severely affected health and depleted any surplus stores. The following 12 to 13 years probably alleviated conditions somewhat but likely not enough to alter declining health/nutrition consequences and/or re-settlement/emigration strategies set in motion by many years of drought. The final ten years, A.D. 1130 to 1140, averaged 6 cm of precipitation and surely motivated a social response consisting of major reorganization.

Farming Strategies

Information regarding farming strategies practiced by the Mimbres people provides data that substantiates increased food stress. A range of agricultural practices may extend crop yields and growing seasons and reflect socially embedded risk reduction strategies.

Irrigation

At least some Mimbres farmers practiced irrigation during the study period, and it likely given land availability and population that the Classic period inhabitants of the Mimbres Valley were dependent on irrigation (Herrington 1979; 1982; Lekson 1986, 1992; Shafer personal communication, 2000). There was reference in the 1890s by Webster to ancient irrigation ditches in the Mimbres Valley (Shafer personal

communication, 2000). Herrington (1979, 1982) noted prehistoric irrigation canals just west of the Mimbres Valley in the mid-portion of the Arenas Valley, Cameron Creek drainage, and upper areas of Lampbright Draw where there are over 4000 meters of ditches and approximately 3000 meters in proximity to the Cameron Creek ruin. A rainfall irrigation network which dates to the Classic period is in Gavilan Canyon, and a ditch system on the NAN ruin was likely part of an extensive irrigation system (Creel and Adams 1985; Ellis 1995). Herrington (1979, 1982) also documented two large dikes apparently used to divert water to irrigation canals as well check dams and terraces in these drainages. Other types of water control and conservation systems, such as relic dykes along the Cameron Creek and Arenas drainages and thousands of check dams and terraces in the Arenas drainage, in association with Classic structures are known (Herrington 1982).

Lekson (1986, 1992:117) states that "about A.D. 1000 [the] Mimbres ... developed ... canal irrigation.... Shafer (personal communication, 2000) agrees that given the population, level of sedentism, and documented dependency on agriculture, the Mimbres had extensive irrigation systems. It is not likely that the Classic population could have survived as long as it did without irrigation.

Terraces

In the uplands adjacent to the Mimbres and Sapillo valleys, Sandor (1983, 1995) recorded and studied thousands of terraced plots from which he concluded that the position of these sites corresponds to: 1) certain elevations (i.e., usually between about 1800 and 2000 meters); 2) slope degree (i.e., < 20 degrees for both hillside and drainage

sites); and 3) claypan (argillic) soils. Terrace placement is similar to modern pueblo spacing of agricultural plots over wide areas of various topographic and elevational settings, such as hillsides, arroyo bottoms, and middle drainages. Given the temporally and spatially sporadic nature of summer rainfall in the Southwest, a dispersed plot strategy within optimal growing zones as noted above would increase the success probability of upland crops.

Frost

Upland fields have some advantages not found in the valley as frosts are more damaging to valley crops than upland crops because the colder, heavier air from early or late frosts settles into the valley (Sandor 1982). In such a case, upland crops may survive when valley crops do not. Along with the possibility of receiving localized rainfall, interdigitation between valley and upland crops may reduce frost damage and increase overall harvests.

Timing

Plants have peak periods when moisture is necessary for optimal growth, maturation, fruition, and even survival and, therefore, are negatively or positively impacted by rainfall timing. For example, Minnis (1985), Sandor (1982) and Maxwell (1995) point out that water deprivation during the "tasseling/silking" period of maize growth can dramatically decrease yields. Thus, it is not just annual or peak growing season precipitation averages that are important. However, due to the low numbers of useful dendrochronological samples, this variable was not available for the environmental reconstruction.

Stream Flow

Creel (1996) noted that confident estimates of prehistoric stream flow from modern gauging may not be possible. Gauging stations today are not located in points which allow fine-grained measurement (Creel 1996). The Mimbres and nearby valleys are part of a regional caldera complex formed by repeated upheavals and implosions due to vulcanism (Creel 1996; Sandor 1982). The underlying volcanic formations which force groundwater to the surface of these valleys vary in proximity to the surface, thus introducing another factor into stream flow predictions (Creel 1996). In fact, contrary to expectations based on changing degrees of aridity in the Mimbres Valley, Faywood, near Old Town, generally has higher amounts of available water than areas near Galaz in the upper valley (Ackerly 1995). Like the specificity of summer rains, no doubt hydrologic characteristics affected individual farm plots up and down the valley. Such micro-spatial impacts are virtually impossible to figure quantitatively. Nevertheless, a number of successive dry years, such as occurred near the end of the Classic period, would lower the overall groundwater level, and stream flow would eventually fall.

Other Variables

Another factor which might affect agricultural success is flooding. Ackerly (1995) noted that flood magnitudes rarely reach damaging levels in the upper valley, but nearly always surpass the damage threshold in the lower valley. Further the peak flood season in the Mimbres Valley area is August during the maturation period in maize growth. If flooding destroyed crops at this time of year, it would be too late to replant and expect a harvest before frost, unless farmers had developed a short-term maturation maize. Such a genetic

possibility exists; it has been demonstrated that maturation dates may increase or decrease in response to several years of later or earlier fall frost occurrences (Muenchrath and Salvador 1995). Modern Hopi and other southwestern farmers today plant short-season maize varieties which mature in as little as 60 to 90 days (Muenchrath and Salvador 1995), but this has not been demonstrated for Mimbres farming and, thus cannot be considered a mitigating factor to food sufficiency in this study.

Other environmental changes that affected resource availability included agricultural land clearing resulting in faunal changes as well as depleting soil fertility through erosion and increased evapotranspiration (Sandor 1982; Shaffer and Sanchez 1992, 1996). An increase in jackrabbits which thrive in open habitats and a decrease in cottontail rabbits which prefer shrubby, thicketed areas is noted throughout the Mimbres Valley archaeological record (Minnis 1985; Schmidt 1998, 1999). Shaffer and Sanchez (1995; see also Plog 1986) further suggest that availability of wild foods would be changed and probably decreased from the spatial requirements and degradative aspects of agriculture. Destructive impacts by insects, weeds, rabbits, deer, excessive heat, wind, and/or hail as well as humans, animals, and plant diseases and technological knowledge also could affect crops negatively (Halstead and O'Shea 1989; Minnis 1985; Sandor 1982; Winterhalder and Goland 1997).

Dietary Sufficiency

If flood plain irrigation agriculture with supplementary upland crops provided fifty percent of the Mimbres dietary needs under normal circumstances during the Classic period (Minnis 1985), then other resources were likely obtained from local, wild plants

and animals as no evidence has been found for extra- or intra-valley food exchange systems. During years of average rainfall the supply of wild foods would have been adequate to meet one-half of the caloric needs of the people during the Classic period (Minnis 1985). However, in years of drought, natural resources, like domesticates, would be negatively impacted and insufficient to fulfill dietary needs.

The first half of the Classic period was unusually favorable for both wild and domestic resource productivity, but beginning around A.D. 1089 and lasting until A.D. 1149, many years of below average and highly variable precipitation levels occurred. Just prior to and during this time, population increases surely compounded pressures for implementing risk reduction strategies (Anyon and LeBlanc 1984; LeBlanc 1986; Minnis 1985). It is doubtful that economic and social structures could have remained unchanged throughout 60 years of frequent low rainfall (O'Shea and Halstead 1989).

Population

Population Estimates and Growth Rates

Population estimates using prehistoric data require conversion formulae for translating artifactual/architectural information into human numbers, as well as assumptions concerning appropriate space per person within each phase, within the environmental context, and within economic constraints. Anyon and LeBlanc (1984) calculated population and growth rates for the Galaz ruin, one of the large Classic period villages, based on such things as architecture, numbers and average size of rooms, burials, and areal surveys of the valley. Assuming that room numbers and roofed areas were constant over time, they suggested a 0.5 percent growth rate for the Late Pithouse period, 0.34

percent for the Classic period, and an overall rate from the Early Pithouse through the Classic periods of 0.5 percent. Using a use-life of 75 years, Anyon and LeBlanc (1984) figured the peak population at Galaz during the late Late Pithouse times was 236 persons. From the Late Pithouse and Classic period data, they estimated the original population of Galaz was 29-31 people. Using growth rates, Anyon and LeBlanc (1984) suggested that the Mimbres Valley population was 2500 to 3000, or ten times its original size, by the end of the Classic period.

Blake et al. (1986) estimated population based on survey data obtained by the Mimbres Foundation from the Mimbres Valley, side drainages, and some adjacent upland areas. Growth rates and population calculations for the Early Pithouse through the post-Classic periods included the assumptions that 1) rooms were inhabited for equal amounts of time; 2) the area per person remained constant during each time period; and 3) growth rates per time period were approximately the same. They projected that the valley growth rate for the Early Pithouse period was 0.18 percent and 0.3 percent for both the Late Pithouse and Classic periods.

Population Variability: Environmental Zones

Blake et al. (1986) also separated population estimates by environmental zones, including northern (upper), central (middle), and southern (lower) valley as well as valley floor, first terrace, wide/ narrow bottom side drainage, mountain park/slope, flat/mesa top, and rolling desert. In the middle valley, during the late Late Pithouse period, there was a resettlement from above the first river terrace to the valley bottom, while the upper valley floor and terrace continued to experience population increases, especially in the

valley bottom. The greatest population increase during the Late Pithouse period occurred in the lower valley bottom.

By the end of the Late Pithouse period, the majority of people, approximately 1080, lived in the large communities of the valley bottom. Large pit structure villages had grown from 25 to 49 consisting of 20 to 124 structures each with an average of 80 people per community reflecting a three-fold increase of villages and people during the period.

The Classic period population increased by nearly twice in the upper valley bottom, but decreased by almost two-thirds in the lower valley floor; while the middle-valley bottom population decreased only slightly (Blake et al. 1986). During this time in the wide-bottom side-drainages, a dramatic increase in population occurred from approximately 1400 people just after the beginning of the Classic period to nearly 2500 people during the period (Blake et al. 1986). Blake et al. (1986) point out that by the end of the Classic period the side-drainage inhabitants were nearly equal to the entire Late Pithouse population. Narrow drainages, uplands, and mesa tops were more heavily occupied than in any previous time.

Population estimates and growth rates clearly show that there were many more people during the Classic period than ever before who were dependent upon the domesticated and wild resources of the valley and its surrounding uplands. Settlement pattern changes in which more areas near secondary, dry-farming, such as side drainages, were used in addition to the large aggregated villages of the bottom support the dramatic increase of population during this time. Conservative estimates of absolute populations

numbers based on 75-year structure use-life indicate a population of approximately 3330 for the Classic period (Blake et al. 1986, Figure 5 and Table 12).

LeBlanc (1983) suggested that about 12 large villages existed in the Mimbres Valley during Classic times and that between 50 to 200 people lived at each of them, indicating a median population of 1500 for the aggregated towns in the valley. Blake et al. (1986) suggest there were probably 1745 people living in 11 villages, a slightly larger number than LeBlanc's estimate. As noted, Blake et al. (1986) also estimated at least an additional 1000 people lived in side-drainages and marginal areas, such as narrow drainages, uplands, and mesa tops. These areas along with the large aggregated villages in the valley all indicate that a large population was farming every available piece of arable land, including those that could be irrigated and those that received rain-fall moisture only.

It should be noted that some current research centered on large Classic villages in the valley present data that question these population estimates. Research at the NAN Ranch site supports similar population sizes as Blake et al. (1986) and Anyon and LeBlanc (1984), but Shafer (personal communication, 1998) suggests that data from architecture, features, burials, and ceramics at NAN may indicate a lack of constant, year-round occupation, thus confounding accurate regional population estimates And, Gilman (n.d.), currently investigating room block occupations at Mattocks notes that perhaps only one family at any given time lived in each block. Shafer's and Gilman's researches may introduce factors of multiple and sequential residency which could alter currently accepted population estimates, but at this time such possibilities are inconclusive and/or

have not been published as have previous estimates by Anyon and LeBlanc (1984), Blake et al. (1986), and LeBlanc (1983).

Summary and Preliminary Inferences

Summary

Environment. The Mimbres people lived in a river valley and surrounding uplands that had a physical environment similar to that of today. Semi-arid desert conditions prevailed and consisted, in part, of violent, random summer rains and slow, gentle winter rains. Precipitation today ranges from about 23 cm per year in the southern extremities to approximately 43 cm or 44 cm in the north (Gabin and Lesperance 1977; Minnis 1985). More moisture falls in the summer, but run-off is greater than in the winter (Minnis 1985; Parham et al. 1983). Elevational changes from approximately 1200 m to 1700 m in the valley to as high as 2400 feet in the northern uplands account for the difference in frost-free days: 150 to 220 days in the valley and 100 frost-free days in the uplands. The valley is underlain by volcanic formations which contribute to the soil fertility as well as to the complexity of ground water flow. Uplands consist of rugged, rocky low mountains with shallow soils. Unpredictability of rainfall, low levels of annual precipitation, limitations imposed by valley margins, frost-free days, and shallow soils of the uplands all contribute to a physical environment that is marginal for crop success. Weather conditions, topographic, and geologic conditions undoubtedly played a central role in shaping the agriculturally-based Mimbres society.

Farming strategies. Farming strategies aimed at mitigating the vagaries and deficits of the physical environment were one avenue employed by the Mimbres to help

insure their well-being. In the fertile valley bottom, irrigation was likely used and every hectare of land that was available and productive was probably farmed by Classic times. There are thousands of terraces, and as well, irrigation ditches, diversion dikes, and check and spreader dams in the uplands. Placement of terraces attests to a system aimed at utilizing optimal ranges within the various elevations, slopes, and soil types in order to take advantage of random and specific environmental conditions. The Mimbres people may have used other less obvious strategies to increase crop success levels, such as micro-crop rotation, soil nutrient replacement by burning, composting/fertilization, fallow years, pest and weed control, pot irrigation, mulching, selection for short-maturation maize varieties, and interplating of crops with nitrogen fixing plants.

Dietary sufficiency. Minnis (1985) estimated that the valley and adjacent upland agriculture could provide 50 percent of the Classic Mimbres diet given average environmental conditions and irrigation. Adequate wild plant and animal resources were locally available in sufficient amounts to provide the remaining 50 percent. However, wild resources also were dependent on beneficial environmental conditions, and like domesticated foods, would be negatively impacted by low precipitation, extreme heat, unseasonable frosts, plant or animal diseases, and/or pest infestations. Farming strategies may have increased the resource amounts somewhat above Minnis' estimates; nevertheless, the Mimbres economic base was tenuous at best.

Population. Anyon and LeBlanc (1984) and Blake et al. (1986) estimated the Mimbres Valley and associated upland populations and growth rates based on average room sizes and uses, burials, areal surveys, various use-life spans for architecture, and

area per person. Anyon and LeBlanc (1984) calculated that the overall population during the Late Pithouse period was about 550 people and that there were around 3300 people during the Classic period. Blake et al. (1986) looked at populations within various environmental zones and estimated that in the late Late Pithouse period the upper valley floor and the first terrace experienced population increase, but that the greatest population increase occurred in the lower valley bottom. The greatest settlement shift was in the middle valley where the population moved from the first terrace to the valley bottom. As many as 50 new villages with 10 to 124 structures each may have been established in the Late Pithouse period with approximately 1080 people living in the large communities scattered throughout the valley bottom (Blake et al. 1986). The overall Mimbres population including large villages, scattered hamlets in the valley, and upland settlements was approximately 1400 people by the end of the Late Pithouse period.

During the Classic period, the population nearly doubled in the upper valley bottom while decreasing by about two-thirds in the lower valley floor. Mid-valley populations changed little during this time. The Classic period population living in wide-bottom, side-drainages in the valley was approximately 2500 people, while the entire Mimbres population was near 3300 with over one-half of these dwelling at 11 or 12 large sites (Blake et al. 1986; LeBlanc 1983).

Preliminary Inferences

Evidence indicates that the inhabitants of the Mimbres Valley and surrounding uplands used a number of techniques to increase the constancy and success of their economic base, and that farming and residential patterns formed complimentary strategies. Water

and soil conservation and diversion systems most likely were in place both in the valley and the uplands. These systems as well as the associated crops necessarily involved maintenance. Irrigation ditches and dikes had to be dug and repaired; water diversion along the ditches was probably modified according to a use and plot schedule. Terraces had to be built and maintained as rocks in the terrace walls washed out of place, and soil fill became too deep or was flooded out. Control of weed and insect infestations demanded attention. All of these activities could be more efficiently executed by close residential settlement and, as population grew, by group cooperation.

Demographic research demonstrates that preferred settlement zones changed and aggregated villages increased during the Late Pithouse and Classic periods. During the relatively favorable environmental time experienced during the Late Pithouse period, large numbers of people moved into the valley, especially the portion between the northern and southern extremes, to take advantage of the fertile farm land and mild, moist weather. Just before the beginning of the Classic period and at several intervals during the period, sequential years of below average rainfall were experienced. During that time, Blake et al. (1986) note a population shift from the drier, lower valley to the upper valley where over one-half of the population resided in large villages and the rest occupied adjacent side-drainages. Precipitation patterns found in the dendrochronological record, farming practices, and demographic estimates all correlate to indicate a group locational pattern determined by economics. Perceived and/or real risks to life-sustaining resources, whether short or long term, surely affected settlement patterns and durations, the agricultural system, and likely other social aspects of the

Mimbres people.

CHAPTER V

COMPOSITIONAL ANALYSIS OF THE MIMBRES BLACK-ON-WHITE CERAMICS

This chapter discusses methodologies that can be used to obtain data from the compositional materials of ceramic vessels as well as the approach used in the study and presents the raw and integrated compositional data along with some preliminary inferences. The methodological approach used in this research, instrumental neutron activation analysis, is presented in greater detail than alternative techniques. This is followed by a section on sample selection, including size, style and temporality, sherds versus whole vessels, and spatial aspects of selection are given. Raw data from the analysis along with statistical procedures used to interpret these data are detailed, after which data synthesis showing presence and direction of exchange as revealed by the compositional data is given along with some preliminary conclusions.

Methodological Approaches to Compositional Analyses

There are two categorically different approaches for identifying similarities and differences in the materials from which ceramics are made. One of these identifies minerals that are included in the ceramic paste. This usually focus on minerals in the tempering additives because they are more easily differentiated, more likely to be

geologically specific, and can often be tied to specific geographic localities than the mineral inclusions in the clay (Miksa and Heidke 1995; Rice 1987; Wiley and Miksa 1994). The other compositional analytic approach, the one used in this study, focuses on the chemical composition of the clay. A number of chemicals are identified, and similarities or differences of the minerals in each clay sample are then used to group like samples from which production loci for the groups are inferred.

Chemical and mineral analyses both may substantiate the use of iconographic style as indicative of interaction levels by documenting vessel exchange (Hagstrum 1995; Mills and Crown 1995; Shepard 1957). The profiles from either chemical or mineral analyses point to clay and/or temper collection locales by identifying vessels with like clays or tempers. Previous studies have shown that the largest percentage of vessels in a sample recovered from a given village that have similar paste profiles will be made from local materials (Arnold 1985; Miksa and Heidke 1995; Neff 1993). In support of this, ethnographic studies document that potters rarely travel more than one to three kilometers from their village to gather their construction materials (Arnold 1985; Miksa and Heidke 1995; Neff 1993). In many cases, non-local samples may be tied to mineral or chemical profiles associated with other villages, thus indicating where the non-local samples were manufactured.

Mineralogic Analyses

Petrographic analysis. Mineral differentiation is important because a large percentage of minerals is often introduced into the clay when temper is added. One type of analysis which identifies minerals in ceramic tempers is called petrography (Wiley and

Miksa 1994). This methodology microscopically types and describes rocks, and thus a portion of all ceramic petrographic studies includes analysis of the tempering agent. Lithological samples from sources near the study areas, usually within a three kilometer radius, are collected according petrographic laboratory guidelines and sent to that laboratory where they are examined. The sample is thin-sectioned for a binocular point-count analysis often using the Gazzi-Dickinson technique that estimates lithological percentages and matches tempering source types to inclusions in the samples' pastes (Stark and Heidke 1992). Data from the point-count analysis may be used to refine and/or confirm profiles of chemical groups from another analysis on the same sample. The results of the petrographic analysis may allow analytic clusters to be tied to the landscape as well as providing statistics for predicting degree of confidence of cluster assignments for the remaining sample when only a percentage was thin-sectioned.

Other mineralogic analyses. In addition to petrography, several types of analyses can be used for identifying minerals in clay such as x-ray diffraction, thermal analysis, and heavy mineral analysis (Rice 1987). X-ray diffraction is based on the recognition of characteristic wave links emitted by electrons bombarding target minerals in the clay. Because prehistoric pottery is made from very complex, non-homogeneous clay and temper, it has large numbers of minerals, and the use of x-ray diffraction can result in a confusing array of wave length peaks almost impossible to read. Thermal analysis focuses on minerals in the clay, rather than in the temper, and the fact that various minerals react differently, but consistently, when heated. This method is difficult to use because prehistoric ceramics contain so many minerals that contrasting reactions may

occur, thus obscuring individual minerals by blurring several together (Mills personal communication, 1994). Heavy mineral analysis is appropriate for dark-fired clays and coarse-grained pastes (Rice 1987). The Mimbres black-on-white ceramics which are used in this study are light grey and fine-grained, indicating that no heavy minerals are present.

Chemical Analyses

Since the early 1960s, chemical analyses have increased mainly because technological advances have occurred which allow for better accuracy, quicker results, and lower costs (Shepard 1957). Like mineralogic analyses, chemical analyses vary in foci, costs, "... sensitivity, precision, and accuracy" (Rice 1987:390). Prior to the 1960s, chemical analyses mainly employed wet methods, or techniques, which relied on the reactions of chemicals in solutions to various reagents (Rice 1987). Although, wet techniques are inexpensive, they require large samples which are often impossible to obtain in archaeological studies, and as well the methods are usually destructive to ceramics. Wet chemistry analyses take relatively large amounts of time to perform, and they are not sensitive to trace minerals (Rice 1987). Frequently, trace and ultra-trace minerals may be the defining difference between samples because major and minor types (equal to or greater than 2.0 percent and 0.1 to 2.0 percent, respectively) may cross-cut samples within a region where differences in the local lithography are subtle (Sinopoli 1991).

Techniques in the latter half of the twentieth century rely on energy rather than solution to quantify chemicals (Bishop and Neff 1989; James 1996; Neff 1993; Rice 1987; Sinopoli 1991). Most of the various methods employing this analytic principle are

based on emission spectrometry (Neff 1993; Rice 1987). Methods such as X-ray fluorescence, electron microprobe, optical emission spectroscopy, and instrumental neutron activation use electrons, neutrons, or X-rays to bombard chemical elements contained within the ceramic paste. This produces a unique, measurable wavelength for each type of chemical element (Bishop and Neff 1989; Mills personal communication, 1994; Neff 1993).

X-ray fluorescence. X-ray fluorescence bombards a sherd with rays which displace electrons from the innermost part of the atom, and as electrons move from outer orbits to fill inner vacancies, measurable energy is released. Wavelengths plotted on a graph produce chemically-specific signatures. The number of peaks emitted by each wavelength per specific chemical element indicates quantity of element present in relation to other elements in the sample. The quantitative measure, however, is affected by sample morphology, especially thickness, because the X-rays can only penetrate 20-200 microns below the surface. In essence, this method produces an analysis of the sample's surface only. In order to avert this problem in X-ray fluorescence, the sample must be ground into a powder. Destructive analysis is not an option for many archaeological studies.

Electron microprobe. Electron microscopy methodologies, including the microprobe technique, can be used to characterize the chemical content of the sample, as well as allowing visual examination of the sample's elemental structure. In the electron microprobe technique, a scanning electron microscope mechanism beams electrons onto the sample's surface from which fluorescence X-rays are emitted. Like the X-ray

fluorescence method, wavelengths unique to each chemical are produced, and quantitative calculations for each chemical can be made from the concentration of elements in the sample. Also, like X-ray fluorescence, electron microprobe beams penetrate only slightly below the surface of the sample. Further, if the sample is not thin enough (2.0 to 10.0 microns) for the beams to penetrate, sample shape likely will distort the quantitative data. The electron microprobe, however, can be manipulated to analyze transects of the sample allowing a visual distribution of the chemical elements in the paste to be created. The data can be further refined by excluding transects that do not include chemical elements of the temper. This aspect of the electron microprobe method is especially useful for sourcing clays while controlling for skewness from tempering agents.

Optical emission spectroscopy. Like the other methods described above, outer orbits of electrons are excited, although not displaced, by heating the sample. Subsequent to heating, as the excited electrons return to their former state, they release energy which is visible and emits element-specific wavelengths that are diffracted onto a photographic plate. Intensity for measuring element concentration is mechanically determined from the density of black lines recorded on the photo plate. This method is destructive, although the sample size required for analysis is relatively small, 5.0 to 100.0 milligrams of crushed material. The accuracy of optical emission spectroscopy is ten percent or less. It can measure major, minor, and trace elements, but the spectral data produced can be difficult to separate if many different chemical elements are present.

Instrumental neutron activation analysis. Instrumental neutron activation analysis was developed in the 1930s, but it was not used for analysis of archaeological material until nearly 1960 (Rice 1987). Even today, there are only a limited number of research centers for this type of analysis because the technique requires a nuclear reactor particle accelerator or radio isotopic neutron emitter (Glascock et al. 1996; Rice 1987). Instrumental neutron activation analysis is extremely accurate in detecting multiple elements and in determining concentrations at a very precise, fine-grained level. Some element concentrations as low as or lower than the nanogram level can be discerned and measured with this technique (James 1998).

The use of instrumental neutron activation analysis for ceramics involves grinding a small amount of material (about 2 cm^2) from which both the exterior and interior surfaces usually have been removed. Surface removal prevents contamination from glazes, paints, natural weather and soil depositions, or human use such as food residues or skin oils (Glascock et al. 1996). Two categories of samples, those of known standards as well as unknown elemental content, are submitted to irradiation (Glascock et al. 1996; James 1998; Rice 1987). The ground ceramic material is placed in a vial inside of the reactor and then irradiated with rays that excite nuclei in the atomic particles composing the ceramic material (Rice 1987). In the case of instrumental neutron activation analysis, thermal neutrons bombard the material (Glascock et al. 1996; James 1998; Rice 1987). After a period of decay, the gamma ray emissions are measured using "a high resolution germanium semiconductor detector" (Glascock et al. 1996; James 1998:1). Measurement can also be done with a scintillator detector, but the semiconductor yields

higher resolution (Rice 1987).

The sample is often analyzed several times during the decay period in order to detect the wave lengths for as many elements as possible (Rice 1987). Elemental half-life emissions determine when the gamma ray spectra will be expressed after irradiation (James 1998; Rice 1987). The process described above uses a delayed analytic technique to measure the element-specific gamma rays as opposed to the less used prompt analysis which measures the gamma ray spectra during irradiation (Glascock et al. 1996). Fluctuation between elements is finer grained because the delay allows the half-life of even the shortest lived radio nuclide to be measured (Glascock et al. 1996).

The instrumental neutron activation process of measuring the various elemental wave lengths with a semiconductor detector and subsequent multi-channel computerized analysis of data over an extended time period allows the use of an instrumental procedure rather than requiring the more costly method of chemical separation. A large number of elements can be analyzed and recorded at the same time. Instrumental neutron activation analysis using the semiconductor and associated data base is efficient both in terms of time and money (Glascock et al. 1996).

Principal-component analysis using chemical elements determined through instrumental neutron activation provides cluster groups reflecting greater and lesser nearness to clay source areas for each sample. Arnold, Neff, and Bishop (1991:70-87) and others (i.e., James et al. 1995; Neff and Bishop 1988) have shown that such a "hierarchical approach," or degree of match in chemical elements, indicates that ceramic samples falling within a proscribed set of "likeness" will be made from material available

within a specific region. Instrumental neutron activation analysis requires small samples (about 2 cm^2, or 200 mg of powder) with relatively little sample preparation time before irradiation (Glascock et al. 1996; Rice 1987).

The method can detect as many as 75 chemical elements, although for ceramics normally about 30 to 33 (Glascock et al. 1996; James 1996; Rice 1987) chemical elements are measured. Instrumental neutron activation analysis is very sensitive to the elemental content of the clay, even in ultra-trace amounts and accurate in determining quantitative element content to "between plus or minus 1 to 10 percent of the reported value" (Glascock et al. 1996:10; Rice 1987). As opposed to many other methods, instrumental neutron activation analyzes the entire sample depth because it can penetrate below the surface of the prepared sample (Rice 1987). Additionally, instrumental neutron activation analysis was chosen for this study because the results will be comparable with sourcing studies of Mimbres ceramics done by Brewington (1992), James (1995 et al.), and Gilman et al. (1994), thus increasing this data base for the Mimbres region.

Compositional Analytic Methodology

Chemical Analysis

As mentioned above instrumental neutron activation analysis was chosen because of its accuracy, element identification and quantification capabilities including ultra-trace elements, analytic ability to include the entire sample depth, and comparability between standards, sample unknowns, and other studies. The instrumental neutron activation research facility chosen for this study is the Texas A&M Center for Chemical Characterization and Analysis. Four reasons account for its selection over other research

institutions. First, least two other instrumental neutron activation analyses of Mimbres black-on-white ceramics have been done at the Center (i.e., James et al. 1995; Shafer and Brewington 1995). These samples have, therefore, been tested for the same array of elements as the samples in this study. This means the samples from each of these studies can easily and confidently be combined and/or compared. Second, Mimbres ceramic scholars have set forth a goal of creating an instrumental neutron activation analytic data base at Texas A&M. Third, Dr. Harry Shafer of the Texas A&M Department of Anthropology is a major authority on Mimbres black-on-white ceramics. Fourth, Dr. Dennis James who conducted the instrumental neutron activation analysis for this study has worked closely with several Mimbres scholars on other ceramic projects and thus has an informed understanding of the data requirements and research foci of Mimbres researchers.

At the Texas A&M Center for Chemical Characterization and Analysis, a delayed technique decay period and instrumental measurement of the gramma rays is done post irradiation using a high resolution germanium semiconductor detector. The Center's semiconductors are EG&G Ortec detectors which have "non-instrumental neutron activational full width at half maximum (... a routine measurement for peak resolution) of 1.65 to 1.70 keV for the 1332 keV line of cobalt -60" (James 1998:1). Electronic modules (EG&G Ortec modular electronics) define the detector pulses after which the signals are converted to digital data based on a Canberra Alpha VAX Genie system (James 1998). The data are saved in a multi-channel analyzer. Analysis of the gamma ray spectra and subsequent calculations also use Canberra software.

At Texas A&M, a gamma spectroscopy system is located at the Center for Chemical Characterization and Analysis so that upon completion of irradiation the samples can be transferred to the counting laboratory within seconds (James 1998). This brief transfer period is significant for elements with extremely short decay times. After counting, the gamma ray wavelength data are entered into a software database via a Genie PC, a version of the Canberra software adapted for personal computer capabilities. Later, the data are sent back to the Center's Alpha system.

The Center also has gamma spectroscopy systems located elsewhere on campus not in conjunction with counting laboratories. These systems are fully automated and have the capacity to count pulses emitted by the irradiated sherd powders at designated intervals for extended time periods, usually over a 24-hour period (James 1998). The procedure uses a Toshiba M-40 programmable logic controller. The automated system measures medium and extended half-life elements.

After irradiation and initial measurements, the stored data are transferred to a Foxprow format preparatory to entering it into multi-variate clustering programs. NADIST and AGCLUS software programs yield intensity dissimilarity dendrograms of the various chemical elements. Subsequent to this manipulation, principal component analysis is preformed and the resulting scores are used to determine probabilities of samples' cluster, or group, membership. Degree of probability for each sample then is visually illustrated in a bivariate plot where spatial closeness or distance between samples can be seen.

Sites

The sherd sample for compositional analysis consisted of five sites, Galaz, NAN Ranch, Old Town, Cameron Creek, and Saige-McFarland, representing the upper, middle and lower Mimbres Valley, and one close and one far outlier. Thirty-one sherds were submitted for instrumental neutron activation analysis from Galaz, 32 from NAN Ranch, 30 from Old Town, 29 from Cameron Creek, and 30 from Saige-McFarland.

The village of Galaz (LA635) which was established sometime after the end of the Early Pithouse period is in the upper portion of the arable part of the Mimbres Valley. It is situated on a first terrace on the west side of the Mimbres River at approximately 5700 feet in elevation (amsl). The site covers 34,375 m^2 (275 m N-S and 125 m W-E). In the summer of 1927, the Southwest Museum excavated "a number of Classic Mimbres rooms" and four pithouses (Anyon and LeBlanc 1984:10). In their three seasons of field work, Jenks and his crew from the University of Minnesota uncovered an astonishing number of structures, 138, including Great Kivas. Nearly all of these were from the Classic period, although some were Postclassic. Equally impressive was the Mimbres Foundation's work at Galaz. In a little over four months, they examined previously dug bulldozer cuts and 18 new backhoe trenches, as well as excavated all or portions of 11 pithouses, a part of a Classic surface room, and one communal structure (Anyon and LeBlanc 1984).

The NAN Ranch ruin (LA15049) is on a first terrace 50 m east of the Mimbres river in the middle Mimbres Valley, and about 17 km south-southeast of Galaz and 15 km north of Old Town (Shafer 1983). The village's initial settlement was near the beginning

of the Late Pithouse period, approximately A.D. 550-600 and continued throughout the Late Pithouse and Classic periods (Shafer 1991c; Shafer et al. 1979; Shafer and Taylor 1986). A Postclassic Black Mountain phase occupation occurs about 100 m from the Classic component.

Shafer (1991d) notes that Bandelier visited the NAN site and made a sketch map in the late nineteenth century (winter of 1882-1883). Subsequently, the NAN Ranch ruin was briefly explored by the Cosgroves in 1926 (Cosgrove and Cosgrove 1932; Shafer 1980, 1982, 1981b; Shafer et al. 1979). From the mid-1950s until nearly 1980, a great deal of destructive excavation was done by relic hunters (Shafer 1980, 1991b; Shafer et al. 1979). In 1978 Texas A&M University began excavating at the Y-Bar NAN ranch. They spent the next twelve years from 1976 to 1989, ten summer seasons, plus one additional season later in 1996, in excavation, testing, survey, and reconnaissance (Shafer 1990; Shafer and Drollinger 1998; Shafer and Judkins 1997). The outcome of this work has revealed a large percentage of two room blocks, identified two other architectural room clusters, uncovered extramural work areas, middens, peripherally associated sites (including one small Postclassic site), possible agricultural fields, an irrigation system, and a likely reservoir along with many associated features and artifacts (Creel 1991; Shafer and Drollinger 1998). The long term excavations at NAN have provided many details and specifics of construction sequences, room-use, and extramural areas that have changed or elaborated previously held ideas regarding Mimbres material culture.

The Old Town site is on the lower Mimbres River about 15 km south of the NAN

Ranch ruin. The main occupational area is east of the river on a bluff which falls sharply to the flood plain. At the base of the bluff is a large midden associated with the ridge-top occupation (Creel 1989b, 1993). Architecture on the top indicates three major construction areas: 1) a northeastern group consisting mainly of Late Pithouse period structures; 2) a large western area nearer the cliff edge which apparently contains Classic Mimbres structures overlying earlier pit structures, and 3) an area approximately 200 meters south of the Classic structures and also near the western ridge edge which is an extensive Black Mountain phase cluster of rooms overlying Late Pithouse construction in parts (Creel 1993, 1997a, 1997b). Surface features and limited excavations indicate that the southern Black Mountain clusters may exceed 100 total rooms covering perhaps 100 m N-S and 30 m E-W (Creel 1993, 1997b). Extent of these buildings and occupational continuity with the Classic period are not precisely known at this time, although people likely were living here by A.D. 600 and continued to until about A.D. 1300.

The Cameron Creek Village is west of the Mimbres Valley about 30 km directly west from both NAN and Old Town and 23 km west-southwest of Galaz. It lies on a ridge toe 38 m above the Cameron Creek valley. Excavation of the site was directed by Wesley Bradfield and covered five field seasons for a total of 22 weeks. The site, which covered about 11,000 m^2 (65 m E-W x 169 m N-S), was comprised of apparently four surface room clusters which were partially underlain by previously occupied pit structures of both the Early and Late Pithouse periods. Bradfield uncovered a total of 138 rooms.

Saige-McFarland is a large multi-component site temporally spanning the late Late Pithouse through the Postclassic periods, and possibly totalled 150 rooms which

were used sequentially over approximately 250 years. Saige-McFarland is in the Upper Gila valley about 80 km west-northwest of the NAN and Old Town sites, 68 km west of Galaz, and 50 km west-northwest of Cameron Creek. It is on an alluvial terrace 27 m above the Gila River. Occupation included a medium-sized pithouse village (about 25 structures) which were subsequently partially covered by four masonry room clusters.

Ceramic Sample

One hundred and fifty-two sherds underwent irradiation and instrumental analysis at the Texas A&M Center for Chemical Characterization and Analysis. Sherds were selected because testing of whole vessels and/or removal of a portion for analysis would be partially or wholly destructive to the vessel. The sherds were obtained from various institutions who graciously allowed long-term loan and partial destruction agreements. The Galaz sherds were selected from the ceramic assemblage collected by the University of Minnesota during their 1929, 1930, and 1931 excavations which are housed at the University of Minnesota Frederick R. Weisman Museum in Minneapolis, Minnesota. Sherds in the compositional sample that represent Cameron Creek and Saige-McFarland were loaned by the University of New Mexico Laboratory of Anthropology in Santa Fe, New Mexico. The owner of the NAN Ranch collection, M. Hinton, kindly gave permission for destructive testing of sherds. A trip was made to Texas A&M University where the NAN ceramics are temporarily housed to select this portion of the compositional analytic sample. Finally, the sherd sample from Old Town was chosen by D. Creel at the University of Texas, Austin, Texas Archaeological Research Center, where the Bureau of Land Management owned Old Town collection is currently housed.

Two sherds from Old Town were obtained from the University of Arkansas at Fayetteville, but only one was large enough to be used for instrumental neutron activation analysis.

Temporal Variability

Sherd selection from the ceramic assemblages at each of the study sites was guided by the research problem, and thus an attempt was made to represent micro time periods equally. Because there were many sherds available from excavation collections, the instrumental neutron activation analytic sample was much more evenly divided among the villages and time periods than the design sample (see Chapter VI). However, the sherds for instrumental neutron activation analysis were chosen before the design data revealed that Styles I, Early II, and Late II did not occur in high enough numbers to be included in the study. Fifty-nine of the instrumental neutron activation sherds were typed as pre-II/III-Early III. Eleven samples (six of which were also pre-II/III-Early III styles) were not assigned to any of the chemical clusters after analysis. The resulting sample totaled 88 sherds which could be assigned to clusters covering the II/III through Late III time frame.

Iconography

When iconographic designs were available and could be temporally identified, they were selected over geometric designs for the instrumental neutron activation analytic sample. Of the 152 samples analyzed by instrumental neutron activation, 54 sherds displayed iconographic designs and another nine were categorized as indeterminate because the design portion on the sherd may have been part of an icon, although not necessarily. Six of the 54 sherds with iconography were unassignable to chemical clusters after analysis,

and five were seriated as pre-II/III-Early III (one of which was also unassigned). Of the 44 remaining iconographic sherds, 17 were from Cameron Creek, 14 were from NAN Ranch, eight were from Galaz, four were from Old Town, and one was from Saige-McFarland. Because such a small area of the iconography was represented on a sherd, it was not possible to place them into iconographic motif categories.

The iconographic sherds comprise 50 percent of the instrumental neutron activation analytic sample (n=88) after pre-II/III-Early III styles and those unassignable to clusters were deleted. It is possible that seven other sherds which are temporally relevant to this study are iconographic. If they are, then the icons represent 59 percent of the sample. Thus, iconographic designs comprise a large portion of the neutron activation analytic sample and reinforce the compositional data's representativeness of iconographic patterns.

Compositional Data

Calculations

The 152 sherds were analyzed through instrumental neutron activation for 31 chemical elements. (For a list of the elements, see Appendix A.) The data from this analysis were entered into a computerized multivariate clustering program from which a dendrogram based on element dissimilarity was generated (Appendix A). A plot of the factor scores for each identified element was produced so that degree of variance could be visually demonstrated (Figure 8) From this, the elements with the greatest degrees of dissimilarity, and therefore greatest importance in establishing clusters with like chemicals was determined.

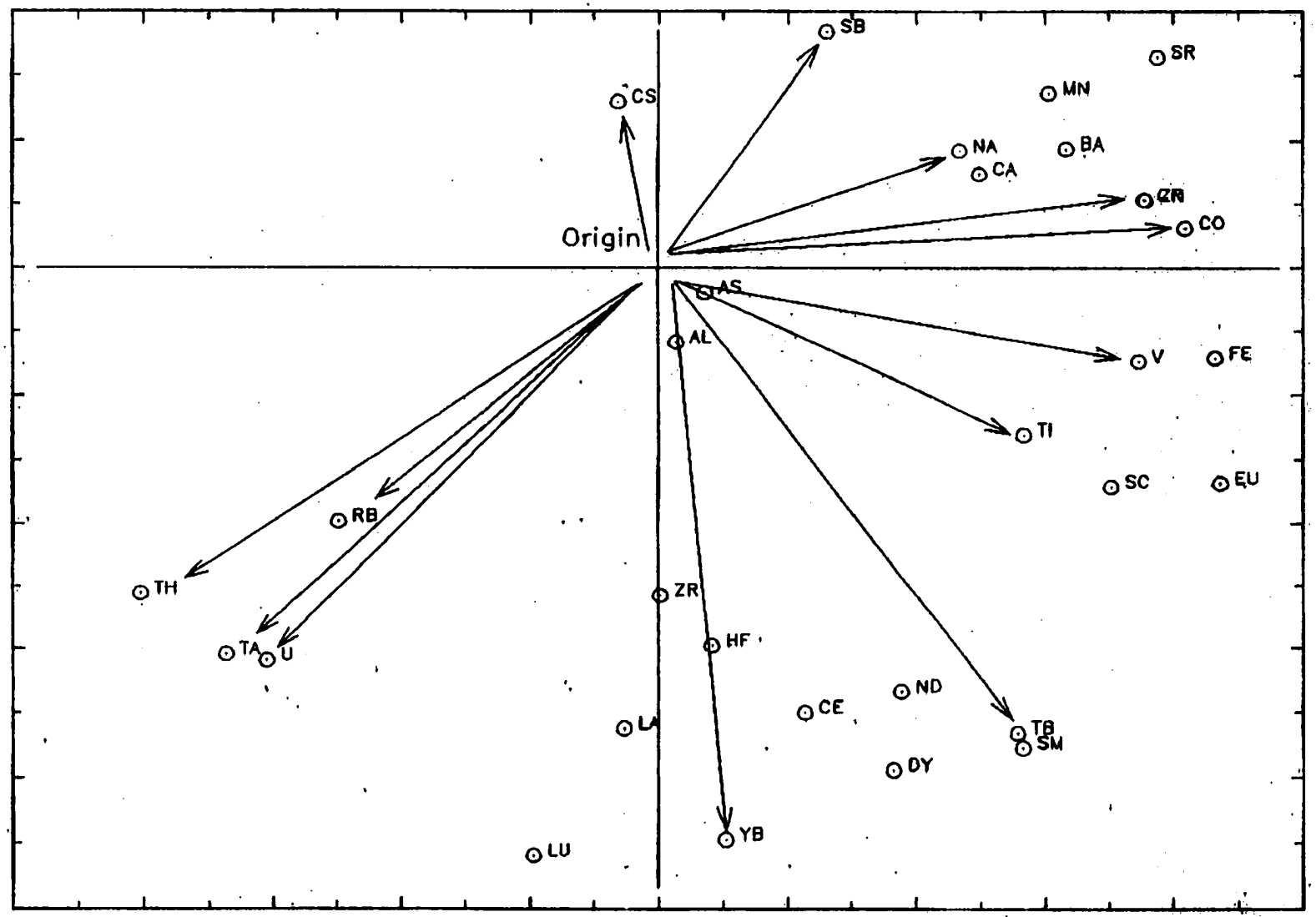


Figure 8. Plot of Mimbres black-on-white chemical compositio analysis showing trace chemical dissimilarities.

Five initial groups, or clusterings, of the samples were determined from the dendrogram. Subsequently, these hierarchical rankings of dissimilarity were converted into a computer program that allowed principal component analysis to be performed on the log transforms. Scores from this manipulation were evaluated for their probability of inclusion in the initial group assignments. A bivariate plot (Figure 9) was generated of the clusterings and their membership probabilities, which provided a display of the groupings, group overlaps, core and peripheral samples for each group, and non-group members (Figure 9). Calculations for assigning the clusters to production sites were based on the dendrogram data because a significant number of samples in three of the clusters (Clusters 1 and 2, and several in Cluster 4) could not be effectively separated into distinct clusters using the principal component generated bivariate plot.

Chemical Cluster Assignment

Each sample was identified by the site from which it was collected, after which all samples were grouped according to instrumentally determined clusters and provenience identifications. From this, the number of samples identified for each of the study sites in each cluster was counted. The percentage of each site's cluster membership was figured according to the number of samples per site and total samples per cluster. In each cluster, the largest percentage of samples from a specific site was assumed to be the site where those sherds were produced. From this manipulation, a production site was assigned to each cluster. Samples of lower percentages in a cluster were considered imports.

Temporal Assignment of the Compositional Sample

In order to address the research question in which changes over time as well as space are

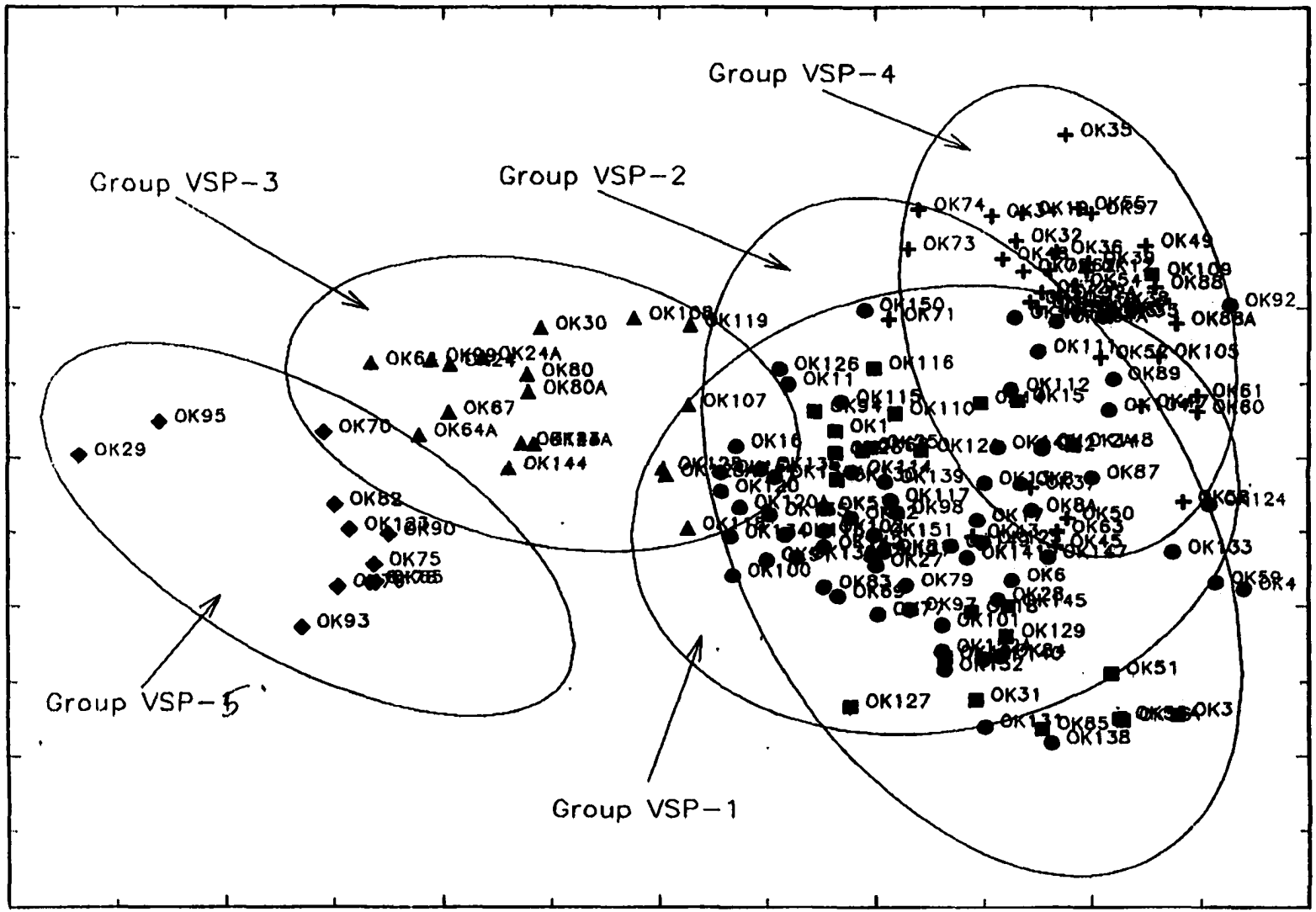


Figure 9. Bivariate plot showing clustering of the sherds.

important, the clusters were also divided into time frames according to the microseriation sequence of Styles I, Early II, Late II, II/III, Early III, Middle III, and Late III. Styles II/III and Early III were combined (see discussion in Chapter VI). As mentioned above, Styles I, Early II, and Late II were not included in the temporal cluster categories for calculating percentages and directions of exchange. These early styles were, however, included in overall cluster percentages to determine each cluster's likely associated production site. Sample numbers and proveniences within each of the five clusters were converted into three different sets of percentages for each of the three temporal divisions: 1) percentage of sherds from each site based on each production site's total sample; 2) percentage of sherds from each site based on the total temporal sample; and 3) percentage of sherds from each site based on the total temporal, imported sample.

Chemical Cluster and Production Locale Assignments

A total of 140 samples (n=152 of which 12 were unassigned) were considered to determine the production site associated with each cluster. Based on this, 60 samples were assigned to Cluster 1 (Figure 9). Of these, 21 (35 percent) were from Galaz, making it the most likely production and importation center for that group of sherds. Cluster 2 had a total of 22 sherds assigned to it; six (27 percent) were from Old Town. Cluster 2 is assumed to be associated with ceramic production at Old Town, although this determination is the most problematic of the five clusters because there is less than 5 percent difference between the Old Town percentage and those of Galaz and NAN which each represent 23 percent of the cluster's sample. Thirteen samples comprised Cluster 3 of which five (38 percent) were from NAN, making it the most likely center of

production. Cluster 4 had 34 samples of which 24 (71 percent) were from Saige-McFarland. Six (54 percent) of the 11 samples comprising Cluster 5 were from Cameron Creek (Figure 9).

Clusters 3 and 5, assigned to NAN and Cameron Creek, respectively, are the most tightly grouped of the five. In Group 5, only two samples occur far from the central clusterings (Figure 9). In Group 3, again all but two are tightly clustered. There are four samples which are assigned to Cluster 1 based on the dendrogram data, but they also fall into the outer periphery of Cluster 3. Groups 1, 2, and 4 as determined by principal component analysis were less distinct than Groups 3 and 5, but tight enough to infer an associated production site for each.

Temporal Separation within the Clusters

II/III-Early III style sherds. In the II/III-Early III category, 40 samples were assigned to clusters (Table 1). Seventeen (43 percent of 40) of these were retrieved from the Galaz site (Cluster 1). Eight (47 percent) of the Galaz sample (n=17), were from Galaz, five (29 percent) were from NAN, three (18 percent) were from Cameron Creek, one (6 percent) was from Old Town, and there were none from Saige-McFarland. Cluster 1 consisted of nine imported sherds (53 percent of 17) and nine iconographic sherds.

Only five (13 percent) of the total II/III-Early III sample sherds were assigned to the Old Town sample (Cluster 2), all of which were imports. Four (80 percent) were from NAN, and one (20 percent) was from Galaz. Iconographic sherds comprised 40 percent (n=2) of Cluster 2.

Cluster 3, NAN, contained seven (18 percent) of the 40 II/III-Early III sherds. Of the seven, three (43 percent of seven) were from Cameron Creek, and there was one each from Galaz and old Town (14 percent of seven) Five (71 percent) of Cluster 3's samples were imported and four (57 percent) were iconographic.

The Saige-McFarland group, Cluster 4, had eight samples (20 percent of 40) of which seven (88 percent) were from Saige-McFarland, and one (13 percent of 8) was from Cameron Creek. There were no samples with iconographic elements.

Finally, Cluster 5, Cameron Creek, had only three (8 percent of 40) samples for this time period, two (67 percent) of which were iconographic. There was one sherd each from Galaz, NAN, and Cameron Creek.

The II/III-Early III sample of 40 represents 46 percent of the usable INAA (i.e., samples falling within the study period and within one of the five clusters). Twenty-three of the 40 (56 percent) were exchange vessels and 17 (43 percent) had iconographic designs.

Middle III style sherds. There were 38 samples during the Middle III time period, A.D. 1060-1110 (Table 1). Sixteen (42 percent) of these were in Cluster 1, and of these six (38 percent of 16) were from NAN, four (25 percent of 16) were from Cameron Creek, and two (13 percent of 16) were from Galaz. Thirteen (81 percent) of Cluster 1's total were imports, and 13 (81 percent) were iconographic.

In Cluster 2, Old Town, seven samples (18 percent of 38) were identified as Middle III style. Old Town, Saige-McFarland, and Cameron Creek were each represented by two samples (29 percent each of 7), and there was one (14 percent of 7) from NAN.

Table 1. Exchange percentages of sherds in the instrumental neutron activation analysis sample.

origin site	temp total produced at origin site	# exp to cluster	exp % of origin site total	exp % of cluster total	exp % of cluster import total	exp % temp total	exp % all 5 clusters import
II/III-Early III; n=40; import n=23; non-import=17							
Cluster 1, Galaz recovered vessels=17 (43.0% tot temp samp); Galaz prod=8 (20.0% temp samp)							
OT	2	1	50.0	5.9	11.1	2.5	4.3
N	12	5	42.0	29.4	55.5	12.5	21.7
SMc	7	0					
CC	8	3	37.5	16.6	33.3	7.5	13.0
Cluster 2, Old Town recovered vessels=5 (12.5% tot temp sample); Old Town prodnction=0							
G	11	1	9.1	20.0	20.0	2.5	4.3
N	12	4	33.3	80.0	40.0	10.0	17.4
SMc	7	0					
CC	8	0					
Cluster 3, NAN recovered vessels=7 (17.5% tot temp samp); NAN prod=2 (5.0% tot temp samp)							
G	11	1	9.1	14.3	20.0	2.5	4.3
OT	2	1	50.0	14.3	20.0	2.5	
SMc	7	0					
CC	8	3	37.5	42.9	60.0	7.5	13.0
Cluster 4, Saige-McFarland recovered vessels=8 (20.0% tot temp samp) Saige-Mc prod=7 (17.5% tot temp samp)							
CC	8	1	12.5	12.5	100	2.5	4.3

Cluster 5, Cameron Creek recovered vessels=3 (7.5% tot temp samp); Cameron C. prod=1 (2.5% tot temp samp)							
G	11	1	9.1	33.3	50.0	2.5	4.3
OT	2	0					
NAN	12	1	8.3	33.34	50.0	2.5	4.3
SMC	7	0					

Middle III n=38; import n=24; non-import n=14

Cluster 1, Galaz recovered vessels=15 (39.5% tot temp samp); Galaz prod=4 (10.5 tot temp samp)							
OT	7	2	28.6	12.5	16.7	5.3	9.2
N	11	6	54.5	37.5	50.0	15.8	25.0
SMc	5	0					
CC	11	4	36.4	25.0	33.3	10.5	16.7
Cluster 2, Old Town **recovered vessels=7 (18.4% tot temp samp); Old Town prod=2 (5.3% tot temp samp)**							
G	4	0					
N	11	1	9.1	14.3	20.0	2.6	4.2
SMc	5	2	40.0	28.6	40.0	5.3	8.3
CC	11	2	5.26	28.6	40.0	5.3	8.3
Cluster 3, NAN **recovered vessels=4 (10.5 tot temp samp); NAN prod=2 (5.2 tot temp samp)**							
G	4	0					
OT	7	2	2.9	50.0	100	5.3	8.3
SMc	5	0					
CC	11	0					

Cluster 4, Saige-McFarland **recovered vessels=3 (7.9% tot temp samp); Saige-Mc prod=3 (7.9% tot temp samp)**							
G	4	0					
OT	7	0					
N	11	0					
CC	11	0					
Cluster 5, Cameron Creek **recovered vessels=8 (21.1% tot temp samp); CC prod=5 (13.2% tot temp samp)**							
G	4	0					
OT	7	1	14.3	12.5	33.3	2.6	4.2
N	11	2	18.2	25.0	66.7	5.3	8.3
SMc	5	0					
Late III, n=10; export n= 2							
Cluster 1, Galaz **recovered vessels=4 (40.0% tot temp samp); Galaz prod=2 (20.0% tot temp samp)**							
OT	1	1	100	25.0	50.0	2.6	4.2
N	2	1	50.0	25.0	50.0	2.6	4.2
SMc	5	0					
CC	0	0					
Cluster 2, Old Town **recovered vessels=0**							
Cluster 3, NAN **recovered vessels=1 (10.0% tot temp samp); NAN prod=1 (10.0% tot temp samp)**							
Cluster 4, Saige-McFarland **recovered vessels=5 (50.0% tot temp samp); SMc prod=5 (50.0% tot temp samp)**							
Cluster 5, Cameron Creek **recovered vessels=0**							

Of these seven, five were imported sherds, and five (71 percent of 16) were iconographic.

At the NAN production center, Cluster 3, there were only four (11 percent of 38) Middle III samples of which there were two each from Old Town and NAN. Half of Cluster 3's sample of four were iconographic.

The total number from Cluster 4, Saige-McFarland, was three (8 percent of 38). All three were from Saige-McFarland, and none was iconographic.

The last group, Cluster 5, Cameron Creek, consisted of eight sherds (21 percent of 38) of which five (63 percent) were from Cameron Creek, two (25 percent) were from NAN, and one (13 percent) was from Old Town. Seven (88 percent of eight) were iconographic, and three (38 percent of eight) were imports.

During the Middle III time period, the overall sample included 24 imported sherds (63 percent of 38) and 27 (71 percent of 38) iconographic samples. The temporal sample comprised 43 percent of the usable instrumental neutron activation analytic sample of 88. Fifty percent of the exchange and iconographic samples for the Middle III times (61 percent and 71 percent, respectively) suggest that icons were a more important item of exchange and more were produced during this time of environmental degradation than earlier in the II/III-Early III times (56 percent and 43 percent, respectively).

Late III style sherds. Ten samples (11 percent of 88) were assigned to the Late III time frame (Table 1). There were four sherds (40 percent) in Cluster 1, two of which were assigned to the production locus of Galaz, one to NAN, and one to Old Town. There were no Late III samples identified in the Old Town cluster and only one, which

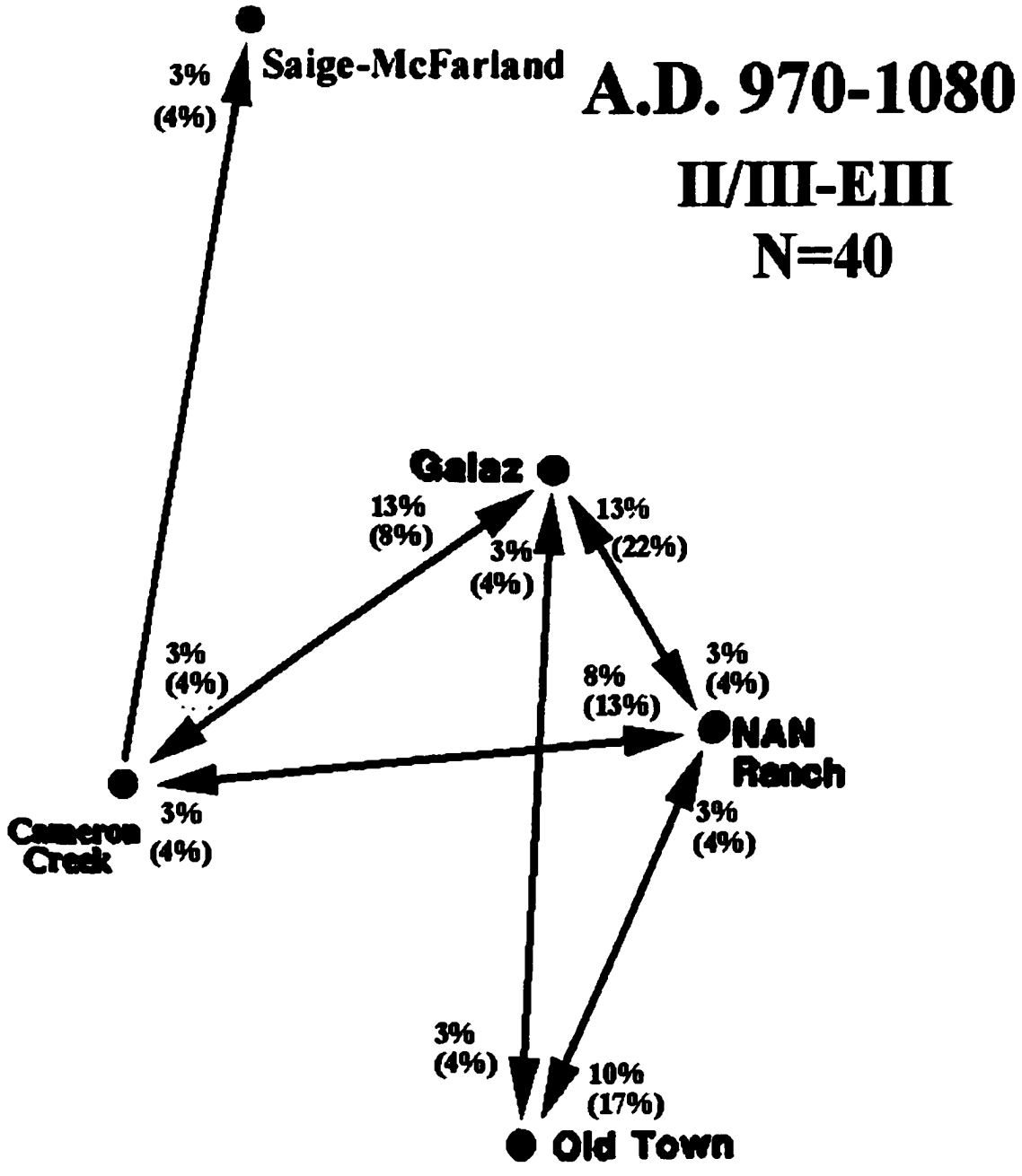
was produced at NAN, in the NAN group, Cluster 3. Five sherds in Cluster 4, Saige-McFarland, were all from Saige-McFarland. Finally, there were no sherds from the Late III sample assigned to the Cameron Creek group, Cluster 5. No iconographic sherds occurred in the Late III period clusters.

Data Synthesis and Preliminary Inferences

If the production loci assignments are correct, and an assumption is made that they are, then non-local sherd numbers and percentages indicate levels and directions of exchange among the villages. Changing directions and varying intensities of exchange are seen when compositional data from the three temporal periods are compared (Figures 10, 11, 12 and 13).

Exchange Patterns for II/III-Early III Ceramics

During the II/III-Early III division, reciprocal exchanges were evidenced among Galaz, NAN, and Cameron Creek, as well as among Galaz, NAN, and Old Town (Figure 10). Based on the total II/III-Early III sample of 40, NAN, Cameron Creek, and Galaz mutually exchanged 38 percent of the vessels, and based on the total number of imported sherds (n=23) in the sample, they traded 64 percent of the exchanged samples. Galaz, NAN Ranch, and Old Town reflected mutual trade that is only slightly weaker than the Galaz-Cameron Creek-NAN group. Exchange among Galaz, NAN, and Old Town represented 35 percent of the entire temporal sample and 55 percent of the import sample. There was only low level importation at Saige-McFarland. A small percent (3 percent) of the total sample reflected the presence of one Cameron Creek sherd at Saige-McFarland, representing 5 percent of the importation sample.



% = Percent of II/III-EIII sample
(%) = Percent of II/III-EIII trade vessels

Figure 10. Exchange percentages and directions during the II/III-EIII time frame

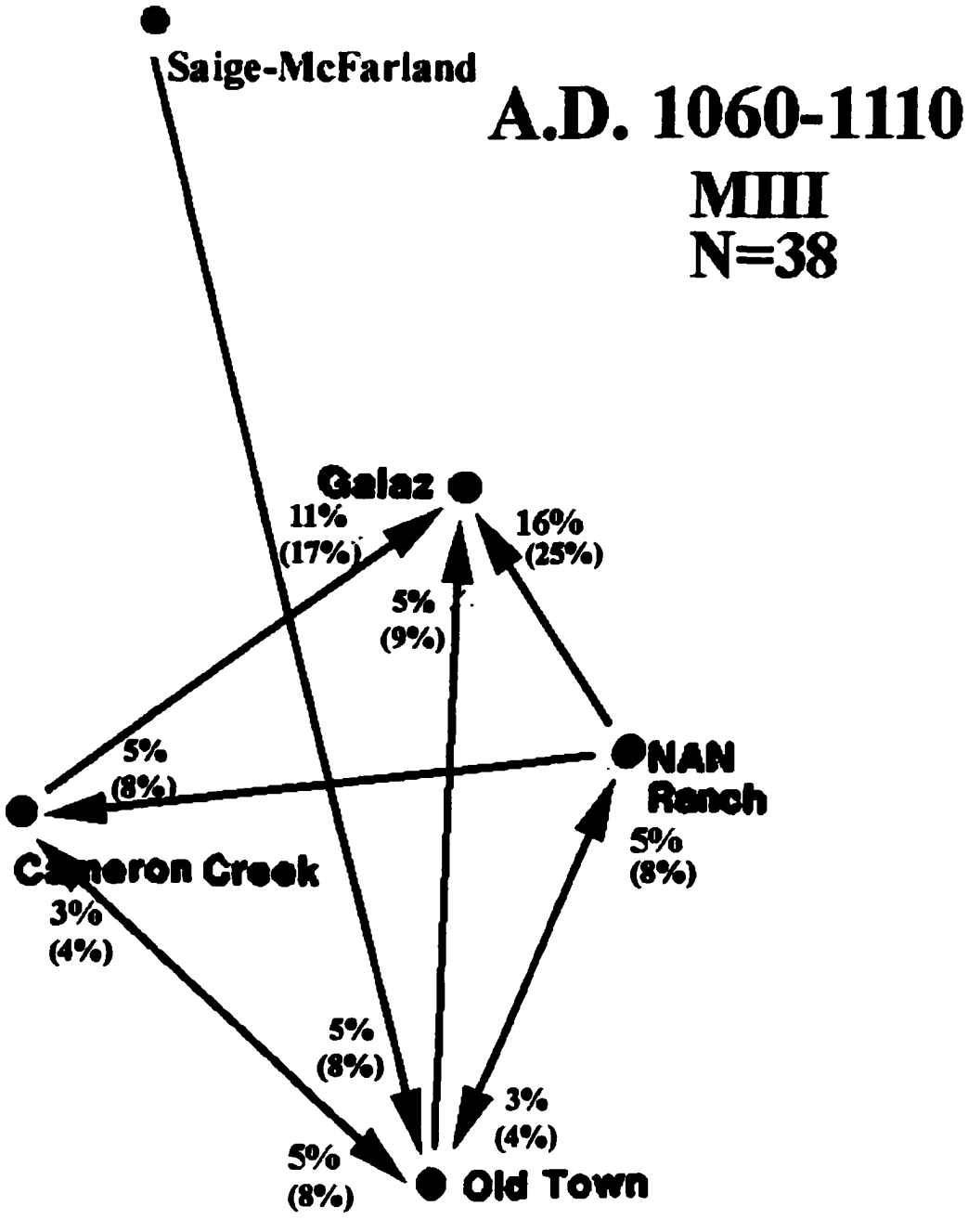


Figure 11. Exchange percentages during the Middle III time frame.

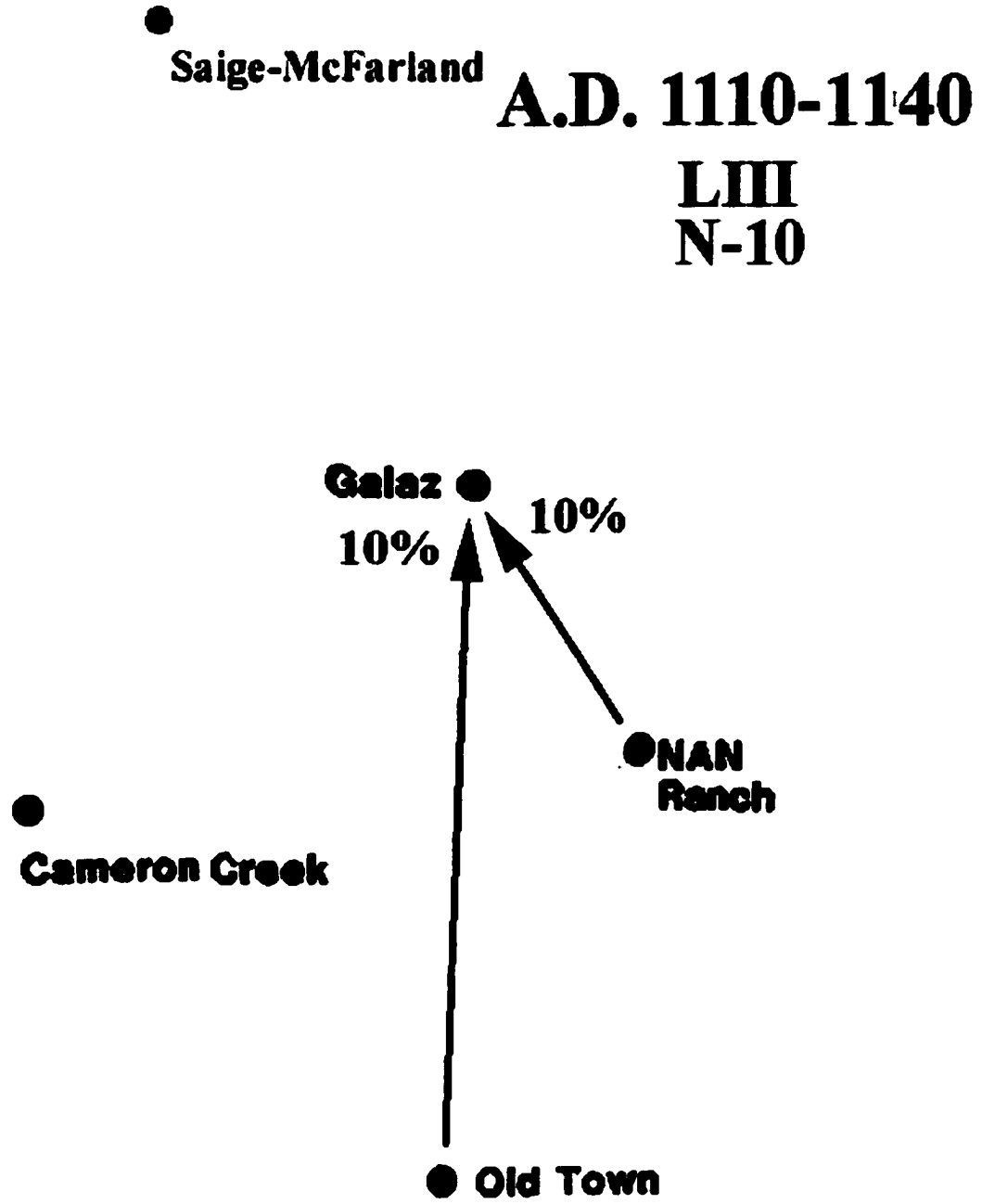


Figure 13. Exchange percentages and directions during the LIII time frame.

The strength of exchange among the sites, excluding Saige-McFarland, likely represents two independent groups, Galaz-NAN-Cameron Creek and Galaz-NAN-Old Town. During the II/III-Early III time period, there appear to be two, overlapping groups united through interaction based on ceramic exchange.

Exchange Patterns for Middle III Ceramics

There are 38 samples in the Middle III period of which 24 (63 percent) were part of exchange. The Middle III clusters support the unification of all of the valley villages and the near outlier of Cameron Creek into an exchange group focused on Galaz. There were no samples from Galaz at any of the other sites, and mutual exchange was evidenced only between Cameron Creek-Old Town and NAN-Old Town (Figure 11). Importation at Galaz (n=12) comprised 32 percent of the Middle III sample and 50 percent of the period's importation sample (n=24). Mutual exchange between both Cameron Creek-Old Town and NAN-Old Town equals 8 percent of the overall sample and 12 percent of the import sample for each of these two groups. Old Town received a small percentage from Saige-McFarland as did Cameron Creek from NAN Ranch. These two importations each equal 5 percent of the Middle III sample and 8 percent of the import sample.

Unidirectional trade was more highly evidenced in this sample than during the earlier period. Five exchange links between sites were unidirectional in Middle III times while there was only one unidirectional link in II/III-Early III times. More of the Middle III villages were linked into one group or were involved in the exchange network, because of the new tie between Old Town and Cameron Creek. Additionally, all sites except Saige-McFarland sent ceramics to Galaz while none left Galaz. Over half of the imported

ceramics ended up at Galaz. All four of the core sites were tightly focused on Galaz.

Exchange Patterns for Late III Ceramics

By Late Classic times, exchange appears to be very minimal (Figure 12). The sample size (n=10) is small compared to the earlier two time periods and imported sherds appeared only at Galaz. There were only four sherds in the Galaz cluster during late times, and 25 percent of these were from Old Town and 25 percent from NAN. No other indications of trade among the villages were supported by the analytic data in this study for the Late Classic period.

Summary of the Compositional Data

The instrumental neutron activation data reflect groups comprised of interacting villages during both the II/III-Early III and Middle III time periods, and show that the membership of these groups changed. During the earlier period, mutual exchange united Cameron Creek, Galaz, and NAN into a group, and a somewhat weaker link was evidenced between Galaz, NAN, and Old Town. Even in this early period, Galaz was a member of both groups and received 39 percent of the imported vessels. The exchange network of Middle III times placed all four villages in one group with a focus on or funneling of vessels to Galaz. Cameron Creek and Old Town participated in mutual trade, thus joining all four core sites, and Galaz seemed to be a focal point, or primary importer during the Middle Classic period. Late III exchange is minimal and unidirectional toward Galaz. Saige-McFarland was never involved in mutual trade, and apparently had no contact with Galaz in any time period.

Preliminary Inferences from the Instrumental Neutron Activation Analytic Data

Preliminary inferences from the instrumental neutron activation analytic data suggest that Mimbres social groups formed and re-formed during the late Late Pithouse and Classic periods. During the early part of the study period the formation of two is indicated. There is a strong suggestion of bonding through mutual ceramic exchange between Galaz, NAN Ranch, and Cameron Creek. Evidence also points to a slightly lesser link among Old Town, Galaz, and NAN. During the early period, interaction through ceramic movement was lively and may reflect different groups interacting for varying purposes. For example, instrumental neutron activation analysis may indicate specific group oriented inter-community gatherings which involved vessels or exchange among villages of different locally produced food commodities.

Villages during the middle portion of the Classic period appear to be coalesced into one strong group consisting of Galaz, NAN, Old Town, and Cameron Creek. Exchange was centered, in some way, on Galaz because it received vessels from all of the other villages but exported ceramics to none of them. There was, however, a modicum of mutual trade between Old Town and Cameron Creek. Otherwise, all trade appears to be unidirectional. The strong ties uniting all four of these villages and the focus on Galaz suggests that the valley villages and the close outlier of Cameron Creek were linked for some reason. The evidence is slim, but the group may have been under the management or direction of people at the Galaz site, at least in some facet of their social organization or activities. The importation of vessels to Galaz could indicate a mutual gathering area for the valley and vicinity. On the other hand, Galaz could represent uneven social

organization in which vessels were a form of tribute, eating and/or tribute containers, or signalers of Galaz's functional/organizational position. During stressful economic periods, Galaz may have been a re-distribution center, water and land rights manager, and/or a site of ritual activities focused on agricultural intensification.

By the end of the study period, ceramic exchange groups had all but disappeared, suggesting that social organization was undergoing radical change. There was a remnant of the Galaz importation pattern, but it was minimal. All three periods taken together demonstrate group formations and change with a particular focus on Galaz. The emphasis on Galaz varies in degrees, but Galaz does seem to occupy a different position within Mimbres social organization than the other villages.

CHAPTER VI

ICONOGRAPHIC ANALYSIS

An analysis of Mimbres black-on-white naturalistic bowls was done in order to place the different designs into iconographic categories and to identify diagnostic elements which correspond to different time periods during the study framework of A.D. 970 to 1140. Temporal placement and provenience data for each vessel allowed distribution of the late Late Pithouse and Classic period icons to be mapped. Sorting of these analytic data revealed patterns of like icon concentrations as well as temporal changes in the distributions. Because certain types of icons were shared, interaction between people, such as visiting, or some other type of travel in which iconographic bowls were exchanged, is inferred. The interaction could also reflect a more passive interaction of idea sharing, in which like iconographic designs were created through imitation.

This chapter discusses and evaluates some of the methodologies used to analyze designs, including a justification for the approach used with the Mimbres black-on-white iconographic designs in this study. This is followed by a detailed description of the study methodology and presentation of the data. The chapter ends with a synthesis of the data

and its application to the study sites along with some preliminary inferences.

Analytic Methodologies Applied to Stylistic Designs

Ceramic design analyses traditionally focus on identifying and categorizing various hierarchically assigned attributes, such as elements, units, and motifs, or focus on defining primary and secondary symmetries of design, such as rotation and reflection. Both approaches have advantages and disadvantages. Attribute analysis primarily suffers from difficulty and subjectivity in defining the components which comprise the various hierarchical levels of attributes and combinations of attributes which comprise the designs. Experience and previous studies reveal that an attribute approach is type specific (Hegmon 1986; Kintigh 1985; Plog 1980; Tanner 1976). That is, the building block arrangement of attributes and operational definitions that function for one ceramic ware's designs rarely are transferrable to another ware type. Symmetry analysis is more objective and universally applicable than attribute analysis because it relies on mathematically defined shapes and because it begins with the design's basic structure or layout (Shepard 1957; Washburn and Crowe 1988). However, symmetry analysis requires whole vessels or very large sherds if primary symmetry is to be determined and often for secondary symmetry to be accurately assessed.

Attribute Analysis

An attribute study classifies design parts as elements, units, motifs, and often includes layout. Because this methodology is type specific, analytic results may be difficult to replicate. The lack of uniformity among typological studies, often within the same society, region, or ware use-area, makes comparative and cumulative studies a

cumbersome and, sometimes impossible, project. If clear definitions accompanied by examples are given for the attribute categories, such as for element, unit, and motif, then replicability is more likely, and the study yields valid information for type- and/or site-specific designs and quite possibly for regional and/or comparative studies.

One of the most clearly defined and objective attribute analyses was developed by Tanner and presented in her 1976 book, *Prehistoric Southwestern Craft Arts*. She proposed an analytic methodology useful for designs associated with any Southwest society which would also be comparable between societies. The universality of the approach was based on "general traits peculiar to the Southwest as a whole" (Tanner 1976:98). Theoretically, Tanner's methodology offered flexibility of adaptation to different social designs. She claimed that the approach's operational definitions "[could] be applied to a [wide] survey of native ceramics" (Tanner 1976:102); however, upon examination, the definitions are often lengthy, and in spite of accompanying examples, sometimes definitions are not clear. For example, an element is defined as the "simplest, irreducible part of a design"and a unit as four separate lines (Tanner 1976:103). A square, therefore, could be four separate elements, or one unit. Tanner's accompanying examples show that in application a square is, in fact, an element. This simple illustration demonstrates the difficulty of a universal methodology using design attributes.

Shortly after Tanner's work, Plog (1980) designed an attribute analysis for painted vessels in the Chevelon region of east-central Arizona. He used a hierarchical approach in which attribute definition was based on recordability capacity of design fragments on sherds and on attribute alternatives present to the painter. As one moves through the

various levels of alternatives, the analysis becomes increasingly subjective. For example, Plog (1980:47) indicates that "[p]rimary motifs are those combinations of design units which are the *strongest* [my italics] units in the pattern. . . ," leaving open the interpretation of 'strongest.' Plog's Chevelon analysis illustrates an adaptative approach to one specific ware type with its unique paired attribute choices, as well as the subjectivity of definition interpretation associated with attribute analysis.

In the late 1980s and 1990s, Hegmon (1986, 1990, 1991) used a similar system to Plog's, including attribute definitions. Rather than using general categories, such as element, unit, and motif, Hegmon's attributes are a complex combination, or package, of lines and curves and involve lengthy definitions which are tailored to ceramic designs associated with Kayenta and Mesa Verde Anasazi people. The methodological approached used in Hegmon's study demonstrated the association of design variations within a temporally and spatially defined region with changing social dynamics, especially during times of stress. Like Plog's approach, Hegmon's analysis is ware specific and based on complex definitions which prohibit replicability of the study by another person and cross-societal comparativeness.

Past attribute analyses emphasize the importance of providing operational definitions as well as the inherent heterarchical nature of design interpretations and design building. An attribute analysis must be used with caution due to the subjective nature of interpreting and applying definitions. However, within specific wares and/or continuous social traditions, it is a useful, detailed, and highly specific method for addressing issues such as boundaries, group identity, messaging/grammars, settlement

patterns, migration, and social responses to changing conditions.

Symmetry Analysis

Design analysis using symmetry is based on the determination of regularly placed, repeating geometric figures, such as rotation, reflection, translation, and glide reflection . The advantage of this approach is its grounding in mathematical principles which permits consistent analyses applicable to any whole, or nearly whole, designs. The shape of most ceramic vessels encourages the use of bands and field divisions, resulting in symmetrical design layouts, characterized by the presence of axes and regular repetitions. Shepard (1957) espoused the use of symmetry as a methodology both for its cross-regional applicability and because there "[p]robably [is] no other quality of design that lends itself as readily to precise definition as symmetry" (Shepard 1957:267). More recently, Washburn and Crowe (1988) illustrated and emphasized the high degree of objectivity in this approach because of its mathematical foundation in defined and invariant principles. Clearly, the limitation to a ceramic symmetry analysis is the necessity of whole, or nearly whole, designs, which can be rare among ancient remains.

Comparative Analysis

Because this study focuses on designs that are iconographic, review and evaluation of analytic methodologies applied to icons is appropriate. Iconographic analyses may use an attribute and/or symmetry approach depending on the nature of the designs. Icons, such as those in this study, are usually not symmetrical, but represent realistic or stylized depictions of natural objects presented in profile or in combinations, resulting in assymetry. Attribute analyses, as the name suggests, focus on individual aspects within a

design, and naturalistic figures are not readily reducible to elemental lines and curves. Because realistic figures or life-forms are not necessarily symmetrical or composed of elemental attribute combinations, some recent studies employ a different technique for studying iconography. Adams (1991), Sundstrom and Keyser (1998), and Thompson (1994) use comparative analyses of iconographies for answering archaeological questions.

Adams (1991) explored the temporal and spatial distribution of the Kachina cult in the North American Southwest by relating certain material cultural changes, such as habitation size and partially or completely enclosed plazas with the appearance of cult iconography. In the study, he used a comparative approach for identifying kachina iconography in prehistoric contexts. In particular, the characteristic features of the historic kachina mask, such as rectangular, toothed mouth, round or square, flat face, headdress, and long, narrow eyes (Adams 1991, 1994; Hays 1994), were comparatively used to identify kachina iconography in mural paintings, ceramic designs, and rock art. Adams'(1991) study of pre- and early-contact kachina iconography covered a large area of the Southwest, including the middle and upper Rio Grande valley, Jornada area, middle and upper Little Colorado River valley, the Cibola area, White Mountains, San Francisco Peaks, Mogollon Rim, and the Hopi Mesas. Although his study included several types of material culture other than iconography to support the spatial and temporal distribution of an ancient kachina cult in the North American Southwest, designating icons as kachina was dependent on comparative analyses of historical and archaeological iconography.

Sundstrom and Keyser (1998) compared Northern Plains shields with known tribal associations to shield iconography displayed on rock art in order to assign social affiliation of the various rock art shields. In the study, many historic motifs showed that shield designs were cross-cultural; however, social identity was distinguishable when the overall iconographic design was viewed. This was because motif arrangement, or structural patterning of motifs, within the whole design, resulted in a style presentation of the shield icons that was associated with particular social groups.

Free-standing shields of known cultural identity shown in ledger art, hide paintings, and ethnographic sketches were compared to shield iconography pecked or painted on rocks in the Black Hills of southwestern South Dakota and northeastern Wyoming and in the northern Cave Hills of northwestern South Dakota. Comparison of the rock art shields with those in the historic art works demonstrated that certain motifs were favored by some tribes while rarely or not at all in others, and that overall design structure, or motif patterning, was tribe-specific. Sundstrom and Keyser (1998) inferred that shield iconography was a group identification vehicle for the northern Plains tribes. This study, like Adam's (1991), identified certain iconography types by comparing ancient and historic icons.

Thompson (1994) compared Mimbres black-on-white iconographic designs with Late Classic Mayan (about A.D. 600-900) and pan-southwestern iconographies to test the idea that there were ideological similarities in pan-American cosmology relating to the Mesoamerican creation myth of the Hero Twins, as recorded in the *Popol Vuh*. Although the stylistic presentation of Mimbres, Mayan and other pan-southwestern

designs may differ, the life-figures and stories represented in each were comparable. That is, the style created by the socially particularistic use of elements and units to build the designs was not necessarily the same, but the results suggested a similar message conveyed through stylistically different icons.

Iconography depicting the characters and events of the Hero Twins myths are seen on ancient stelae in Mexico, on Mayan and Mixtecan codices, on kiva murals in the North American Southwest, on Mimbres bowls, as well as on representational figures and in linguistic meanings of historic puebloan groups. Parallel aspects of the myth include the pandemic association of rabbit and moon, deer and sun, fish and emergence through water from the underworld, bats with "death eyes," other death symbols, or elements of other animals combined with the bat, monster and bear, and macaws and parrots. Depiction of the numbers and relative sizes of these figures within each icon further tied them to Mayan (and, eventually, pan-American) mythology according to Thompson (1994).

Each of the three examples above used a comparative analytic approach to examine iconography. Adams' (1991) and Sundstrom and Keyser (1998) both depended on a historical data set to identify ancient icons. As in this study, Sundstrom and Keyser (1998) focused on group membership defined by iconography, and paralleling this research even more closely because temporal changes were included, Adams (1991) identified spatial boundaries of the pan-southwestern kachina cult. Thompson (1994) attempted to demonstrate shared ideology within a large area through iconographic comparison, and although, he did not use as many historical materials, some historic

puebloan myths and icons as well as ancient writings aided in the research. This study analyzed iconographic designs in order to categorize and temporally place icons unique to one society and demonstrate motif clustering related to group membership. Although each of the above studies identifies group memberships and/or boundaries, the comparative approach used by each is not applicable to this study because comparative data sets are unknown and because the research focuses on sub-groups of the Mimbres society, all of which potentially use the same icons. Thus, although comparison of icon distributions between sites is necessary, evaluation of separate iconographies would not aid in identifying individual Mimbres groups.

Background for Analysis of Mimbres Black-on-white Designs

Symmetry analysis of designs has been used much less than the older, more traditional attribute analysis. The reason for this are not entirely clear. Certainly, in many cases, whole designs are not available, but often they are. Perhaps, habit and tradition are the greater influence. Nevertheless, both approaches evaluate stylistic variations within a set of designs. In the Mimbres area, black-on-white designs have long been categorized using attributes. For example, Haury (1936) successfully seriated Mimbres painted pottery in the late 1930s by identifying clusters of attributes, such as elements, sets of elements, and field layout. Haury's typology provided the framework for all subsequent ceramic sequence refinements of the Mimbres black-on-white series.

After a long hiatus in research, the Mimbres Foundation extensively surveyed and excavated in the Mimbres region beginning in the 1970s. One of the important results of their field work and research was a re-classification of Haury's stylistic types for the

Mimbres ceramic black-on-white designs. Like Haury, they used attributes, such as rim bands and line thickness, to refine the earlier defined large groups designated as Boldface Black-on-white and Mimbres Classic Black-on-white. The Mimbres Foundation divided the black-on-white ceramics into three temporal groups, Style I (Boldface), Style II (Transitional), and Style III (Classic), thus allowing the gradually changing designs to be better manipulated and correlated with architectural and subsistence shifts and facilitating discussion of the designs. Even with the addition of the transitional style, they noted many other minor stylistic categories could be observed within the continuum (Anyon and LeBlanc 1984).

Seriation and formal typing of the fine-grained attribute clustering observed by the Mimbres Foundation was done by Shafer and Brewington (1995) subsequent to long-term excavations at the NAN Ranch and Old Town ruins in the Mimbres Valley. The longevity of the projects, good stratigraphic context, and large ceramic assemblages tied to tree-ring dates, especially at NAN, allowed Shafer and Brewington (1995) to view the evolution of Mimbres black-on-white design attributes at a more precise level than was previously possible The resulting microseriation provided a useful typology, allowing temporal placement of designs and associated artifacts, features, and architecture into generational-level time frames.

An attribute approach based on Shafer and Brewington's (1995) microstyles is used in this study for three reasons: 1) temporal designations of Mimbres black-on-white designs is based on stylistic attributes; 2) the iconography is not represented in repeated designs that can be laid out according to symmetry principles; and 3) all previous

analyses of Mimbres black-on-white designs are based on attributes, and although this makes the analysis type-specific, it is consistent with previous studies for the designs. The iconographic design layouts include the presence or absence of rim bands which are one of the primary temporal diagnostic tools used with the Mimbres black-on-white designs. Additionally, although the designs used in this study are life-forms, certain attributes, such as eye shapes and sizes, are style and time sensitive.

Attributes for determining temporality are based on definitions given by Shafer and Brewington (1995) for microstyles. Although their definitions, upon first reading, may not appear to be typical, formal attributes, they in fact, are. Formal definitions of "element," "unit," "layout," and "motif" are not given, but specific, recurring temporally sensitive attributes are noted. The definitions are mainly descriptive and are centered on "units" and "layout." The most predominant and prevalent identifying attribute for all temporal categories is the presence or absence, number, and type or rim bands. Other attributes have a greater variance in frequency of occurrence throughout the black-on-white series. "Units," such as wavy lines, or fine versus thick line hatchuring, may occur on only one or two microtypes, while suspended triangles may be an important attribute in another microstyle.

Layout of the design is also important for typing. Designs may extend to the rim, be suspended from a rim band, or be centrally focused within the bowl with no attachment to a band. Also, the amount of white area surrounding the iconographic design is temporally significant.

In general, Mimbres black-on-white design motifs are either geometric or

iconographic. Motif analysis of the iconography can be categorized hierarchically, and the choice of category specificity depends on the research question and sample size. The iconographic designs present many different life forms. These may be classed as human, animals, anthropomorphs, and story. These categories, subsequently, may be divided into adult and children and/or male and female humans, and into animal types such as fish, birds, and insects. These could be combined to refine the anthropomorph group. Type of story, such as hunting, ritual, family life, or mythological, may be defined. Further efforts might include genus and species of animals, numbers of individuals, presence or absence of geometric inclusions, positive or negative design presentation, feature proportion, and/or ratios of co-occurring life forms.

Iconographic Design Analytic Methodology

The naturalistic designs of the Mimbres black-on-white ceramics were used in this study because they were clearly iconographic in their representation. Mimbres black-on-white ceramics consist of both geometric designs and iconographic, or life-form, designs. A regionally representative sample of iconographic designs was chosen for analysis, and the designs were sorted into life-form and temporal categories from which spatial and temporal distributions were determined. The motif category sort and temporal assignment portion of the analysis were completed three separate times with significant time intervals in between to insure consistency of placement. Any analysis focused on stylistic diagnostic elements is vulnerable to some degree of subjectivity because artistic individuality or creative ability as well as perception and interpretation by the analyst are variable factors.

Design Analytic Sample

Sites. Five large villages, Galaz, NAN Ranch, Old Town, Cameron Creek, and Saige-McFarland, were chosen as representative of the Mimbres region as noted above in the compositional analysis chapter (Chapter V). Each of these villages was inhabited during the late Late Pithouse and throughout the Classic periods. Three of them are in the regional heartland, the Mimbres River valley, the core of village aggregation during the Classic period, and two other villages, Cameron Creek and Saige-McFarland, expand the sample to a regional level and are at varying distances from the heartland. Cameron Creek is west of the Mimbres River valley, and about equidistant, or 20 kilometers, from each of the valley towns. Saige-McFarland is a more distant outlier located in the Gila River valley and is approximately 75 kilometers north-northwest of Cameron Creek ruin and about 75 kilometers northwest of Galaz. The population size of each of these towns probably was similar during the study period, although the farther outlier, Saige-McFarland, may have been less populous than the others during the Classic period (Lekson 1988).

Iconography. The naturalistic designs were chosen for this study because of their iconographic, or emblematic, effect (see discussion in Chapter II). Iconographic, or emblematic, style is unambiguously stated and conveys cultural or traditional meanings by symbolically targeting a specific referent (Weissner 1990). Although the exact meaning or referent of Mimbres iconography may never be known, the emblematic characteristics do suggest that icon preferences may be related to emically perceived, as

well as etically defined, social groups and ideologic messages directed toward those groups. For example, the icons could identify lineage related groups, allegiance to certain beliefs or causes, and/or ethnicity. Thus, Mimbres iconographic designs are an appropriate vehicle for identifying groups within the Mimbres society.

Sample size and selection. The iconography used in this study was taken from designs on whole vessels as most sherds do not offer a field that is large enough to determine the design's overall motif. Every whole vessel design from each of the five study sites that was available in archives and published reports was used, and in many cases, these vessels also were viewed in museum collections.

There was a total of 450 examples of naturalistic designs from the five sites. Of these, the preservation conditions of 367 allowed them to be analyzed for motif type and temporality. There were 174 whole vessel iconographic designs from the Galaz ruin, 58 from NAN Ranch, 45 from Old Town, 82 from Cameron Creek, and eight from Saige-McFarland.

Analytic variables. Different variables were recorded and entered into a computer data base in the iconographic analysis. These included: 1) site and museum identification numbers; 2) Mimbres Foundation temporal styles; 3) Shafer and Brewington's microstyles; and 4) motif main element. In addition to these, a number of other variables, such as burial/non-burial, positive/negative, stylized/realistic, and others were recorded that may be useful in future studies focused on refinement of the foundation laid in this study (see Appendix B).

Iconographic categories. The various iconographic designs were assigned to

general categories based on the predominant life-form displayed. There were 20 single image categories which included groups such as birds, fish, humans, frogs, lizards, and turtles. Additionally, there were three categories for equally predominant, but different, motif types in the same design, although these occurred in very low percentages. Generalized categories were used, such birds or insects, rather than more specific categories, such as quail or snapping turtle, because classification at the genus or species level, although frequently possible, would result in categorical sample sizes too small for calculating distribution patterns.

Temporal categories. Each design was analyzed for stylistic attributes which allowed placement in seriational groups. Two different typologies were used for comparative purposes and greater accuracy. One stylistic approach used the tripartite division that was developed by the Mimbres Foundation, and the other placed designs according to Shafer and Brewington's (1995) microseriation.

Iconographic Data

Temporal Assignment of the Designs

After the designs had been analyzed, only nine fell within Styles I, Early II, or Late II likely reflecting low populations and early development of the black-on-white styles. Therefore it was not appropriate to use the early styles in the spatial-temporal distribution calculations because such low numbers would not allow valid inferences. After the nine early vessels were subtracted, 358 designs remained in the design sample. The Style II/III designs were combined with Early III designs, primarily because of the uncertainty of the temporal or social aspects of the defining attributes of Style II/III. According to

Shafer and Brewington (1995), the II/III category may represent a group of potters that was producing Mimbres black-on-white vessels during Late II and Early III times rather than designating a temporally transitional style of design. Also, combining the II/III and Early III designs created a larger sample group (n=76), thus adding confidence to patterns of interaction revealed in the data. Saige-McFarland had only a total of eight iconographic designs, five of which were pre-Early III. This deleted it from statistical manipulations; however, the low quantity of iconographic vessels at Saige-McFarland contributes information concerning participation in icon sharing and group responses.

After the early stylistic categories were deleted and the II/III and Early III categories were combined, there were three remaining groups for the analysis. These included II/III-Early III, Middle III, and Late III. The II/III-Early III sample size was 76, the Middle III category included 269 designs, and the Late III was comprised of 13 designs (Table 2).

Within the II/III-Early III group, there were 47 designs from Galaz, 10 from NAN, eight from Old Town, nine from Cameron Creek, and two from Saige-McFarland. In the large Middle III category, the Galaz sample comprised 121 of the iconographic designs while NAN's sample was 43, Old Town's was 35, Cameron Creek's was 69, and Saige-McFarland had only one Middle III naturalistic design vessel. In the small Late III category, there were four naturalistic designs from Galaz, three from NAN, two from Old Town, four from Cameron Creek, and none from Saige-McFarland (Table 2).

Iconographic Assignment of the Designs

As noted above, iconographic categories consisted of general life-form types. The motifs

Table 2. Percentages of icon type of site total, temporal total, and temporal type.

Style II/III-Early III Icons (n=76 (20.77% of 366 study sample)						
SITE	**Galaz**	**Old Town**	**NAN**	**Saige-Mc**	**Cameron Creek**	**Tot**
#/site	47	8	10	2	9	76
site total % of temp total	61.8	10.5	13.2	2.6	11.8	
BIRD						
#/site	9	3	2	0	4	18
% site tot	19.2	38.0	20.0		44.4	
% temp tot	1.2	4.0	2.6		5.3	23.7
% temp type	50.0	16.7	11.1		22.2	
FISH						
#/site	0	1	1	0	1	3
% site tot		13.0	10.0		11.1	
% temp tot		1.3	1.3		1.3	4.0
% temp type		33.3	33.3		33.3	
INSECTS						
#/site	8	1	2	1	2	14
% site tot	17.0	13.0	20.0	50.0	22.2	
% temp tot	10.5	1.3	2.6	1.3	2.6	18.4
% temp type	57.1	7.1	14.3	7.1	14.3	

MAMMAL						
#/site	9	1	2	0	0	12
% site tot	19.2	13.0	20.0			
% temp tot	11.8	1.3	2.6			15.8
% temp type	75.0	8.3	16.7			
HUMANS						
#/site	3	0	1	0	1	5
% site tot	6.4		10.0		11.1	
% temp tot	4.0		1.3		1.3	6.6
% temp type	60.0		20.0		20.0	
RUMINANT						
#/site	5	1	1	0	0	7
% site tot	10.6	13.0	10.0			
% temp tot	6.6	1.3	1.3			9.2
% temp type	71.4	14.3	14.3			
COMBOS						
#/site	1	0	1	0	0	2
% site tot	2.1		10.0			
% temp tot	1.3		1.3			2.6
% temp type	50.0		50.0			
OTHER						
#/site	0	1	0	1	0	2
% site tot		1.3		50.0		
% temp tot		1.3		1.3		2.6
% temp type		50.0		50.0		

Style Middle III Icons n=269 (73.5% of 366)						
SITE	**Galaz**	**Old Town**	**NAN**	**Saige-Mc**	**Cameron Creek**	**Tot**
#/site	121	35	43	1	69	269
site total % of temp total	50.0	13.0	16.0	0.4	25.7	
BIRD						
#/site	18	4	11	1	17	51
% site tot	14.9	11.4	25.6	100	24.6	
% temp tot	6.7	1.5	4.1	0.4	6.3	19.0
% temp type	35.3	7.8	21.6	5.9	33.3	
FISH						
#/site	24	5	10	0	12	51
% site tot	19.8	14.3	23.3		17.4	
% temp tot	8.9	1.9	3.7		4.5	19.0
% temp type	47.1	9.8	19.6		23.5	
INSECTS						
#/site	12	2	4	0	10	28
% site tot	9.9	5.7	9.3		14.5	
% temp tot	4.5	0.7	1.5		3.7	10.4
% temp type	42.9	7.1	14.3		35.7	

MAMMALS						
#/site	16	7	4	0	6	33
% site tot	13.2	20.0	9.30		8.70	
% temp tot	6.0	2.6	1.5		2.2	12.3
% temp type	48.5	21.2	12.1		46.2	
HUMANS						
#/site	11	8	2	0	5	26
% site tot	9.1	22.9	4.7		7.3	
% temp tot	4.1	3.0	0.7		1.9	9.7
% temp type	42.3	7.7	7.7		19.2	
RUMINANT						
#/site	11	3	6	0	7	27
% site tot	9.1	8.6	14.0		10.1	
% temp tot	4.1	1.1	2.2		2.6	10.0
% temp type	40.7	11.1	22.2		25.9	
COMBOS						
#/site	12	4	1	0	7	24
% site tot	9.9	11.4	2.3		10.1	
% temp tot	4.5	1.5	0.4		2.6	8.9
% temp type	50.0	16.7	4.2		29.2	
OTHER						
#/site	17	2	5	0	5	29
% site tot	14.1	5.7	11.6		7.3	
% temp tot	6.3	13.0	1.9		1.9	10.8
% temp type	58.6	6.9	17.2		17.2	

Late Middle III Icons n=13 (3.55% of 366)						
SITE	**Galaz**	**Old Town**	**NAN**	**Saige-Mc**	**Cameron Creek**	**Tot**
#/site	4	2	3	0	4	13
site tot % tot temp	30.8	15.4	23.1		30.8	
BIRD						
#/site	2	1	2	0	1	6
% site tot	50.0	50.0	66.7		25.0	
% temp tot	15.34	7.7	15.4		7.7	2.2
% temp type	33.3	16.7	33.3		16.7	
FISH						
#/site	0	0	0	0	0	0
INSECTS						
#/site	0	0	0	0	1	1
% site tot					25.0	
% temp tot					7.7	0.4
% temp type					100	
MAMMALS						
#/site	1	0	0	0	1	2
% site tot	25.0				25.0	
% temp tot	7.7				7.7	0.7
% temp type	50.0				50.0	

HUMANS						
#/site	0	1	0	0	0	1
% site tot		50.0				
% temp tot		7.7				0.4
% temp type		100				
RUMINANT						
#/site	0	0	1	0	0	1
% site tot			33.3			
% temp tot			7.7			0.4
% temp type			100			
COMBOS						
#/site	0	0	0	0	1	1
% site tot					25.0	
% temp tot					7.7	0.4
% temp type					100	
OTHER						
#/site	1	0	0	0	0	1
% site tot	25.0					
% temp tot	7.7					0.4
% temp type	100					

that occurred most often were birds, fish, combinations, humans, insects, mammals, and ruminants. There were 75 birds for all sites and time periods, 55 fish, 32 humans, 42 insects, 47 mammals, and 36 ruminants, totaling 287 or 80 percent of the 358 bowls in the iconographic analytic sample for the study.

Each iconographic category was subjected to statistical analysis. Chi tests were done between paired sites for each time period and for each icon type to determine if the sites and motif were related. The null hypothesis that there was no statistical difference in the number of icon X at site A versus site B during time period Z was rejected at the significance level of $(p) < .05$. In this test, rejection of the null hypothesis indicated that there was a five percent possibility that the relationship could occur only by chance. Therefore, chi tests which *accepted* the null hypothesis, or were statistically insignificant, indicated that there was a relationship between the two sites during a given time period associated with a particular icon type, or that frequency of icon sharing was not by chance.

Each iconographic type at each site during each time period also was converted to percentages based on the number of icon X within the site's sample size for each time period, for percent of icon X of all icons during the time period, and for the percentage that site's icon X represented of all icon Xes for the entire temporal sample (see Table 2). For example, there was a total of 121 iconographic designs at Galaz during Middle III times of which 11 were ruminants, representing nine percent of the 121, four percent of the whole temporal iconographic sample, and 41 percent of all Middle III ruminants. Percentages for the nine predominant motif types in the three stylistic categories are

given in Table 2. Percentages above 10 were considered to be significant for identifying preference and sharing patterns because there were fewer iconographic types with percentages of 10 or above than those below 10 percent.

Iconographic-Temporal Integration

II/III-Early III style icons. In the II/III-Early III category, chi-squared tests on the Galaz iconographic data indicated that a relationship between all sites with shared icon types was probable except for sharing of the "other" iconographic category between Old Town and Saige-McFarland and between NAN and Saige-McFarland. These relationships were also seen in the percentage calculations (Table 2). There was a 19 percent preference each for both birds and mammals with a slightly less than 17 percent preference for insects. At NAN, birds, insects, and mammals all ranked at 20 percent. At Old Town, only birds had a high percentage (38 percent). Cameron Creek's iconographic sample had 44 percent birds and 22 percent insects. No iconographic designs among the seven top categories were found in high percentages at Saige-McFarland.

Middle III style icons. Chi-squared tests of the Middle III sites and iconographic types indicated that there was no relationship between Galaz and Saige-McFarland, NAN and Saige-McFarland, or NAN and Cameron Creek with bird icons or between Galaz and Old Town, Old Town and Cameron Creek, or Old Town and NAN with human icons. The Middle III sample revealed that Galaz had 20 percent fish iconography, 15 percent birds, and 13 percent mammals. At NAN, there were 26 percent birds, 23 percent fish, and 14 percent ruminants in the sample. Humans comprised 23 percent of Old Town's Middle III sample followed by 20 percent mammals, 14 percent fish, and 11 percent

birds. Cameron Creek had 25 percent birds, 17 percent fish, and 14 percent insects. As in the II/III-Early III situation, Saige-McFarland had no ranking iconographic designs.

Late III style icons. During the Late III times, Galaz had 50 percent birds, NAN had 67 percent birds, Old Town had 50 percent birds and 50 percent humans, while Cameron Creek had 25 percent each of birds, insects, mammals, and combinations. These percentages are based on extremely low samples; chi-squared tests were not applicable. Again, Saige-McFarland's sample does not rank among the top, overall categories.

Data Synthesis and Preliminary Inferences

Late Late Pithouse and Early Classic Period Trends

Motif distributions indicate that during the late pre-Classic and early Classic periods, A.D. 970-1060/80, Galaz, NAN, and Cameron Creek shared bird and insect symbols in high percentages and likely were members of a group. In addition, NAN and Galaz had a strong tie through the mammal motif, making the NAN-Galaz link the strongest during this time because they each had a large percentage of three shared motifs, birds, insects, and mammals. Finally, Old Town was tied into this interaction with a 38 percent representation of birds. It appears that NAN, Galaz, and Cameron Creek may have been members of one group with NAN and Galaz the most closely linked, and Old Town more weakly associated with them.

Middle Classic Period Trends

The pattern of shared motif preferences changes during middle Classic times from A.D.1060 to1110. The sample size during this time is 269. Fish are predominant at

Galaz; secondary at Cameron Creek and at NAN; and third in preference at Old Town. As in earlier times, birds continue to dominate at Cameron Creek and at NAN, but are fourth at Old Town. And although fish and birds occur in high percentages at Old Town, humans motifs are the primary category there. Galaz and Old Town also share a secondary linking through mammal iconography. Each of the four sites had a high percentage of both birds and fish, and if these two categories are combined, then all four villages have a 26-49 percent preferences for bird-fish iconography. The middle Classic pattern indicates a more focused pattern of interaction among the villages than in the previous period because four rather than three villages share identical motifs, birds and fish, in high percentages and because fish represent the use of a new membership symbol. This suggests that these four villages were members of one group which may have been a response to increasing economic tensions occurring during the latter two decades of the Middle Classic in that environmental degradation began during that time.

Late Classic Period Trends

The late Classic period, A.D.1110-1140, was a time when the effects of a number of unfavorable environmental conditions had accumulated (Minnis 1985), and during which dramatic re-organization occurred (Creel 1994, 1996; Hegmon et al. 1998). The Late Classic design data parallel this social re-organization in that black-on-white ceramic sample sizes decrease dramatically, fish motifs disappear completely, and bird motifs are primary, but at a generally lower level when sample sizes are considered than in any previous time period.

Preliminary Inferences

The iconographic spatial and temporal data show that bird motifs are present in relatively high percentages throughout the study period (Table 2; Figures 13, 14, 15). This may be a group identification marker tying the Cameron Creek and Mimbres River drainage sites together and within which smaller social groups formed. However, as Minnis (personal communication, 1998) has pointed out, birds are a prominent motif in many areas of the Southwest, and therefore symbolic categories other than birds may be more indicative of group membership.

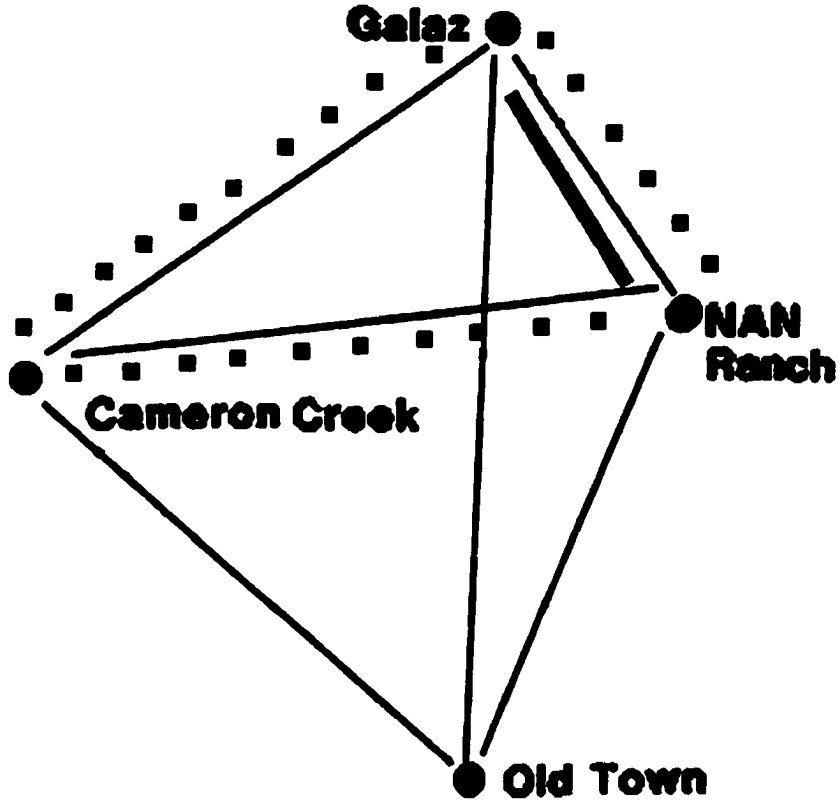
If birds are deleted from the data, support for the Galaz-NAN-Cameron Creek group in II/III-Early III times is even stronger and certainly graphically clearer (Figure 13). If Middle III patterns are considered without birds, then fish are dominant at Cameron Creek, Galaz, and NAN; at Old Town mammals are still preferred to fish, but fish do occur at a 14 percent level (Figure 14). The sudden and inclusive appearance of fish iconography shared among all four sites supports the idea that group membership among Mimbres villages in and near the valley was more unified during the middle Classic time than before or after.

Saige-McFarland

A.D. 970-1080

II/III-EIII

N=76



= Birds

= Insects

= Mammals

Figure 13. Shared icons during the II/III-EIII time frame.

Saige-McFarland

A.D. 1060-1110

MIII

N=269

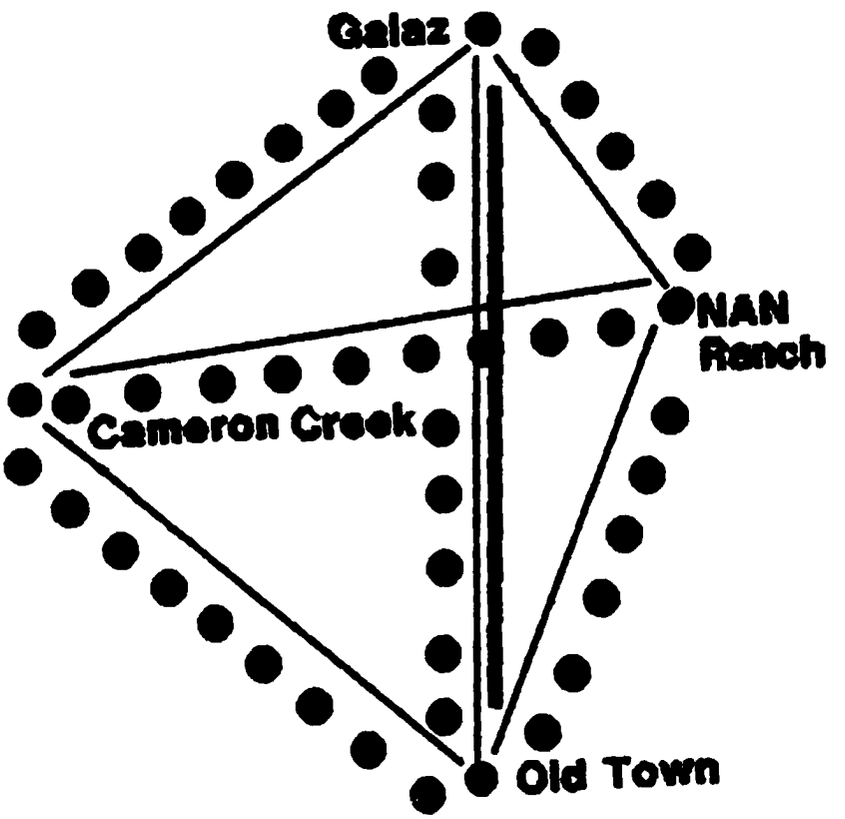


Figure 14. Shared icons during the MIII time frame.

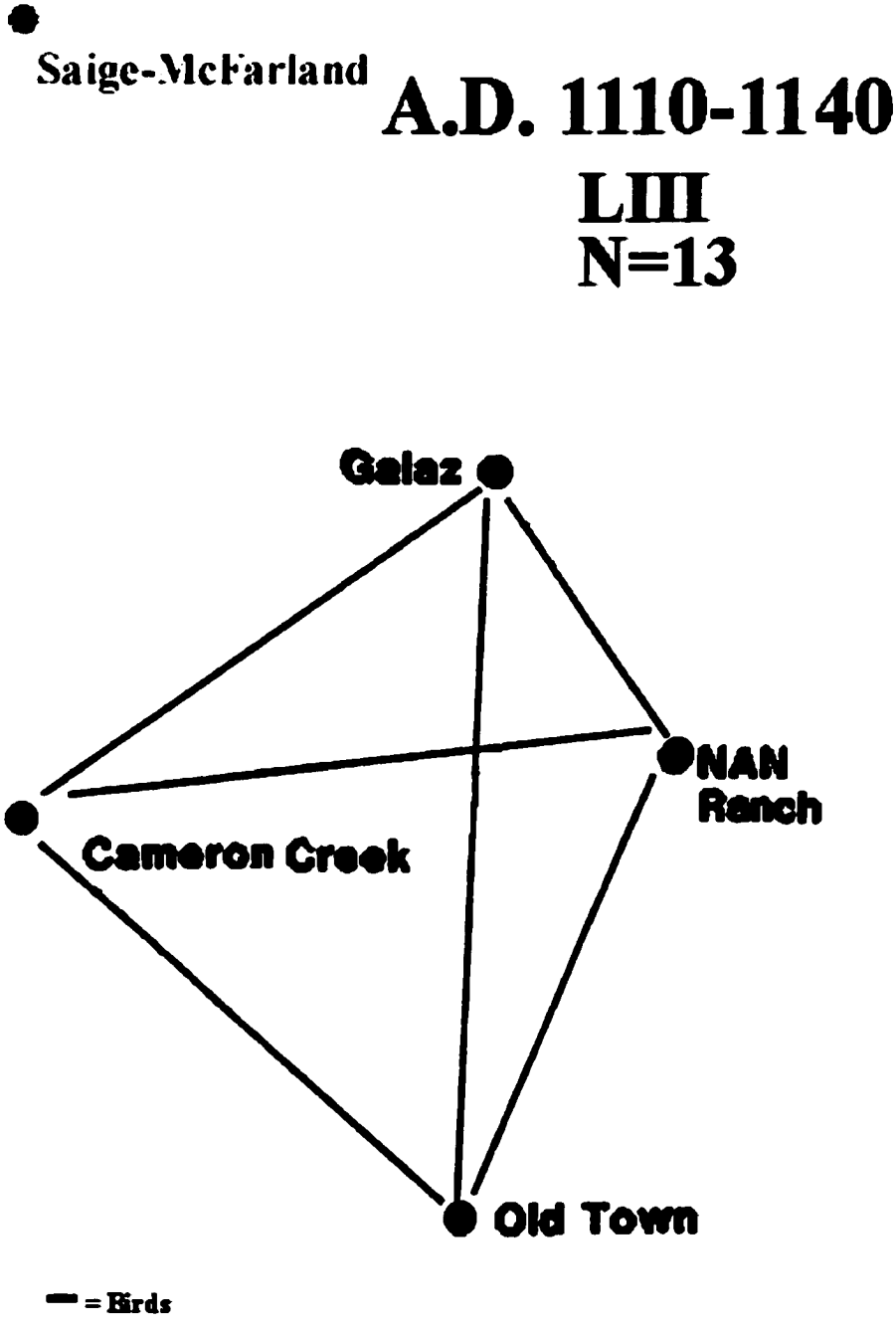


Figure 15. Shared icons during the LIII time frame.

CHAPTER VII

CONCLUSION

Review of the Study

The seed for this research was a persistent and nagging curiosity about the meaning or purpose of Mimbres iconographic ceramics. The icons caught my attention and have held it for over a decade just as they likely were intentionally painted in a stylistically dramatic manner to catch and maintain the Mimbres people's attention. The meaning of these icons has long intrigued historic people as well, and although many proposed explanations have been put forth, few have pursued their conjectures with scientifically-based research.

Realizing that reaching into the ancient mind to ascertain the meanings underlying the icons would be virtually impossible, I began to explore how one might approach even a surficial understanding of these enduring and technically sophisticated naturalistic designs. At that time, Mimbres black-on white studies included only one small investigation of design distribution and one focused on exchange from which systematically-based inferences could be formed (i.e., Gilman et al. 1994; C. LeBlanc 1977). However, because the icons are of life-forms, primarily animals or humans, they suggest the ethnographically documented use of totemic animals that is associated with large kin-related groups. Other icons suggested mythological beliefs because the designs

are stylized animals and/or fantastic combinations of various animals or people and animals. This association is supported by ethnographic research as well as painted murals, reliefs, and geneological codices from Mesoamerica. Additionally, some of the iconographic ceramic paintings tell stories and are perhaps the closest thing to writing in pre-contact North America. For example, painted descriptions of gender specific clothing, hunting techniques and weapons, possible ritualistically associated activities such as parrot transport and training, and childbirth can be read on Mimbres black-on-white naturalistic bowl interiors.

Totemic, mythological, and narrative aspects provided starting points for hypothesis formation in this study. If the various icons functioned in something like a totemic role, then there should be spatial patterning of the icon types because ethnographically it has been shown that subsistence-based kin groups often live close together and/or maintain strong social ties. However, there was no way to quantifiably demonstrate that iconographic clustering of Mimbres black-on-white designs was associated with kin-related people, but a reasonable assumption could be made that they were tied to social groups.

Each Mimbres naturalistic design is unique in some way (Figure 16). This uniqueness may be accounted for by the fact that a number of nested or overlapping smaller social groups could exist within a larger group. Differing elements included in the iconographic designs might identify one or more groups while the motif may be emblematic for a larger group. For example, turkeys or swallows both fall within the category of birds; yet, while representing the large group (birds) they may as well identify

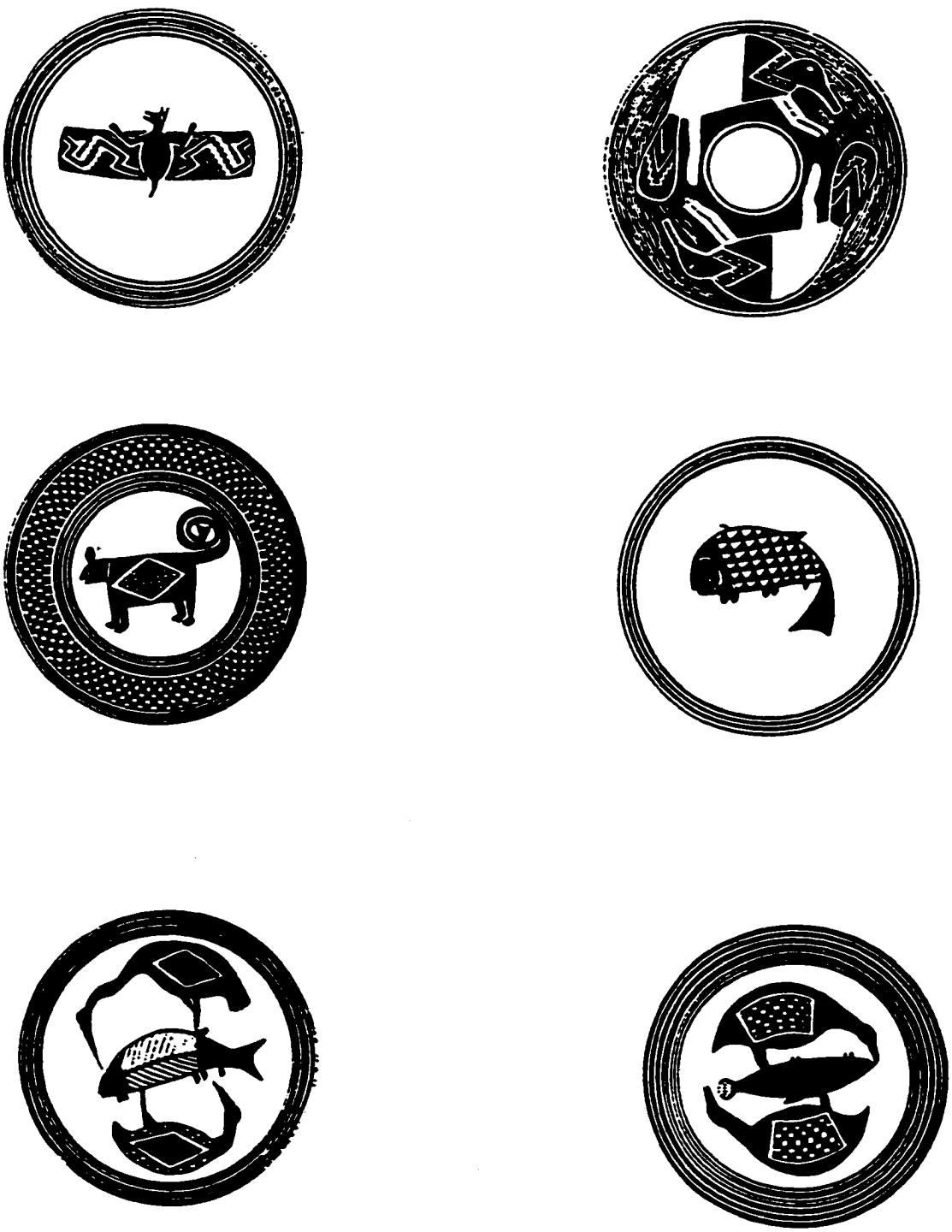


Figure 18. Iconographic designs showing uniqueness of each.

a sub-group (turkeys or swallows). A closer look at each icon would show that each turkey or swallow had some deliberately different or added feature that made that turkey bird or swallow bird icon unique. In a spiral of complexity suggesting multiple social groups, each added feature, such as a checkerboard pattern on a swallow's back, might match the same geometric pattern on the body of an antelope. Available research time and iconographic vessel quantities necessarily limited such detailed focusing on co-occurring, intersecting icon sub-categories. I felt, however, that larger groups likely could be inferred if general icon types clustered and that these data would provide a beginning foundation from which future studies might derive more fine-grained information.

Identification of mythological and narrative representations of the various icons indicated that they were important in the beliefs of the Mimbres people. Ideologic constructs encapsulate important cultural concepts concerning origin, reason for being, interpretation of the physical environment, and behavioral expectations. In other words, the icons appear to carry representational messages of primary importance, encoding the Mimbres world view. The life-form designs of Mimbres black-on-white pottery likely were deliberately iconographic in stylistic presentation in order to encapsulate and clearly transmit the society's basic operative information, some of which may have been defining group memberships as well as appropriate social responses.

The story designs combine realistic life-forms, fantastic figures, iconographic style, and as well, form a narrative. This particular type of iconographic depiction puts the higher ideals of the encoded cultural constructs into everyday and ritualistic situations. Perhaps, they were examples of how to apply expected behavior or interpret

ecological events. The stories may also have been reminders that cosmological constructs were to be practiced in everyday life, particularly those directly associated with spiritual, ritualistic, or life-giving ideals.

Archaeologists have used ceramic style, including decoration, as a reflective tool for identifying group boundaries and as temporally sensitive markers for organizational changes. In this study, the style of Mimbres black-on-white iconographic designs was used in such a manner. Spatial and temporal distribution of the iconographic types supported by ceramic exchange data allowed patterns to emerge from which interacting social entities could be inferred. These same patterns, when temporally juxtaposed with economic variabilities (environmental and demographic factors), are used in this chapter to demonstrate the active, mediating role of the icons in social organizational change. Co-occurrence of fluctuations between economic aspects and iconographic distribution indicated that the icon variability was not a delayed, reflective consequence of other changes. Rather, the temporally and spatially fluctuating iconographic patterns indicated that interacting social groups formed and re-formed in conjunction with and in response to environmental-demographic changes affecting economic conditions. The encoded iconographic messages apparently indicated that a particular group response to these conditions was necessitated.

The Study Questions

This research has presented both quantitative and qualitative data for supporting the hypotheses that:

1) If iconographic-exchange patterns occur which show a high percentage of

shared icons at two or more Mimbres villages, then these villages are members of a group because of their high level of interaction;

2) If these iconographic-exchange patterns change through time, then it may be assumed that group memberships have changed; and

3) If the group membership patterns change through time and the temporal patterns correlate with economically stressful periods, then it may be inferred that Mimbres iconography actively functioned in the formation, identification, and maintenance of groups.

Quantitative Data

The analyses of the chemical composition of Mimbres black-on-white ceramics yielded quantitative data for mapping the iconographic-exchange distribution used in testing the first hypothesis. In order to demonstrate that icon sharing among villages indicated group membership, evidence that the iconographic distribution was the result of interaction (i.e., iconographic vessel exchange) rather than imitative behavior had to be demonstrated. These data were supported by the presence of like icons clustered in high percentages at more than one village. The compositional and iconographic design analyses provided scientifically quantifiable data for testing the hypothesis. Much of the environmental material relied on Minnis' 1985 study which was based on quantitative data. Additionally, dendrochronological dates obtained since Minnis' study provided hard evidence for annual precipitation amounts.

Qualitative Data

Population counts, primarily based on the relationships between room counts, floor space,

and room use-life, were only partially quantitative because they were formulated on differing assumptions concerning space per person used and structure-room use-life. The review of Mimbres material culture provided the archaeological background for the study. Settlement patterns, architecture, and artifacts were not scientifically measured or statistically manipulated, but rather presented as general trends and characteristics. The general characteristics of Mimbres materials were assimilated from descriptive reports and from tested hypotheses documented in published and unpublished manuscripts. The qualitative, descriptive presentation of Mimbres materials was given to provide spatial and temporal trends against which change or constancy could be compared with the more substantiated iconographic-ecological patterns.

Review and Syntheses of the Data Sets

All lines of evidence need to be integrated in order to confirm group formation and re-formation, and the active, motivating role of the icons in the Mimbres society during the A.D. 970 to A.D. 1140 time period. The two ceramic analyses are summarized, and then synthesized. This is followed by a review of Mimbres materials, environmental reconstruction, farming strategies, and population estimates.

Review of the Compositional Analysis

The instrumental neutron activation analysis of the chemical composition of Mimbres black-on-white vessel materials revealed spatially and temporally changing distribution patterns for the ceramics. One hundred and fifty-two sherds from the study sites were analyzed for 31 trace chemicals from which sherd clusters were statistically calculated based on a hierarchical ranking of chemical dissimilarities. Sherds dating prior to the

study period as well as those not assignable to any chemical clusters were deleted from the sample. Of the 88 remaining sherds, 50 percent were clearly part of iconographic designs. Another seven sherds were probably iconographic, and if included would raise the icon percentage to 59. This large percentage of icons in the INA sample increases confidence in the sample's representativeness of the iconographic patterns derived from it.

In each of the clusters determined from principal component analysis, the largest percentage of samples retrieved from the same site were assumed to represent the site where these sherds were produced. Five different clusters were revealed, and each represented one of the five study sites. Samples within each cluster were also placed in one of the three temporal groupings.

Distribution patterns from the compositional analysis indicating that in the Style II/III-Early III category, reciprocal vessel exchange comprising 38 percent of the total temporal sample occurred among Galaz, NAN, and Cameron Creek. This represented 64 percent of the early time's exchange vessels. A second group formed by Galaz, NAN, and Old Town had very similar levels of exchange as the first group (i.e, 35 percent and 55 percent). Galaz was the only one of the four valley area sites that received vessels from all three of the others during the early time.

During Middle III times, A.D. 1060-1110, all four valley vicinity sites united in vessel exchange, and direction of exchange revealed an increased focus on Galaz where imported vessels equal 32 percent of the temporal sample and 50 percent of the temporal importation sample. There are no sherds from Galaz at any of the other sites. Two weak

links created through mutual exchange occurred between Cameron Creek and Old Town and between NAN and Old Town. During Middle III times, unidirectional trade predominated with the focus of exchange on Galaz.

Exchange patterns for Late III vessels is minimal. The sample size (n=10) is smaller than the previous time period's, and imported sherds only occur at Galaz.

The compositional data indicated that changing group formation occurred during the late pre-Classic and Classic periods. In the early part of the time frame when trade was generally bi-directional, two groups formed: 1) a strong group consisting of Galaz, NAN, and Cameron Creek, and 2) a moderately linked group comprised of Galaz, NAN, and Old Town. Galaz was a member of each of these groups and received 39 percent of the imported vessels. Exchange patterns of the Middle III period support a unity of the four villages through similarity of vessel exportation to Galaz, and by the predominance of unidirectional trade. Five of the six exchange links during the middle Classic were unidirectional, while only one was unidirectional during the previous time. Cameron Creek was more strongly linked to valley trade in the middle times because it exported vessels to Galaz, and in contrast to the previous time, it exchanged vessels with another village, Old Town. Exchange was minimal in the late times with only a vestige of the Galaz importation focus remaining.

Review of the Iconographic Analysis

The iconographic sample consisted of 367 designs from the five study sites. Initial design analysis revealed that there were only nine Style I, Early Style II, and Late Style II; therefore, only Styles II/III and Early III, Middle III, and Late III representing time spans

of A.D. 970-1060/80, A.D. 1060-1110, and A.D. 1110-1130, respectively, were used in discriminating spatial and temporal patterns of iconographic distributions.

Icons were assigned to general categories such as bird, fish, or mammal, and typed according to a microseriational methodology developed at Texas A&M University (Brewington and Shafer 1995). Styles II/III and Early III were combined in order to create a larger, more relaible sample and because Style II/III may be more representative of an artist or group or artists who produced these designs during the Late II to Early III transition or during the early Early III times (Shafer and Brewington 1995). Icons in each category were subjected to chi-squared tests for each pair of sites and during each time period. They were also figured according to the icon type percentage within each site, within all icon types for the time period, and for percentage of each particular icon type at all sites during the time period.

Styles II/III-Early III yielded a distribution of high preferences for birds and mammals at Galaz; birds, insects, and mammals at NAN; birds only at Old Town; and birds and insects at Cameron Creek. No high percentage motifs from the top ranking icons occurred at Saige-McFarland. In the Middle III time frame, all sites, except for Saige-McFarland which again had no ranked types, had high percentages of birds and fish. In addition, Galaz showed a high proportion of mammals while ruminants were important at NAN. Besides birds and fish, Old Town had high percentages of humans and mammals; Cameron Creek had significant occurrences of insects. The sample was quite small (n=13) for the Style Late III icons, but in general, birds predominated.

These distributions indicate that in the earlier time, A.D. 970-1060/80, Galaz,

NAN, Old Town, and Cameron Creek, had significant numbers of bird icons. Within this larger group, Galaz, NAN, and Cameron Creek shared high percentages of bird and insect symbols and, as well, Galaz and NAN had a strong link represented by frequent occurrences of mammal icons at both of these sites. These percentages suggest two groups linked by shared preferences of icon types. Nested groups may be represented with Galaz-NAN within the Galaz-NAN-Cameron Creek group, both of which are part of the valley-area group, Galaz-NAN-Old Town-Cameron Creek, linked by birds.

In the middle Classic times, all four sites are strongly linked through the sharing of two icons: birds and fish. Galaz and Old Town also share the mammal icon in high percentages. During this time all four of the sites are more strongly linked than before because all show a high preference for the same two motifs. Additionally, the fish icon is a new entry into the most preferred icon types, and this may indicate the emergence of a different emphasis on some particular ideologic aspect such as group formation and/or social behavior.

The late period icon distribution reflects a breakdown in the production and, therefore, possibly in the importance of iconographic designs. This in turn may indicate a dramatic change or breakdown in some, several, or all aspects of social organization.

If one considers the pan-Southwest use of bird motifs, this symbol could be deleted, but group formation and re-formation within the Mimbres region still are indicated by iconographic distribution. For example, Style II/III-Early III icon patterning reveals that Galaz-NAN-Cameron Creek formed a group in sharing insect motifs and that Galaz-NAN had a strong tie with high percentages of mammals. In the middle period,

unity continued to be expressed among all four sites after birds were deleted as seen in the high occurrence of fish icons at each site. Deletion of bird motifs in the late times emphasizes the social disorganization or change of that period as no other motifs besides birds were shared among the sites. Thus, whether the three temporal samples' iconographic patterning is considered with or without the bird category, group formation and re-formation is indicated through the sharing of icons.

Synthesis of the Ceramic Data

A.D. 970 to 1080 ceramic data. Syntheses of the two ceramic data sets show that each supports the patterns revealed in the other. Exchange data at this time between Galaz and NAN indicate that NAN sent 42 percent of its locally produced vessels to Galaz, while Galaz exported 9 percent of its the black-on-white vessels to NAN. Trade between the two comprised over 26 percent of all trade during the early time with NAN sending 22 percent of this 26 percent to Galaz. Icon sharing during the early time period was quite strong between Galaz and NAN who share three icon types, all of which were above 17 percent of each site's sample. Together they shared 61 percent of all birds, 92 percent of all mammals, and 71 percent of all insects occurring in the early sample.

Seventeen percent of the traded vessels moved between Galaz and Cameron Creek, and they share 72 percent of the bird and 71 percent of the insect icons. Cameron Creek sent 13 percent of all exchanged vessels to Galaz, while Galaz sent only four percent to Cameron Creek.

Galaz and Old Town reflect a weaker connection in that they only shared bird icons and eight percent of the trade. At NAN and Cameron Creek, however, trade

comprised 17 percent of all exchange with the greater portion of this exchange link going from Cameron Creek to NAN. They shared approximately 33 percent of the bird icons and 29 percent of the insect icons.

The group formed by exchange activities among Galaz, NAN, and Cameron Creek was strong, encompassing 30 percent of all vessels and 60 percent of all traded bowls. Galaz, NAN, and Cameron Creek represented 83 percent of all birds and 86 percent of all insects for the early Classic times. Within this group an even stronger tie was evidenced between Galaz and NAN who shared 61 percent of the birds, 71 percent of the insects, and, additionally, 92 percent of the mammals, and 26 percent of the traded vessels. The two-way tie between Galaz and Old Town is rather weak (8 percent of all trade), while trade between NAN and Old Town is 21 percent of all exchange vessels. All of these sites, Galaz, NAN, Old Town, and Cameron Creek have high percentages of bird icons, but Old Town shares no other icon types in percentages above ten with these sites.

These four villages are identified as one group by bird iconography which appeared on their ceramic bowl interiors quite frequently. Three of them, Galaz, NAN, Cameron Creek, were joined as seen in the use of bird and insect symbols as well as over one-half of the traded vessels. Finally, Galaz and NAN had an alliance cemented by a third shared icon, mammals, and over one-fourth of all the exchange occurred between them. Both the compositional and iconographic distributions indicate nested alliances within the central Mimbres villages during the late Late Pithouse and early Classic periods.

Within this nesting, there is also evidence that Galaz played a somewhat central role. Galaz received from and exported to all three of the other villages, importing 39 percent and exporting 12 percent of all exchanged vessels. The other sites sent high percentages of the iconographically painted bowls they produced to Galaz.: NAN sent 42 percent, Old Town sent 50 percent, and Cameron Creek sent 38 percent.

A.D. 1060 to 1110 ceramic data. Galaz became even more central as an importer during the middle Classic period when it received 50 percent of the traded iconographic vessels. Additionally, Galaz did not export *any* iconographic bowls, and whereas unidirectional trade was limited and weak in the prior time, it was greatly increased and strongly focused on Galaz in the Middle Classic period.

Unity among the four villages was cemented through the high usage of bird and fish icons at all of them during mid-Classic times. Bi-directional trade occurred between two sets of villages, Old Town-NAN and Old Town-Cameron Creek; however, each of these two links comprises only 12 percent of all trade. These connections may indicate weak alliances between the villages in each of these sets.

A.D. 1110 to 1140 ceramic data. During the end of the Classic, there was little trade or sharing of iconographic motifs. The small sample size for this time indicates that very few vessels were being made and that likely icons no longer functioned in their previous role.

Review of Material Patterns

During the early Pithouse period, small villages of about 10 or fewer houses were located on upland ridges and knolls, while Late Pithouse period occupations were in the

Mimbres Valley bottom, first terraces of the river, and wide-bottom drainages. The number of sites and the population increased by three-fold in the Late Pithouse period with villages ranging in size from 25 to 125 structures. At the beginning of the Classic period many of the villages were built over pit house communities, but later settlements also occurred in narrow side drainages and uplands. By Postclassic times, population in the valley fell substantially and out-migration occurred toward the east into the Black Range and to the southeast.

Subsistence focused on horticulture and foraging with an increased emphasis on farming through time as evidenced by village size, farming strategies, shifts in ratios of large-to-small game exploitation, greater percentages of jackrabbits in archaeological remains, and ground stone use. Through-trough metates which were associated with maize processing, generally increased in size and numbers. The number of formal chipped stone tools decreased from the Early Pithouse through Classic periods, although there were always more in the upper than the lower valley. Stone hoes with use-wear were found at NAN and Cameron Creek. Postclassic evidence in the Eastern Mimbres suggests that a more prudent exploitation strategy which did not deplete wild and domestic resources as quickly as during the Classic was used.

Architectural changes occurred as pit houses evolved from small, round, oval, or bean-shaped structures during the Early Pithouse period to increasingly rectangular houses in the Late Pithouse period. A greater number of houses were remodeled and many entryways were extended. Most dramatic of the architectural changes was the shift from semi-subterranean to above ground structures during the late Late Pithouse to

Classic period transition. In the Classic period, there was greater variety in room function and size, and the use of cobble and mortar walls and plastered floors and walls became common. Some exceptions to this included cobble and/or slab-masonry wall construction in some of the late pit houses at Galaz, NAN, Old Town, and Cameron Creek and, flat roofs during the late Late pithouse period at NAN and Old Town. Architecture at NAN during the Classic period evidenced differences in quality of construction between two of the room blocks, while Classic period architecture at Saige-McFarland was unusually uniform among the room blocks.

Communal areas grew dramatically culminating with the construction of Great Kivas in the Three Circle phase of the Late Pithouse period, some of which were used into the Classic period. Late Late Pithouse and Classic period communal structures at Galaz and Old Town had some architecture that differed from the norm. The Great Kiva at Galaz was the largest in the Mimbres area and included unusual features and artifacts, such as green stones set in the floor, a sipapu and a bead enwrapped macaw burial. A communal grouping at Old Town included a platform mound and associated disarticulated male burial, large communal structures, and associated road.

During the Late Pithouse and into the Classic period, burials were in abandoned room fill, later shifting to sub-floor and open areas adjacent to room clusters. Interments in middens and extramural plazas increased during the Classic period. Most burials were flexed or semi-flexed until Postclassic times when cremation was predominant. Cranial and post-cranial burials were found at Galaz and Old Town, and midden burials at NAN and Cameron Creek showed differential treatment between plaza and sub-floor

interments.

Treatment of grave goods changed from the inclusion of a whole vessel and/or scattered sherds to placing of a whole, "killed" vessel or vessels over or near the deceased's head. The quantity of grave goods increased through time, but were always greater in the Mimbres Valley burials than in those occurring elsewhere. Atypically, grave goods associated with burials in the South room block at NAN were richer than those in the East room block, and at Galaz and Saige-McFarland unusually large numbers of ceramic vessels were in two graves. At NAN, female burials usually had more ceramics than males, awls were only with females, shell bracelets occurred most often with adult men, and palettes were only with infants or children. At Galaz, certain combinations of grave goods, such as turquoise and shell or ceramics and jewelry tended to co-occur. Grave good patterns at some of the study sites may reflect more intensity of excavation and/or analyses than many sites in the Mimbres region, and thus some of the burial related trends may not reflect differences, but rather that the norm is not known at this time.

Painted ceramics changed dramatically in design style and production quantity as the earliest painted pottery, Mogollon Red-on-brown, was quickly succeeded by Three Circle Red-on-white. By A.D. 900 or possibly earlier, black-on-white designs appeared and increased in quality and quantity, perhaps 30 times greater in numbers by the middle Classic period than earlier. By A.D. 1140, painted vessel production was low and design elements, such as rim bands, often were sloppily done. Stratigraphic continuity of Style II black-on-white is not as clearly reflected at Galaz and Saige-McFarland, while at Saige-

McFarland an unusually large percentage of Mogollon Red-on-brown occurred in all time periods.

Hearths evolved from informal, shallow depressions in the Early Pithouse period to formal, circular but unlined ones in the Late Pithouse period. During the Late Pithouse to Classic transition, formal adobe or slab-lined hearths predominated. Storage pits beneath house floors decreased from the Early Pithouse to Late Pithouse period when a few unattached, above ground structures likely were used for storage. Rooms within the room blocks were used for storage during the Classic period.

Review of Economic Factors

The ceramic iconographic and compositional patterns function to support the presence of alliances/groups within the Mimbres society and that group membership changed through time. These patterns have performed a passive, reflective role for research purposes. The study hypotheses, however, also claim an active, mediating role for the icons in the formation and re-formation of the groups. The idea that icons both motivated and maintained alliances can best be supported by demonstrating co-occurrence of change between icon-exchange patterns and one or more other systemic elements. If icons were merely reflective, there likely would be a lapse in time between any impacting ecological change or changes and icon spatial distribution variability. Further, the co-occurring systemic changes should be highly variable in terms of degree or length and impact a major organizational component of Mimbres society such as economics, politics, or religion, in which significant variability would impact the society in such a way as to elicit a group response.

Earlier in the study, environmental and demographic conditions as well as farming strategies were reconstructed and discussed. These three elements likely had direct impact on Mimbres agricultural success and sufficiency. Water was a primary factor in horticultural success in the semi-arid Southwest, and various farming strategies probably helped conserve or increase water availability. Demographic conditions including population numbers and settlement patterns influenced crop sufficiency because more people needed more food, and both the numbers and the locational residency of these people affected the amount of land available for planting as well as proprietorship.

Environment. Environmental reconstruction was based primarily on data and inferences taken from Minnis's (1985) study. Recent tree-ring indices from the Mimbres Valley served to support his findings on precipitation patterns. In addition, other factors such as ground water, stream flow, elevational differences, length of growing season, and flooding were considered. About one-half of Classic Mimbres dietary needs probably were filled by domesticated products, primarily maize (Minnis 1985). The main factors affecting sufficiency of domestic production were amount and availability of water and amount and fertility of farm land.

Precipitation in the Mimbres region is relatively marginal for maize growth which requires about 25 cm of water during the growing season (Minnis 1985). Average precipitation amounts in the valley vary from about 43 cm in the upper valley to a little over 30 cm in the lower reaches of the valley (Gaben and Lesperance 1977). The greatest amount of rain falls in the summer, but it does not normally begin until about two months after maize is planted and often the precipitation is very locally specific and almost

always comes in the form of violent thunderstorms (Parham et al. 1983). Sudden cloud bursts dump large amounts of water onto parched fields, and the result is a high percentage of run-off with much less water actually soaking into the ground where it can be used by crops. Additionally, evapotranspiration rates in the summer exceed rainfall (Anyon and LeBlanc 1984). In such a situation, irrigation likely would be a necessity for providing the required moisture to the plants, and thus both rainfall amounts and stream flow adequacy were important.

Minnis's (1985) study indicated that extended periods of low precipitation occurred during the A.D. 970s, A.D. 1030 to 1045, A.D. 1090 to 1120, and again from A.D. 1130 to 1140. Stream flow was reckoned by Minnis (1985) to be adequate for irrigating the 1512 hectares of arable land in the valley during average or above average years, although stream flow for irrigation would also have been affected by soil permeability, levelness of fields, and underlying geologic formations (Creel 1996; Herrington 1982; Minnis 1985). Also, distance between the underlying volcanic rock which forces water to the surface varies considerably throughout the valley (Ackerly 1995; Creel 1996). Some years of low rainfall might be balanced in sections of the valley by stream flow adequate for irrigation. However, it is unlikely that a number of successively dry or low precipitation years could be overcome in this manner.

Using ethnographic data, Minnis (1985) estimated it would take 0.6 hectares of land per person in below average rainfall years to provide one-half of a person's dietary needs. By correlating caloric needs and availability of wild resources within the Mimbres catchment area, it was determined that during years of average precipitation there would

be adequate wild resources to fill the other 50 percent of dietary needs. He also suggested that these consumption requirements were supplemented by upland dry farming.

Farming strategies. Research, especially by Herrington (1979, 1982) and Sandor (1983), have demonstrated that the late Late Pithouse period and Classic period Mimbres people employed a number of farming strategies aimed at increasing crop success. Evidence of prehistoric irrigation has been found in the Mimbres Valley and nearby uplands (Herrington1979, 1982; Shafer personal communication, 2000). Other farming strategies included water conservation and diversion devices, such as dikes, check and spreader dams, and terraces in the uplands and nearby drainages (1982) in these same regions. Archaeological evidence, ethnographic data, and population estimates strongly indicate that irrigation was a necessary strategy in order for the Classic Mimbres people to have sufficient food.

Population. Crop sufficiency and land availability are measured against population size. Population estimates suggested for the Mimbres area during the study period differ due to varying values assigned to room use-life, space or room numbers per person, and consistency of the values over time. Anyon and LeBlanc (1984) estimated that during the late Late Pithouse period the valley sustained 553 people if each person required $6m^2$ of floor space and there was a three percent growth rate. Using the same values, they estimated a little over 3200 people inhabited the valley during the Classic period. Blake et al. (1986) figured growth rate for the Late Pithouse period was 0.25 percent and for the Classic period from 0.83 to 1.00 percent. They suggested about 3330 people lived in the valley in Classic times with over one-half of these residing in 11 large

sites of 125 to 200 rooms each. Blake et al. (1986) also projected that during the tremendous growth rate evidenced in the Classic period, nearly as many people as during the entire Late Pithouse period resided in large side drainages. They noted that residences increased in narrow drainages, uplands, and mesa tops after the Late Pithouse period.

Environmental, Farming Strategies, and Demographic Synthesis

Environmental reconstructions suggest that farming was a risky subsistence practice during the A.D. 970 to 1140 time frame. Average moisture was low, and fluctuations in seasonal and annual patterns of precipitation increased crop uncertainty. The use of a number of risk reducing farming strategies supports the marginality of horticulture in the semi-arid Mimbres region. During the late Late Pithouse period to early Classic times, population grew substantially. A number of below average years of rainfall occurred in the A.D. 970s, during which about 40 percent of the time some food stress was experienced, and after which hard times did not occur again for 50 to 65 years. From A.D. 1030 to 1045 a little over one-half of the years were inadequate for meeting the dietary needs of the people (Minnis 1985). During this time, population continued to grow with possibly as many as 2500 people inhabiting the valley's large aggregated villages and side drainages. After A.D. 1045, precipitation was adequate or above for crop success and, it was not until near the end of the century that another drought began. From A.D. 1045 to 1090, there were no stressful years, and over one-half of the years produced above average crop yields (Minnis 1985). A 30 year below average precipitation stretch was experienced from A.D. 1090 to 1120, during which time Minnis (1985) suggested food stress was likely experienced for about 13 of the years. A meager

10 year respite for recovery was followed by another 10 years of inadequate rainfall, resulting in at least seven to eight years of food stress (Minnis 1985). During the Classic period, population shifted from the drier, lower valley to the more mesic upper valley (Blake et al. 1986).

Responses to Subsistence Stress

Risk and uncertainty are and probably always have been a part of life for humans. Environmental and cultural variability are frequently unpredictable in that they may vary randomly in spatial, temporal, and scalar ways (Adler 1996; Halstead and O'Shea 1989). Human beings respond to these variables through a host of mechanisms which match in degree the level of the perceived threat of the uncertainty (Minnis 1985). For example, among tribal horticulturalists and peasant farmers, stress is most often associated with uncertainty regarding environmental fluctuations which affect crop yields. A range of possible outcomes for fluctuations in rain may be mentally noted by the farmer or society, and subsequent mechanisms within their knowledge base weighed for effectiveness against the unknown variables of future rainfall. The degree and intensity of response to uncertainty depends on the farmer's perception of risk and possibilities of outcomes associated with various strategies.

Strategies to minimize anticipated threats are based on societal size and density, type and intensity of subsistence base, levels of technology, societal world view and rules, and exploitation of resources, and may include storage, exchange, mobility, and diversity. Halstead and O'Shea (1989) and Minnis (1985) have noted that the most efficient mechanisms are those that are low-level with little investment in time, energy, or

resources, although these may be quite limited in degree and range of effectiveness. High-level strategies correlate with perceived high-level stressors which come with large initial investments and maintenance costs. Such responses often are embedded within social institutions in order that they will be in place when rare occurrences of severe uncertainty occur. Other generalizations about stress responses suggest that 1) stress response choices are not always optimal in terms of actual positive economic outcome because all groups include extra-economic social institutional constraints when choosing their response; 2) stress response mechanisms tend to become layered as social complexity increases; 3) the choice of response is generally a compromise between the perceived threat and desired outcome; 4) people do not necessarily make decisions beneficial to individuals or to the group; and 5) social mechanisms are the most powerful of response strategies (Adler 1996; Cashdan 1990; Halstead and O'Shea 1989; Johnson 1978, 1982; McCay and Achesson 1987; Ortiz 1980; Winterhalder 1990).

Responses of storage, exchange, mobility, and diversity can be implemented and manifested in many specific forms. For instance, Hames (1990) demonstrated that among the Yanomami exchange takes the form of sharing, that frequency of sharing increased with fluctuations in resource availability, that as uncertainty increased more families became involved in sharing, and that kin directed sharing decreased when a high level threshold of threat was reached. In this case, responses to uncertainty manifested as exchange or sharing and included specific guidelines concerning the type and direction of sharing as constrained by social perceptions and others' actions.

Mobility in the form of multiple residences, or "punctuated abandonment," is used

by the Raramuri of northern Mexico who have dispersed agricultural plots and associated dwellings (Graham 1994). The Khar o Tauran also respond to subsistence threats with a mobility strategy. They practice irrigation agriculture and animal husbandry, live in a semi-arid environment with permanent, year-round villages composed of baked mud block structures as well as having specialized summer stations and semi-subterranean winter residences (Horne 1993). The permanent villages, however, are not necessarily occupied continuously and may end, after only a short occupation in terminal abandonment or planned/unplanned, spaced re-use. For the Khar o Tauran, subsistence uncertainty is a direct result of irrigation and land use, both of which become less and less efficient and profitable as population increases and individual claims to land parcels grow.

Minnis (1985) suggests that strategies against food shortage may include procurement diversification as well as increased social and alliance interactions. He uses examples from the Tikopia taro farmers of the western Pacific, the Fringe Enga of western New Guinea who primarily raise sweet potatoes and pigs, and the Gwembe Tonga farmers of Zambia to illustrate use of these strategies. Minnis (1985:17) also notes that responses to subsistence threats involve the "historical, environmental, social and cultural context of each group," and that the number of groups involved parallels the intensity of response.

Rautman (1993) tests for the presence of alliances among ancestral Peubloan peoples of central New Mexico (A.D. 900-1250) by correlating ceramic style frequencies among spatially distant villages with climatic variables. Her outcomes strongly support

the idea that villages were allied in an exchange or sharing strategy to insure food availability. M. Nelson (1999) argues that during the Classic to Postclassic transition in the Mimbres region dispersal from aggregated villages to small hamlets, farming of smaller, more numerous plots, and possibly sequential residency were high level social responses to food stress intensity.

Iconography, Stress, and Group Responses

It is proposed in this study that a relationship exists between iconography and social group formation in which icons play an active role as well as a passive, reflective function. The theoretical model suggests that iconography acts as an interface or filter between external events, such as environmental variation, and social responses to those events by encoding ideology. The icons, therefore, carry messages about how the world is perceived or interpreted and about appropriate interactions and responses by members of the society to events. Thus, when something happens it is normally perceived and reacted to according to socially acceptable parameters. Events and responses are scalar and parallel each other in intensity. A small event may necessitate only an individual response; more intense events elicit more inclusive responses, such as action by a family, clan, or other type of group.

In this study, a case has been made that the Mimbres economy was moderately affected during two different and widely separated decades (i.e., A.D. 970-980 and A.D. A.D. 1035-1043) between A.D. 970 and 1060, and that it was significantly threatened or impacted by environmental variability during the middle Classic period, A.D. 1060 to 1140. Environmental conditions, farming strategies, and demography demonstrate

increasing imbalance between resource sufficiency and population in the last half of the middle Classic and into the late Classic period. The length and intensity of droughts compounded by a large population created a real threat to food sufficiency.

Mild droughts during the late pre-Classic and early Classic period co-occurred with the presence of two groups, Galaz-NAN-Cameron Creek and Galaz-NAN, and a moderate exchange focus on Galaz. During the latter half of the middle Classic period, a long, severe time of low precipitation and maximum population correlated with strong unification of Galaz-NAN-Old Town-Cameron Creek into one group sharing fish-bird icons and taking large numbers of iconographic vessels to Galaz. Continued overall low rainfall compounded by the middle Classic population climax combined in the late Classic period to create food insufficiency that could not be overcome in the heartland and surrounding uplands. Coping strategies probably intensified and shifted from those used earlier. Severity of threat and altered responses are supported by lack of icon exchange which is nearly non-existent in the late Classic period.

Because temporal and spatial ceramic distributions co-occur with environmental variability, the iconographic vessels cannot be seen as merely reflective of social activity resulting in group formation and re-formation. Co-occurrence suggests that the icons were a functional element of group action related to economic impacts from environmental-demographic conditions and played a mediating role in a group response to economic uncertainty that entailed spatially and temporally differential interaction between the villages evaluated in this study.

Iconographic Bowls, Exchange, and Distribution

The iconographic-exchange data have demonstrated that different sets of villages were allied through ceramic interaction from A.D. 970 to A.D. 1140. However, the question of 'why would ceramics be exchanged during times of stress?' must be addressed. Vessels, of course, might serve as containers for transporting items of exchange. For example, they could be used to transport food. However, in a study measuring 699 Mimbres black-on-white bowls from Galaz, including all temporal styles, mean depths were from about 8-9 cm and mean diameters were 18-20 cm (Powell 1992). These measurements indicate that Mimbres' bowls are quite shallow, and the likelihood of their use in transporting food is slim. Almost any solid or liquid would eventually spill out of transported Mimbres bowls.

Perhaps the bowls themselves were exchanged for another commodity, such as food. Two objections are evident here: 1) although some villages may have suffered more than others from the droughts due to the locally specific nature of summer thunderstorms, it is not likely that any village had surplus food for more than one or two years due to available surplus amounts, storage capabilities, and spoilage, and 2) although production of black-on-white vessels increased immensely during the middle Classic period, the earlier cited Galaz study revealed no statistically significant standardization for these vessels. Standardization, or uniformity of size and shape, would be expected if the vessels were an exchange commodity because increased production for surplus as well as nestability for transport normally result in some degree of vessel standardization (Costin 1991)..

Longacre (1991) documented ceramic distribution associated with gift giving among the Kalinga of north-central Luzon in the Philippines. He noted that among the Kalinga gifting usually occured among kin and was intended to strengthen familial ties. Cancian (1972) and others (i.e., Halstead and O'Shea 1989; Hames 1990; Ortiz 1980; Wiessner 1990) have indicated that groups coalesce in stress reduction strategies related to food insufficiency. Mimbres iconographic bowls may have been gifts given at communal gatherings between family or kin members or other types of groups in order to establish or reinforce relationships. A shared iconographic motif might indicate membership in a group while individual elements of the iconographic design could identify single members and/or sub-groups. Earle (1990) noted that display objects (i.e., symbols/icons) have an active role of communicating group membership, defining relationships among groups, and delimiting group rules of access. Individuals belonging to or joining a group might make and exchange a vessel with their personal identifying symbol(s) embedded in the group and/or societal icon.

Braun (1991) showed that changes in vessel decoration over time were tied to changes in group organization at the level of the household. Braun's pots were everyday ware used in a domestic situation, not publically visible, and therefore they were linked to a small social unit, the family. Although most Mimbres black-on-white iconographic vessels show use-wear, they almost certainly were not everyday ware for several reasons (Bray 1982). The time and effort entailed in obtaining kaolin for the white slip, technical skills involved in manufacturing the thin walled vessels, and time and skill needed to create the sophisticated designs indicate that the bowls held a unique and valued position

in Mimbres society. Following Braun's (1991) thought, the Mimbres black-on-white vessels likely were not domestic, everyday ware and so associated with family units, but more probably related to supra family groups and public events. The iconographic bowls, then, may have been for gifting and/or feasting at public events in order to identify an individual, as well as that individual's membership in a group or groups, to reinforce group ties, and to indicate group as well as societal rules of behavioral response. In addition to functioning as a messaging agent, the bowls may have ben used for eating/serving containers at feasts and/or ritualistic offering vessels.

Longacre (1991) noted that bartering is also an important aspect of ceramic distribution among the horticultural Kalinga. His study indicated that about 800 pots out of a sample of 1000 were involved in extra-village exchange and that most were traded for commodities such as rice or other foods, and occasionally for other items such as minerals for paint. Like Mimbres villages, none of the Kalinga bartering villages were far apart (less than 5 km). Bartering could be a possibility among the Mimbres, especially during the earlier, agriculturally beneficial times of the A.D. 970 to 1060 period. Some areas of the valley may have had higher maize yields in some years than others, and vessels may have been bartered for corn, but during extended dry periods, as noted above, it is doubtful that any village or individual would have surplus with which to barter after one or two years. As well, ceramic distribution patterns likely would be less distinctive than have been shown by this study if they resulted from intra-valley precipitation variability. Given the nature of summer rainfall in the Southwest, micro-variability within the valley or heartland would result in frequently shifting areas of high and low

crop yields, creating more fine-grained patterns than could be seen in the archaeological record.

Soil fertility and/or depletion could result in areas of higher and lower yields from which a ceramic-food commodity bartering system might emerge. Ceramic bartering distribution patterns consequent of soil variability would change less frequently than those resulting from intra-valley precipitation rainfall fluctuations because normally soil properties change over extended periods of time and even 40 percent fertility (nitrogen) depletion of soil generally takes 50 years in modern corn crop fields. As well, although Mimbres soil fertility has been shown to decrease through time, soil depletion has not been demonstrated (Sandor and Gersper 1988). Bartering does not seem a likely candidate for iconographic-exchange distribution patterns plotted in this study in light of the locational variability of summer rainfall, the nature of soil change and length of depletion, and the lack of vessel standardization.

In Rautman's (1993) study cited above, she uses modern data to model environmental fluctuations in central New Mexico from about A.D. 900 to 1250 in order to predict alliance partners among a number of villages. Stylistic distribution of ceramics at the study sites confirmed her predictions that alliances between villages likely formed based on anticipated high yields at one of the two villages during any given year and agreements of resource sharing between these same villages. Interaction and ceramic movement occurred as the result of travel between partners of the "alternative resource area" villages either to cement relationship and/or to access food commodities. Arguments against this explanation for ceramic distribution patterns in this study

correspond to those regarding intra-valley rainfall variability, soil conditions, surplus quantities, and vessel production costs noted in association with commodity transportability and bartering discussed above.

Another option for the ceramic distribution in association with group action could be that bowls were transported by individuals attending ceremonial and/or feasting events. Because the icons probably carry several levels of meaning, possibly including individual and kin identity as well as the society's ideologic concepts, a person may have taken to a ritual one or several bowls identifying himself/herself as well as his/her membership in a kin group and/or other group memberships. Individualistic identity elements of the design may pertain to one person and possibly associate that person with the function or role (i.e., eating, serving, offering) of that particular bowl. Likewise, kin and/or group associated design elements may link the individual with a group and place the owner of the bowl within the constraints of that group's ethos, while the overall icon may relate the person and group to Mimbres societal ideologic concepts. Thus, an individual's bowl might contain the food he/she would consume during a feast, might be a serving or communal dish for his/her group(s), and/or function as an offering dish during a ceremony as well as identify the person as Mimbres and encode appropriate individual, group, and societal perceptions and behavior. One dish might serve all of these purposes, or perhaps a person would take two or three bowls to a ritual and feasting occasion. Dishes that functioned as eating/serving bowls during feasting should have wear marks on them from utensils, while dishes containing offertory foods might not display such use marks. However, if one dish served several purposes, or if dishes were

used for functions at temporally separate events, then the presence of use-wear on many of the vessels would be explained.

It is plausible that rituals increased in importance and/or frequency when uncertainty and stress were high. In a non-stratified society, religious-politico, economic, and social aspects are inextricably linked. Economic success is likely perceived as being as dependent on religious practices as it is on environmental conditions, and absence of rainfall at crucial times and/or inadequate amounts likely would be attributed to disfavor of the deity or deities associated with rain and horticultural success. Acts of propitiation, such as sacrifices, offerings, petitions, and other rituals, would surely increase during unfavorable times. Pauketat and Emerson (1991:919) note that rites of intensification "play a critical role in the resolution of cosmological discontinuities" and that such events entail community or group participation as an essential component. Thus, with the middle Classic Mimbres we have more bowls of high value likely used at public group events with icons painted on them that define various group memberships as well as ideologic concepts.

Embedded within the rites of intensification and associated iconographic ceramics, an additional group response to subsistence uncertainty may be found. If groups also functioned in alliance to define and protect land-use and/or water rights, then icons might identify members of these alliances as well as encode appropriate response behaviors. It is also possible such a function of the icons was independent from ceremonialism and that icon distributions resulted from cooperative behavior between linked villages in protecting and maintaining land and water access. The focus on Galaz,

especially during the Middle III times, likely does not indicate reciprocal interaction associated with land and water maintenance work, although it could suggest that Galaz played a managerial role in such a strategy.

Conclusions

It was noted earlier that the data indicate greater unity of the heartland villages during the middle Classic times than earlier, and that exchange at this same time focused on Galaz. This may reflect a more inclusive and more costly response mechanism paralleling greater stress than was in place during the late Late Pithouse and early Classic period. Perhaps, Galaz had become a focus for ceremonial activities. During the Three Circle phase of the Late Pithouse, Galaz already had the largest kiva in the Mimbres branch. The Great Kiva was superceded sometime around A.D. 1000 by Communal Structure 73 which was somewhat smaller, but "much more elaborate" (Anyon and LeBlanc 1984:125). As noted in Chapter IV, Structure 73 contained a sipapu filled with white sand, two polished and embedded green stones north and south of the sipapu and pointing toward it, a military macaw wrapped in turquoise and shell beads beneath one of the greenstones, a 1.22 m long arc inscribed in the floor, and floor embedded logs (possibly foot drum remains). The entry ramp of Structure 73 opened onto a large open area at the center of the village. Communal structures used during the Classic period at the other study sites do not compare with Galaz Structure 73 in size or elaboration.

Galaz and Old Town did share mammal icons in high percentages during the middle Classic period and both had cranial and post-cranial (sacrificial?) burials. As well, Old Town had unusual ceremonial architecture and received vessels from NAN,

Cameron Creek, and Saige-McFarland, albeit in low percentages. It is not clear what this may mean, but perhaps Old Town shared a secondary, but similar role to Galaz or had some special ritualistic function not revealed by the exchange data.

Iconographic bowl production proliferated during the middle Classic time, drought periods were longer and more severe, and the population continued to increase. Stress resulting from economic uncertainty was greater than it had ever been for the Mimbres people. Communal events aimed at mitigating economic insufficiency likely increased somewhat during the earlier time period, but especially in the latter half of the middle Classic. Mimbres icons with their multiple embedded elements and motifs of scalar identifications and ideologic directives were ideally compact, highly visible group directives. Robb (1998:330) observes that "[Icons] work because of the coherent ties between different kinds of meanings [i.e., personal and group identity as well as ideology] which make . . . participation compelling, identity meaningful, and ritual effective." Galaz may have functioned as the focal point for rites of intensification during the middle Classic food shortage and possibly as a center for land–water management. The great proliferation of vessels at this time, especially the large sample at Galaz, along with a high percentage of importation at Galaz, and the dual use of the public plaza and more private, enclosed Structure 73 for rituals and/or feasting suggest that at least part of the group interaction included rites of intensification in which iconographic vessels played a significant role in membership identification and encoded ideologic behavioral directives. Distribution of the icons, their co-occurrence with times of perceived and real food stress, population estimates, and other supporting archaeological evidence such as increased

dependence on agriculture suggest that the iconographic designs on Mimbres black-on-white bowls were actively functioning in the formation and re-formation of village alliances associated with group responses to economic insufficiency during the late Late Pithouse and Classic periods of the Mimbres society.

As noted at the beginning of the study, the exact meaning of Mimbres iconographic messages may never be known. Hodder's (1991a) study of Ilchamus decorated calabashes clearly demonstrates the multi-level nature of messages carried by symbols and emphasizes Crown's (1994:131) statement that "most attempts at interpreting . . . [the] content of pottery designs have depended on . . . informants." However, by examining the "nature of [their] presentation, the context of their use, and the pattern of their distribution" (Earle 1990:74), we may understand a function of the Mimbres icons by recognizing associated behavior. Perhaps, no more can be said with confidence of the Mimbres icons at this time than that they were highly specialized symbols co-occurring with group formation and re-formation during the late Late Pithouse and Classic period. Inferences from co-occurring events and contextual materials, however, suggest that the icons likely were associated with group responses to stress in the form of ceremonialism , and possibly, resource management.

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APPENDIX A

SAMPLES SUBMITTED FOR INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS

ID#	SITE	PROV	INST/#	NAT	STYLE	WHOLE/ SHERD/ RIM
VSP001	OT	-	AR47-133-16	Y	E/MIII	W
VSP002	OT	-	AR47-133-24	Y	MIII	W
VSP003	OT	-	UT1684-58	-	I	S
VSP004	OT	-	UT2086	-	I	S
VSP005	OT	-	UT1674	-	I	S
VSP006	OT	-	UT1693	-	I	S
VSP007	OT	-	UT2399	-	I	S
VSP008	OT	-	UT2397	-	I	S
VSP009	OT	-	UT1576	Y	I	S
VSP010	OT	Area C	UT1926	Y	II	S
VSP011	OT	Area B Unit 9, Rm.B8	UT2880a	-	LII	S
VSP012	OT	Area B Unit 9, Rm.B8	UT2104	-	EII	S
VSP015	OT	Area A	UT565	-	LII	S
VSP016	OT	Area B	UT1414	-	EII	RS
VSP017	OT	Area A	UT85	-	LII	S
VSP018	OT	Area A	UT376	-	LII	S
VSP019	OT	Area A	UT49	-	LII	RS
VSP020	OT	Area A	UT12	-	E?II	RS
VSP021	OT	Area A	UT85	-	E?II	S
VSP022	OT		UT2527	-	LII	RS
VSP023	OT		UT2121	-	LII	RS
VSP024	OT	Area A	UT1532	Y	EIII	S
VSP025	OT	Area A	UT1074	Y	E/MIII	S
VSP026	OT	Area A	UT1522	Y	MIII	S
VSP027	OT	Area A	UT1071	Y	LII?/EIII	S
VSP028	OT	Area C	UT1760	-	MIII	RS
VSP029	OT	Area C	UT1933	-	MIII	RS
VSP030	OT	Area C	UT2672	-	MIII	RS
VSP031	OT	Area A Unit 1C	UT414	-	LIII	RS

VSP032	OT	Area A Unit 1C	UT1	-	MIII	RS
VSP033	OT	Area A Unit 1C	UT12	-	MIII	S
VSP034	SM	Rm11, L3	LA6494	-	I	RS
VSP035	SM	Rm11, L3	LA6494	-	MIII	RS
VSP037	SM	Rm13, L4	LA6526	-	MIII	RS
VSP038	SM	Rm13, L4	LA6526	-	EIII	RS
VSP039	SM	Pl620 E510, L2	LA6824	-	I	S
VSP040	SM	Pl630 E646 L2	LA6514	?	EIII	RS
VSP041	SM	Pl620 E510 L2	LA6824	-	LIII?	RS
VSP042	SM	Pl630 E640 L2	LA6514	-	LII	RS
VSP043	SM	Rmll, L6	LA6494	-	EII	RS
VSP044	SM	Rm5, L2	LA6482	-	I/EII	RM
VSP045	SM	Rm12, F17	LA6823	-	EII	S
VSP047	SM	Pl, F44	LA6824	?	MIII?	RM
VSP048	SM	Rm12, L8	LA6823	?	MIII	RM
VSP050	SM	Rm12, F17	LA6823	-	I	RM
VSP052	SM	Pl620 E510 L2	LA6824	?	LIII	RM
VSP053	SM	Pl620 E510 L2	LA6824	?	E/MIII S	
VSP054	SM	Rm11, L6	LA6494	N	LII	RM
VSP056	SM	Pl620 E510 L2	LA6824	?	EIII	S
VSP057	SM	Pl620 E510 L2	LA6824	-	LIII	RS
VSP058	SM	Pl620 E510 L2	LA6824	-	LIII	RS
VSP054	SM	Rm5, L1	LA6482	-	E/MIII	S
VSP060	SM	Pl640 E550 L4	LA6514	N	MIII	S
VSP061	SM	Pl620 E510 L2	LA6824	-	LIII	RS
VSP062	SM	Pl640-650 E550, L4	LA6514	-	EIII	RS
VSP063	SM	F1, 640 E540	LA6514	-	EIII	RS
VSP064	SM	Rm.P1 U, L2	LA6519	-	EII	S

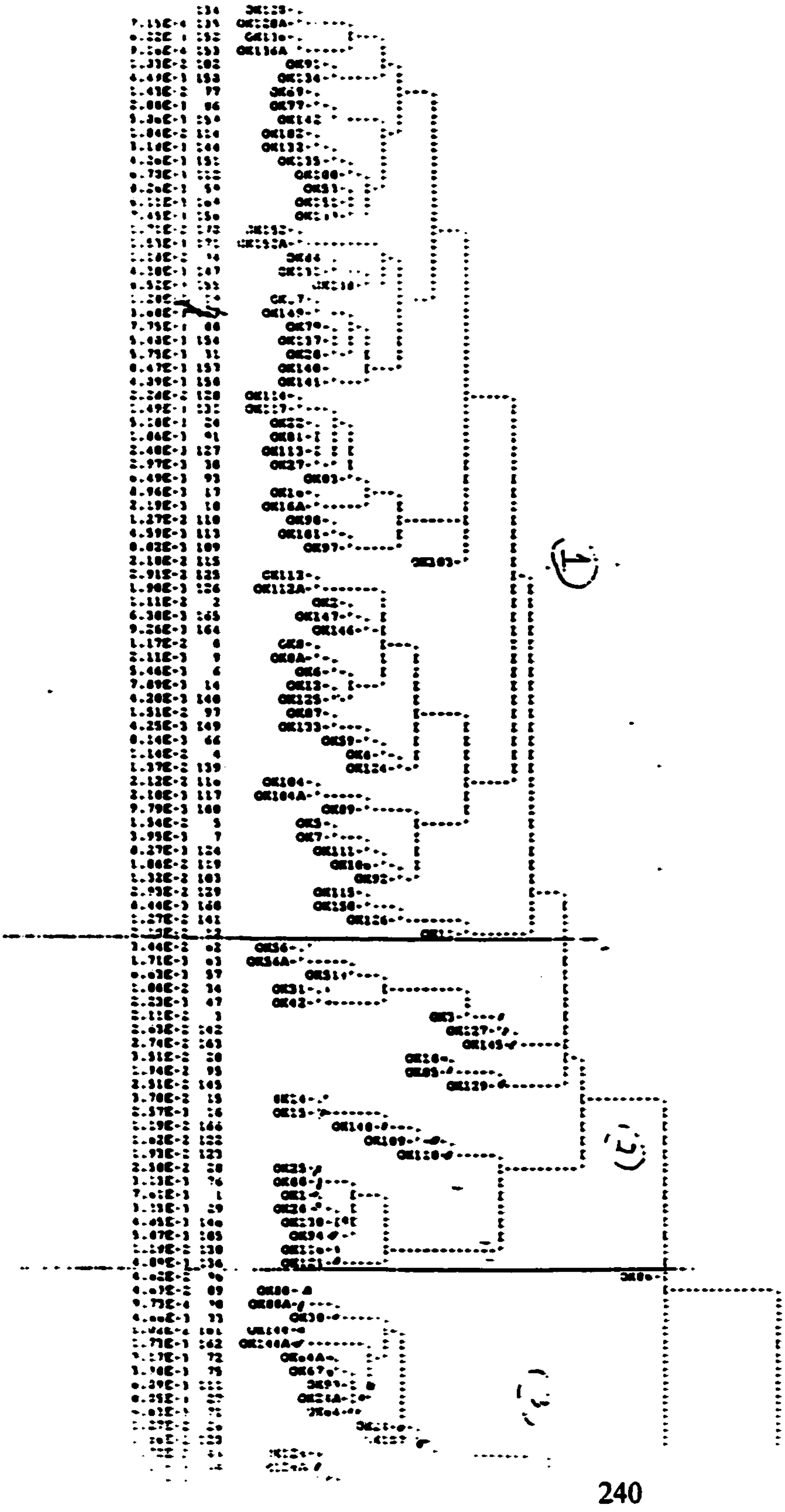
VSP065	SM	Rm11, L4	LA6494	-	E/MIII	S
VSP068	SM	Rm5, L1	LA6482	-	EII	RS
VSP069	SM	PI620-30 E510, L2	LA6487	-	LII	RS
VSP070	SM	RmP1, 610 E510, L5	LA6519	-	I	S
VSP071	CC	LA190, PR148	LA6657	-	I	S
VSP072	CC	LA190, PR148	LA6657	-	I	S
VSP074	CC	LA190 Bt PR 100 & 108	LA18731	-	EII	S
VSP077	CC	LA190 Bt PR 100 & 108	LA873	?	EII	RS
VSP079	CC	LA190	LA15978	-	LII?	RS
VSP080	CC	LA190 PR114	LA6444	-	LII	RS
VSP084	CC	LA190 Bt PR 100 & 108	LA873	-	EIII	RS
VSP085	CC	LA110 PR105	LA6657	-	EIII	RS
VSP091	CC	LA190 PR116	LA873	N	M/LIII	RS
VSP092	CC	LA190 PR114	LA6657	-	I/EII	RS
VSP093	CC	LA190 Kiva	LA3722	N	EIII	S
VSP094	CC	LA190 PR148	LA6657	N	MIII	RS
VSP098	CC	LA190 Kiva	LA3722	N	M/LIII	S
VSP099	CC	LA190 PR108	LA6447	N	MIII	S
VSP100	CC	LA190 PR110	LA3720	N	MIII	RS
VSP101	CC	LA190 PR107	LA3719	N	MIII	S
		(17)				
VSP104	CC	LA190	LA15978	N	M/LIII	RS
VSP105	CC	LA190 PR116	LA873	N	MIII	S
VSP107	CC	LA190 PR111	LA6657	N	II/III	S
VSP109	CC	LA190-1928	LA15839	N	EIII	S
VSP11-	CC	LA190 PR114	LA6659	N	MIII	

S							
VSP112	CC	LA190 PR114	LA6659		N	II/III	
S							
VSP114	CC	LA190-1928	LA5839	N	EIII		S
VSP116	CC	LA190-Kiva	LA3722	N	EIII		S
VSP117	CC	LA190-test trench 50' W of N house	LA3720	N	MIII		RS
VSP118	CC	LA190 PR116	LA873		N	MIII	
S							
VSP121	CC	LA190-Kiva	LA3722	N	II/III		S
VSP123	CC	LA190-1928	LA15839	N	MIII		RS
VSP125	CC	LA190	LA15978	N	I		S
VSP126	CC	LA190 Bt PR 100 & 108	LA873	-	I/EII		RS
VSP127	NAN		King	N	MIII		S
VSP128	NAN		5-977(22)	N	MIII		S
VSP129	NAN	Rm15, L5 99.95-99.38 1982	87-1/5-1468(15)-		LII		S
VSP130	NAN		Type Col.78-1/N 3-74(48)		EIII		S
VSP131	NAN		Type Col.78-1/N 4-26(59)		LII		S
VSP132	NAN		78-1/0	N	MIII		S
VSP134	NAN	AreaD,Rm50 SW quad,L3	78-1/3-568(50)	N	MIII		RS
VSP135	NAN	SW F3	Type Col.78-1/C		N	MIII	S
VSP136	NAN	Rm15, Unit 6 1982	78-1/5-98.97-98.62	-	LIII		RS
VSP139	NAN		Type Col.78-1/ADEFS	N	MIII		S
VSP140	NAN		King	N	MIII		RS
VSP141	NAN	Area D, NW quad,Rm50,L2	78-1/3-236 (50)	-	EIII		RS
VSP142	NAN	Area D, N of Rm50	78-1/3-349 (50)	-	EII		RS
VSP143	NAN	Area D, N of Rm50	78-1/3-349 (50)	-	EII		RS
VSP144	NAN	Area D. NW Quad.Rm50,L2	78-1/3-236 (50)	-	I		S

VSP145	NAN	Area D, NW Quad, Rm50,L2	78-1/3-236 (50)	-	EIII		S
VSP146	NAN	1x3m strip#3 L2	78-1/4-782 (50)	N	MIII		S
VSP147	NAN	1.3m strip#3 L2	89-14-782 (50)	-	EIII		RS
VSP148	NAN	Area D,Rm50 NE Quad	78-1/3-67 (50)	-	EIII		S
VSP149	NAN	Rm15, Unit 5 98.98-98.88	1982	-	II/III		RS
VSP150	NAN	Rm15, Unit 6 98.76	78-1/5-1410	-	EII		S
VSP151	NAN	Area D, Rm50 SE Quad, L3	78-1/3-562 (50) 1980	-	EIII		RS
VSP152	NAN	Rm50, NE Quad L3	78-1/3-387	N	EIII		S
VSP153	NAN	Rm50, NE Quad L3	78-1/3-387	-	LIII		RS
VSP154	NAN	Rm50, NE Quad L3	78-1/3-387	-	II/III	S	
VSP155	NAN		King	N	EIII		S
VSP156	NAN		King	N	MIII		S
VSP157	NAN	Area D, Rm50 SW Quad, L2	1980;78-1/N 3-191(50)	EIII		S	
VSP158	NAN	Rm5, Unit 8 99.77-99157	1982;78-1	-	MIII		RS
VSP159	NAN	Area D, SE Quad, L2	7-8-1/3-294 (50)	N	MIII		S
VSP160	NAN		78-1/5-1402-(15)		II/III		RS
VSP161	GZ	PR42A-B	Lot 3	-	EII		RS
VSP163	GZ	PR42A-B	Lot 3	-	EIII		RS
VSP165	GZ	under Rm 84, 85 & above PR42A	Lot 4	-	I		RS
VSP166	GZ	Rm42, above 2nd floor	Lot 12	?	I		S
VSP168	GZ	Rm42, above 2nd floor	Lot 12	-	I		S
VSP169	GZ	Rm42, above 2nd floor	Lot 12	-	LII		RS
VSP170	GZ	Rm42, above	Lot 12	-	LII		RS

		2nd floor					
VSP171	GZ	Rm42, above 2nd floor	Lot 12	-	II/III		RS
VSP173	GZ	Rm36, above floor	Lot 94	-	EII		S
VSP174	GZ	Rm36, above floor	Lot 94	N	MIII		RS
VSP175	GZ	Rm36, above floor	Lot 94	?	MIII		RS
VSP176	GZ	Rm36, above floor	Lot 94	N	MIII		RS
VSP177	GZ	Rm36, above floor	Lot 94	N	EIII		S
VSP178	GZ	Rm36, above floor	Lot 94	-	LIII		RS
VSP180	GZ	Rm62, above 2nd floor	Lot 63	-	II/III	RS	
VSP181	GZ	Rm62, above 2nd floor	Lot 63	-	LII		RS
VSP183	GZ	Rm62, above 2nd floor	Lot 63	-	LII		RS
VSP184	GZ	Rm62, above 2nd floor	Lot 63	N	EIII		RS
VSP185	GZ	Rm62, above 2nd floor	Lot 63	N	MIII		RS
VSP186	GZ	Rm62, above 2nd floor	Lot 63	-	II/III		RS
VSP187	GZ	Rm62, above 2nd floor	Lot 63	N	E/MIII		S
VSP188	GZ			"choice"-N Classic type	MIII		RS
VSP189	GZ	Rm42, above floor	Lot 13	-	EIII		RS
VSP191	GZ	Rm42, above floor	Lot 13	-	EII		RS
VSP192	GZ	Rm113, below fill		Lot 120-	I		RS
VSP193	GZ	Rm113, below fil		Lot 120-	EII		RS
VSP194	GZ	Rm113, below fill		Lot 120-	I		RS
VSP195	GZ	Rm113, below fill		Lot 120?	EIII		RS

VSP196	GZ	Rm113, below fill	Lot 120-	II/III	RS	
VSP197	GZ	Rm113, below fill	Lot 120-	LIII		RS
VSP199	GZ	Rm113, below fill	Lot 120N	EIII		RS



APPENDIX B

DATA VARIABLES - KEY

ID#: 1 + Museum # = NAN
2 " " " = Galaz
3 " " " = Old Town
4 " " " = Cameron Creek
5 " " " =

Style: Macro: 1 = I; 2 = II; 3 = III

Micro: 1 = E1
2 = L1
3 = E2
4 = II/III
5 = L2
6 = E3
7 = M3
8 = L3
9 = indeterminant

Naturalistic:
1 = Pure
2 = Mixed (naturalistic = geom. border)
3 = Pure A (naturalistic + geom. on bodies/motif)
4 = Mixed A (Naturalistics in geom. border)
5 = Unknown/unclear

Impression:
1 = Positive
2 = Negative
3 = Combination
4 = Unclear

Burial:
1 = Yes
2 = No
3 = Unknown

Motif component type:

1 = One
2 = Twin opposition
3 = Similar dual opposition
4 = Varied
5 = Story
6 = Incorporated into geometrics
7 = Unclear

Motif main element:

1 = Antelope
2 = Anthropomorphic
3 = Bat
4 = Bird
5 = Deer
6 = Fish
7 = Frog
8 = Human
9 = Insect
10 = Lizard
11 = Mt. Goat
12 = Rabbit
13 = Snake
14 = Tadpole
15 = Turkey
16 = Turtle
17 = Other combinations (besides anthropomorphic)
18 = Unknown/unclear

Motif main component style:

1 = Natural
2 = Stylized
3 = Child/very poorly executed
4 = Unknown/unclear