heights suggest that while jars may have been manufactured and used for different functions, not all archaeological sites and pottery types had an even distribution of jars types.

### IV.F. Drums

Four drums are included in this sample. With the exception of the small (8 cm) Dulces Incised: Dulces Variety drum from Zacpetén, drum diameters range from 16 cm to 18 cm. Ixlú has two drums with diameters of 16 cm (Xuluc Incised: Tzalam Variety) and 18 cm (Picú Incised: Thub Variety) and Tipuj has an Hobonmo Incised: Hobonmo Variety drum with a 16 cm diameter. All other drums not included in the study but excavated at Zacpetén, Ixlú, and Tipuj have diameters that range from 16 cm to 22 cm.

## V. Surface Treatment and Decoration

### V.A. Surface Treatment

As discussed in Chapter 5, monochrome slipped surface finishes have a matte, low luster, or "waxy" finish. Surfaces with matte finishes often show striation marks under low magnification (10X). The striation marks are not fresh, indicating that they are not the result of washing after excavation. While most undecorated sherds have a matte finish, some have a low luster to "waxy" finish. Striation marks are not visible under low magnification, but the burnished surfaces have a glossy, uneroded appearance. "Waxy" finishes may be the result of two layers of slip and heavy burnishing (Rice 1987b:149-150). As stated previously, "waxy" surface finishes typically occur on Augustine pottery from Tipuj.

Decorated Postclassic sherds typically have low luster exterior surfaces.

Decorated surfaces were first slipped with a creamy to light red-orange primary slip with a matte to low luster finish that is not heavily burnished. However, most interior surfaces are very eroded and determination of a burnished slip is difficult. Circumferential bands were painted on top of the primary slip. The design was painted next as is evident from design lines crossing the circumferential bands. Specific design elements are discussed below. After the design was painted, slip was applied to the exterior surface, interior rim, and interior bases (e.g., tripod dishes). Slip from the interior rim often appears over the circumferential bands and may "bleed" into the design panel. Design execution is clumsy as compared to most Late Classic polychrome design executions.

## V.B. Decoration

Eighteen decorative motifs appear on Postclassic Petén slipped pottery used in this study. Of the 18 decorative motifs, 8 also occur on pottery from earlier time periods, in codices, on murals, or on incised material culture such as stela. Some decorative styles of Petén Postclassic slipped pottery have previously been analyzed, with special reference to the significance of reptile motifs (Rice 1983, 1985b, 1989). This study builds on those analyses. The following section describes the 8 decorative motifs as found on Petén Postclassic slipped pottery, other media where the decorative motifs occur, and their possible significance.

V.B.1. Hook or Curl (Figure 52). The most common decorative motif on Petén Postclassic slipped pottery is the hook or curl. Hooks and curls that appear as single elements on pottery are typically flanked by parentheses. In this sample, hooks and curls occur on Ixpop Polychrome: Ixpop Variety and Chompoxté Red-on-paste: Akalché

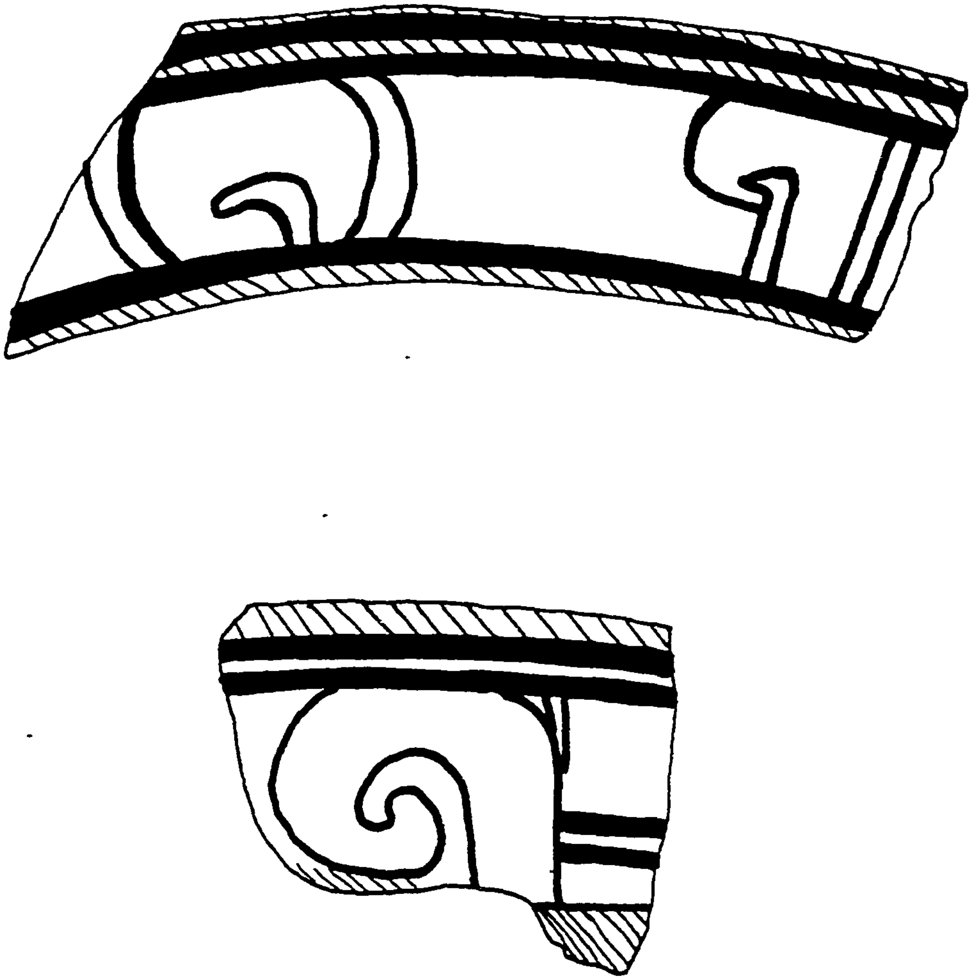


Figure 52: Hook or Curl Motif (Ixpop Polychrome).

Variety pottery from Zacpetén, Ixpop Polychrome: Ixpop Variety and Picú Incised: Picú Variety pottery from Ixlú, Ixpop Polychrome: Ixpop Variety and Pek Polychrome pottery from Ch'ich', Ixpop Polychrome: Ixpop Variety pottery from Macanché Island, and Chompoxté Red-on-paste: Akalché Variety and Pastel Polychrome pottery from Topoxté Island.

The first appearance of the hook or curl motif appears on Early Classic period pottery and continues through the Late Postclassic period pottery. Hellmuth (1987:Figure 5) presents Early Classic pottery from the Uaxactún region with encircled hooks or curls as the dominant decorative feature. He states that these hooks designate the surface of the underworld from which monsters emerge. In addition to representing the underworld surfaces, hooks also appear as water monster pupils (Hellmuth 1987:156). Smith (1955:66) also notes the presence of the hook on Tzakol 1, 2, and 3 pottery from Uaxactún.

Late Classic polychrome pottery has hooks and curls in three contexts. First, hooks form the pupil of reptiles in underworld scenes (Kerr 1989:Figures 1834, 1119; 1990:Figure 2713; 1992:Figure 3622; 1994:Figure 4926, 4957). Second, individuals who are the center of the painted design sit on round stones (altars) made of hook or curl elements (Kerr 1989:Figure 1398; 1992:Figure 3422, 3007) or are pictured reclining next to large hooks or curls (Kerr 1992:Figure 3198). Finally, hooks and curls appear in shells used to make noise (Kerr 1989:Figure 808).

In the Terminal Classic and Postclassic period, the hook or curl becomes more prevalent and occurs in northern Yucatán from the Cehpech to the Tases periods (Smith 1971). The curl also appears at Seibal as an incised and polychrome decorative motif on

Isla Gouged-incised and Lombriz Orange Polychrome pottery. The incised hook appears on a vessel with a central design element of the long nosed god (Sabloff 1975:Figure 392). Gifford (1976:Figure 196) also notes the presence of the hook or curl element with a reptilian element on Ixpop Polychrome pottery.

In addition to occurrences on pottery, hooks and curls commonly appear in murals and codices. At Tulum, curls and hooks co-occur with underworld scenes and Chac (Miller 1982:91). Love (1994:44) notes that Chacs, God C/Ku sit on hooks or curls in the Dresden and Paris codices.

From the appearance of hooks and curls throughout Maya history as described above, one may suggest that the decorative element represents part of the underworld–the watery surface because of its importance with regard to the underworld surface and the appearance of the hook or curl as the pupil of the water monster (Hellmuth 1987). They may also represent the Maya hieroglyphs for *mu* and/or *waj* (Hofling, personal communication 2001). The same element continues to the Postclassic period in much the same context and may thus have the same significance.

V.B.2. Mat Motifs (Figure 53). Three variations of the mat motif appear on Petén Postclassic slipped pottery: stepped frets to make coils or mats, horizontal and vertical braids, and S-shaped curves. Stepped fret mat motifs appear on Picú Incised: Picú Variety pottery from Ixlú. Horizontal braided mat motifs appear on Chompoxté Red-on-paste: Chompoxté Variety, Chompoxté Red-on-paste: Akalché Variety, and Macanché Red-on-paste: Macanché Variety pottery from Zacpetén, on Picú Incised: Picú Variety pottery from Ixlú, on Dulces Incised: Dulces Variety, Canté Polychrome: Canté Variety,

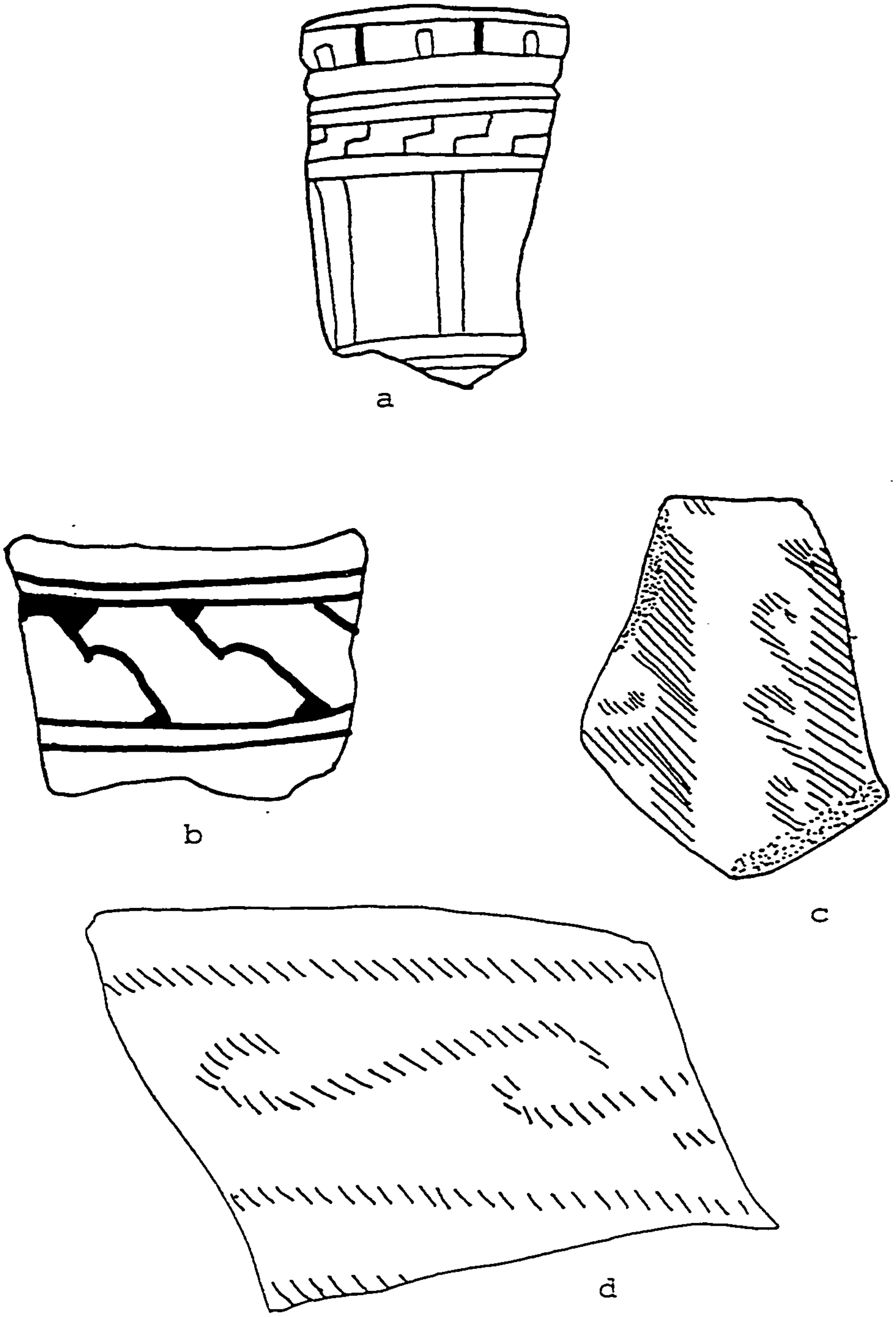


Figure 53: Mat or Braid Motifs: a) Stepped-fret (Picú Incised: Picú Variety); b) Horizontal Braided Mat (Ixpop Polychrome); c) Vertical Braided Mat (Chompoxté Red-on-paste: Akalché Variety); d) S-shaped Mat (Macanché Red-on-paste: Macanché Variety).

Chompoxté Red-on-paste: Akalché Variety, and Picú Incised: Picú Variety pottery from Topoxté Island, and on Xuluc Incised: Ain Variety pottery from Macanché Island. Vertical braided mat motifs occur only on Chompoxté Red-on-paste: Chompoxté Variety pottery from Zacpetén. S-shaped curves occur on Hobonmo Incised: Ramsey Variety, Chompoxté Red-on-paste: Akalché Variety, and Macanché Red-on-paste: Macanché Variety pottery from Zacpetén, on Picú Incised: Picú Variety pottery from Ixlú, on Pek Polychrome: Pek Variety and Picú Incised: Picú Variety pottery from Tipuj, on Ixpop Polychrome: Ixpop Variety, Picú Incised: Picú Variety, and Xuluc Incised: Ain Variety pottery from Macanché Island, and on Dulces Incised: Dulces Variety and Canté Polychrome: Canté Variety pottery from Topoxté Island.

Stepped fret and braided mat motifs first appear during the Early Classic period in the Maya lowlands region. Stepped fret mat decoration appears on Ixcanrio Orange polychrome, Dos Arroyos Orange polychrome, and Juleki Cream polychrome pottery at Barton Ramie (Gifford 1976:Figures 72, 96, 126) and Lucha Incised pottery from Seibal (Sabloff 1975:113).

Late Classic polychrome pottery also has the stepped fret as a mat motif. Kerr (1992:Figure 4339) presents a roll out picture of a scene with the step fret design motif on its jar neck. In addition to Late Classic occurrences, Brainerd (1958:Figure 24f 2, 4) shows that black slateware from Mayapán has the same stepped fret mat design as seen in Kerr's example.

Postclassic murals from Tulum Structures 5 and 16 and the door frame from Las Monjas at Chich'en Itzá use braids composed of the stepped fret to symbolize the path of the sun (Millbrath 1999:74) or an umbilical cord. Miller (1992:94) suggests the braided cords made of stepped frets represent umbilical cords seen in the Paris Codex Folio 19 and 22 and

> may refer to a joining of the mythical umbilical cord described in the Kusansum Myth. . . . It is also possible that the myth's severed, blood-filled cord is reconnected through the ritual ceremony depicted in these murals [at Tulum] and that this joining is indicated by the circular knotlike motif at the exact center of the Structure 5 mural. The vegetal forms growing out of the 'umbilical cord' may refer to a pictorial metaphor for a cord containing blood (i.e., Kusansum) and generating life. The twisted cords shown in the interior paintings of Structures 5 and 16 may therefore be umbilical cords: 'The rope of tying together, The womb of heaven, The womb of earth. . . .'

Miller further explains that similar umbilical cords appear in Postclassic codices from Highland Mexico that may represent Robertson's (1970) Late Postclassic International Style.

The braided or woven mat motif is the most common mat motif in the lowland Maya region. It first appears on Tzakol pottery from Uaxactún (Smith 1955:64) and Chich'en Itza (Smith 1971:48). The mat motif becomes synonymous with kingship by the Late Classic period and is present on most carved stela and pottery that depicts rulers (Robicsek 1975). Rulers are shown holding bicephalic monster scepter bars with mat motifs on the body of the bar or seated on mats or thrones with the braided design. In addition to denoting Maya royalty, mat motifs serve as design panel dividers. Kerr (1989:Figure 1117; 1994:Figure 4628, 4629) presents Late Classic polychrome braided mat motifs that divide glyph bands from main design areas, that divide round reptile faces, and that divide the lip/rim area from the body of a vessel.

Postclassic pottery and mural paintings also use braided mat motifs. In addition to Petén Postclassic pottery, mat motifs occur on Ardilla Gouged-incised pottery from Copán (Willey et. al. 1994:Figure 67t), on Mauger Gouged-incised pottery from Barton Ramie (Gifford 1976:Figure 190), and on Mexican Fine Orange ware and Chichen Slate ware from Chich'en Itza (Brainerd 1958:Figure 80bb; Smith 1971:48). Vertical mat motifs occur on Papacal Incised pottery and Yobain Plano-relief pottery from Mayapán (Smith 1971:Figure 47 i,o).

In addition to Postclassic pottery, mat motifs appear on murals from Tulum. Miller (1982:91, Plate 37) suggests that the mat motif in combination with chevrons on the mural from Tulum Structure 16 depicts the Underworld because confronting figures are positioned above braided mat motifs that separate the figures from the underworld scene. The same motifs are found on Chamá funeral pottery (Miller 1982:92).

The least common mat motif design is created by a series of S-shaped curves. The earliest occurrence of this version of the mat motif, appears at Uxmal on Tzakol pottery (Smith 1971:58). While Smith states that this motif occurs in northern Yucatan from the Early Classic to Late Postclassic period, the S-curve mat motif appears more frequently during the Postclassic period. Brainerd (1958:18je, 50i3, 57d, 61b, e, 77b) presents drawings of Postclassic slateware from Uxmal, Kabah, and Chich'en Itza with this design motif.

The differences in mat motif depictions may represent two distinct meanings: umbilical cords and signs of Maya kingship. Although additional meanings may be attributed to the mat motif, the longevity of the design motif as well as its context through time suggests that Petén Postclassic pottery with similar mat motifs may represent similar meanings.

V.B.3. Night Eye (Figure 54). The eye motif in Figure 54 appears on Ixpop Polychrome: Ixpop Variety pottery and Picú Incised: Cafetoso Variety pottery from Zacpetén and on Ixpop Polychrome: Ixpop Variety and Picú Incised: Picú Variety pottery from Ixlú. Although this motif does not thus far occur on pottery outside of the Petén lakes region, it occurs in Postclassic murals at Tulum and Santa Rita and Maya and Aztec codices. Tulum's Structure 5 mural and Santa Rita's Mound 1 mural have this element in the top band. Eyes appear in the center of a diving god or bee abdomen as viewed from the top of the creature (Roys 1965:65). Miller (1982:85) suggests that the eye represents the starry night sky with a jaguar pelt as the sun transforms into a jaguar at night. In addition to this meaning, the night eye may be part of the cult of Venus as Morning Star (Miller 1982:97). The cult of Venus as Morning Star depicts the reemergence of Venus from the Underworld at dawn as the result of Quetzalcoatl-Kukulcan cyclically passing into and out of the Underworld as Venus so that the sun may appear.

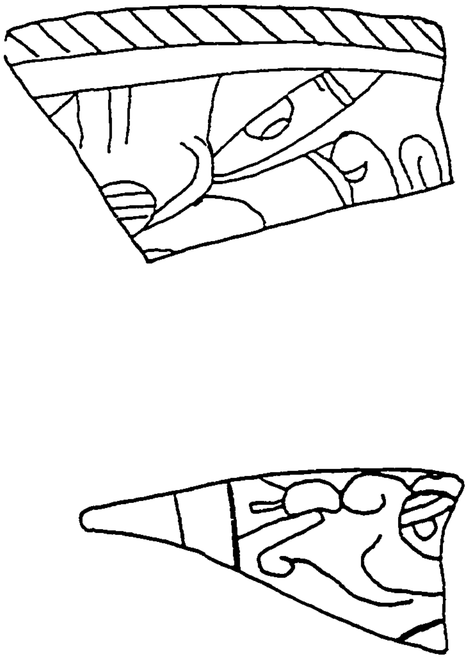


Figure 54: Night Eye Motif (Picú Incised: Picú Variety).

In addition to depictions on murals, the eye motif also occurs as part of the heavenly sphere in glyph T646 at House E in the Palace of Palenque (Hellmuth 1988:169). The Codex Nuttall (Nuttall 1975), the Codex Mendoza Folio 60r (Berdan and Anawalt 1997), and the Codex Borgia (Seler 1963:83) also depict the eye as part of the night sky.

From the above examples of the eye motif, one can suggest that the eye represents an element of the night sky. More specifically, the eye and its attached body may depict the "underlying unity in the concentration on cosmic boundaries between night and day, death and life, underworld and upper world, immortal and mortal, ritual disorientation and spiritual reintegration" (Miller 1982:97-98).

V.B.4. Embedded Triangles (Figure 55). Embedded triangles appear on the following Petén Postclassic pottery types: Sacá Polychrome: Sacá Variety and Macanché Red-on-paste: Tachís Variety pottery from Zacpetén and on Dulces Incised: Dulces Variety pottery from Topoxté Island .

In addition to Petén Postclassic pottery types, embedded triangles also occur on Late Preclassic Ixcanrio Orange-polychrome pottery from Barton Ramie (Gifford 1976:Figure 72c), on Early Classic Lucha Incised pottery from Seibal (Sabloff 1975:113), and on Mamon, Chicanel, and Tzakol 1, 2, and 3 pottery from Uaxactún (Smith 1955:68).

During the Late Classic period, the embedded triangle appears more frequently and over a wider geographical area. It is found on northern Yucatán pottery (Smith

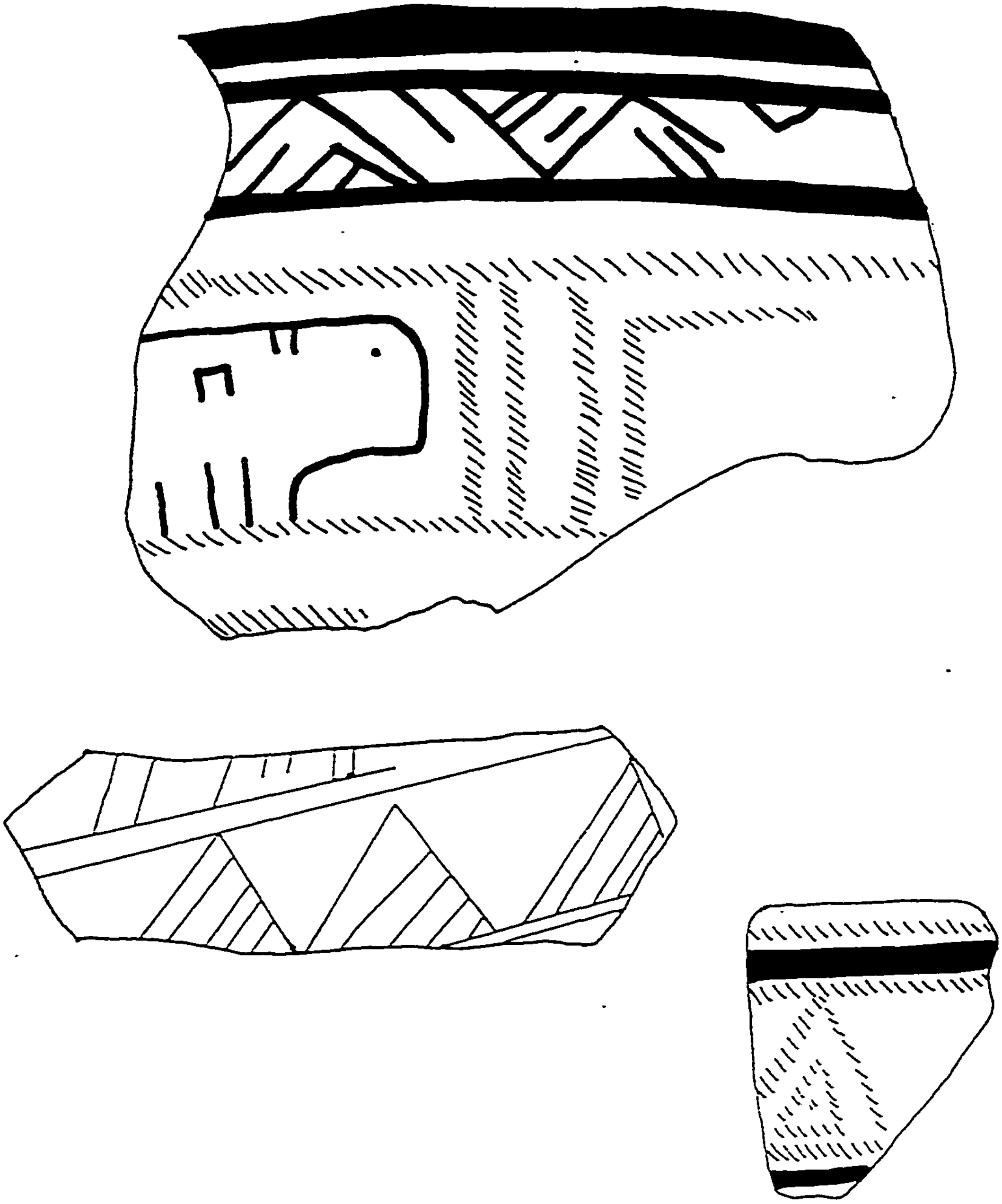


Figure 55: Embedded Triangle Motif (Sacá Polychrome and Picú Incised: Picú Variety).

1971:61), on Tepeu 1, 2, and 3 pottery from Uaxactún (Smith 1955:68), and on Masica Incised pottery at Copán (Willey 1994:Figure 108a). In addition to embedded triangles appearing as primary decorative motifs, Kerr (1994:Figure 4929; 1997:Figure 744) presents Late Classic polychrome vessels with embedded triangles as part of various central figures' thrones.

Postclassic pottery from Colhá and northern Yucatán have embedded triangle designs that resemble those of Petén Postclassic slipped pottery. Triangles commonly occur on Mauger Gouged-incised pottery from Colhá (Valdez 1987:Figure 57d) and Tinum Red-on-cinnamon pottery from Uxmal and rarely on other Tases period pottery (Smith 1971: 61-62). The connection between Petén and northern Yucatán pottery is clear in that the designs are almost identical.

Although no scholar has stated the significance of the embedded triangle, it may represent some aspect of royalty because of the presence of embedded triangles on thrones.

V.B.5 *Ajaw* Glyph (Figure 56). The *ajaw* glyph appear on Chompoxté Red-on-paste: Akalché Variety pottery from Zacpetén. Similar *ajaw* glyphic representations appear in the *Chilam Balam of Chumayel* (Craine and Reindorp 1979), on a vessel from northern Yucatán (Kerr 1990:Figure 3199c), and in Postclassic Maya codices. In addition to Postclassic contexts, the *ajaw* glyph occurs more frequently during the Late Classic period on pottery (especially Codex style pottery) as well as other forms of material culture such as stelae and lintels. The glyph usually signifies the *ajaw* calendric day name or the rulership title.

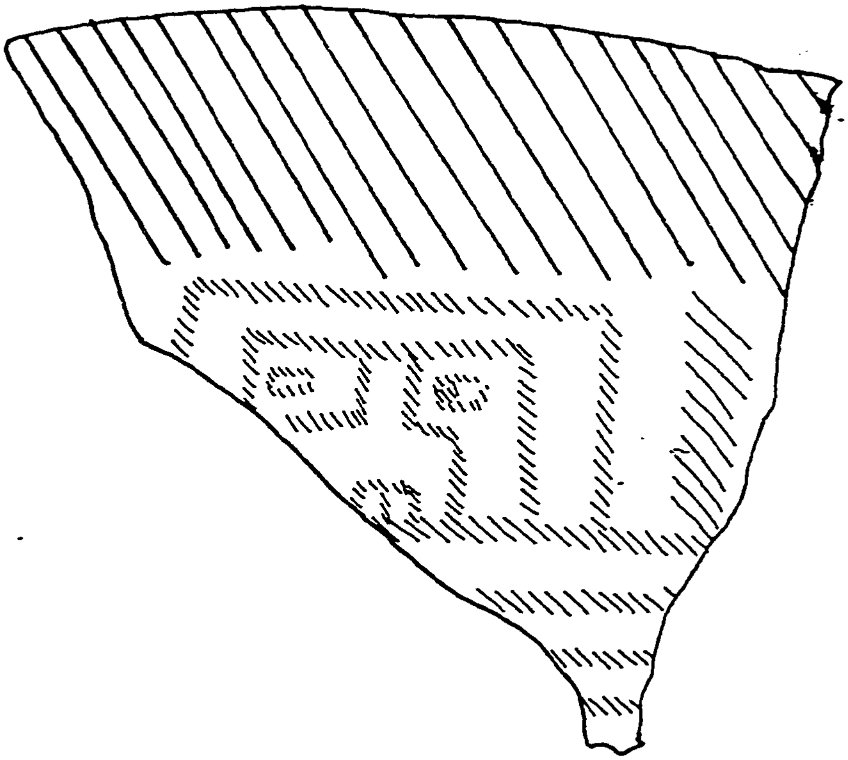


Figure 56: *Ajaw* Glyph Motif (Chompoxté Red-on-cream: Akalché Variety).

### V.B.6 Terraces or Stepped Pyramids (Figure 57).

Terraces or stepped pyramids (hereafter, terraces) occur on Chompoxté Red-on-paste: Kayukos Variety and Ixpop Polychrome: Ixpop Variety pottery from Zacpetén and on Canté Polychrome: Canté Variety and Chompoxté Red-on-paste: Akalché Variety pottery from Topoxté Island.

The terrace motif first occurs on Tzakol 2 and 3 pottery from Uaxactún (Smith 1955). Late Classic pottery with terrace motifs appears on Tepeu 1 and 2 pottery from Uaxactún (Smith 1955:61) and on the Saxche Orange polychrome pottery from Altar de Sacrificios (Adams 1971:Figure 44b). The interior element of the Uaxactún design is u-shaped while the interior element at Altar de Sacrificios is a hook or curl. Kerr (1994:Figure 4550, 4661) presents two examples of the terrace motif as design panels. On one vessel (Figure 4550), the panel divider may also serve as the back wall of the place where the scribe sits. The other vessel (Figure 4661) has ghost-like creatures in the interior of the terrace. The terrace panel is above a serpent scene.

Terminal Classic pottery from El Mirador (Zacatel Cream-polychrome) and Seibal (Torro Gouged-incised) have the terrace motif in design panels near the rim of the vessel.

During the Postclassic period, the terrace motif occurs more frequently. At Chich'en Itza and Mayapán, the terrace motif appears on Cerro Montoso Polychrome, Yalton Black-on-orange, Papacal Incised, and Xuku Incised pottery types (Brainerd 1958:82a, 42, b30-31; Smith 1971:61). Terraces with interior hooks or curls also occur at

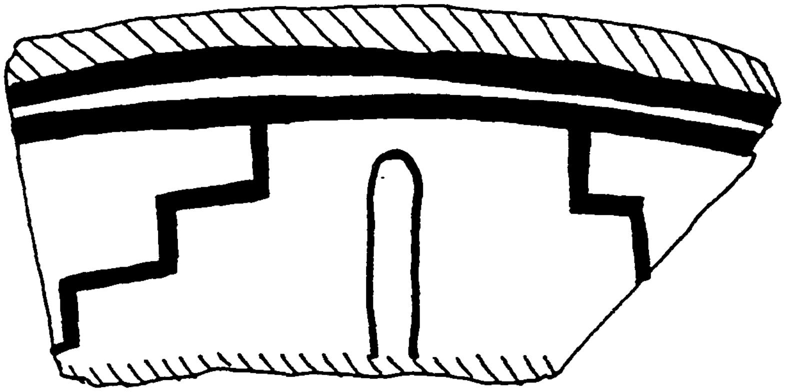


Figure 57: Stepped Terrace/Pyramid Motif (Ixpop Polychrome).

Mayapán and other sites in northern Yucatán occupied during the Sotuta to Tases periods (Smith 1971:61).

Finally, terraces frequently occur in the Codex Nuttall (1975) as design panels, "sky bands," thrones, and pyramids. Pohl (1994:88) states that the terrace in Mixtec codices indicates a place sign such as Tollan "place of the reeds."

While terraces may suggest place names such as those seen in Mixtec codices, no other information exists as to their meaning in the Maya lowlands.

### V.B.7. Sky Band Motifs

Many Postclassic design motifs also occur on other media as part of sky bands. Thus, the following section describes the design elements found on Petén Postclassic slipped pottery and on depictions of skybands in the lowland Maya area. Typically, skybands that appear carved on structures, lintels, and stela and painted on pottery depict a bicephallic celestial monster (Freidel and Schele 1988:73). The bicephallic monster consists of a long snouted reptile on the left side and an alligator/cayman creature with a Venus glyph on the right side (Carlson and Landis 1985:117). The two heads have open jaws that symbolize the symbolic cave, dragon mouth, or niche of emergence from which creation and dynastic mythology originates (Carlson and Landis 1985:118).

Carlson and Landis (1985), Freidel, Schele, and Parker (1993), and Millbrath (1999) provide four different contexts for skybands. First, skybands appear as a symbolic canopy. The symbolic canopy depicts the intersection of the Milky Way and the ecliptic (Millbrath 1999:259). In this case, glyphic elements in the body of the bicephallic monster bear symbols of planets and constellations. In addition to celestial glyphic elements, Venus signs form collars around the two heads of the bicephallic monster (Carlson and Landis 1985:118). This type of symbolism typically appears in Postclassic codices.

Second, skybands function as frames surrounding dynastic scenes. By surrounding a royal figure with a skyband, the skyband connects the individual to the celestial realm. Pacal's sarcophagus lid provides one of the best examples of this type of symbolism.

Third, skybands form part of bases, platforms, and thrones. When rulers are depicted standing or sitting on skybands, they become elevated to the heavenly realm (Carlson and Landis 1985:121). Skybands as bases, platforms, and thrones "impart a celestial context to the individual seated on them" (Carlson 1988:288).

Fourth, skybands often appear on the edge of royal clothing or as part of royal costume. Skyband glyphs that represent the bicephalic monster's body commonly occur on ceremonial bars carried by rulers, belts, loincloths, cloaks, mantles, and headdresses. By wearing ritual regalia with skyband imagery, the individual "becomes, in his person, a microcosm. He is placed in the celestial house and the ancestral niche of emergence" (Carlson and Landis 1985:122).

Carlson (1988:279) further states that "placing skyband elements around rims or inside or outside lips of plates and bowls creates for the bowl a cosmological boundary like that provided by the heavenly spanning dragon." Taking the argument further, it may be possible to suggest that design elements that occur in the body of the bicephallic monster and singly on a vessel may represent the cosmological boundary that is important to the portrayal of royal Maya dignitaries resulting in a vessel with ritual or royal significance.

The bicephallic monster's body contains a number of different glyphic elements that are each enclosed by a rectangle and represent scales of the reptile. Carlson and Landis (1985) provide analysis for 13 main signs that appear in the body of the bicephallic celestial monster: the *K'in* symbol, the sun deity, the mirror/shield pendant, the lunar symbol, Venus/*Lamat* symbol, the two eyes symbol, the *K'an* cross, the *Akbal* symbol, the serpent segment, the *Zip* monsters, the crossed bands, the bearded sky and bearded sky cross, and the beard and scroll. While many of the symbols are deciphered, more remain unknown (Schele and Miller 1986:47).

Petén Postclassic slipped pottery has four of the 13 main signs (the *Lamat* glyph, the *Akbal* glyph, the *Zip* monster, and the beard and scroll motifs) that occur in combinations of threes or fours.

V.B.7.a. *Lamat* Glyph (Figure 58a). The *Lamat* glyph appears on Ixpop Polychrome: Ixpop Variety and Picú Incised: Picú Variety pottery from Ixlú.

*Lamat* glyphs appear on Late Classic pottery as parts of benches with a seated Moon Goddess (Kerr 1997:Figure K504), as parts of skybands (Kerr 1989:Figure 1898, 1994:Figure 5007), and as part of an underwater scene with fish (Kerr 1992:Figure 3134).

*Lamat* glyphs also occur in the Postclassic Paris, Dresden, and Madrid codices. The first year bearer page is 5 Lamat which is signified by a vertical column of *Lamat* glyphs. The Tancah cenote cave also contains *Lamat* glyphs in conjunction with 1 *Ajaw*

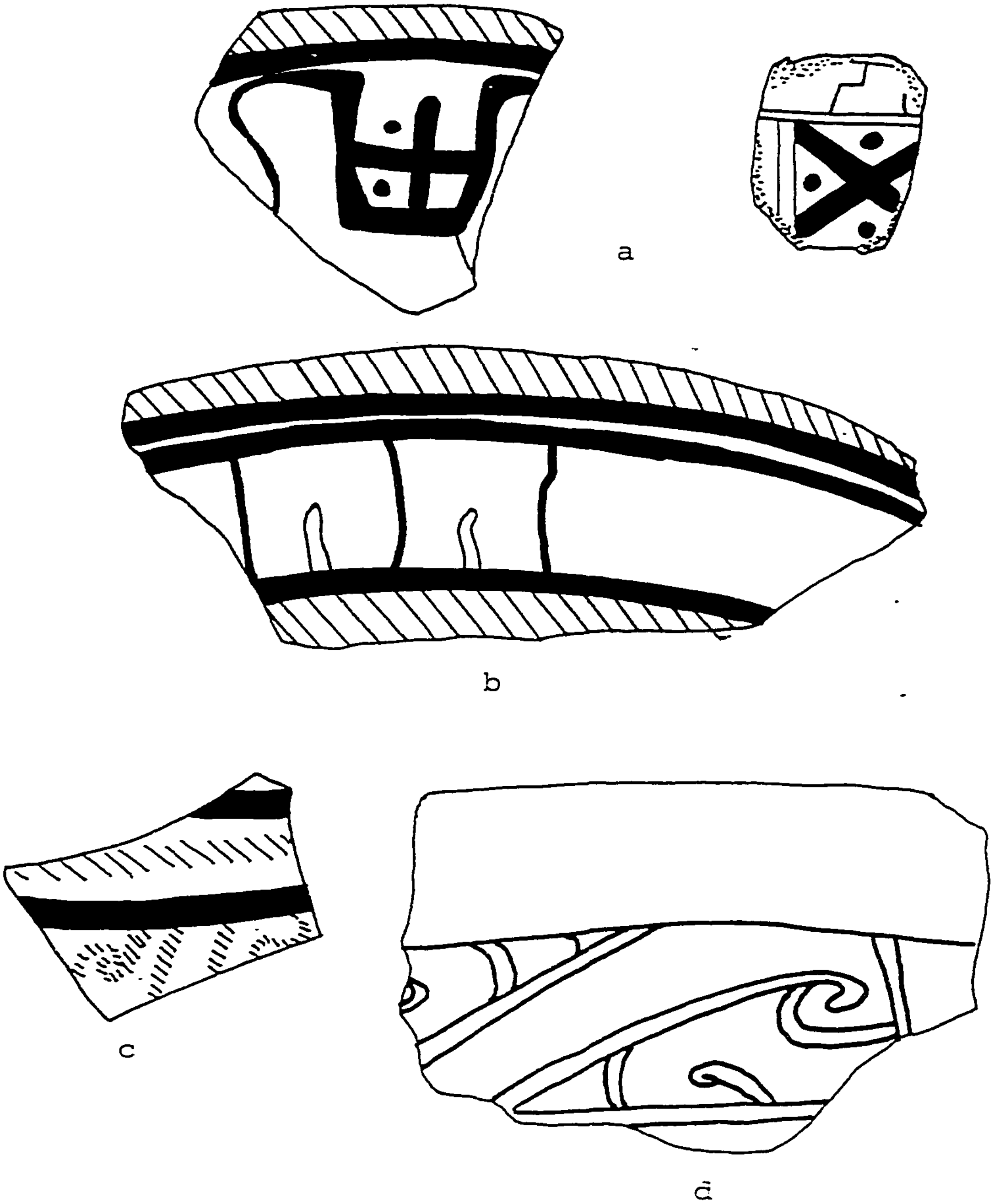


Figure 58: Skyband Motifs: a) *Lamat* Glyphs (Ixpop Polychrome and Picú Incised: Picú Variety); b) *Akbal* Glyphs (Ixpop Polychrome); c) *Zip* Monster (Sacá Polychrome); and d) Beard and Scroll/*Ilhuitl* motif (Picú Incised: Picú Variety).

glyphs.

Miller (1982:87) states that the combination of glyphs in the Tancah cenote signifies Venus as morning star during the five *Uayeb* days for the new year. In addition to Miller's interpretation of the Tancah cenote cave, Thompson (1970:220) and Carlson and Landis (1980), state that the *Lamat* glyph is a variant of the Venus glyph.

V.B.7.b. *Ak'bal* Glyph (Figure 58b). The *Akbal* glyph appears on Ixpop Polychrome: Ixpop Variety pottery from Zacpetén and Macanché Island and on Canté Polychrome: Canté Variety pottery from Topoxté Island.

*Akbal* glyphs appear on Late Classic polychrome pottery as part of a stone or altar with a seated ruler (Kerr 1994:Figure 4689). The glyphic representation also occurs in Postclassic contexts. The Paris Codex presents the *Akbal* glyph (similar to those seen on Postclassic pottery) in skybands where *Pawajtuns* sit, on the *Akbal* year bearer page as a vertical column, and as skybands and thrones throughout the codex (Love 1994:71,83, 89; Miller 1982:93).

In Cholan and Yucatec, *Akbal* means "night" or "darkness" and is associated with jaguars and the Underworld (Carlson and Landis 1980:126). Willson (1924) states that *Akbal* glyphs co-occur with the sun sign to complete the day/night dyad. The *Akbal* skyband element may also represent two insect eyes above an undulating body of a serpent or dragon (Carlson and Landis 1985:126; Beyer 1928). The motif consists of two eyes with fang-like pupils, a triangular nose, and a scalloped bottom (Carlson and Landis 1985:126). Postclassic pottery motifs consist only of the eye elements that Carlson and Landis (1985:126) suggest resemble the scroll eye motif seen in other depictions of reptiles.

V.B.7.c. *Zip* Monster (Figure 58c). This motif occurs on Sacá Polychrome: Sacá Variety pottery from Ixlú and on Chompoxté Red-on-paste: Akalché Variety pottery from Topoxté Island.

The *Zip* monster takes many glyphic forms, but the form painted on Postclassic slipped pottery has its origin in the Olmec dragon (God I) (Lowe1981:42). Both forms of the motif commonly appear on Late Classic pottery. The Princeton vase 14 (Coe 1978) and the Grolier vase (Coe 1973) have the s-shaped fret.

Postclassic Medium Red wares and the skybands from Las Monjas from Chich'en Itza have the *Zip* monster motif (Brainerd 1958:Figure 83b16, 17, 18). It also appears as an element in a throne, as a roof top sky band with the death god seated on top on the *Lamat* year page, and in constellation pages of the Paris Codex (Love 1994:11, 71, 89). The Mexican Codex Mendoza Folio 70r depicts a scribe with a box that has the *Zip* monster symbol on the outside of the box (Berdan and Anawalt 1997:231).

The *Zip* monster is the patron of the third month and is composed of crossed bands representing the sky, a main sign of chac signifying red or great (Carlson and Landis 1985:127). Carlson and Landis also believe that the s-shaped fret discussed as a possible mat motif may represent the *Zip* monster in its most abstract form. Hofling (personal communication 2001) and Wanyerka (personal communication 2000) also state that the *Zip* monster may refer to Mars because of its affiliation with the four Mars beasts in the Dresden Codex.

V.B.7.d. Beard and Scrolls (Figure 58d). The beard and scroll motif occurs on Hobonmo Incised: Ramsey Variety and Picú Incised: Picú Variety pottery from Tipuj.

This variant first appears in Olmec pottery (Lowe 1982) and may also be classified as the *Zip* monster as discussed above. Smith (1955:74) notes that the decorative element occurs on Tepeu 3 pottery from Uaxactún as a variant of the *ilhuitl* glyph. Tulum Red pottery from Tulum and Ichpaatun have incised decorations identical to those of the Petén lakes region and Tipuj (Brainerd 1960:Figure 4, and 5e). Graham (personal communication 2000) notes the presence of the same decorative motif at Lamanai and Valdez and Guderjan (1992:23, Figure 1j) note its presence on a Palmul Incised vessel with a similar decorative motif.

Carlson and Landis (1985:127) "interpret the 'beard and scrolls' element as containing the 'beard' and 'scroll' diagnostics of the bearded dragon, where the 'scroll' may be either the ophidian eye scroll or a nose ornament, such as appears on page 4 of the Codex Madrid." This decorative element also resembles the Aztec *ilhuitl* sign for day, sun, or festival (Nicholson 1955). The *ilhuitl* symbol has its origin in the Zip monster in the Maya area and is also part of the "Eye of the Reptile" symbol at Teotihuacán and Xochicalco (Nicholson 1955:106). According to Nicholson (1955:104, 110), the *ilhuitl* symbol represents the celestial band in Aztec sculptures and ceramic and indicates the profession of *tlacuilo* or scribe. Carlson and Landis (1985:127) agree that the scroll over scroll variant may be related to the *Zip* monster and/or the bearded dragon complex. The scroll over scroll variant best resembles Petén Postclassic design elements.

V.B.8. Bird and/or Feathered Serpent Motifs (Figure 59). A number of bird motifs occur on Mengano Incised: Mengano Variety and Macanché Red-on-paste: Macanché Variety pottery from Zacpetén, on Picú Incised: Picú Variety pottery from Ixlú, on Johnny

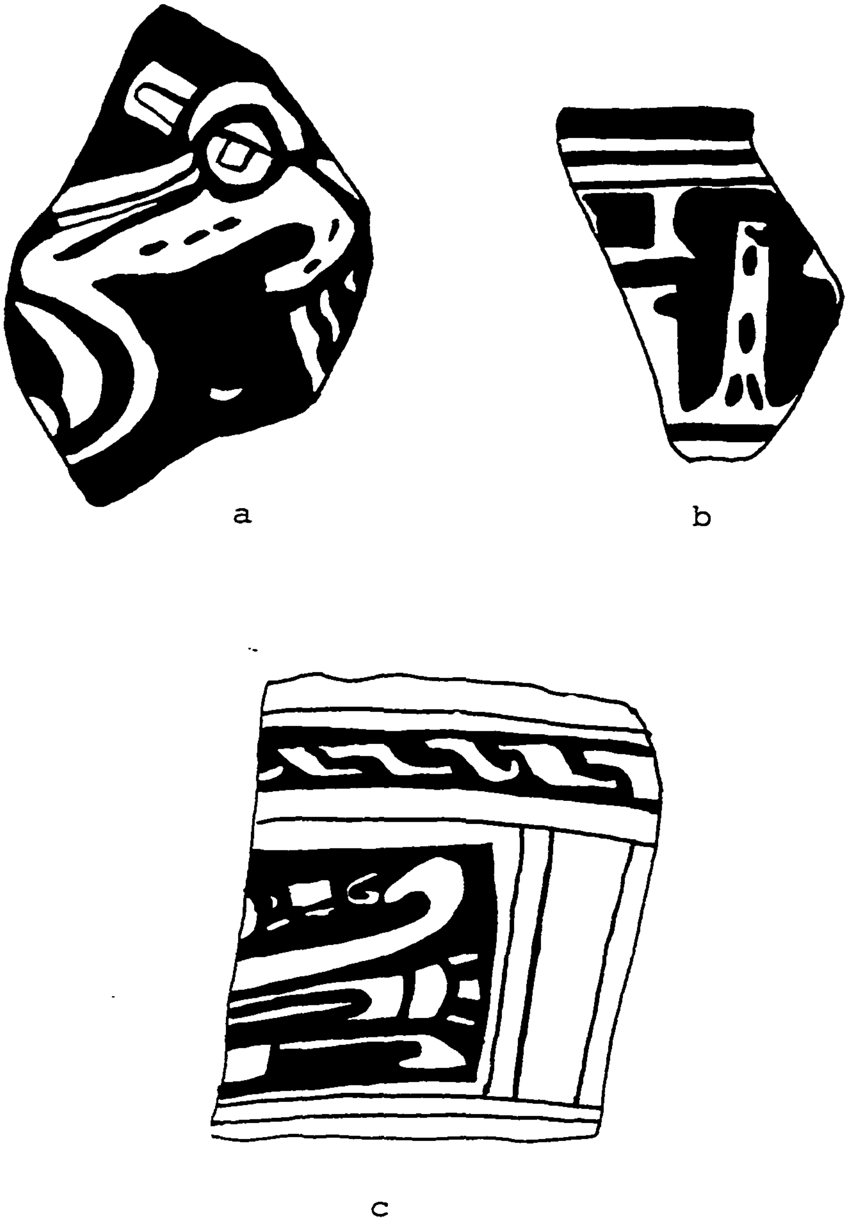


Figure 59: Bird Motifs [a) Macanché Red-on-paste: Macanché Variety; b) Mengano Incised; and c) Picú Incised: Picú Variety].

Walker Red: Black Label Variety and Picú Incised: Picú Variety pottery from Tipuj, on Chompoxté Red-on-paste: Akalché Variety and Chompoxté Red-on-paste: Chompoxté Variety pottery from Topoxté Island, and on Chompoxté Red-on-paste: Akalché Variety and Xuluc Incised: Ain Variety pottery from Macanché Island.

Birds occur on all types of pottery throughout the history of the Maya. Figure 59a may represent a vulture that appears on Folio 13 of the Dresden Codex. In addition to Folio 13, a vulture stands on a snake that may represent Venus as "the planet in conjunction with a vulture constellation" on page 36b (Milbrath 1999:270, Figure 5.4b). In the Paris Codex zodiac pages, a vulture appears as a zodiac sign (Bricker and Bricker 1992:171). Vultures also occur in the Popul Vuh and are associated with the Sun God, the Moon Goddess, and Hunahpu, and as signifiers of deity names in glyphic contexts. Similar birds also appear in the central design panel (Kerr 1994:Figure 4687, 1997:Figure K5082, K5722).

Most of the "bird" motifs on Petén Postclassic slipped pottery appear as a result of the presence of feathers (Figure 59c). The presence of feathers may indicate a bird motif in general, or they may also represent the plumed serpent that is important in Maya history and cosmology. In the Popul Vuh, the plumed serpent is present during creation and has personal traits of a great knower and great thinker (Tedlock 1985:73). The plumed serpent may also be Kukulcán/Quetzalcoatl. In addition to the mythical context of Kukulcán, Landa (Tozzer 1941:20-23 n. 128) states that the Itzá of Chich'en Itzá were ruled by someone named Kukulcán who came from central Mexico and was known as Quetzalcoatl. At the time of his fiery death, Kukulcán reappears as the morning star, Venus. At Chich'en Itza, Quetzalcoatl is associated with warrior and in Venus-warfare contexts as seen in murals (Milbrath 1999:181) and in Postclassic Mexico, Quetzalcoatl served as a title of rulership (Weaver 1993:492).

V.B.9. Miscellaneous Design Elements (Figure 60). These design elements may represent glyphic variants, but I was unable to locate correlates in published material. All elements except Figure 60e occur on

Ixpop Polychrome: Ixpop Variety pottery from Zacpetén. Figure 6.18ee occurs on Ixpop Polychrome: Ixpop Variety pottery from Tipuj and Chompoxté Red-on-paste: Akalché Variety pottery from Topoxté Island.

From the data presented above, I preliminarily define three technological style groups that reflect differences in ceramic ware categories. Although five types of "low-tech" analyses were completed (slip and paste color measurements, hardness measurements, firing conditions, form measurements, and surface treatment and decoration), only slip and paste color measurements, firing conditions, and surface treatment provide enough variability to initially divide the pottery sample into possible technological style groups that reflect the choices made by Petén Postclassic Maya potters.

The first technological style group contains Volador Dull-Slipped ware pottery that includes the Paxcamán, Fulano, and Trapeche ceramic groups. Pottery from this technological style group has the greatest variability in slip colors (as reflected in higher richness, evenness, and heterogeneity indices for slip colors before and after refiring), revealing that Maya potters were not able to achieve uniform slip colors perhaps because of variations in firing technologies and/or differences in slip mineral characteristics. The

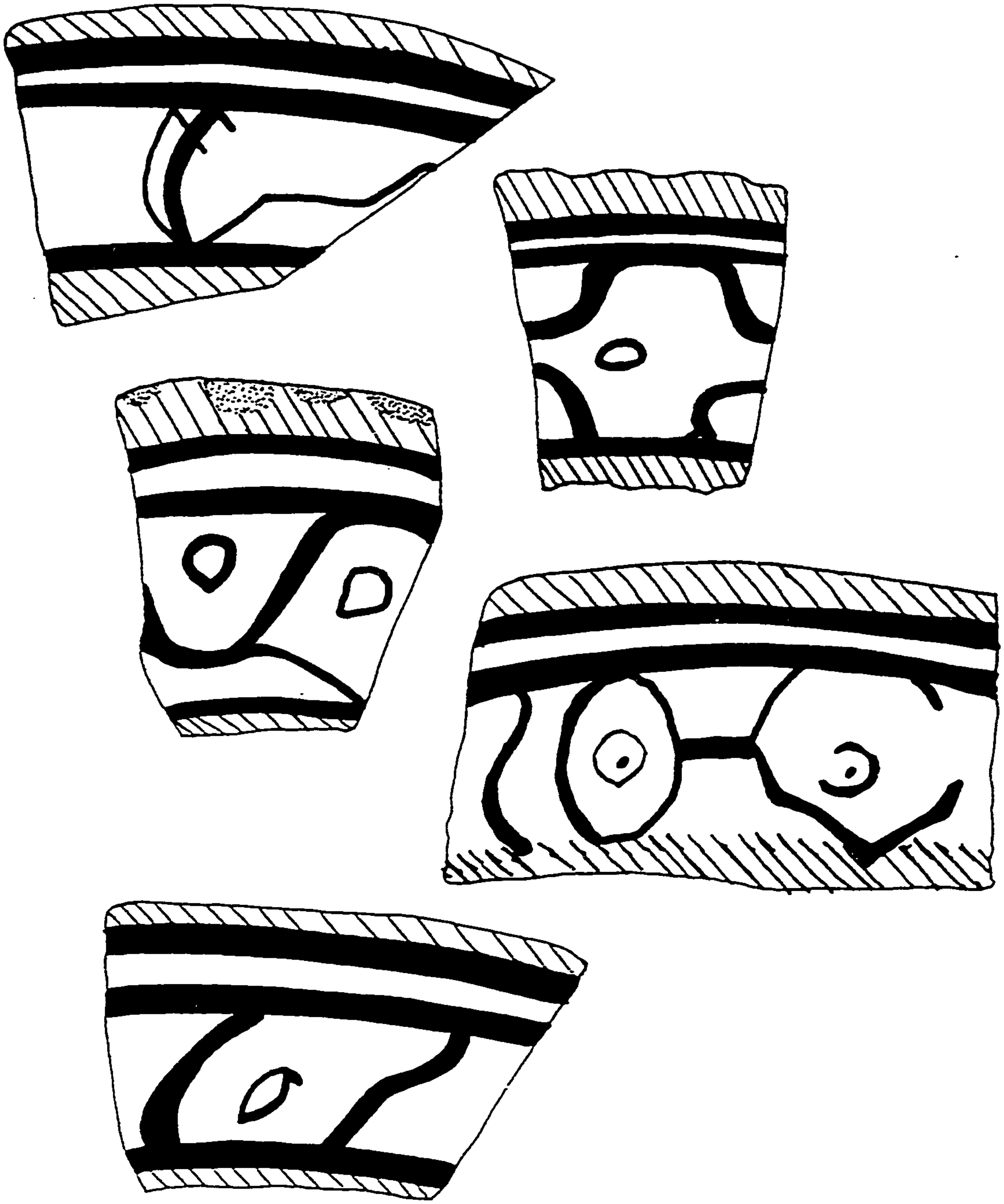


Figure 60: Miscellaneous Motifs (Ixpop Polychrome).

variability of slip colors in this technological style group is not the result of the inclusion of three ceramic groups with different slip colors (e.g., red, black, and "pink"), but rather is distinctive because of the within-group slip color variability of each ceramic group. In addition to differences in slip colors, this technological style group exhibits the most variability in paste composition and core color, and the greatest presence of double slipped and/or "waxy" surface finishes. The overall variability of this technological style group reflects differences in access to resources such as clays, materials used during firing such as fuel, and manufacturing procedures. If social boundaries were being contested during the Postclassic period, it is possible that Itzá and Kowoj potters may have had differential access to resources such as clays, materials for temper, pigments for decoration, and fuel for firing. In addition to limited access to resources because of possible boundary conflicts, fuel for firing may have been restricted due to the depletion of wood and grasses in populated areas. These factors may have contributed in the choices that the Petén Postclassic Maya potters made during manufacturing.

The second technological style group is represented by Vitzil Orange-Red ware pottery. Slip color variability is relatively lower than that of technological style group 1, but not as low as in technological style group 3. A distinctive feature of this group occurs in firing technologies. When these sherds were refired in an electric kiln to temperatures above 600°C, the majority of the sherds developed a black layer just below the slipped surface. Because the black layer is not present in the original archaeological sherd, I suggest that the Petén Postclassic Maya potters who produced this pottery may have known about this effect and fired pottery so as to avoid the black layer that interferes with the probably intended slip color. In addition to the black layer, the majority of tripod plates of this technological style group have a "waxy" surface finish. Potters who produced the "waxy" surface finish may have a "specialized" knowledge regarding surface finishes and/or differential access to the material that produced the surface finish.

The third initial technological style group consists of pottery from the Clemencia Cream Paste ware. Pottery in this group exhibits the least variability in slip and core colors and lacks exterior slips with a "waxy" surface finish. While variation exists, it is not to the extent of the previous two technological style groups. The reduction in variability may support the idea that Clemencia Cream Paste ware pottery is believed to have been made at a single location--the Topoxté Islands--and traded to other sites. It also suggests that Petén Postclassic Maya potters who produced this pottery may have been restricted to a particular type of cream-colored clay, but had equal access to fuel resources for firing. In addition to resource allocation, potters may have had a better working knowledge of the cream-colored clays.

Technological styles developed from this level of analysis demonstrate the technological and decorative variability of Petén Postclassic slipped pottery. The technological and stylistic differences are the result of potter's behavioral patterns and the choices that were made during manufacture, and may reflect differences in Petén Postclassic Maya social reality and indigenous knowledge.

# CHAPTER 7

# MINERALOGICAL ANALYSIS

Mineralogical analyses represent the third level of analysis and results from petrographic and x-ray diffraction analyses are presented below. Employing these types of analyses, I identify slip characteristics and the minerals present in the sherds of this study as well as the abundance, association, granulometry, and shape of minerals and other inclusions in the clay pastes. It may be possible to determine minerals that are naturally present and those that were culturally added in the process of pottery manufacture. This level of analysis also provides suites of minerals in the clay paste that correlate to technological style groups.

## I. Slip Observations

Red and black slipped surfaces have a relatively uniform slip that ranges from .25-.75 mm. While this range includes most slipped surfaces some (n=6) Topoxté, Paxcamán, Trapeche, and Fulano slips have thicknesses of 1.75-2.75 mm. Most sherds, regardless of the thickness of the slip, have an oxidized layer (tan in color) that appears directly below the slipped surface. This layer ranges in thickness from .25-1.25 mm. An oxidized layer does not occur on sherds where the clay paste is dominated by pores.

Through the use of the petrographic microscope, I can determine the existence of “double slipping” on some exterior surfaces of Trapeche and Paxcamán ceramic group sherds from Ixlú, Zacpetén, and Tipuj. The slip that is next to clay paste is red and typically contains small amounts of cryptocrystalline calcite. These slips have thicknesses that range from .5-.75 mm. On top of the red slip is a tan slip that has a relatively even thickness of .5 mm. The tan slip also includes some cryptocrystalline calcite. The red and tan slips have different extinction angles.

Some Ixpop Polychrome, Paxcamán Red, Augustine Red sherds from Tipuj have a "double-slip" that consists of a red slip nearest to the clay paste similar to those previously discussed. The second slip is different from the red slip in color and because of its high quantities of quartz inclusions. This outer layer ranges in thickness from 1-1.75 mm. Again, the two layers of slip have different angles of extinction.

Interior surfaces can also be slipped and have the same general characteristics as those discussed above. In addition to general red and/or black slips, decorative areas have a "primary" slip over which a decorative motif is painted. This slip is placed directly over the clay paste and has a thickness that typically ranges from .3-1 mm and is tan in color. Black and red decorative motifs have thicknesses that are slightly thinner than typical exterior slip (.25-.5 mm) and do not contain observable mineral inclusions such as quartz and cryptocrystalline calcite. Some Ixpop Polychrome and Sacá Polychrome sherds from Ixlú and Zacpetén have a layer of translucent (tan in color) slip applied over the decorated panel. This overcoat is devoid of minerals such as cryptocrystalline calcite and quartz and is approximately .5 mm thick.

## II. Petrographic Analysis of the Clay Pastes

Petrographic analysis allows the archaeologist to note differences in the pottery sample that may not be apparent through "low tech" analyses or binocular microscopy. The identification of mineral inclusions in a pottery paste also provides information concerning the variability of the paste within a ceramic group and/or ceramic type and the relationship between ceramic group and/or ceramic type. The range of variability is important when discussing the possibility of the technological styles of pottery because "tempering material is the least likely to be obtained from distant sources, because its specifications are broad and because something that will serve the purpose can be found nearly everywhere" (Shepard 1956:165). As such, differences in mineral inclusions in a ceramic paste may correlate to differences in decoration which may ultimately suggest differences in social/ethnic identity.

Because of this possibility, the following section presents general information about the inclusions present in the 273 thin sections that I analyzed as well as qualitative and quantitative data of these inclusions minerals.

## II.A. Inclusions Present in Petrographic Analysis

II.A.1. Quartz $SiO_2$. Quartz occurs naturally in most rocks and unconsolidated sediments. It is deposited in aqueous solutions, such as sea or lake water, with the enclosing rock and can form chert horizons when replacing limestone (Klein and Hurlbut 1993:529). The quartz crystallographic structure does not readily break down with erosion, but breaks down into smaller sand-sized particles. At 573°C, quartz undergoes a crystalline inversion that often changes the volume by 2% and slightly changes its molecular structure (Shepard 1956:29). Its hexagonal crystallographic structure produces a mineral with a hardness of 7 that fractures conchoidally (Klein and Hurlbut 1993:527).

In thin section, uniaxial positive quartz minerals have no pleochroism, no cleavage, low relief, and first order birefringence colors (.009) (Ehlers 1987:32-33).

In pottery, quartz can act as a flux and form glass at temperatures above 950°C (Rye 1981:34). Rye (1981:34) suggests that because of the enlargement of the molecular structure at 573°C, vessels with quartz inclusions "would be detrimental in low-fired cooking vessels, which can be exposed to temperatures higher than this each time they are used, with consequent danger of fracture." Therefore, in theory, large amounts of quartz in a clay paste may suggest a non-cooking function for the vessel. However, archaeologists do not find evidence of this quartz inversion in low-fired prehistoric pottery.

II.A.2. Chert $SiO_2$. Chert is a microcrystalline granular variety of quartz and results from the replacement of limestone with solutions carrying silica (Klein and Hurlbut 1993:529). It can take two forms depending on original recrystallization: nodule formations and bedded rocks. Similar to quartz, chert is hard, fractures conchoidally, and does not erode, but will recrystallize (Chesterman 1995:723).

In thin section, chert may occur with siliceous skeletons of shell or algae and with similar birefringence colors as quartz. In the present study, chert appears as sub-rounded fragments that resemble a conglomeration of small quartz crystals.

II.A.3. Chalcedony $SiO_2$. Chalcedony is a microcrystalline, fibrous variety of quartz. It is deposited in aqueous solutions and "usually forms at or near surface conditions in cavities, veins, or as a replacement of preexisting minerals or fossils" (Ehlers 1987:234). Chalcedony can also be a detrital grain in sediments and may be derived from weathering of silicate rocks. Chalcedony tends to recrystallize to quartz with time.

In thin section, chalcedony appears as a uniaxial positive mineral with a colorless pleochroism, a fibrous habit, no cleavage planes, and a hexagonal crystallography. Birefringence colors occur up to first order white (.005-.009).

II.A.4. Hematite $Fe_2O_3$. Hematite is a widespread mineral that occurs in a great variety of soils and most commonly in soils of tropical and warm temperate regions (Klein and Hurlbut 1993:380). Within those regions, it is more common in well-drained soils and its occurrence may be the result of a more rapid decomposition of organic matter in these soils. Hematite is also a significant authigenic component of clay fractions (Allen and Hajek 1989). The total amount of iron in the clay fraction may be the result of small nodules of magnetite, pyrite, and/or hematite "rather than being evenly distributed as fine particulate matter" (Rice 1987b:335-336).

Hematite is a uniaxial negative mineral with a hexagonal crystallography, no cleavage, red-brown pleochroism, and a hardness of 5-6. Its tabular to flaky habit appears in thin sections with a high order white birefringence (.28).

II.A.5. Biotite $K(Mg, Fe)_3(AlSi_3O_{10})(OH)_2$. Biotite commonly occurs in igneous and metamorphic environments. In igneous environments, biotite appears in granites, diorites, gabbros, and perodotites and in metamorphic environments it occurs in most volcanic or plutonic rock (Elhers 1987:177). Biotite alters to kaolin or montmorillonite in extreme weathering conditions (Elhers1987:177). Although it is unlikely that biotite is intentionally added to clay, poorly crystalline biotite can increase the plasticity of clays (Rye 1981:35).

In thin section, biotite is a monoclinic, biaxial negative mineral with perfect cleavage, a tabular habit, and a strong pleochroism that ranges from brown to reddish-brown to green (Ehlers 1987:177). The mineral is relatively soft (2.5-3) with a third order birefringence color (.04-.07).

II.A.6. Gypsum $CaSO_4 \bullet 2(H_2O)$. Gypsum occurs in sedimentary deposits as an interstratified layer between limestone and shale and underlying rock salt beds (Klein and Hurlbut 1993:428). It is one of the first minerals to form with the evaporation of salt water. In such environments, gypsum is often associated with anhydrite, calcite, dolomite, and halite. It also occurs in volcanic regions "where limestones have been acted upon by sulfur vapors" (Klein and Hurlbut 1993:428). Gypsum is a soft mineral (2).

In thin section, gypsum is a colorless, monoclinic, biaxial positive mineral with a negative relief. Its monoclinic structure appears as euhedral, elongated, tabular, or stubby prisms that have good to perfect cleavage (Ehlers 1987:253). Bifrengence colors are first order pale yellow (.01).

II.B.7. Calcite $CaCO_3$. Calcite is a major mineral in sedimentary deposits and is usually the sole mineral of limestone. As part of a limestone bed, calcite results from the decomposition of shells and other skeletons from sea animals (Klein and Hurlbut 1993:406). As part of a carbonate sediment, calcite can recrystallize resulting in euhedral calcite and/or polycrystalline calcite. Euhedral calcite recrystallizes in carbonate cements in open spaces and polycrystalline calcite typically is of replacement origin (Fifarek, personal communication 2001). Calcite also occurs with gypsum in limestones and commonly decomposes into clays with a high calcareous content. In addition to sedimentary deposits, calcite combines with quartz sand to form sandstone crystals found primarily in France and South Dakota, and occurs as a secondary mineral in igneous rocks as a late crystallization product of lavas (Chesterman 1995:432).

Calcite minerals have a hexagonal crystallography, perfect cleavage, a variety of habits, and is commonly twinned. When calcite appears as single crystals, it takes a rhombohedral or scalenohedral habit. In coarse aggregates, the crystal habit is typically anhedral and in sedimentary environments, such as limestones, calcite occurs as oolites or spherulites (Ehlers 1987:108). Calcite crystals are typically colorless to white to pale shades of gray and can vary from yellow to red to green with impurities or elemental substitutions in the mineral structure (Chesterman 1995:432).

Calcite frequently occurs in pottery. It is a relatively inert mineral at temperatures below 750°C, but when calcite is heated above 750°C, it decomposes into $CO_2$ and CaO (Rice 1987b:98). As CaO, lime absorbs moisture to form quicklime ($Ca[OH]_2$), releases heat, and expands in volume causing stress and cracking in the clay body (Rice 1987b:98). Because of this chemical decomposition, pottery typically crumbles. At 950°C, calcite becomes vitrified when it combines with sodium and silica to form glass (Rye 1981:33). In thin section, calcite minerals are uniaxial negative with a higher order white birefringence color (.172) (Ehlers 1987:108).

II.A.8. Plagioclase Felspar $CaAl_2Si_2O_8$ or $NaAlSi_3O_8$. Plagioclase feldspar typically occurs in volcanic, metamorphic, and detrital rocks. It can alter to kaolin, and with metamorphism, plagioclase can alter to epidote (Ehlers 1987:151). The triclinic mineral has euhedral, anhedral, tablet, lath, or microlite habits, perfect cleavage planes, and polysynthetic and Carlsbad twins.

In thin section, plagioclases are biaxial positive minerals (except for oligoclase, bytownite, and anorthite), have a colorless pleochroism, and a first-order white to yellow birefringence color (.008-.013).

II.A.9. Alkali Feldspar Na, K $AlSi_3O_8$. Alkali feldspars occur in igneous and metamorphic rocks. Many different types of feldspars exist, but microcline is the feldspar variant present in this study. Feldspars are characterized by "good cleavages in two directions which make an angle of 90°, or close to 90°, with each other," a hardness of 6, and simple and polysynthetic twinning (Klein and Hurlbut 1993:532). Their triclinic crystal habits range from stubby prisms to tabular crystals to laths (Ehlers 1987:138).

In thin section, microcline is a triclinic, biaxial negative mineral with a colorless pleochroism and a first order white birefringence color (.007) (Klein and Hurlbut 1993:536).

II.A.10. Shell. Volador Dull-Slipped ware sherds are characterized by shell inclusions. On the basis of pottery from Macanché Island, Rice (1987a:105-106) suggests that all shell inclusions represent fresh water animals skeletons that commonly occur in local lake beds and lake shore clays. Rice (1987a:105-106) states that the following genuses occur in the soils around Lake Macanché and in the sherds from Macanché Island: *Pyrgophorus*, *Cochliopina*, *Tropicorbis*, and *Aroapyrgus*. Cowgill(1963:282) also notes the presence of *Cochliopina* shells in pottery from Lake Petén Itzá.

In thin section, shells have a similar birefringence to calcite, are thin and slightly curved. In some instances, shells are cut in cross-section showing the different chambers of the shell.

II.A.11. Pores/Voids. Pores exist in pottery because of the natural interstitial spaces in the clay mineral (primary pores) or because of the release of gases (secondary pores)

(Rice 1987b:350). Secondary pores result from the shrinkage of the clay body due to the release of water vapor (Velde and Druc 1999:113). If the clay body is no longer plastic when the gas forms, irregularly shaped pockets form. Rice (1987b:Figure 12.3) illustrates many different forms of pores. In addition to pockets of gas, sherds with long, linear and somewhat wavy pores parallel to the vessel wall may indicate pores that are the result of a potter compressing and/or smoothing the clay in more than one area (Velde and Druc 1999:113). Pores can also be the result of organics or sponge spicules present in the clay body, burned out during firing, or the result of the evaporation or erosion of a soluble mineral such as salt. In thin section, pores appear as empty spaces with no color.

II.A.12. Fossils. Fossils occur in some sherds. Although no attempt was made to identify the genus or species of fossil, they may be the result of animal skeletons that create limestone and/or calcite. In thin section, fossils appear similar to chert but are smaller in size.

II.A.13. Organics. Organics in clay pastes represent plant material naturally present in the clay or added by the potter to reduce "shrinkage and improve the workability of clays that are too plastic" (Rye 1981:34). Naturally occurring organics tend to be larger and more irregularly shaped, whereas added organic material may have a more even distribution of size due to cutting or chopping of the organic material. While most of the organic material burns out during firing, low fired pottery may contain a great deal of organics. In thin section, organics appear dark brown to black and do not produce a birefringence color.

## II.B. Qualitative Analysis of Clemencia Cream Paste Ware Sherds

The following section provides qualitative information about the inclusions present in the Clemencia Cream Paste ware sherds (n=51) of this study.

Quartz

Size: Coarse (1.6-.575 mm) and Medium to Very Fine (.425-.025 mm)

Frequency/Percentage: Rare (1-2 %), Sparse (4-6 %), or Common (20%)

Degree of Sorting: Poor

Roundedness: Sub-angular, low sphericity or sub-rounded, high sphericity

Chert

Size: Coarse (1.25-.75 mm) and Medium to Fine (.3-.15 mm)

Frequency/Percentage: Rare (less than 1 %)

Degree of Sorting: Poor

Roundedness: Sub-angular, low sphericity

Chalcedony

Size: Coarse (1.125-.625 mm) and Medium to Fine (.425-.075 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Sub-angular, low sphericity, or rounded

Hematite

Size: Coarse (.8 mm), Medium (.5-.25 mm), and Fine to Very Fine (.15-.025 mm)

Frequency/Percentage: Rare (less than 1%), Sparse (3 %), and Common (10%)

Degree of Sorting: Poor

Roundedness: Sub-rounded, high sphericity or sub-angular, low sphericity

Biotite

Size: Coarse (1.25-.525 mm), Medium (.425-.25 mm), and Fine (.25-.1 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Angular, rectangular, sub-angular, low sphericity, and veins

Calcite

Euhedral Calcite

Size: Coarse (1.35-.575 mm) and Medium to Fine (.5-.1 mm)

Frequency/Percentage: Rare (1 %) to Sparse (2-6 %)

Degree of Sorting: Poor

Roundedness: Angular, low sphericity

Polycrystalline Calcite

Size: Coarse (1.375-.625 mm) and Medium to Very Fine (.5-.025 mm)

Frequency/Percentage: Rare (1-2 %)

Degree of Sorting: Poor to Very Poor

Roundedness: Sub-angular, low sphericity

Cryptocrystalline Calcite

Size: Coarse (.75-.575 mm), Medium (.275-.25), and Fine (.175-.075 mm)

Frequency/Percentage: Rare (less than 1 %), Common (20-25%), and Abundant (30-45%)

Degree of Sorting: Poor to Fair

Roundedness: Sub-angular to sub-rounded, low sphericity

Plagioclase

Size: Coarse (.075 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Sub-angular, low sphericity

Feldspar

Size: Fine (.25-.2 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Sub-angular, low sphericity

Shell

Size: Medium (.375-.25 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Circular

Pores/Voids

Size: Coarse (2.325-.6 mm) and Medium to Fine (.5-.05 mm)

Frequency/Percentage: Sparse (2-7%), Common (10-20%), and Abundant (40-70%)

Degree of Sorting: Fair to Poor

Roundedness: Angular to sub-angular and veins, low sphericity

Fossils

None counted

Organics

Size: Fine to Very Fine (.15-.025 mm)

Frequency/Percentage: Rare (1 %) to Sparse (3-10 %)

Degree of Sorting: Fair to Poor

Roundedness: Rounded

Clemencia Cream Paste wares may be characterized petrographically as dominated by poorly sorted, sub-angular calcareous minerals (primarily cryptocrystalline calcite) with lesser amounts of quartz, and minor amounts of chert, chalcedony, feldspar, biotite, and hematite minerals. In general, most sherds are not highly porous, but a sub-sample of Clemencia Cream Paste ware sherds are highly porous. These sherds can also be identified by their clay birefringence colors that range from .003-.007, with the most porous sherds having a clay birefringence color that ranges from .016-.019.

In addition to these general ware-based characteristics, Clemencia Cream Paste ware sherds (n=51) form three distinct groups based on the suite of minerals present in the clay paste. First, eleven sherds have a small percentage of minerals that range from fine to very fine in size. These clay pastes are dominated by pores that comprise 50-80 percent of the paste volume and are the only Clemencia Cream Paste ware sherds to contain plagioclase and feldspar minerals. Clay birefringence colors of this group range from .016-.019.

The second clay paste group consists of seven sherds with the following mineral suite of inclusions: euhedral, polycrystalline, and cryptocrystalline calcite, hematite, and biotite minerals, and organics. Angular euhedral and polycrystalline calcite may have been added during the pottery manufacturing process. A bimodal distribution of mineral inclusions (30-45 percent and 55-70 percent) exists in the clay pastes of this group. Clay birefringence colors range from .006-.007.

The final group consists of 33 sherds that have euhedral, polycrystalline, and cryptocrystalline calcite, hematite, shell, organics, biotite, chert, and chalcedony minerals and shell and organics present in the clay paste. Thin sections of fired white clay from Yaxhá that may have been used in the manufacture of Clemencia Cream Paste wares demonstrate the presence of naturally occurring chalcedony and biotite in the raw clay. Therefore, euhedral and polycrystalline calcite and chert may have been added as temper during the processing of the clay. All minerals of this group typically comprise 40-60 percent of the clay paste. However, seven sherds have a clay paste with 25-30 percent mineral inclusions and two sherds have a clay paste with 70 percent mineral inclusions. Clay birefringence colors of this group range from .003-.007.

## II.C. Qualitative Analysis of Vitzil Orange-Red Ware Sherds

The following section provides qualitative information of the inclusions present in the Vitzil Orange-Red ware sherds (n=80) of this study.

Quartz

Size: Coarse (.9-.575 mm), Medium (.45-.275 mm), and Fine (.225-.025 mm)

Frequency/Percentage: Sparse (3-5 %) and Common (10-30%)

Degree of Sorting: Fair to Poor

Roundedness: Angular to sub-angular, low sphericity

Chert

Size: Coarse (.575 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Sub-angular, low sphericity

Chalcedony

Size: Coarse (1.45-.5 mm), Medium (.4-.3 mm), and Fine to Very Fine (.225-.075 mm)

Frequency/Percentage: Rare (1%) to Sparse (2%)

Degree of Sorting: Poor

Roundedness: Sub-rounded, low sphericity

Hematite

Size: Coarse (1.3-.575 mm), Medium (.475-.4 mm), and Fine to Very Fine (.25-.025 mm)

Frequency/Percentage: Sparse (2-5%)

Degree of Sorting: Fair to Poor

Roundedness: Rounded

Biotite

Size: Coarse (1.35-.75 mm) and Medium to Very Fine (.5-.075 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Angular to sub-angular, low sphericity

Calcite

Euhedral Calcite

Size: Coarse (1.05-.575 mm) and Medium to Fine (.5-.1 mm)

Frequency/Percentage: Rare (1%), Sparse (3-8%), Common (10-30 %), and Abundant (45-70%)

Degree of Sorting: Poor to Fair

Roundedness: Angular, low sphericity

Polycrystalline Calcite

Size: Coarse (1.575-.575 mm) and Medium to Very Fine (.45-.075)

Frequency/Percentage: Rare (1%)

Degree of Sorting: Poor

Roundedness: Sub-angular, low sphericity

Cryptocrystalline Calcite

Size: Coarse (.625 mm), Medium (.45-.25 mm), and Fine to Very Fine (.25-.025 mm)

Frequency/Percentage: Rare (1%), Sparse (2-4%), Common (15-35 %), and Abundant (40-80 %)

Degree of Sorting: Fair to Poor

Roundedness: Sub-angular, high and low sphericity

Plagioclase

None counted

Feldspar

Size: Very Fine (.075 %)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Angular, rectangular, low sphericity

Shell

Size: Coarse (.675 mm) and Fine (.175 mm)

Frequency/Percentage: Rare (less than 1 %)

Degree of Sorting: Poor

Roundedness: Rectangular, low sphericity

Pores/Voids

Size: Coarse (3.25-.5 mm), Medium (.4-.375 mm), and Fine (.25-.075 mm)

Frequency/Percentage: Sparse (3-7 %), Common (10-30 %), and Abundant (50-80 %)

Degree of Sorting: Fair to Poor

Roundedness: Angular to sub-angular, low sphericity

Fossils

None counted.

Organics

None counted.

Vitzil Orange-Red wares may be characterized petrographically as dominated by poorly sorted, sub-angular calcareous minerals (primarily cryptocrystalline calcite) with lesser amounts of quartz and hematite, and minor amounts of chert, chalcedony, feldspar, and biotite minerals and organics. In general, most sherds are not highly porous, but a sub-sample of Vitzil Orange-Red ware sherds are highly porous. Some of the pores in this ware category are the result of sponge spicules that have been burned out during firing

(Utgaard, personal communication 2000). Vitzil Orange-Red sherds can also be identified by their clay birefringence colors that range from .09-.11, with the most porous sherds having a clay birefringence color that ranges from .006-.01.

In addition to these general ware-based characteristics, Vitzil Orange-Red ware sherds (n=80) comprise four distinct groups according to the type of inclusions present in the clay paste. The first group consists of 17 sherds with minerals and pores that comprise 60-80 percent of the clay paste. Mineral sizes range from fine to very fine and represent 5-10 percent of the clay paste. This group is the only group of the Vitzil Orange-Red ware sherds to have feldspar in the clay paste. The remaining 55-70 percent of non-clay material in the clay paste is pores. While most of the pores represent organic material that burned during firing, some of the longer, thinner pores represent sponge spicules (Utgaard 2000, personal communication). Clay birefringence colors range from .006-.01.

The second group of 48 sherds have quartz, chert, chalcedony, hematite, biotite, euhedral, polycrystalline, and cryptocrystalline calcite minerals, and shell inclusions in the clay paste that range in size from very fine to coarse. One sherd has coarse quartz minerals with embedded hematite (aventurine quartz) and two sherds have long, wavy pores that parallel the vessel wall. The angular quartz minerals may have been added during pottery manufacture. Minerals and pores comprise 40-60 percent of the clay paste. Birefringence colors range from .09-.11.

Five sherds comprise the third group that contain fine to very fine cryptocrystalline calcite. The calcite occupies 80-90 percent of the clay paste. Clay bifrringence colors range from .09-.11

The fourth group contains 10 sherds. Cryptocrystalline calcite and quartz make up 50-70 percent of the clay paste. Similar to the second group, some quartz minerals have embedded hematite veins (aventurine quartz) and long, wavy pores that parallel the vessel walls. The angular quartz may also have been added during the processing of the clay. Clay birefringence colors range from .09-.11.

### II.D. Qualitative Analysis of Volador Dull-Slipped Ware Sherds

The following section provides qualitative information of the inclusions present in the Volador Dull-Slipped ware sherds (n=142) of this study.

Quartz

Size: Coarse (.625 mm), Medium (.5-.275 mm), and Fine (.25-.025 mm)

Frequency/Percentage: Sparse (2-5%), Common (10-25%), Abundant (40%)

Degree of Sorting: Poor to Fair

Roundedness: Sub-angular, low sphericity

Chert

Size: Medium (.25 mm)

Frequency/Percentage: Rare (1%)

Degree of Sorting: Good

Roundedness: Sub-angular, low sphericity

Chalcedony

Size: Coarse (1.25-.525 mm), Medium (.475-.3 mm), and Fine (.2-.125 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Sub-angular to sub-rounded, high sphericity

Hematite

Size: Coarse (3.75-.525 mm), Medium (.375-.25 mm), and Fine (.15-.075 mm)

Frequency/Percentage: Rare (1%), Sparse (2-5%), and Common (10%)

Degree of Sorting: Very Poor to Poor

Roundedness: Sub-rounded, high sphericity, sub-angular, low sphericity, and veins

Biotite

Size: Coarse (2.5-.525 mm), Medium (.5-.25 mm), and Fine (.2-.075 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Angular, rectangular, low sphericity, and veins

Calcite

Euhedral Calcite

Size: Coarse (1.5-.525 mm) and Medium to Fine (.375-.075 mm)

Frequency/Percentage: Rare (less than 1%), Sparse (3-5%), Common (15-25%), and Abundant (40%)

Degree of Sorting: Very Poor to Poor

Roundedness: Angular, low sphericity

Polycrystalline Calcite

Size: Coarse (1.875-.525 mm), Medium (.5-.275 mm), and Fine (.25-.075 mm)

Frequency/Percentage: Rare (1%), Sparse (2-4%), and Common (10-30%)

Degree of Sorting: Poor to Fair to Good

Roundedness: Sub-angular, low sphericity

Cryptocrystalline Calcite

Size: Coarse (1.625-1.5 mm), Medium (.3-.275 mm), and Fine (.25-.05 mm)

Frequency/Percentage: Sparse (2%), Common (15-35%), and Abundant (40-80%)

Degree of Sorting: Poor to Fair

Roundedness: Sub-angular, low sphericity

Plagioclase

None counted.

Feldspar

None counted.

Shell

Size: Coarse (2.75-.525 mm) and Medium to Fine (.4-.1 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Circular

Pores/Voids

Size: Coarse (3.75-.625 mm), Medium (.5-.25 mm), and Fine (.1-.05 mm)

Frequency/Percentage: Sparse (3-7%) and Common (10-15%)

Degree of Sorting: Very Poor to Poor

Roundedness: Sub-angular, low sphericity

Fossils

Size: Fine (.175-.075 mm)

Frequency/Percentage: Rare (less than 1%)

Degree of Sorting: Poor

Roundedness: Rounded, sub-rounded, high sphericity

Organics

Size: Medium (.5-.225 mm) and Fine (.15-.075 mm)

Frequency/Percentage: Sparse (2-8%)

Degree of Sorting: Fair

Roundedness: Rounded and sub-rounded, high and low sphericity

Volador Dull-Slipped wares may be characterized petrographically as dominated by poorly sorted, sub-angular calcareous minerals (primarily cryptocrystalline calcite) with lesser amounts of quartz and euhedral and polycrystalline calcite, and minor amounts of chert, chalcedony, feldspar, biotite, and hematite minerals and organics and shells. In four cases, the sherds were dominated by medium sized quartz with lesser amount of calcareous minerals, and minor amounts of chert, biotite, and hematite minerals and shells. Volador Dull-Slipped sherds are not highly porous. These sherds can also be identified by their clay birefringence colors that range from .006-.017.

In addition to these ware-based characteristics, Volador Dull-Slipped ware sherds form two groups based on the presence of different suites of inclusions that comprise the clay paste. The first group contains 105 sherds and is characterized by quartz, chert, chalcedony, hematite, biotite, euhedral, polycrystalline, and cryptocrystalline calcite minerals, and shell, fossils, and organic matter that range in size from very fine to coarse. The majority of the sherds have minerals, pores, and organics that comprise 40-60 percent of the clay paste; however, 12 sherds have minerals that occupy 15-35 percent of the clay paste and one sherd has minerals that comprise 70 percent of the clay paste.

There are five unique pore and mineral characteristics in this group. First, twenty percent of the sherds of this group are characterized by long, wavy pores parallel to the vessel wall. Second, shell fragments in this group are more complete (similar to a cross section). Third, some quartz and calcite minerals are perfectly oval in shape. Fourth, quartz minerals tend to occur in two size categories suggesting naturally present and intentionally added quartz. Finally, small fragments of biotite occur in larger hematite minerals. Birefringence colors range from .006-.017.

Thirty-seven sherds comprise the second group. This group has quartz, cryptocrystalline calcite, hematite, shell, and organic inclusions in the clay paste and they comprise 45-50 percent of the clay paste. In contrast to the above group, only one sherd has long, wavy pores that parallel the vessel wall. Birefringence colors range from .006-.017.

## II.E. Quantitative Analysis of Petrographic Data

The following section employs point counting data to further describe the variability of the ceramic wares described above. In order to better analyze the effect of the association of minerals in a clay paste, combinations of three types of inclusions are examined below through the use of ternary charts. Because of the requirement of three data values, those sherds that do not have the three values being plotted are not included. Five different combinations of minerals and pores of the three pottery wares reinforce the groupings previously described above and correspond to data presented in Chapter 8.

II.E.1. Ternary Plots of Euhedral, Polycrystalline, and Cryptocrystalline Calcite. As a result of petrographic examination, I detected the presence of calcite with different types of crystallinity. In order to test the possibility of groupings based on calcite crystallinity, euhedral, polycrystalline, and cryptocrystalline calcite frequencies were plotted. Ternary charts of the data counts of three crystalline forms of calcite present in the clay paste of the sherds in this sample appear in Figures 61-63.

Clemencia Cream Paste ware sherds typically lack polycrystalline calcite, have small amounts of euhedral calcite, and have relatively high quantities of cryptocrystalline calcite (Figure 61). This is not surprising given the marly texture of the paste. Although most sherds group together, four Chompoxté Red-on-paste: Akalché Variety sherds and one Canté Polychrome sherd each from Zacpetén and Tipuj have distinctive quantities of euhedral and cryptocrystalline calcite.

Vitzil Orange-Red ware sherds form three groups according to the presence of calcite (Figure 62). The first group lacks polycrystalline calcite, has small amounts of euhedral calcite, and high quantities of cryptocrystalline calcite. This group corresponds to the third and fourth groups described in section II.C. The second ternary chart group consists of small amounts of polycrystalline calcite and moderate quantities of euhedral and cryptocrystalline calcite. Two of the Augustine Red sherds come from Zacpetén and one from Tipuj. The third group is dominated by euhedral calcite and lacks polycrystalline and cryptocrystalline calcite. Three of these Augustine Red sherds come from Ixlú, one from Zacpetén, and one from Ch'ich'.

Volador Dull-Slipped ware sherds also form three groups (Figure 63). The majority of the sherds lack or have small quantities of euhedral and polycrystalline calcite and have high quantities of cryptocrystalline calcite. Another group has moderate amounts of euhedral calcite and relatively high quantities of polycrystalline and cryptocrystalline calcite. These Trapeché Pink sherds come from Zacpetén. Finally, the

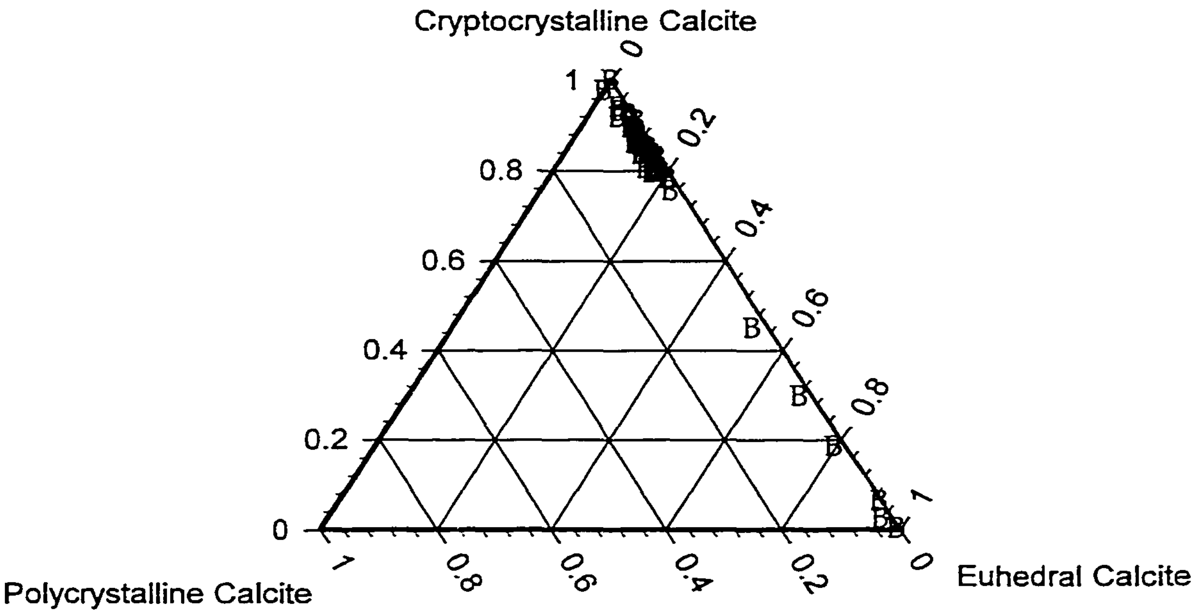


Figure 61: Clemencia Cream Ware Paste Sherds

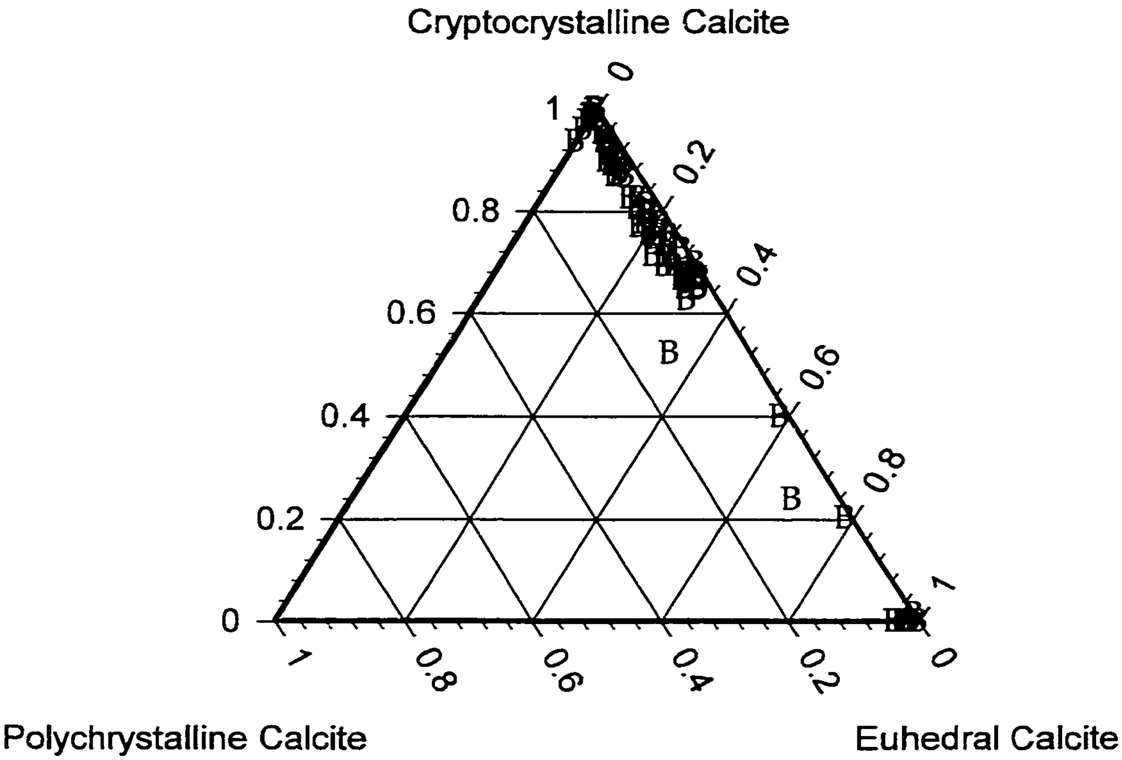


Figure 62: Vitzil Orange-Red Ware Sherds

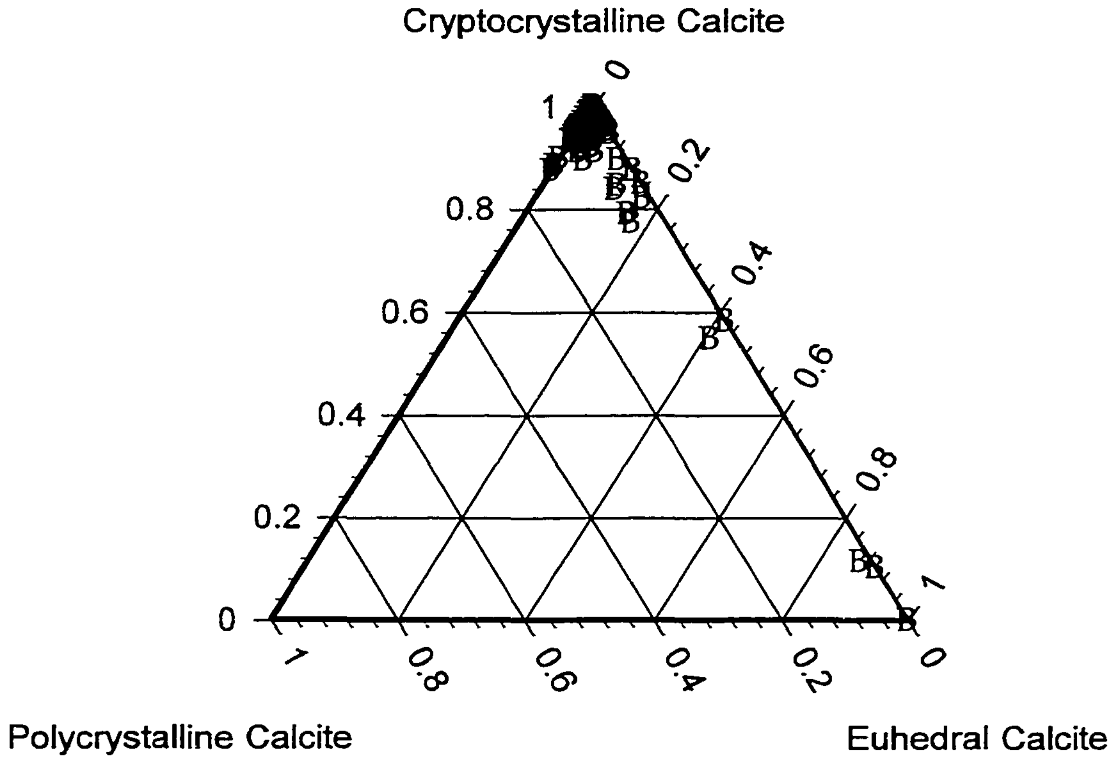


Figure 63: Volador Dull-Slipped Ware Sherds

third group consists of sherds with high amounts of euhedral calcite and low amounts of cryptocrystalline and polycrystalline calcite. All but one of these sherds are decorated and three come from Zacpetén, one from Chi'ch', and one from Tipuj.

II.E.2. Ternary Plots of Pores/Voids, Quartz, and Cryptocrystalline Calcite. Ternary charts of the combination of counts for pores/voids, quartz, and cryptocrystalline calcite appear in Figures 64-66. I chose to examine the combination of pores/voids, quartz, and cryptocrystalline calcite because of the presence of these components in the majority of sherds and because petrographic analysis suggests that the quantities of these components of the clay pastes may form clusters.

Clemencia Cream Paste ware sherds form two groups that correspond to the groupings based on petrographic examination described above in section II.B(Figure 64). The first group consists of relatively low to moderate quantities of pores/voids and quartz and high quantities of cryptocrystalline calcite. This group corresponds to groups two and three discussed in section II.B. The second ternary chart group is dominated by pores/voids and has small amounts of quartz and calcite. This group corresponds to the first group of sherds discussed in section II.B. and includes all Topoxté Red sherds from Ixlú and two Topoxté Red sherds from Tipuj.

Vitzil Orange-Red ware sherds form three loosely defined "groups" based on the presence of pores/voids, quartz, and cryptocrystalline calcite (Figure 65). The first group consists of low to moderate quantities of pores/voids and quartz and moderate to high quantities of cryptocrystalline calcite. The second group has moderate to high quantities of pores/voids and low amounts of quartz and voids and includes three Augustine Red

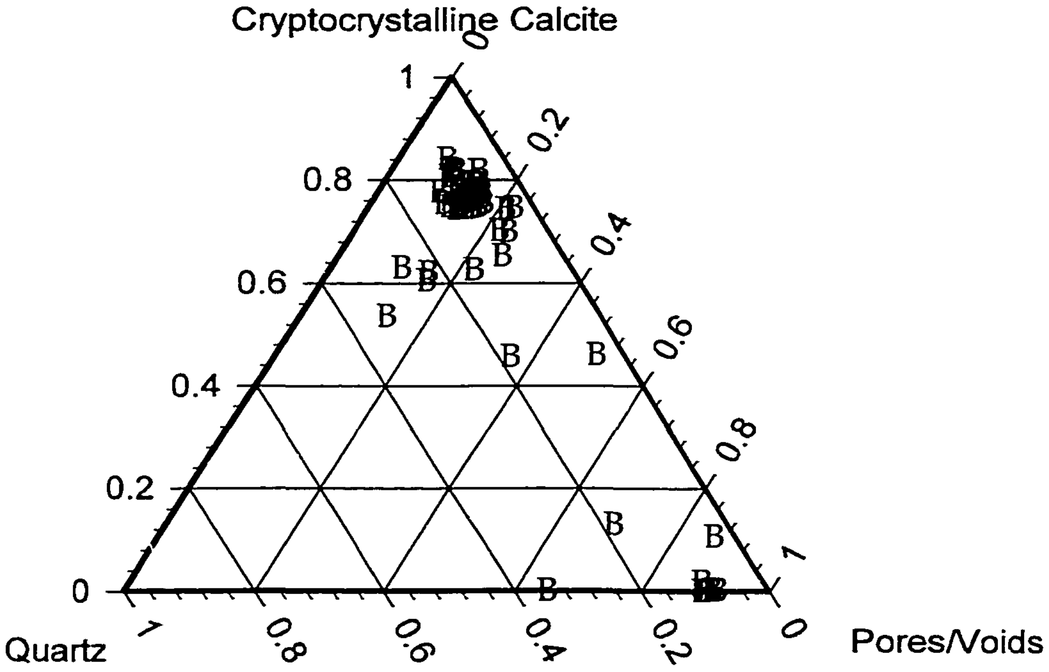


Figure 64: Clemencia Cream Paste Ware Sherds

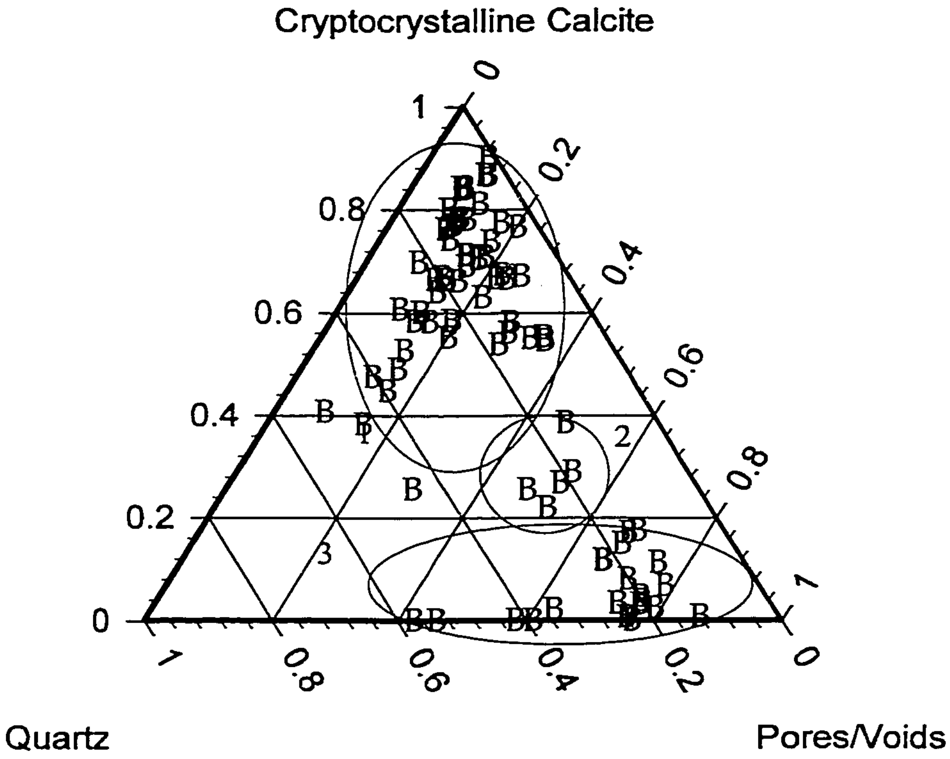


Figure 65: Vitzil Orange-Red Ware Sherds

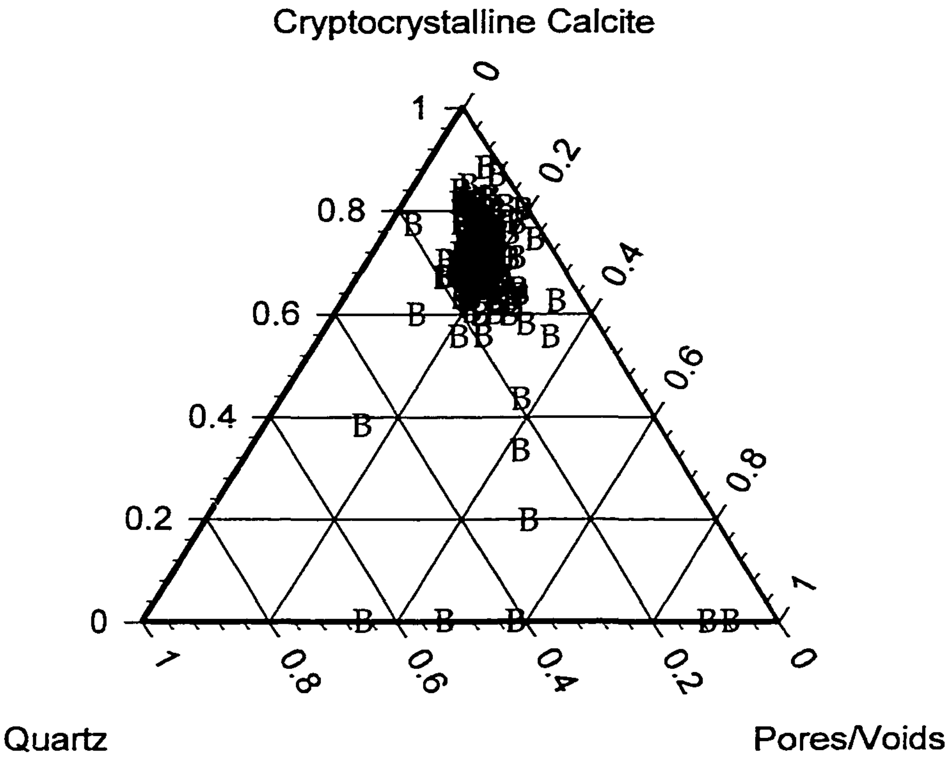


Figure 66: Volador Dull-Slipped Ware Sherds

sherds from Chi'ch' and two sherds from Zacpetén. Finally, the third group has a high quantity of voids, low to moderate quantities of quartz, and moderate to high amounts of cryptocrystalline calcite. This group has three decorated sherds and 10 Augustine Red sherds from Ixlú, five Augustine Red sherds from Ch'ich, and four Augustine Red sherds from Zacpetén and corresponds to the first petrographic group discussed in section II.C.

Volador Dull-Slipped ware sherds also form three groups as seen in the ternary plot of the data (Figure 66). The first group has low quantities of pores/voids and quartz and high amounts of cryptocrystalline calcite. Another scatter of sherds has moderate amounts of pores/voids and cryptocrystalline calcite and moderate to high quantities of quartz. This scatter is composed of two sherds (Macanché Red-on-paste and Ixpop Polychrome) from Zacpetén, one Picú Incised: Picú Variety sherd from Ch'ich', and one Paxcamán Red sherd from Tipuj. The final group has high quantities of voids and varying amounts of quartz and cryptocrystalline. All sherds in this group come from Zacpetén.

II.E.3. Ternary Plots of Cryptocrystalline Calcite, Quartz, and Hematite. Ternary charts that display the quantities of cryptocrystalline calcite, quartz, and hematite of the sherds in this study are presented in Figures 67-69. I chose this combination of minerals because of the relatively consistent presence of cryptocrystalline calcite and the varying amounts of quartz and hematite minerals noted in petrographic examination. Hematite was chosen because of its abundance in Vitzil Orange-Red paste wares that have orange-red pastes due to the presence of hematite in the clay paste and the relative lack of hematite in the Clemencia Cream Paste ware and the Volador Dull-Slipped ware sherds.

Clemencia Cream Paste ware sherds form two distinct groups (Figure 67). The

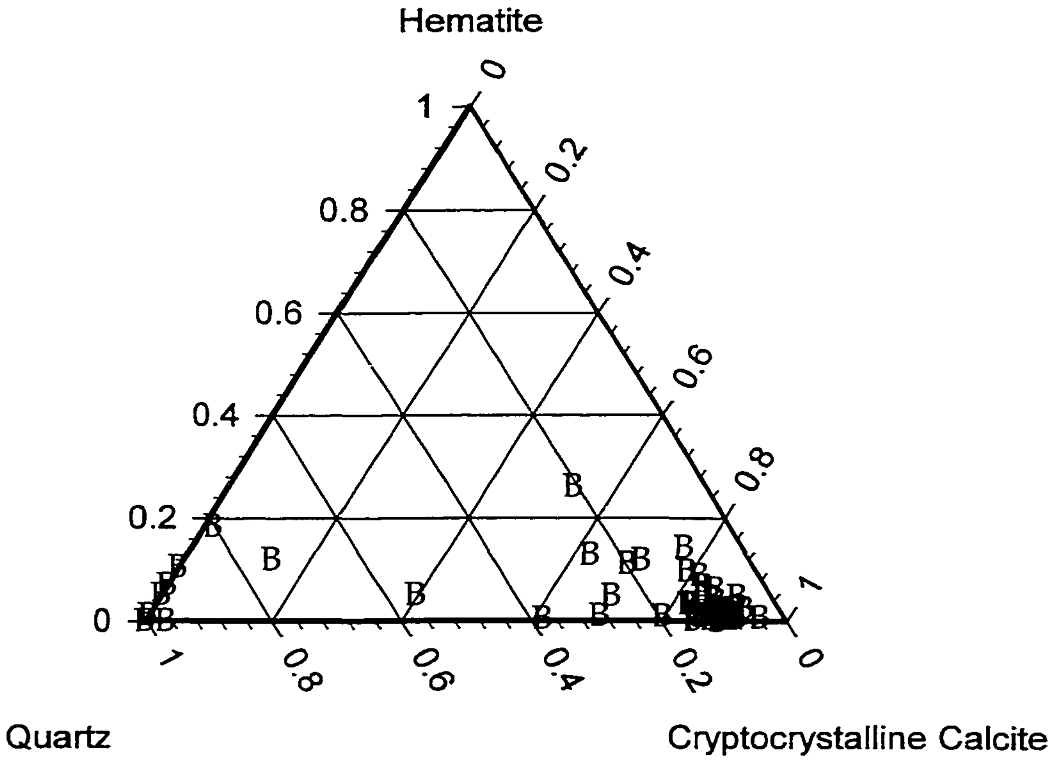


Figure 67: Clemencia Cream Paste Ware Sherds

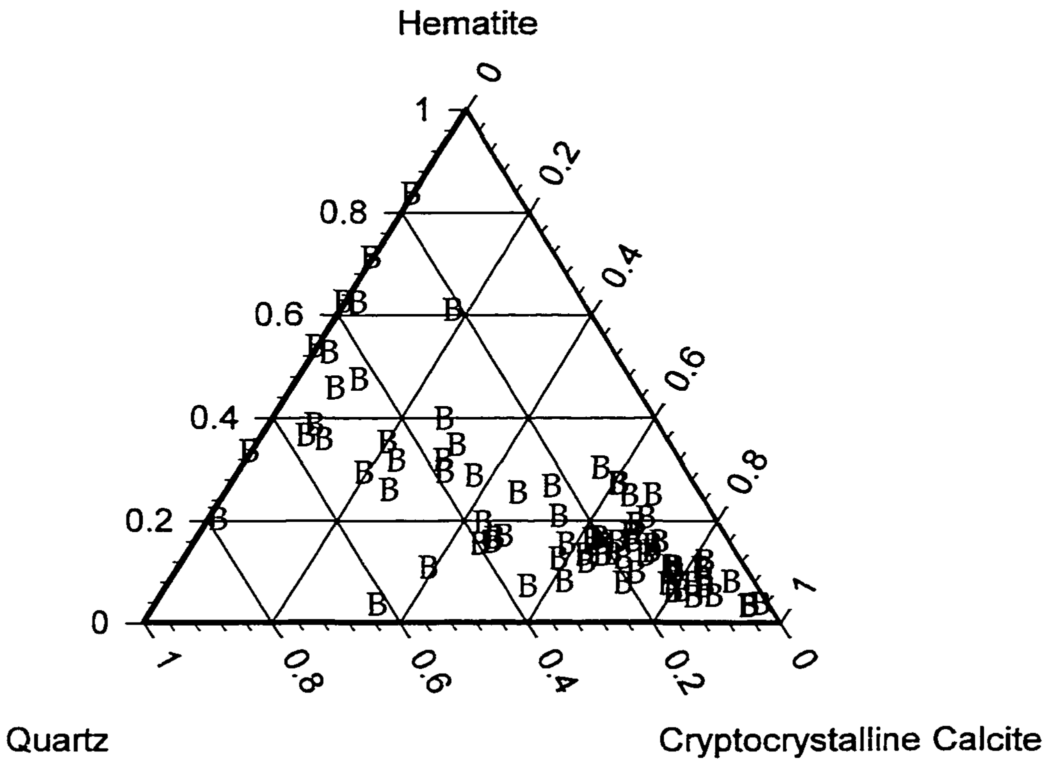


Figure 68: Vitzil Orange-Red Ware Sherds

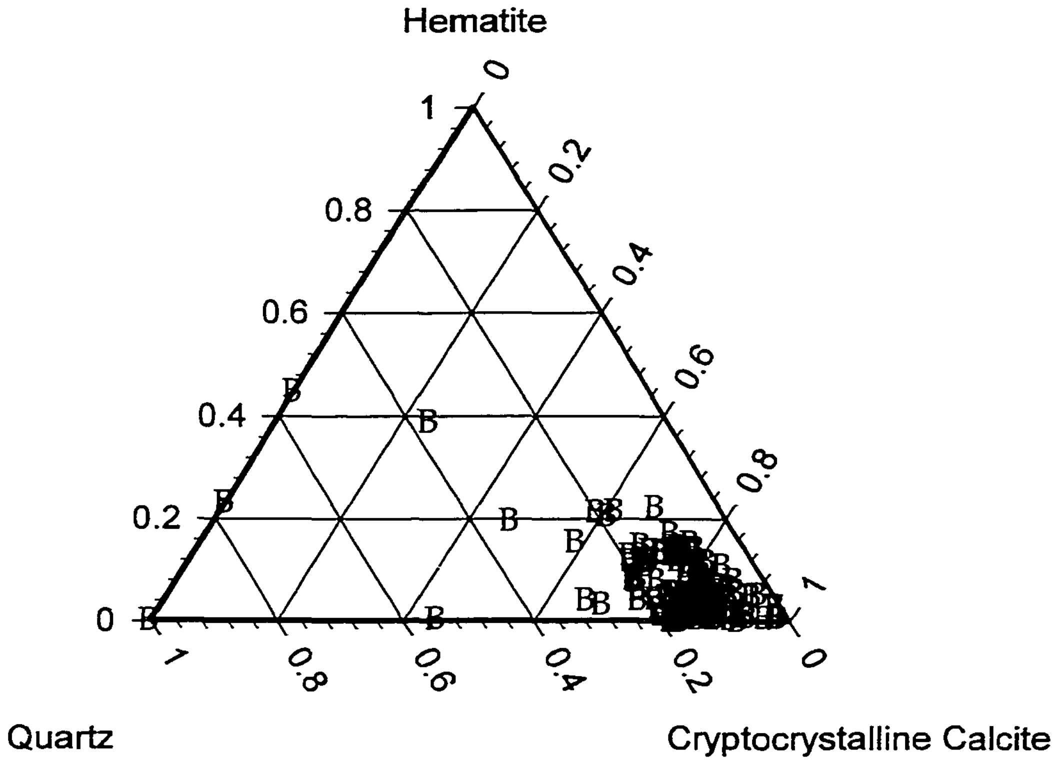


Figure 69: Volador Dull-Slipped Ware Sherds

ceramic paste of the first group consists of high quantities of cryptocrystalline calcite and hematite and low quantities of quartz. All sherds from Ixlú appear in this cluster. The second group is the exact opposite with high quantities of quartz and low quantities of hematite and calcite in the sherd paste.

The Vitzil Orange-Red ware sherds do not form distinctive groups based on these three elements, which suggests a continuum of minerals present in the clay matrix (Figure 68). Although no distinct groups occur, one cluster of sherds has high quantities of cryptocrystalline calcite and hematite and low to moderate frequencies of quartz. Most of the sherds that comprise this group are from Ixlú and three are from Ch'ich' and three from Zacpetén.

Volador Dull-Slipped ware sherds form one main group characterized by a large amount of cryptocrystalline calcite and low quantities of quartz and hematite (Figure 69). Five sherds exist outside of this group and three of them have high quantities of quartz and low quantities of hematite and cryptocrystalline calcite. These sherds represent three decorated sherds and two undecorated sherds from Zacpetén, one undecorated sherd from Ch'ich, and one decorated and one undecorated sherd from Tipuj.

II.E.4. Ternary Charts of Pores/Voids, Quartz, and Hematite. Ternary charts for pores/voids, quartz, and hematite are found in Figures 70-72. This combination of clay paste components represents three inclusions that are present in the majority of sherds and have shown to be distinctive in the ternary charts previously discussed. Therefore, by comparing the three components, it was hoped that their relative importance as far as frequency in the clay paste would be better illustrated. Unfortunately, obvious

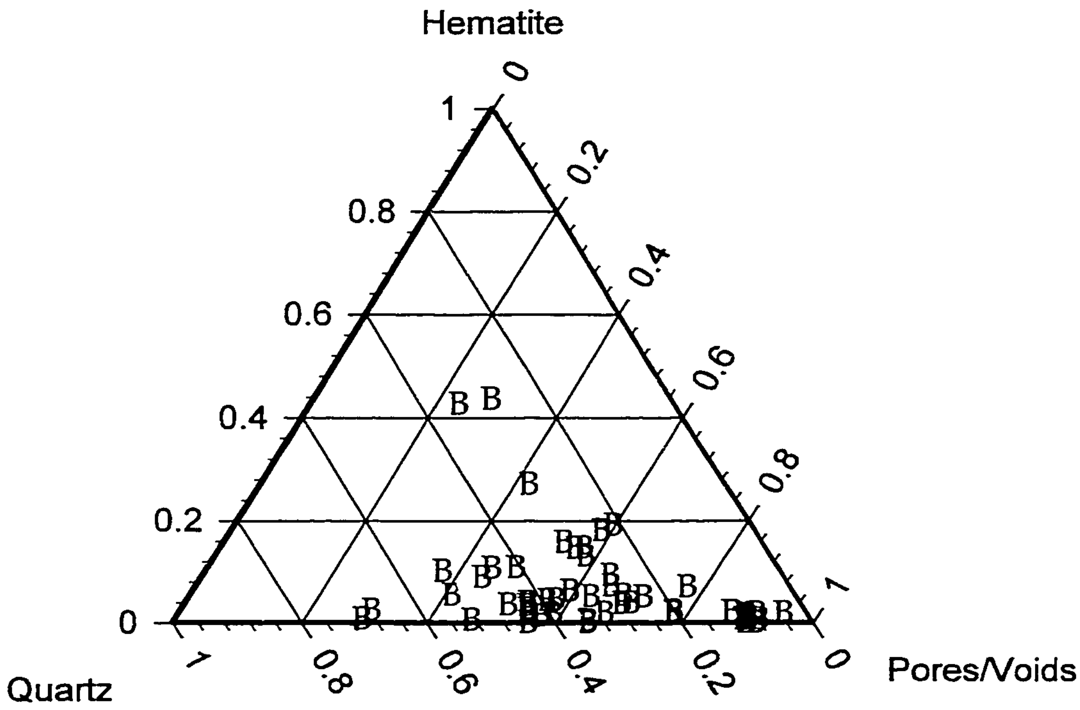


Figure 70: Clemencia Cream Paste Ware Sherds

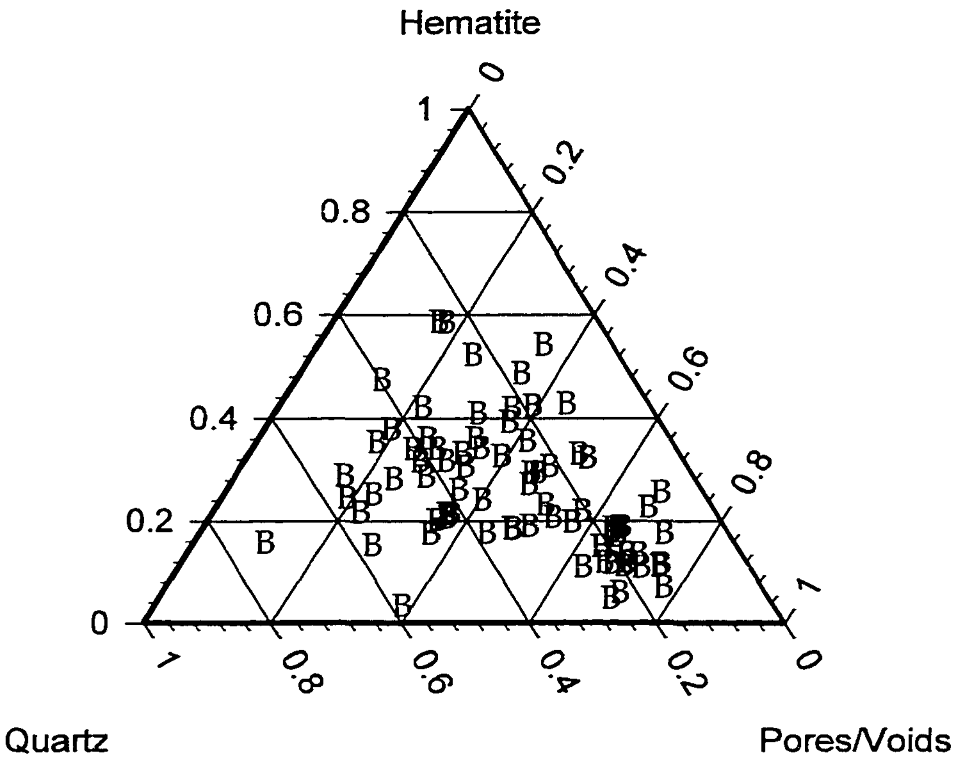


Figure 71: Vitzil Orange-Red Ware Sherds

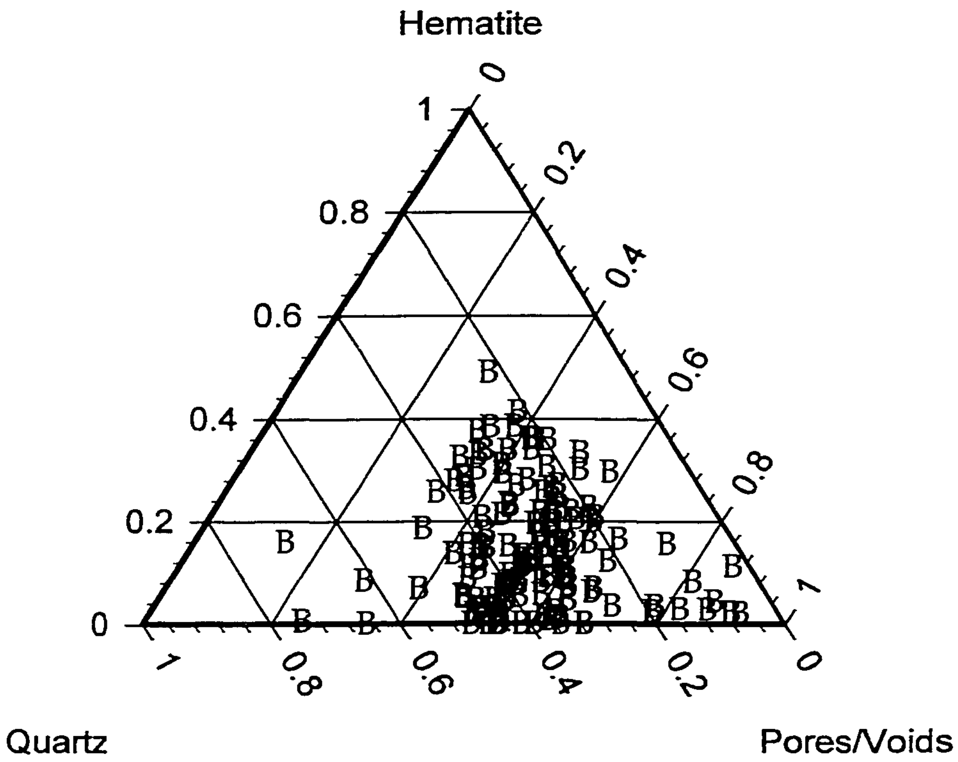


Figure 72: Volador Dull-Slipped Ware Sherds

differences only occur in the Clemencia Cream Paste ware sherds.

Clemencia Cream Paste sherds form one large group with two outlier groups (Figure 70). The large group has moderate to high amount of pores/voids and a variation in the quantity of hematite and quartz minerals. The two outlier groups, composed of Chompoxté Red-on-paste: Akalché Variety sherds from Zacpetén and Topoxté Red sherds from Ixlú, have a low quantity of pores/voids and a moderate amount of quartz and hematite. This chart is confusing because of the absence of the distinct groupings based on high quantities of pores/voids in petrographic examination and previous ternary charts. Although this division is not obvious in the current ternary chart, there are five sherds from Ixlú slightly separated at the lower right corner.

Vitzil Orange-Red ware sherds also form one large cluster in the center of the ternary chart suggesting a common occurrence of the components in all sherds (Figure 71). Although Vitzil Orange-Red clay pastes should form distinct groupings as evident from petrographic analysis, the distinction is not obvious from these three components. However, a small cluster of these sherds occurs in the lower right corner of the chart.

Sherds of the Volador Dull-Slipped ware demonstrate the same trend as discussed above for the Clemencia Cream Paste and Vitzil Orange-Red ware sherds (Figure 72). The only apparent difference exists in the tightness of the cluster of sherds due to the moderate amount of quartz present in the majority of sherds. Unfortunately, the relative importance of these components in the clay pastes is not apparent in the ternary charts.

II.E.5. Ternary Charts of Cryptocrystalline Calcite, Chalcedony, and Biotite. Ternary charts that plot the presence of cryptocrystalline calcite, chalcedony, and biotite appear

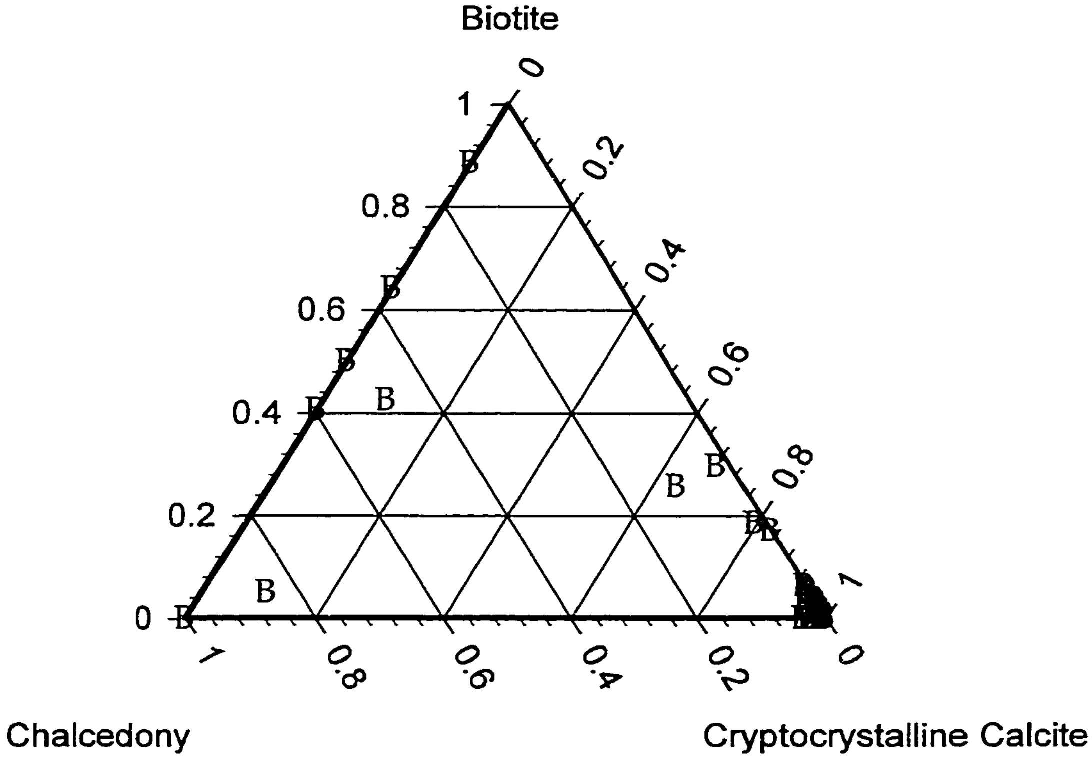


Figure 73: Clemencia Cream Paste Ware Sherds

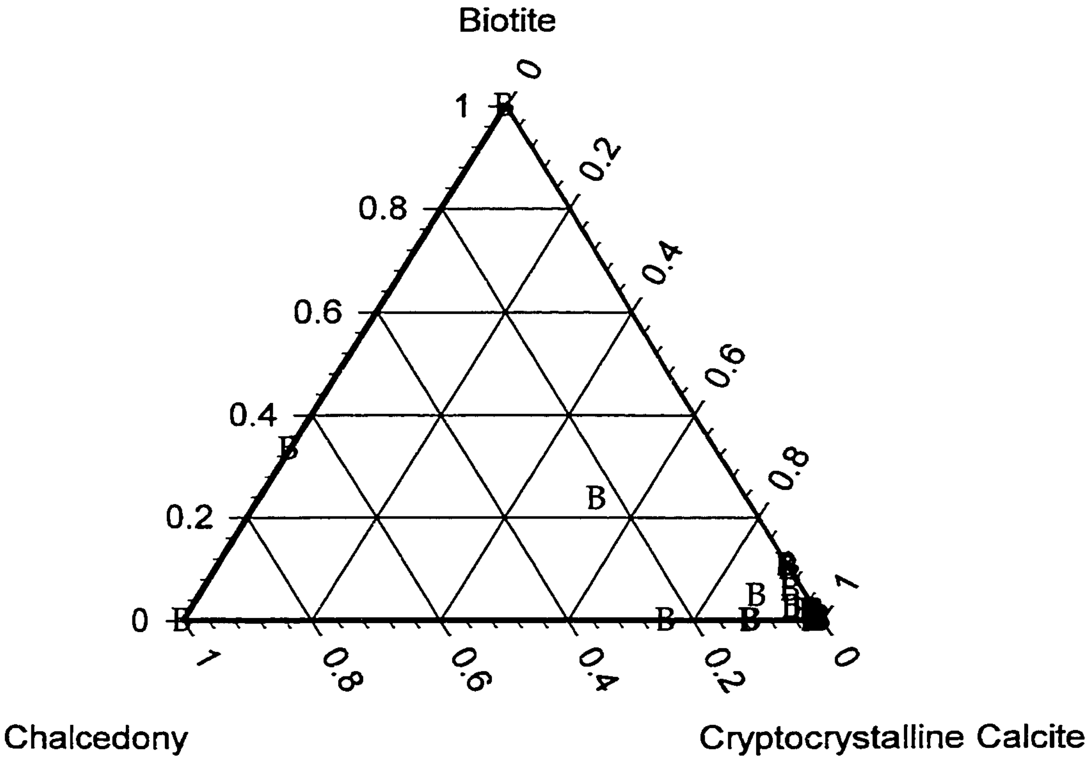


Figure 74: Vitzil Orange-Red Ware Sherds

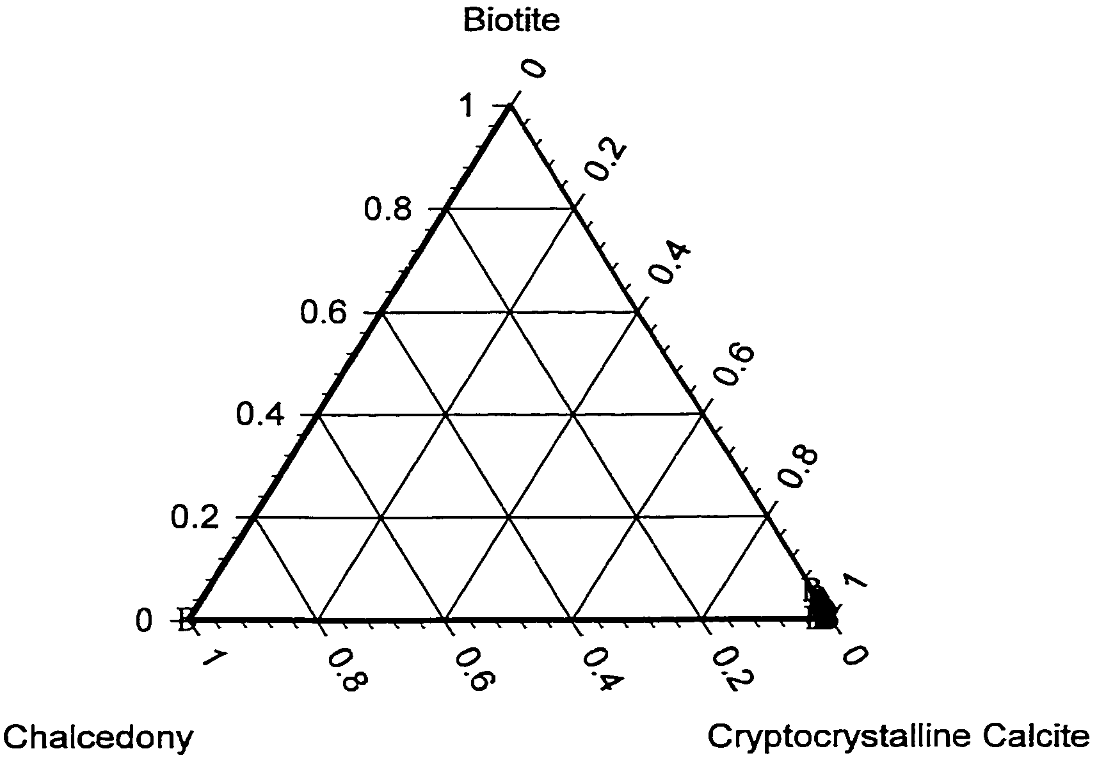


Figure 75: Volador Dull-Slipped Ware Sherds

in Figures 73-75. I chose to compare these three minerals because of the varying presence of chalcedony and biotite in the clay pastes of the three ceramic wares. In petrographic examination, biotite occurs with calcite or with calcite and chalcedony to form two distinct groups (see sections II.B., II.C., and II.D.). Therefore, by examining the presence of the three minerals, the petrographic groups based on the presence of biotite and chalcedony may be further illustrated through the ternary charts.

Clemencia Cream Paste ware sherds form two “groups” or scatters when the three minerals are plotted together (Figure 73). The first “group” consists of high quantities of cryptocrystalline calcite, no chalcedony, and low amounts of biotite. This “group” corresponds to the second petrographic group discussed in section II.B. The other scatter contains low quantities of cryptocrystalline calcite and varying amounts of biotite and chalcedony. This scatter consists of Topoxté Red sherds from Ixlú.

Vitzil Orange-Red ware sherds form two “groups” or scatters that appear on the right and left sides of the ternary charts (Figure 74). The first group consists of high quantities of cryptocrystalline calcite and low quantities of chalcedony and biotite. A few sherds in this group lack chalcedony and biotite. The second scatter contains a range (low to high) of quantities of the three minerals. Equal quantities of sherds from the four archaeological sites in this study occur throughout the graph.

Volador Dull-Slipped ware sherds form one group with an outlier from Zacpetén (Figure 75). The group is represented by high amounts of cryptocrystalline calcite and by low quantities of chalcedony and biotite. This group may represent the first petrographic group discussed in section II.D. Unfortunately, the ternary chart group does not reflect the division of sherds with the presence of biotite and chalcedony and those without either of the two minerals as determined through petrographic analysis.

In sum, the petrographic analysis presented in sections II.B., II.C., and II.D. the ternary plots presented in section II.E. suggest various groups of clay paste components. In general, the differences in the groups of the three pottery wares result from the presence of pores/voids, chalcedony, and biotite. Clemencia Cream Paste ware sherds form three mineralogical groups: 1) clay pastes that lack mineral inclusions and have an abundance of pores/voids; 2) clay pastes with biotite minerals; and 3) clay pastes with chalcedony and biotite minerals. Vitzil Orange-Red ware sherds form two basic groups of mineral components: 1) clay pastes with an abundance of pores/voids; and 2) clay pastes with the presences of all minerals in varying quantities. Finally, Volador Dull-Slipped ware sherds also form two basic groups of minerals: 1) clay pastes with biotite and chalcedony and 2) clay pastes lacking biotite and chalcedony. These differences correlate to differences in elemental concentrations (Chapter 8) and to differences in technological styles (Chapter 9).

## II. X-Ray Diffraction Analysis

Clays from Yaxhá and Zacpetén as well as 15 sherds representing all of the ceramic wares and groups and some of the pottery types were analyzed using x-ray diffraction analysis. Only 15 sherds were tested because these sherds had estimated original firing temperatures below 450°C. Preliminary tests on sherds fired above 450°C demonstrated that clay mineral peaks were not detected because clay mineral structures begin to collapse at this temperature.

### II.A. Clays of the Petén Lakes Region

To fully understand the variability of clays and other minerals present in the mineralogical analysis described below, a discussion of the geology of central Petén is warranted. The Petén lakes region is characterized by a karstic surface with slumped bedding composed of sediments that date from the late Cretaceous to the Eocene periods (Vinson 1962). The chain of lakes, of which Lake Petén Itzá is the largest, lies in an east-west anticline and exhibit superficial interior drainage patterns (Cowgill et. al. 1966:2). The oldest unmetamorphosed or partly metamorphosed sediments of the Santa Rosa Formation overlie pre-Carboniferous metamorphic rocks and granites (Vinson 1962:429). The Santa Rosa Formation is overlain by the Todos Santos Formation (upper Jurassic) that resulted from the embayment deposition from the Gulf of Mexico (Vinson 1962:431). This series of red beds (called so because of the iron content in the clays to make them "red") exists throughout Guatemala, Belize, and the Yucatán Peninsula. Although the description of "red beds" suggests that the beds are colored red, in fact, the colors range from white to reddish brown and include quartz gravels (Lopez Ramos 1975:271). Salts interlayer the Santa Rosa Formation's red beds (Lopez Ramos 1975:272; Vinson 1962:431).

Cretaceous limestones, dolomites, and argillaceous to arenaceous clastics (the Coban Group) overlay the Santa Rosa Formation. The Coban Group is a thick sedimentary sequence of "carbonates and evaporites deposited under restricted to open marine conditions" (Banks and Carballo 1987a:60). Carbonate and evaporite beds are interbedded with anhydrites and halite and different concentrations of minerals and carbonates allow geologists to divide the Coban Formation into four distinct levels (A-D): Level D consists of limestones and dolomites that developed in a salt facies and has the thickest layer of evaporites; Level C is 20 percent carbonate; Level B is 50 percent carbonate; and Level A is not discussed in detail (Banks and Carballo 1987b:72; Vinson 1962:432).

The Coban group is overlain by the Campur Formation (Upper Cretaceous) that consists of limestone facies. The limestone facies are "gray, gray-brown, and tan limestone interbedded with shale, siltstone, and limestone breccia" (Vinson 1962:432).

Above the Campur Formation is the Lacandon Formation of the Verapaz Group (Upper Cretaceous) that consists of white detrital limestone characteristic of algal beds (Vinson 1962:441). The Lacandon limestone beds produce the karstic surface of Petén, Belize, and the Yucatán Peninsula.

The Petén group (Early Tertiary/Lower Eocene) is divided into the Toledo and Cambio Formations in the Petén lakes area. The sediments of the two formations were deposited contemporaneously and are differentiated by lithology. The Cambio Formation consists of shale and graywacke facies and contains fragmented limestone, siltstone, marlstone, and conglomerate limestones (Vinson 1962:443). Above the Cambio Formation, the Toledo Formation appears as a series of indurated shale and clay shale that are brown to olive gray and contain chert (Vinson 1962:448).

The Santa Amelia and Buena Vista Formations (lower Eocene) define what is commonly referred to as "Petén marls and limestone" (Wadell 1928:344). The lower Santa Amelia Formation is composed of dolomite, limestone, and marl shelf facies (Vinson 1962:447). Cream-colored microgranular sediments are interbedded with reddish evaporitic clays and limestone breccias. Tikal sits on the Santa Amelia Formation (Cowgill et. al. 1963:5). The formation is distinguished from the Buena Vista

Formation by an extensive basal gypsum bed (Vinson 1962:447). "[L]enticular layers of massive gypsum, white and cream-colored fine granular limestone and dolomite, chalky dolomite, chalky marlstone, pellet limestone, limestone breccia, and conglomerate and reddish gypsiferous clay" compose the extensive gypsum bed (Vinson 1962:448). Because of the proximity of this bed to the Buenavista Formation, evaporites predominate the dolomitic formation.

As stated above, the lakes in Petén region are a result of karstic landscapes and regional faulting. Sediment cores from Lakes Petenxil (Cowgill et. al. 1966), Yaxhá and Sacnab (Deevey et. al. 1979,1980), and Salpetén and Quexil (Brenner 1994) provide mineralogical evidence for the types of clay minerals that line the lake beds and are found in the surrounding inland areas. Each lake differs as to its specific water chemistry (see Table 38) because of the base exchange of clays, evaporites (especially gypsum), and dolomite (Deevy et. al. 1980:440).

Cowgill and Hutchinson (1963) and Cowgill et al. (1966) cored Lake Petenxil, Bajo de Santa Fé, and Bajo de Santa Ana Vieja. X-ray diffraction analysis of the clay sediments from the cores determined that halloysite ($2H_2O$ form) with minor amounts of montmorillonite, gypsum, quartz, and pyrite composed the clay matrix (Cowgill et. al.. 1966:52). However, when cores from the northern portion of the Petenxil drainage were

Table 38: Ionic Proportions in Petén Lake Waters (percentage composition in milliequivalents (from Deevey et. al. 1980:Table 8).

| | Ca | Mg | Na | K | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|
| Yaxhá | 32.07 | 5.64 | 8.77 | 3.23 | 39.5 | 6.67 | 4.07 |
| Sacnab | 24.65 | 9.35 | 12.47 | 4.48 | 35.6 | 8.30 | 5.13 |
| Quexil | 36.3 | 5.7 | 6.8 | 1.7 | 40.6 | 5.4 | 3.5 |
| Petenxil | 39.7 | 3.5 | 5.4 | .4 | 32.8 | 2.8 | 15.3 |
| Sacpuy | 27.2 | 8.1 | 13.5 | 2.6 | 37.0 | 8.7 | 3.0 |
| Petén Itzá | 32.0 | 14.5 | 3.8 | 1.1 | 14.9 | 3.1 | 30.5 |
| Macanché | 14.6 | 28.0 | 4.8 | 1.8 | 19.7 | 5.6 | 25.5 |
| Salpetén | 28.7 | 16.7 | 3.4 | .6 | .8 | 2.6 | 47.1 |

mineralogically tested, the clay matrix was almost entirely montmorillonite with small amounts of halloysite and large quantities of quartz (Cowgill et. al. 1966:55). Bajo Santa Ana Vieja sediments were primarily poorly formed halloysite as evident in lower than expected x-ray diffraction peaks (Cowgill et. al. 1966:125). Bajo de Santa Fé (near Tikal) contained montmorillonite and halloysite clay minerals and some quartz minerals (Cowgill and Hutchinson 1963:25-26). Low x-ray diffraction peaks for montmorillonite again suggest small, poorly developed crystalline structures. Cowgill and Hutchinson (1963:26) stated that clay minerals form poorly developed crystals when the sediments are embedded in high concentrations of organic matter and are formed *in situ* by decomposition. In addition to the gray montmorillonite/halloysite clays of Bajo de Santa Fé, Cowgill and Hutchinson (1963:32) also examined nearby montmorillonite and quartz red clays. These clay beds also had a small quantity of halloysite.

Deevey et. al. (1979, 1980) cored the Eocene sediments of Lakes Yaxhá and Sacnab. They stated (Deevey et. al. 1979:420) that the main sediment is allochthonous with a large quantity of montmorillonite clay that most likely eroded from impure limestone.

Brenner (1994) core Lake Salpetén and Quexil and determined that the main clay mineral was montmorillonite with a small portion of halloysite.

These differences in clay minerals and other minerals in the area may have presented Postclassic Maya potters with a variablity of clays with different working properties. Montmorillonite clays swell in the presence of water and potter's would have had to understand the problems associated with clay shrinkage in order to produce a successful vessel. In addition to the types of clay minerals, other minerals such as quartz and gypsum may also have affected the clay properties making it more manageable.

## II.B. X-Ray Diffraction Analysis of Clemencia Cream Paste and Volador Dull Slipped/Snail Inclusion Ware Raw Clays

II.B.1. Clay Samples. Four clay samples representing clays used in the manufacture of Clemencia Cream Paste ware pottery came from the mainland around Lake Yaxhá, the location of Topoxté Island. The Central Petén Historical Ecology Project (CPHEP) collected the clay during the 1973-1974 field seasons. Clay sample 11836 came from Brecha 4 at a depth of 100-110 cm near Mound S12, west of the Late/Terminal Classic site of Yaxhá, on the mainland across from the Topoxté Islands. The raw clay has a gray color (2.5Y 6/0) and after the clay is filtered, the color changes to light gray (10YR 7/1). Clay sample 11846 came from a road cut near the intersection of the road to Yaxhá and the road to Melchor de Mencos at kilometer marker 64-65. No depth was given. The color of the raw clay is gray (5YR 5/1) and when filtered the color changes to pale brown (10YR 6/3). This clay appears similar in texture in its dry state to clay 11836. The third clay sample 11886 also came from a road cut at the Lake Yaxhá cruce at kilometer marker 62. It is a white clay (5YR 8/1) that forms rather large "clumps" and when filtered changes color to a lighter white (7.5YR 8/0). When this clay was prepared for XRD analysis, it flaked off the slide when air dried. The final clay sample, Fine, is a very fine powdery white clay (10YR 8/1) in its natural state that came from Pit 3 in Brecha 2 at Yaxhá (no depth is given). When filtered the clay does not change color.

In addition to the Clemencia Cream Paste ware clays, one sample of gray, snail inclusion clay was sampled from Zacpetén on the west lake shore between architecture Groups A and C. The dry clay has a gray (1GLEY 6/1) color that does not change when filtered.

### II.B.2. Results of X-Ray Diffraction Analysis

II.B.2.a. Clemencia Cream Paste Wares. Raw clay samples 11836, 11846, and Fine were analyzed untreated and treated with ethylene glycol, and sample 11886 was only tested treated with ethylene glycol because once it air dried, the clay separated from the glass slide. The untreated samples exhibited peaks around 6.5 2θ that range in d-spacing from 12.9-14.0 Å (Figures 76-79). When the samples were treated with ethylene glycol, the 6.5 2θ peaks shifted to approximately 5 2θ. In addition to the 100 percent peak at 6.5 2θ, the treated sample shows other peaks of intensity at approximately 10.5 2θ, 16 2θ, 20.5 2θ, and 26 2θ. These peaks indicate the presence of smectite clay minerals (Moore and Reynolds 1997:241-243). Upon closer examination, clay samples treated with ethylene glycol demonstrate montmorillonite peaks almost identical to those noted by Moore and Reynolds (1997:Figure 7.8) and Figure 6 and Table 5 presented above.

In addition to clay mineral peaks, calcite and quartz also occur. Calcite is represented by peaks at approximately 29.37 2θ, 36 2θ, 39 2θ, and 43 2θ (Chen 1977). Quartz is represent by a 100 percent peak at 26.67 2θ (Moore and Reynolds 1997:251). Other minerals may exist, but due to the background noise and the abundance of calcite no other minerals can be detected with certainty.

II.B.2.b. Zacpetén Raw Clay Sample. The clay sample taken from Zacpetén was analyzed untreated because when treated with ethylene glycol, the clay did not adhere to

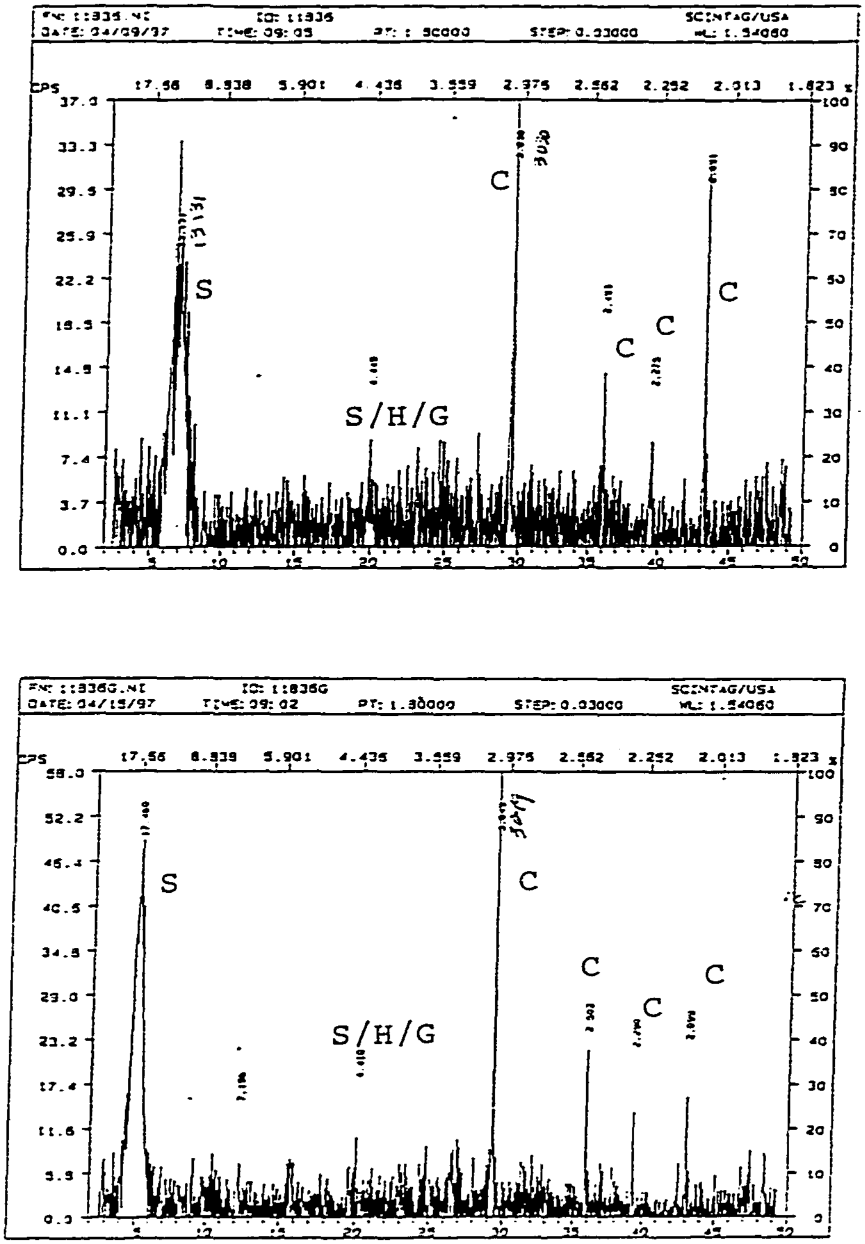


Figure 76: X-ray diffraction pattern for clay sample 11836. Graph A shows untreated clay and Graph B shows clay treated with ethylene glycol. (S=smectite, H=halloysite, G=Gypsum, C=Calcite)

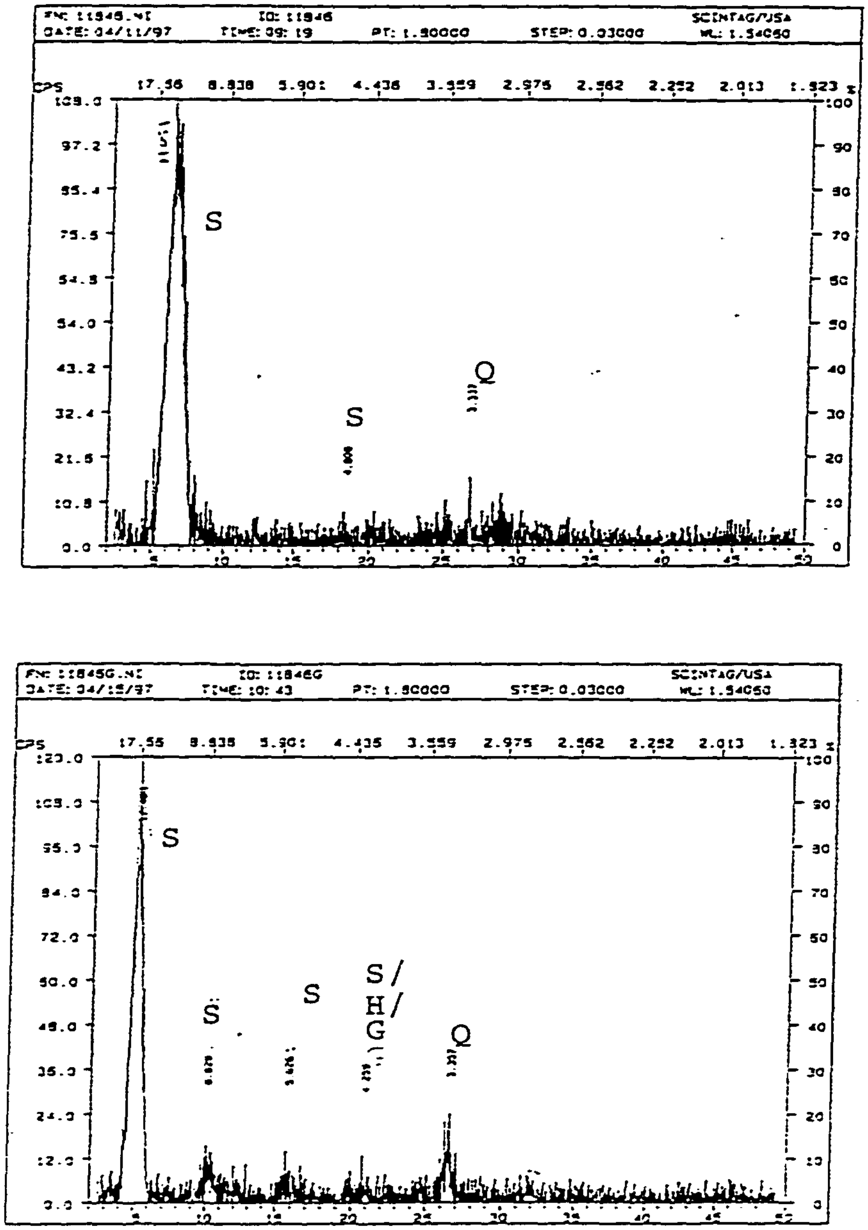


Figure 77: X-ray diffraction pattern for clay sample 11846. Graph A is untreated clay and Graph B is clay treated with ethylene glycol. (S=smectite, Q=quartz, H=halloysite, G=gypsum)

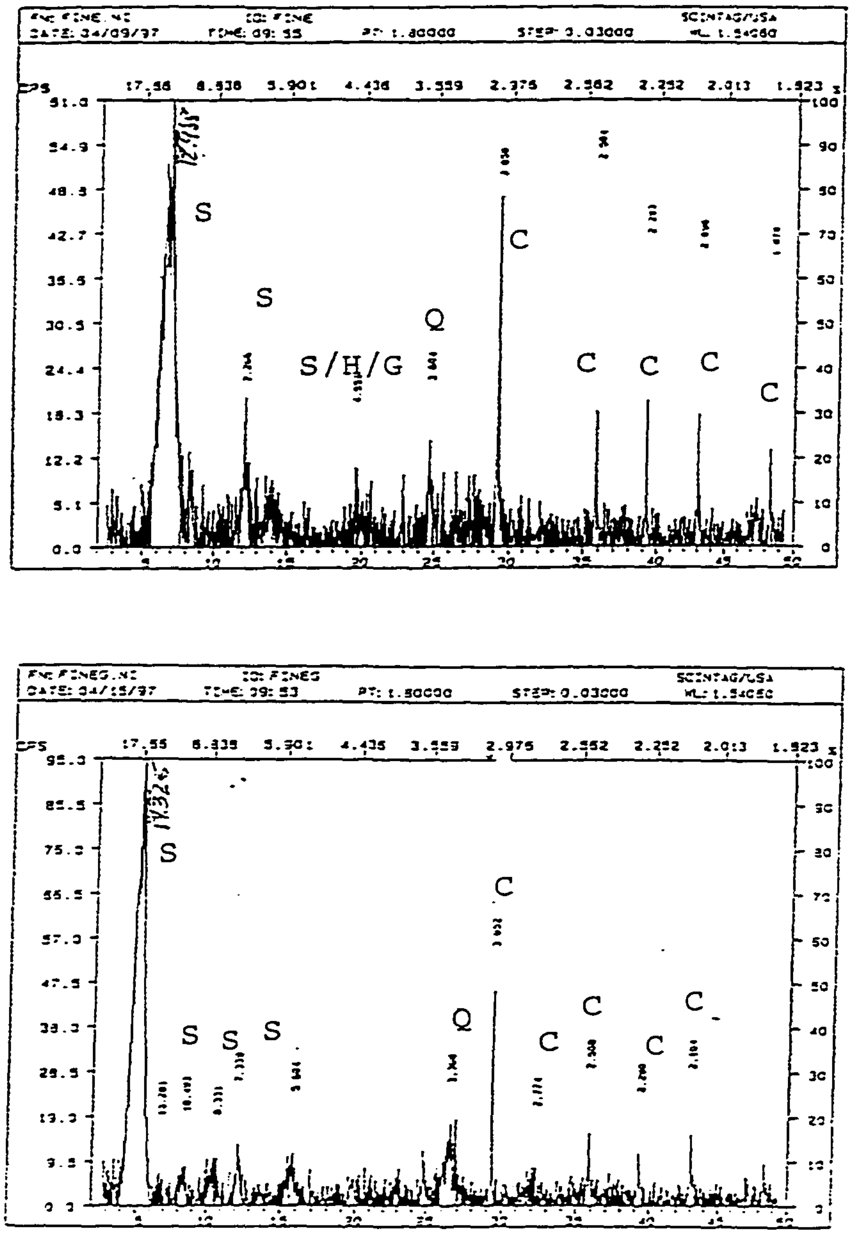


Figure 78: X-ray diffraction pattern for clay sample Fine. Graph A is untreated clay and Graph B is clay treated with ethylene glycol. (S=smectite, H=halloysite, G=gypsum, Q=quartz, C=calcite)

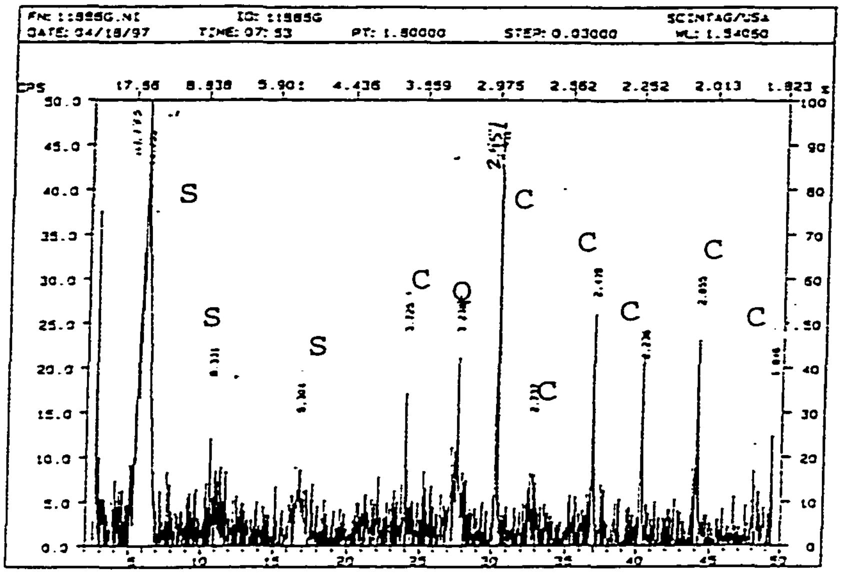


Figure 79: X-ray diffraction pattern for clay sample 11886G. The sample is treated with ethylene glycol. (S=smectite, C=Calcite, Q=quartz)

the slide. Although it was not analyzed treated with ethylene glycol, the peaks can be compared to those of untreated clay samples of the Clemencia Cream Paste ware and to figures in Moore and Reynolds (1997) to determine the possible presence of smectite clays.

Clay intensity peaks occur at approximately 6.5 $2\theta$ and 20 $2\theta$ (Figure 80). Unfortunately, many of the other probable smectite peaks (24 $2\theta$ and 29 $2\theta$) are masked by the abundant calcite. Nevertheless, the unmasked peaks suggest that montmorillonite may be the clay mineral present in this sample.

In addition to montmorillonite, calcite peaks occur at approximately 23 $2\theta$, 29 $2\theta$, 36 2 $2\theta$, 39 2 $2\theta$, 43 $2\theta$, and 43-49 2 $2\theta$. Biotite may be present as suggested by a peak at approximately 8 $2\theta$. Gypsum also occurs in the clay sample with two possible peaks at approximately 20.5 $2\theta$ and 31 $2\theta$. Other minerals may occur, but because of the abundance of calcite, their peaks may be obscured.

### II.C. Sherds Analyzed

Only a very small number of sherds (15) were analyzed by x-ray diffraction. As previously noted, only sherds with a low estimated firing temperature (below 450°C) could be tested because clay minerals begin to loose their hydroxyl water at 500°C, resulting in a change of the clay mineral structure. Although this is a small sample size, it represents most of the 10 groups discussed in the EDS section of Chapter 8. Table 39 presents the basic characteristics (site, structure, type, and variety) of the sherds analyzed and their corresponding EDS group.

All sherds samples were initially analyzed untreated to determine the presence of

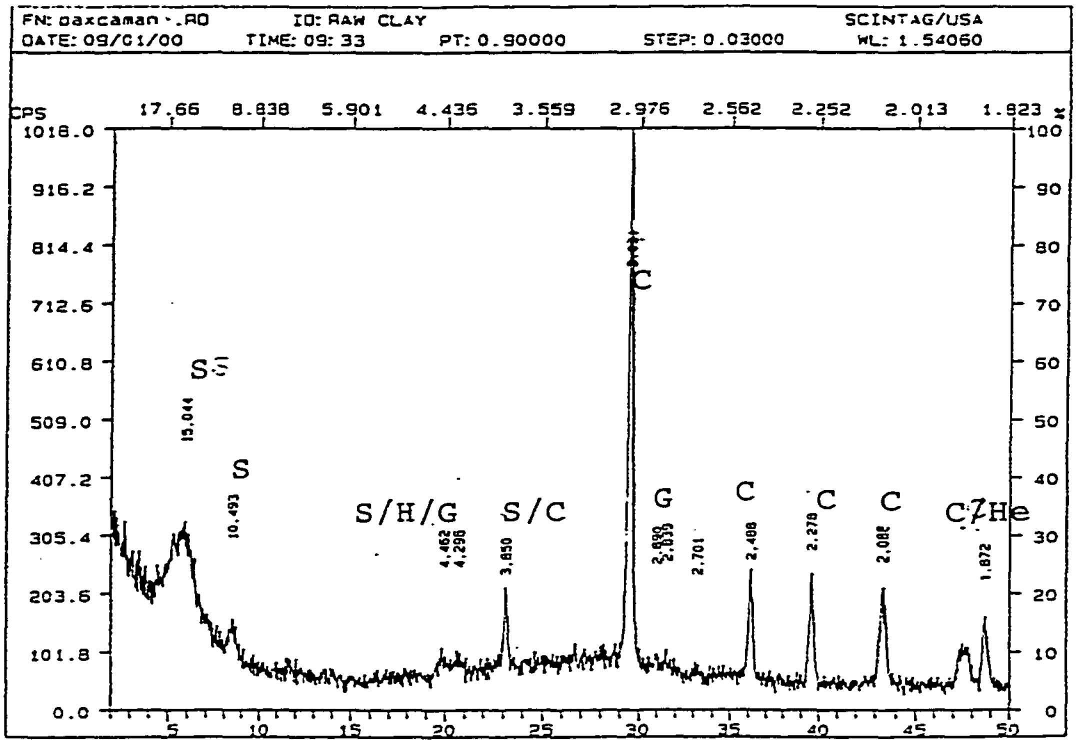


Figure 80: X-ray diffraction pattern for clay sample from Zacpetén. The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, He=hematite)

Table 39: Basic Characteristics of the Sherd Samples Used for X-ray Diffraction Analysis

| Sherd Sample | Site | Structure Number | Type: Variety | EDS group |
|---|---|---|---|---|
| ZT 7181 | Zacpetén | 606 | Chompoxté Red-On-Paste: Akalché Variety | E |
| ZT 15666 | Zacpetén | 767 | Chompoxté Red-On-Paste: Akalché Variety | E |
| ZT 18124 | Zacpetén | 615 | Chompoxté Red-On-Paste: Akalché Variety | F |
| IT 21875 | Ixlú | 2034 | Topoxté Red: Topoxté Variety | I |
| IA 23640 | Ixlú | 2022 | Augustine Red: Augustine Variety | E |
| IA 21831 | Ixlú | 2034 | Pek Polychrome: Pek Variety | D |
| ZA 18019 | Zacpetén | 719 | Augustine Red: Augustine Variety | C |
| CA 3702 | Ch'ich' | 188 | Augustine Red: Augustine Variety | D |
| IP 21870 | Ixlú | 2034 | Picú Incised: Thub Variety | D |
| IP 25463 | Ixlú | 2016 | Paxcamán Red: Paxcamán Variety | D |
| TP 143 | Tipuj | 2 | Picú Incised: Picú Variety | A |
| ITR 20463 | Ixlú | 2023 | Trapeché Pink: Trapeché Variety | J |
| ITR 28518 | Ixlú | 2041 | Trapeché Pink: Trapeché Variety | A |
| CTR 3916 | Ch'ich' | 188 | Trapeché Pink: Trapeché Variety | C |
| ZTR 12260 | Zacpetén | 721 | Trapeché Pink: Trapeché Variety | A |

clay mineral peaks. Two sherds (ZT 8124 and IA 21831) presented stronger clay mineral peaks and were thus analyzed a second time after being treated with ethylene glycol. The following section presents data from these two samples as they serve as the baseline XRD data for the remaining 13 analyzed sherds. Where differences occur, they are noted, but because of the lack of clear clay mineral peaks and the basic pattern of calcite and gypsum peaks, no further discussion is needed. X-ray diffraction graphs of all samples are presented in Figures 81-95.

Treated sherd samples ZT 8124 and IA 21831 (Figures 81 and 82) demonstrate smectite peaks at approximately 6 2θ, 10 2θ, 19-20 2θ, and 27 2θ. Other smectite peaks may occur, but they are masked by calcite peaks at approximately 23-24 2θ and 29 2θ. The smectite peaks resemble montmorillonite peaks described by Moore and Reynolds (1997:Figure 7.8). Halloysite may be present at approximately 20 2θ, but its presence is masked by montmorillonite and gypsum mineral peaks. Literature suggests that halloysite is present in the lake clays in the Petén lakes region and therefore should be included as a possible clay mineral (Cowgill and Hutchinson 1963; Cowgill et al.1966).

In, addition to montmorillonite and possible halloysite peaks, calcite and gypsum peaks can be identified with certainty. Calcite peaks at 23 2θ, 29 2θ, 36 2θ, 39 2θ, 43.5 2θ, and 47-49 2θ constitute the majority of peaks present in the x-ray diffraction graphs and mask many other mineral peaks. Gypsum peaks occur at approximately 20.5 2θ and 31 2θ.

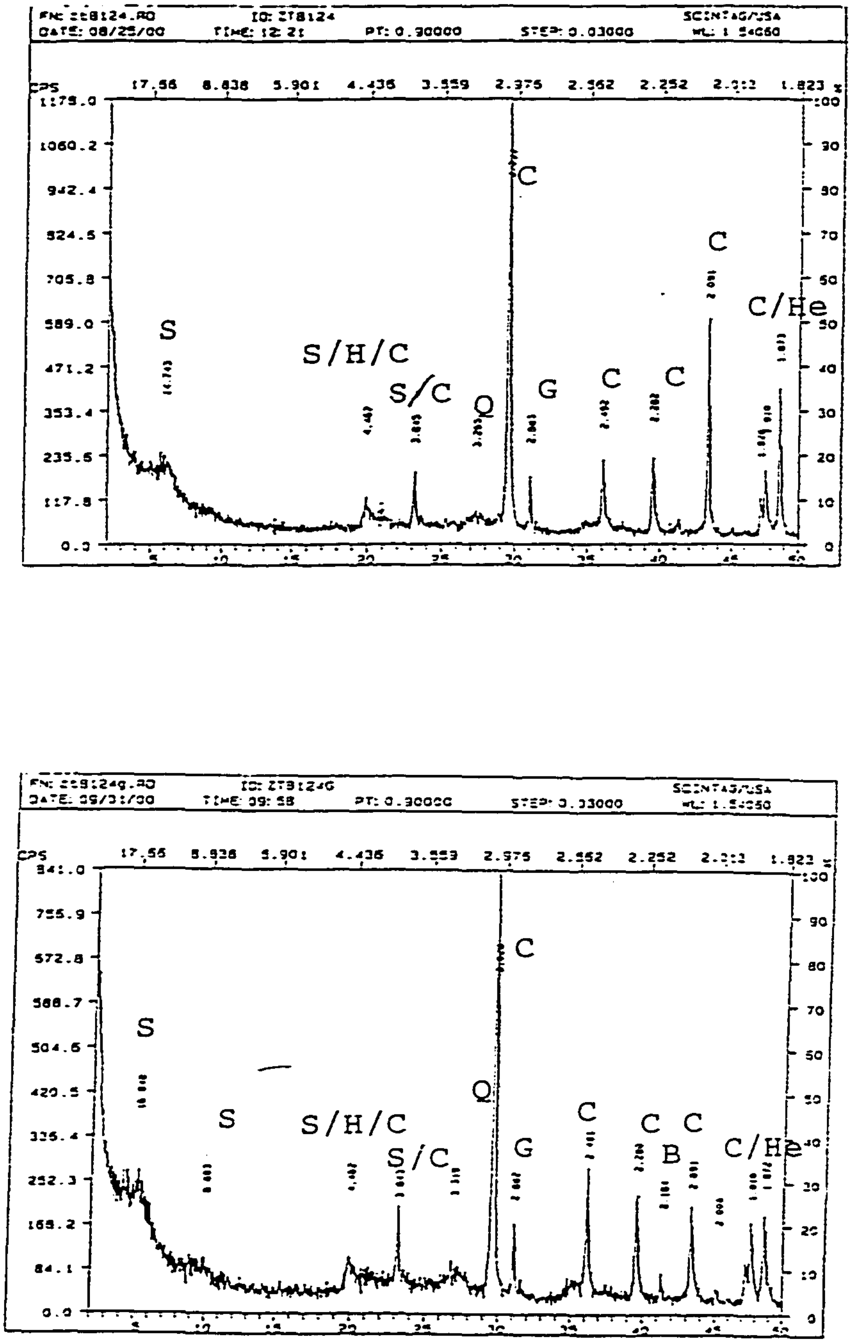


Figure 81: X-ray diffraction pattern for sherd sample ZT 8124 (Chompoxté Red-on-paste: Aklaché Variety from Zacpetén). Graph A is untreated and Graph B is treated with ethylene glycol. (S=smectite, H=halloysite, C=calcite, Q=quartz, G=gypsum, B=biotite, He=hematite)

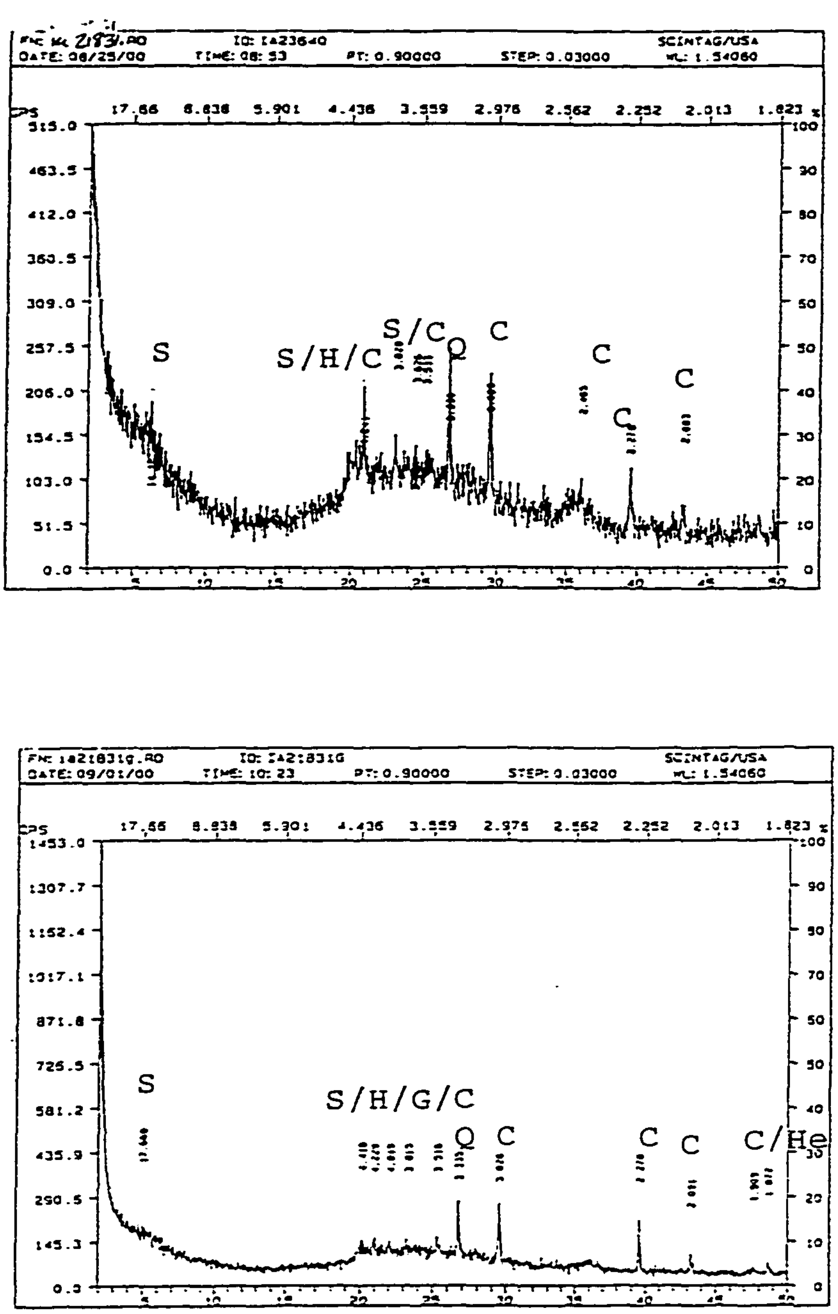


Figure 82: X-ray diffraction pattern for sherd sample IA 21831 (Pek Polychrome from Ixlú). Graph A is untreated and Graph B is treated with ethylene glycol. (S=smectite, H=halloysite, C=calcite, Q=quartz, G=gypsum, He=hematite)

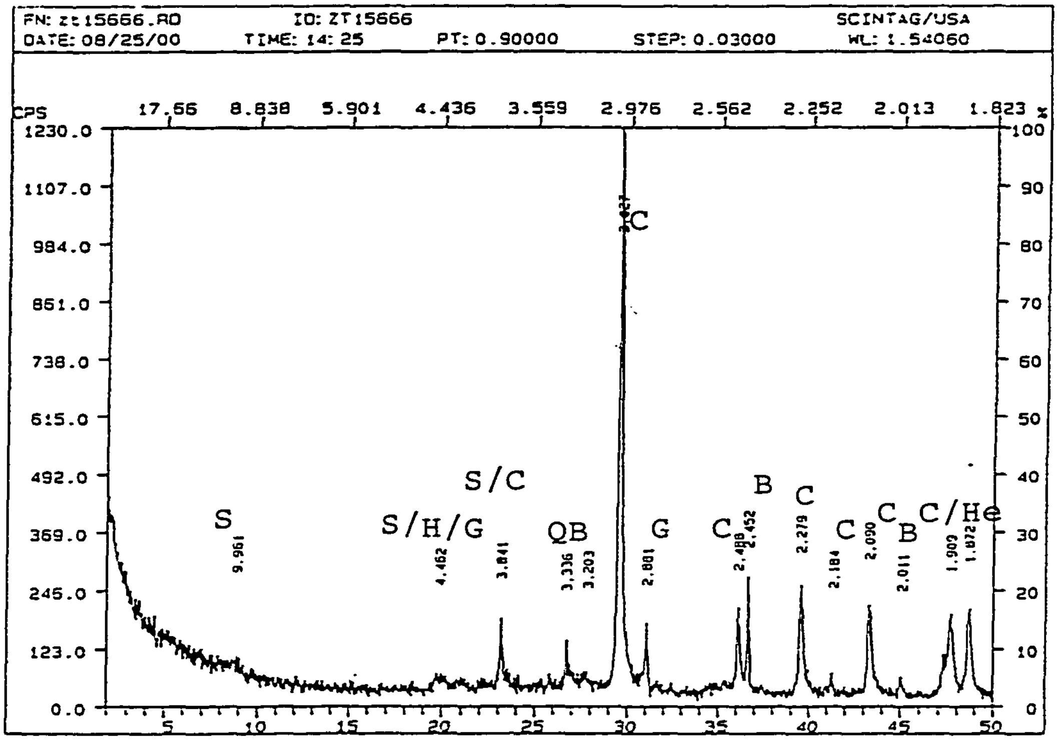


Figure 83: X-ray diffraction pattern for sherd sample ZT 15666(Chompoxté Red-on-paste: Aklaché Variety from Zacpetén). The sample is air dried.(S=smectite, H=halloysite, G=gypsum, Q=quartz, B=biotite, C=calcite, He=hematite)

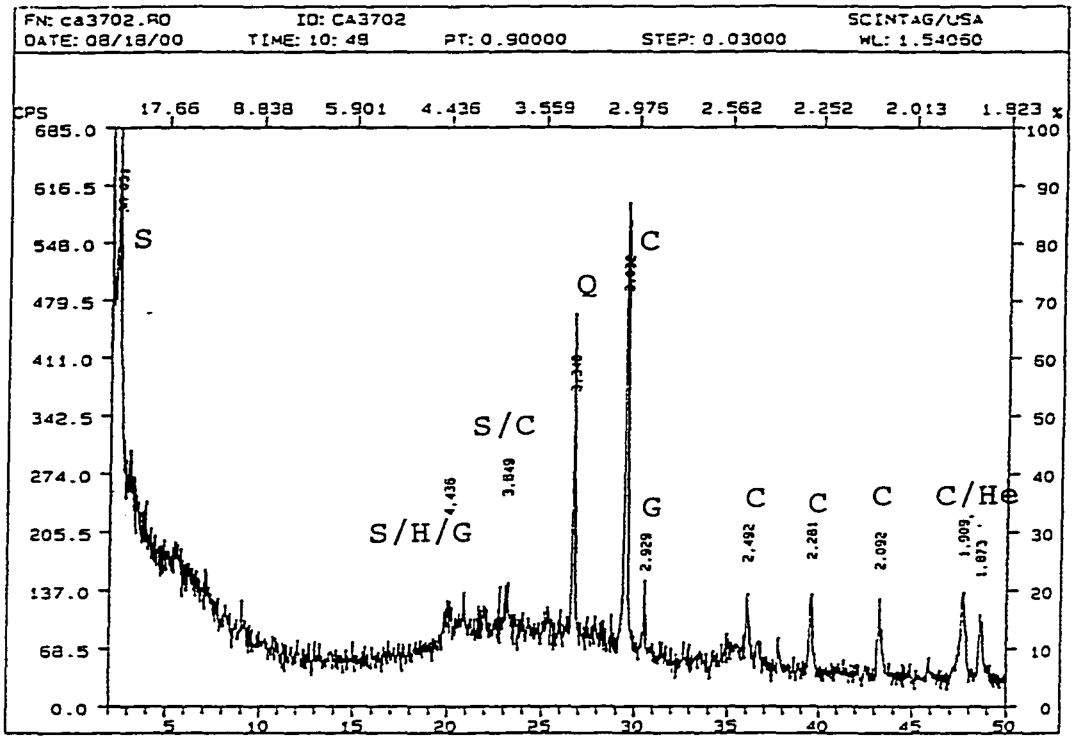


Figure 84: X-ray diffraction pattern for sherd sample CA 3702 (Augustine Red from Ch'ich'). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

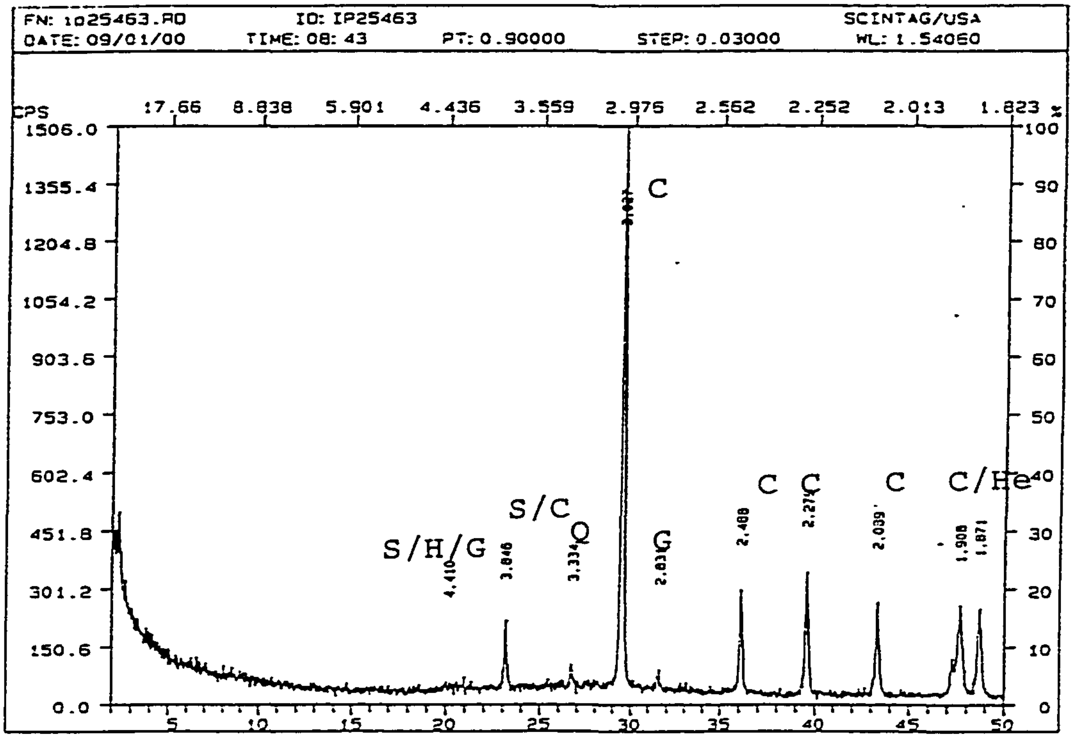


Figure 85: X-ray diffraction pattern for sherd sample IP 25463 (Paxcamán Red from Ixlú). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

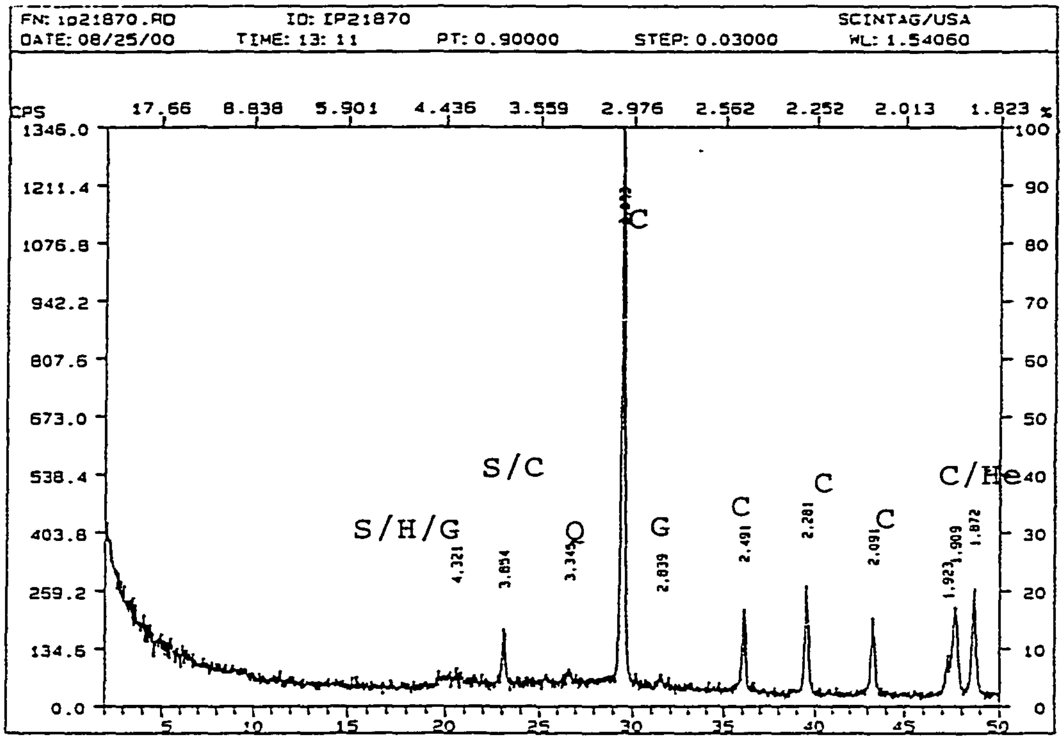


Figure 86: X-ray diffraction pattern for sherd sample IP 21870 (Picú Incised: Thub Variety from Ixlú). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

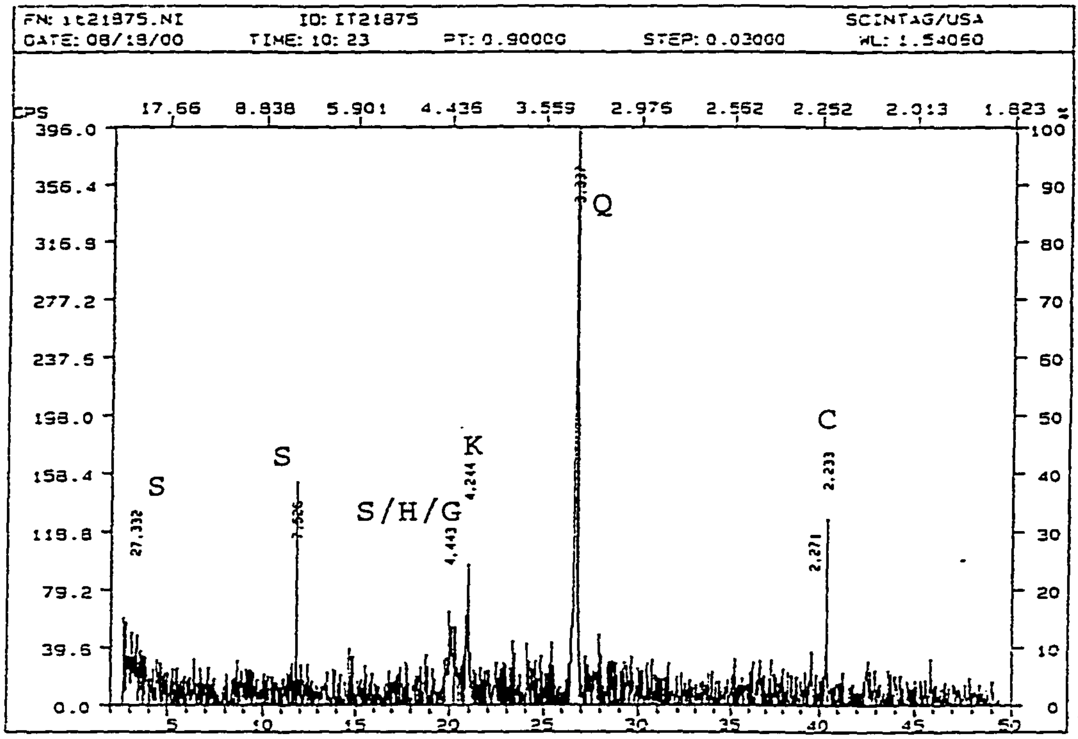


Figure 87: X-ray diffraction pattern for sherd sample IT 21875 (Topoxté Red from Ixlú). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, K=k-feldspar)

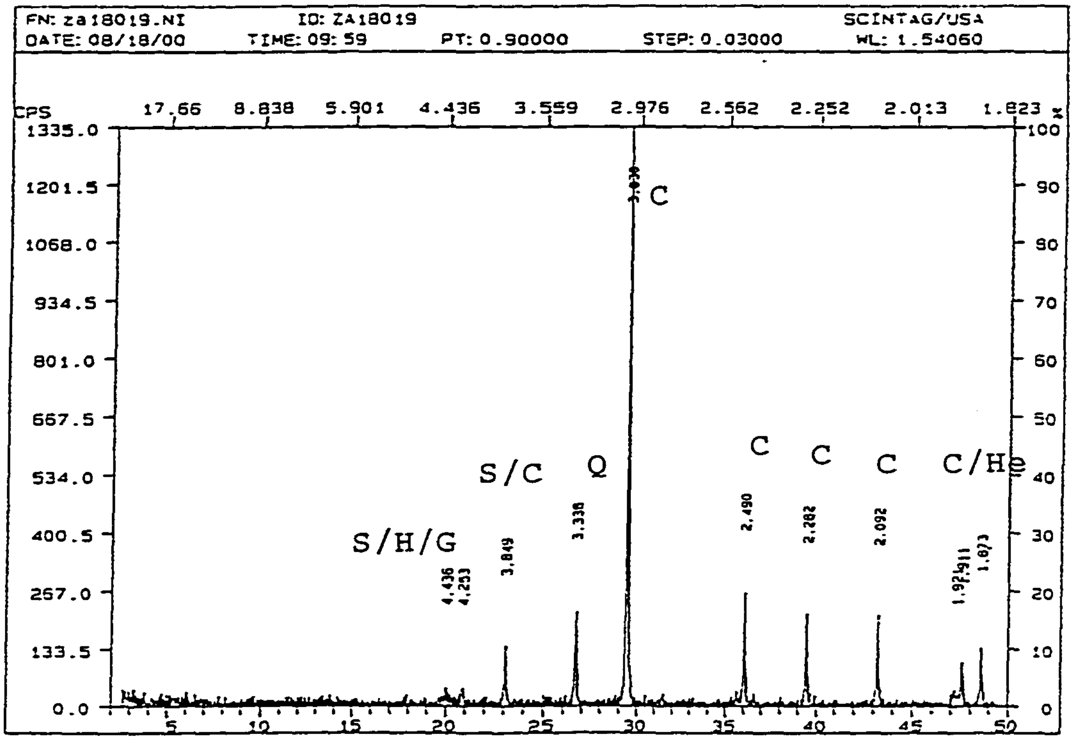


Figure 88: X-ray diffraction pattern for sherd sample ZA 18019 (Augustine Red from Zacpetén). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

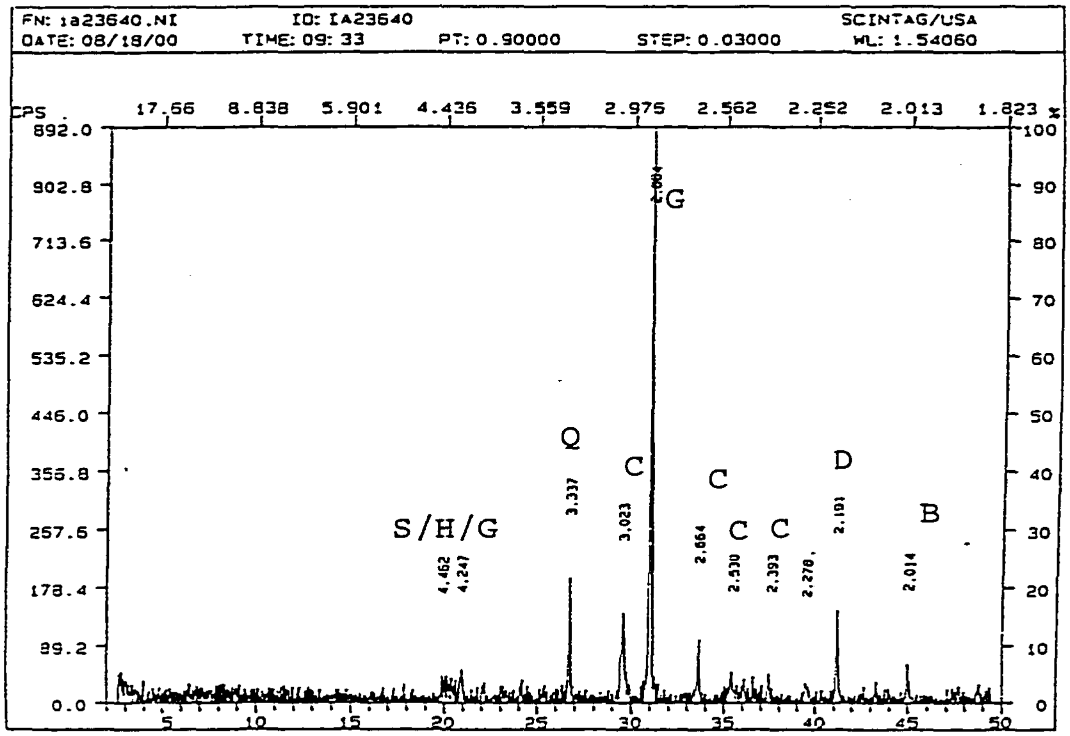


Figure 89: X-ray diffraction pattern for sherd sample IA 23640 (Pek Polychrome from Ixlú). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, B=biotite, D=dolomite)

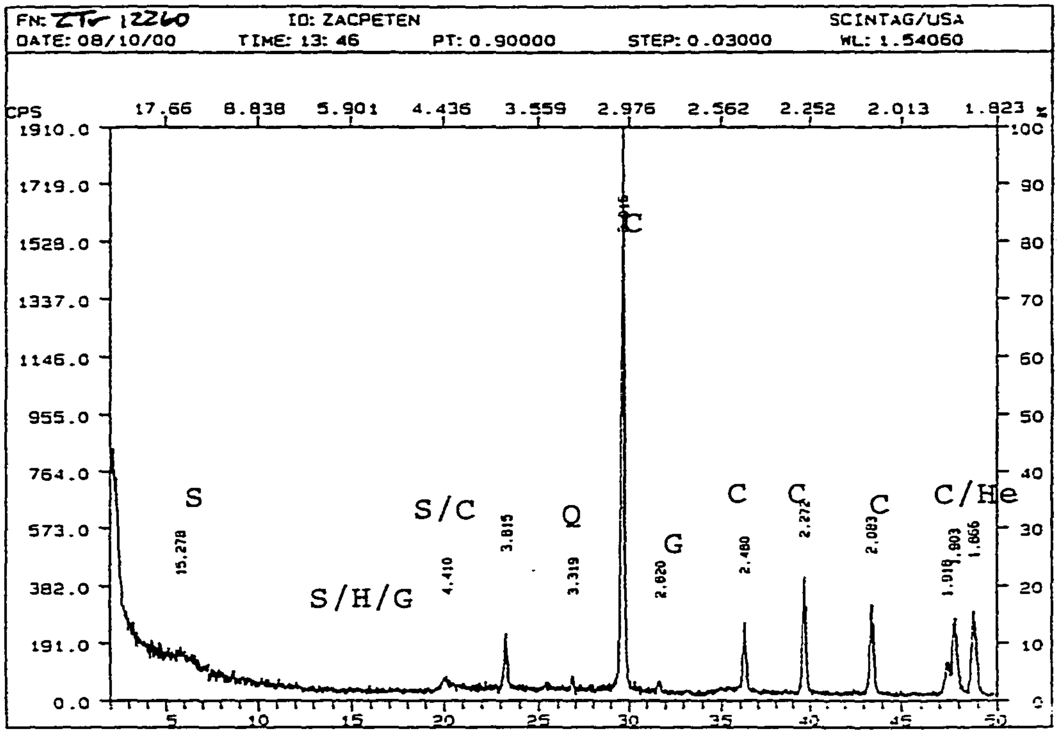


Figure 90: X-ray diffraction pattern for sherd sample ZTR 12260 (Trapeché Pink from Zacpetén). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

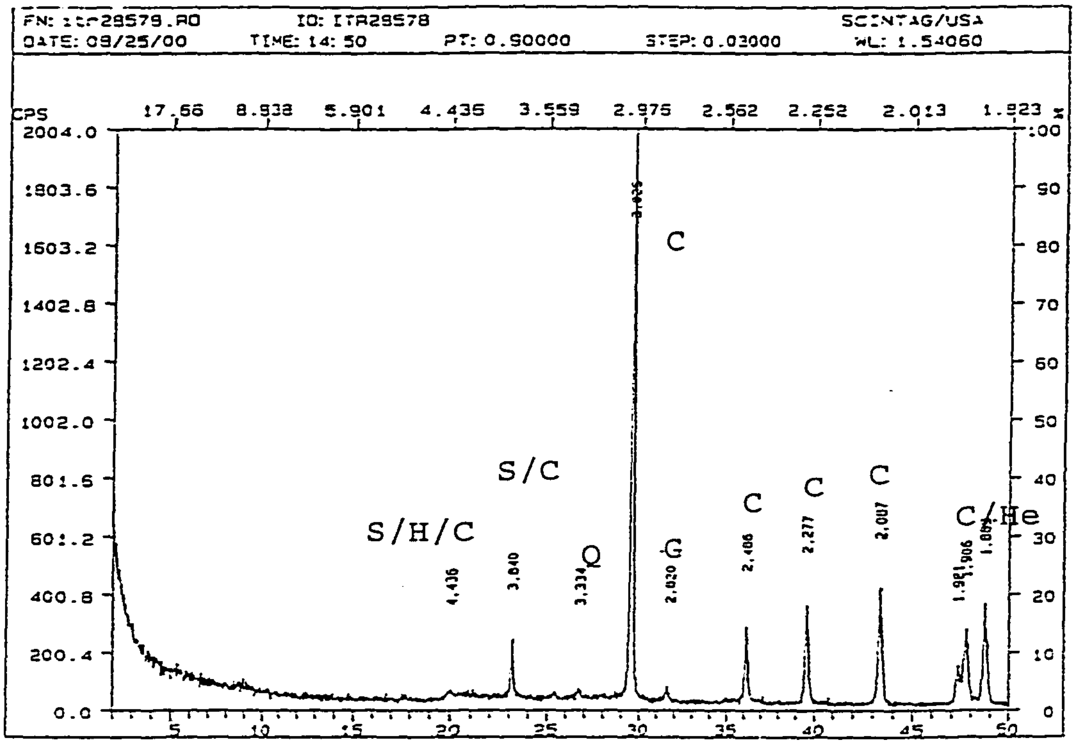


Figure 91: X-ray diffraction pattern for sherd sample ITR 28518 (Xuluc Incised: Tzalam Variety from Ixlú). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

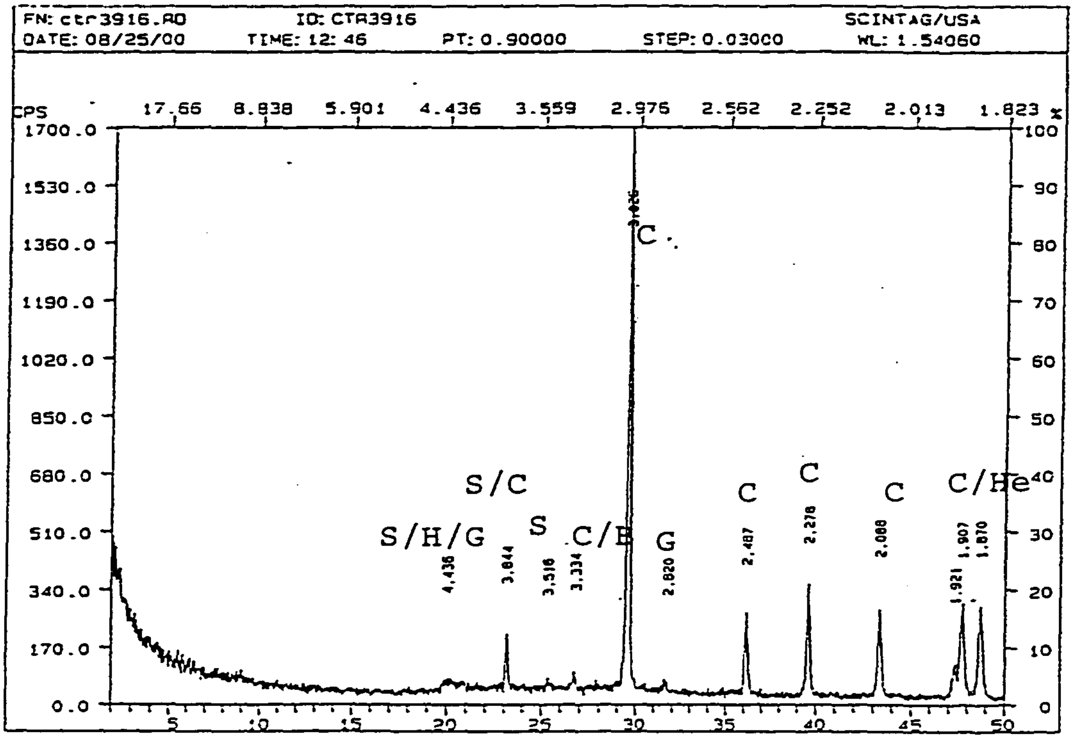


Figure 92: X-ray diffraction pattern for sherd sample CTR 3916 (Trapeché Pink from Ch'ich'). The sample is air dried.(S=smectite, H=halloysite, G=gypsum, C=calcite, B=biotite, He=hematite)

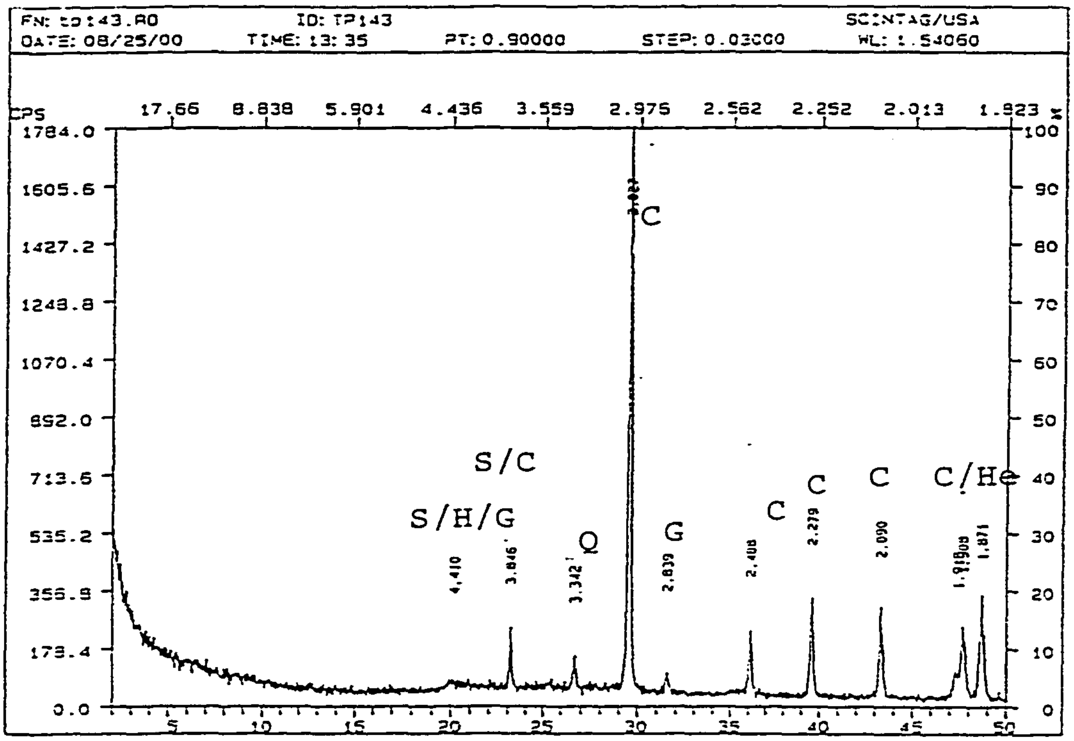


Figure 93: X-ray diffraction pattern for sherd sample TP 143 (Picú Incised: Picú Variety from Tipuj). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

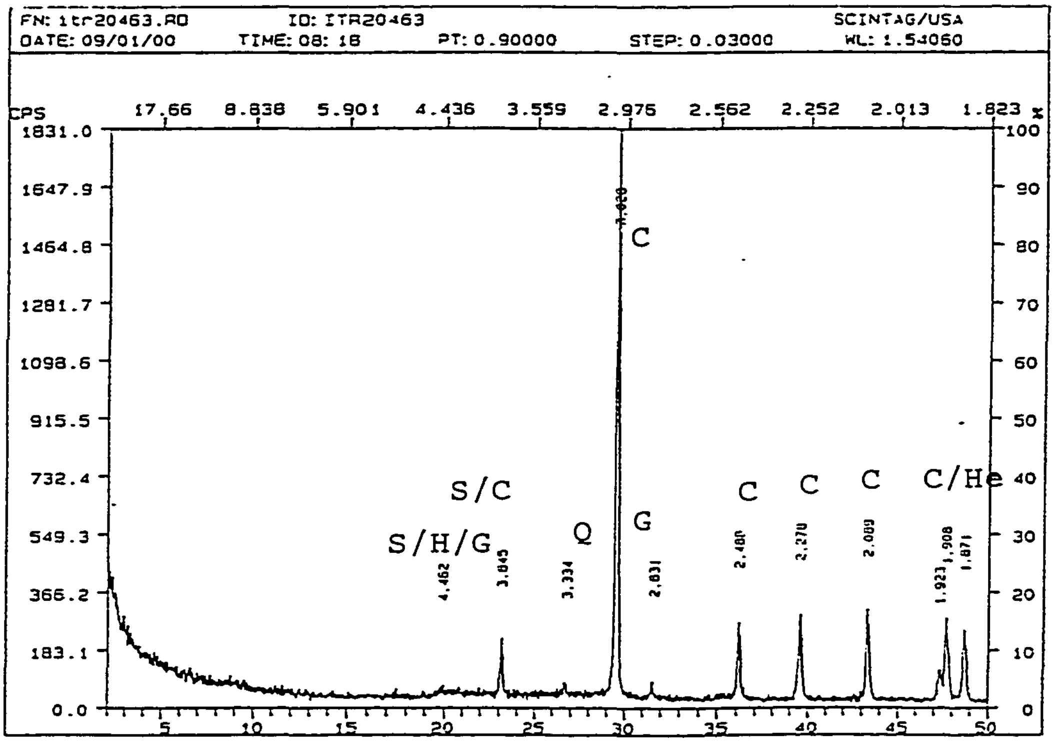


Figure 94: X-ray diffraction pattern for sherd sample ITR 20463 (Trapeché Pink from Ixlú). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

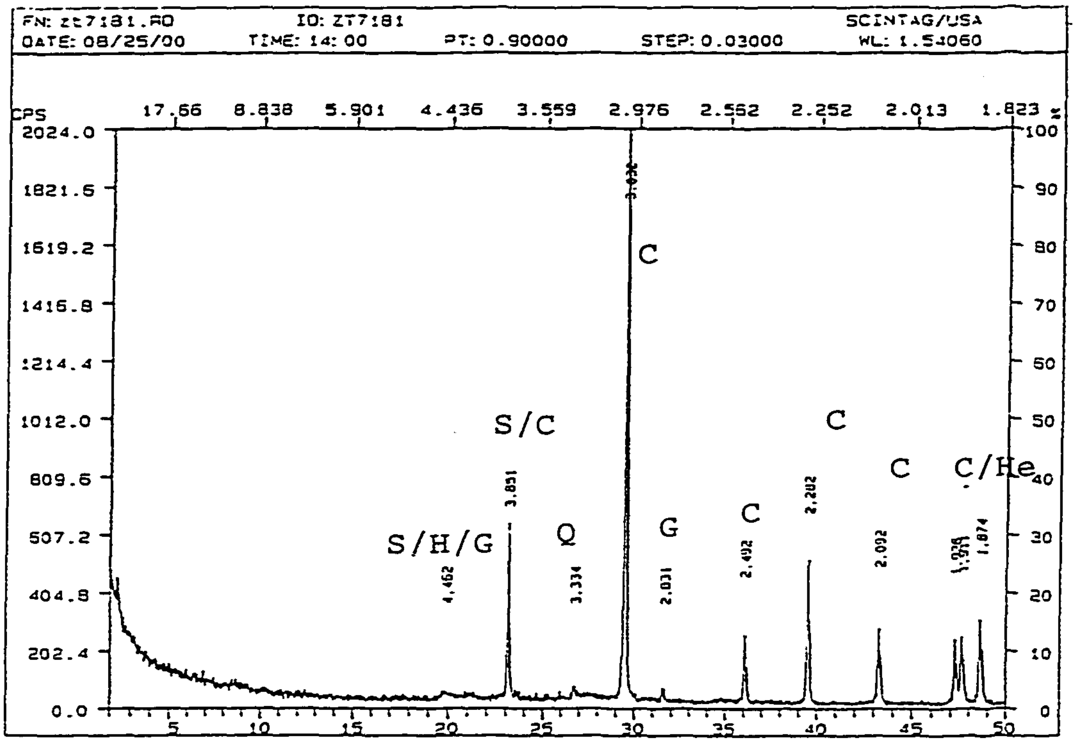


Figure 95: X-ray diffraction pattern for sherd sample ZT 7181 (Chompoxté Red-on-paste: Akalché Variety from Zacpetén). The sample is air dried. (S=smectite, H=halloysite, G=gypsum, C=calcite, Q=quartz, He=hematite)

Quartz, k-feldspar, hematite, and biotite may also occur in the clay paste of the analyzed sherds. In most samples that contain quartz, the 100 percent intensity peak occurs at 26.67 2θ and is typically the second tallest peak after the 100 percent clay peak of the diffraction graph. However, in sherd samples from this study, the quartz peak is uncharacteristically small. It is possible that the quartz mineral is also masked by a montmorillonite peak in the same 2θ area.

K-feldspar occurs in the sherd sample of this study; however, its 100 percent intensity peak rarely appears. Instead, a secondary peak appears at approximately 21 2θ. It is difficult to identify because of the lack of the primary peak, because it does not occur as a separate peak, and because it occurs with a combination of montmorillonite and halloysite mineral peaks.

Hematite and biotite are difficult to identify in the current x-ray diffraction graphs. Hematite may occur in the series of peaks ranging from 46-49 2θ and is most likely masked by the presence of calcite. The strongest example of biotite appears on the x-ray diffraction graph of sherd ZT 15666 (Figure 83). Peaks at approximately 27.5 2θ, 37 2θ, and 45 2θ suggest the presence of biotite. Unfortunately, the 100 percent intensity peak at 17.73 2θ does not appear on any of the graphs. Nevertheless, petrographic analysis suggests that the occurrence of biotite is rare and this may result in low intensity peaks.

X-ray diffraction analysis of clays from Yaxhá and Zacpetén and sherds from the sites of Ch'ich', Ixlú, Zacpetén, and Tipuj demonstrate that montmorillonite and possibly halloysite clay minerals occur as the clay minerals present in the clay pastes. The presence of montmorillonite and halloysite is supported by the lack of mineral identifying peaks of sherds that are estimated to be fired to 500°C when their mineral structures begin to change. In addition to the clay mineralogy of the sherds, this analysis demonstrates the extent to which calcite is an abundant mineral in the clay paste because some calcite peaks tend to overlap and mask other mineral peaks. Finally, while x-ray diffraction analysis did not identify all of the minerals present in the sherds, it did complement the petrographic analysis, providing a more complete mineralogical picture of the sherds in this study.

Based on the mineralogical data presented above, I suggest four preliminary technological style groups that reflect the mineral suites of the sherd pastes. In addition to similar mineral suites, the refined technological style groups exhibit differences in decorative modes previously described. Unlike the preliminary technological styles presented in Chapter 6, these technological styles do not correlate to Postclassic ceramic ware categories.

The first technological style group consists of sherds of the Topoxté and Augustine ceramic groups where clay pastes are dominated by pores. Sherds in this group have monochrome slips, matte surface finishes, and similar core colors.

The second technological style group includes sherds from the Paxcamán, Trapeché, and Augustine ceramic groups. Sherds from this technological style group have large quantities (50-80%) of cryptocrystalline calcite in the clay paste. The majority of sherds from this group have a monochrome slip; however, a few sherds have black line decoration or fine line post-fire incised decorations.

Clay pastes of the third technological style group contain quartz, chert, chalcedony, hematite, and calcite mineral inclusions. Sherds from the Paxcamán, Trapeché, Fulano, Augustine, and Topoxté ceramic groups are represented in this technological style group and the majority of sherds are decorated with black or red painted decoration or incised decoration.

Finally, the fourth technological style is represented by sherds from the Paxcamán, Trapeché, Fulano, Augustine, and Topoxté ceramic groups that have quartz, chert, chalcedony, hematite, calcite, and biotite minerals in the clay paste. Again, the majority of sherds in the fourth mineralogically based technological style are decorated; however, the decoration appears as black, red, red-and-black, or incised decoration.

Unfortunately, x-ray diffraction did not yield additional information by which to define mineralogical technological styles because of the presence of montmorillonite and halloysite clay minerals and an overwhelming dominance of calcite in all of the clay pastes.

The differences that delineate these four mineralogically based technological styles demonstrate that technology (clay pastes) affects style. This is seen through the choices made by the Petén Postclassic Maya potters with regard to materials used in pottery manufacture (e.g., clays and mineral inclusions) and painted decorations. The choice of clays, mineral inclusions, and pigments for painted decoration may be influenced by the resources that were readily available. If the Itzá and Kowoj Maya were in conflict with each other, it is probable that potters from the different communities may have been restricted to resources within their culturally defined territories. Choices at the resource level may reflect sociological and cultural constructs that underlie and direct the producer's actions, resulting in differences that can influence the social representation of material culture and indicate social/ethnic identity.

# CHAPTER 8

# CHEMICAL ANALYSIS RESULTS

This chapter represents the fourth level of analysis of Petén Postclassic slipped pottery and combines geochemical (major, minor, and trace elements) analysis with multivariate statistics to determine the existence of groupings of sherds based on the elemental compositions of the clay pastes of the sherds in this sample. Results from this stage of analysis support the data presented in the previous chapters as well as provide additional data that were not detected by type-variety analysis, "low-tech" analyses, and mineralogical analyses.

Here I use a different approach to chemical compositional analysis than most scholars employing the same methodology. I am seeking to combine the chemical analysis with stylistic and mineralogical data to identify groups of ceramics, rather than to define ceramic paste groups solely on the basis of elemental analysis. By combining chemical compositional data obtained from SEM, EDS, and strong-acid extraction ICPS analysis with typological, "low-tech," and mineralogical analyses, I am not relying solely on chemical composition data to identify the different pottery groups. As such, I am expanding the type of research conducted by Maya archaeologists with regard to chemical composition data to suggest possible behaviors (choices) that may have resulted in the selection of certain clays and/or minerals for the manufacture of Petén Postclassic slipped pottery. I also demonstrate that anthropologically based questions can be supported through chemical composition data.

## I. Scanning Electron Microscopy (SEM) and Energy Dispersive X-Ray Spectroscopy (EDS) analysis

Scanning Electron Microscopy (SEM) and Electron Dispersive X-Ray Spectroscopy (EDS) analyses were completed for the same 100 sherd sample used for strong-acid extraction Inductively Coupled Plasma Spectroscopy (ICPS) analysis discussed below with different but complementary results. The sample was originally to be examined by x-ray diffraction to determine the clay mineral content of the clay paste. However, because of problems obtaining clay mineral identification as discussed above, I collected preliminary clay mineral data through SEM and EDS analysis. In addition to sherd samples, raw clay standards for halloysite, montmorillonite, and kaolinite were analyzed to provide comparative clay mineral data.

EDS data (elements present in the clay paste) result from an electron beam striking the sherd paste and emitting different energy signals according to the mineral that is being measured. The energy sources are noted as distinctive elements and their intensities are measured so as to produce semi-quantitative data. The energy signals are also recorded by the SEM where the data are gathered and the SEM produces an image.

Although the goal was to measure only the clay minerals present in the clay pastes of the sherd sample, this was not always accomplished. First, the data from the x-rays come from the selected spot of analysis and the surrounding area due to the "spreading" of the x-ray throughout the sample. Second, it was impossible to separate calcite from the sherd sample resulting in measurements that were not entirely clay mineral samples.

Element presence and relative elemental intensity of raw clay minerals (halloysite, montmorillonite, and kaolinite) and sherd paste minerals were obtained through EDS analysis and images of the different clay minerals from the raw clays and sherd pastes were obtained through SEM analysis. From the elemental data and research of the elements that compose clay minerals and other mineral inclusions present the clay paste, as determined from petrographic analysis, I was able to determine the clay minerals present in the sherd paste and to account for the remaining elements through the identification of other minerals present in the sherd paste. When compared to the raw clay sample data, I can suggest the range of possible clay minerals that may be present in the sherd samples based on elemental presence, peak intensities, and photograph comparison. The groups may be the result of local geography or the result of culturally added minerals used as temper. From these data, I detected 10 elemental combinations in the sherd sample (Table 40). Figures 96-105 are the EDS graphs of the 12 different elemental concentration groups and corresponding SEM images. Figures 106-108 represent EDS graphs and SEM images for the three clay standards.

Table 40 Elements Present in the 10 EDS Groups and the Ceramic Groups Associated with the EDS Groups

| EDS Groups | Elements Present in the EDS Group | Ceramic Groups Represented by EDS Groups |
|---|---|---|
| | | |
| A | C, O, Al, Si, Ca, Fe | Augustine, Paxcamán, Trapeche, Topoxté |
| B | C, O, Al, Si, K, Ca, Fe | Augustine, Paxcamán, and Topoxté |
| C | C, O, Al, Si, K, Ca, Ti, Fe | Augustine, and Paxcamán |
| D | C, O, Al, Si, Cl, K, Ca, Ti, Fe | Augustine, Paxcamán, Fulano, Trapeche |
| E | C, O, Al, Si, Mg, K, Ca, Ti, Fe | Augustine, Paxcamán, and Topoxté |
| F | C, O, Al, Si, Mg, Cl, K, Ca, Fe | Topoxté |
| G | C, O, Al, Si, Na, Cl, K, Ca, Ti, Fe | Augustine |
| H | C, O, Al, Si, Mg, Cl, K, Ca, Ti, Fe | Augustine, Paxcamán, Fulano, Trapeche, Topoxté |
| I | C, O, Al, Si, Mg, Na, Cl, K, Ca, Ti, Fe | Topoxté |
| J | C, O, Al, Si, Mg, Cl, S, K, Ca, Ti, Fe | Paxcamán |

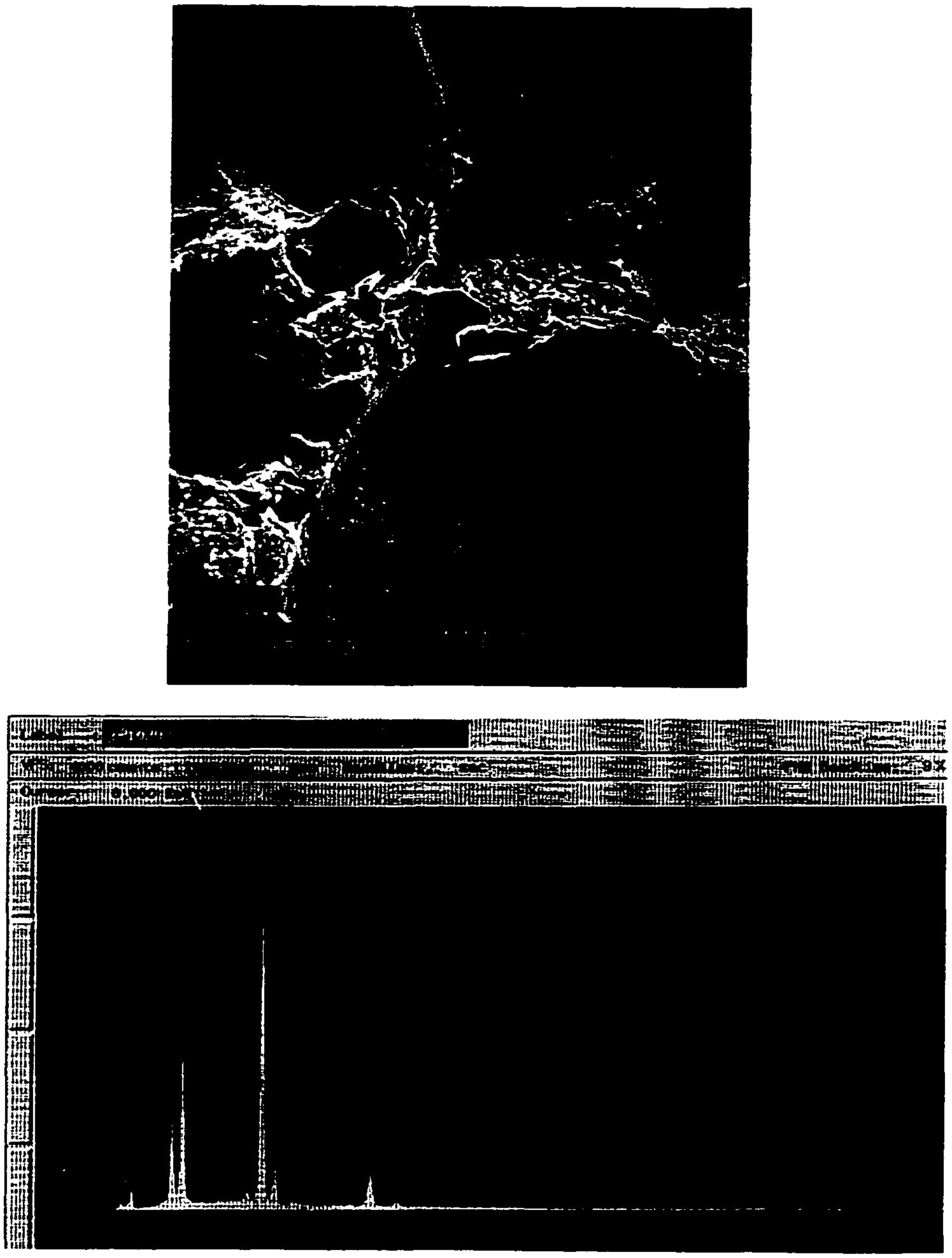
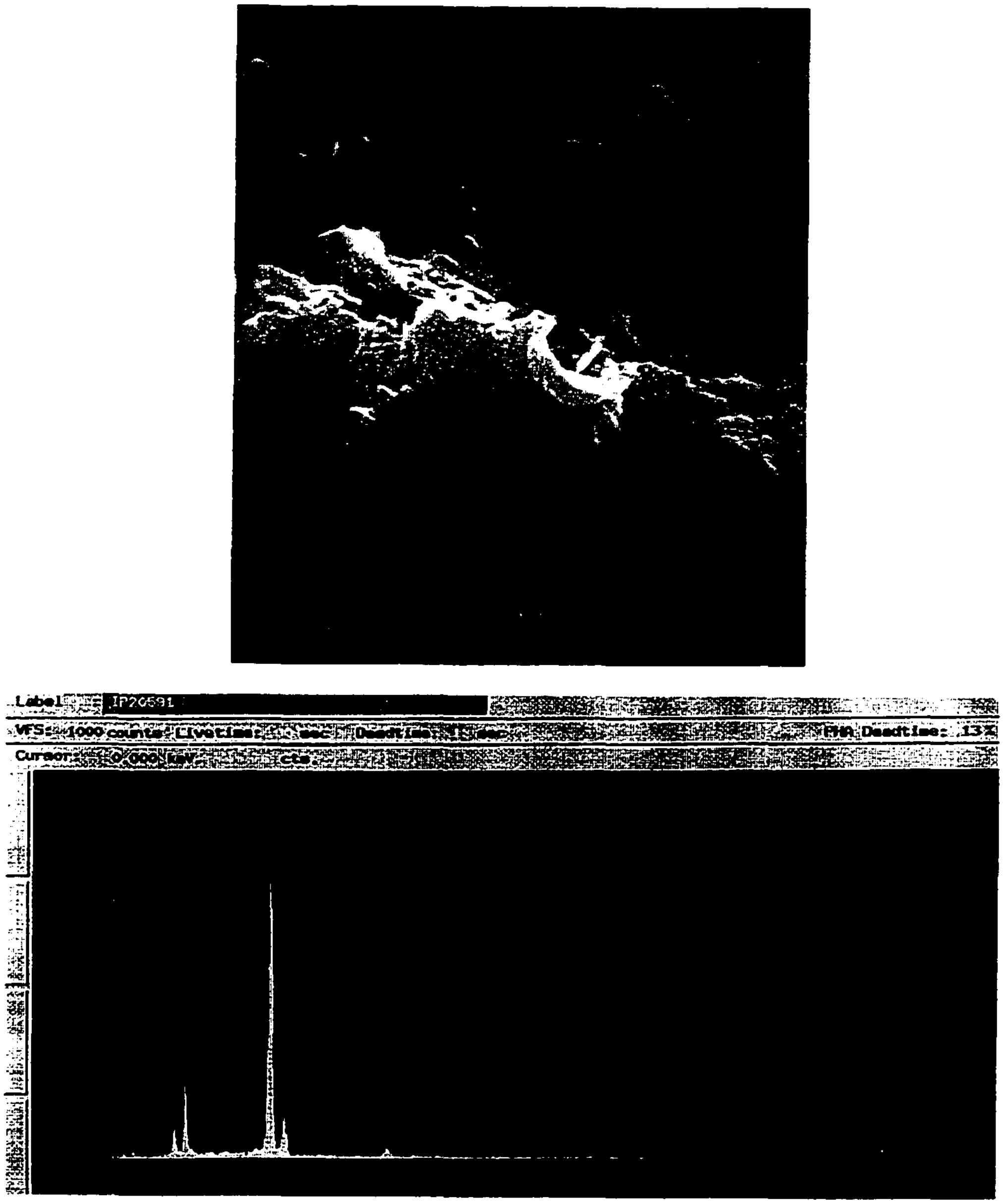


Figure 96: SEM and EDS data for ZP 10797 (Macanché Red-on-paste: Macanché Variety). This sherd represents EDS group G.



Label: IP20591

VFS: 1000 counts Livetime: [illegible] sec Deadtime: [illegible] sec PHA Deadtime: 13%

Cursor: 0.000 keV [illegible] cts

Figure 97: SEM and EDS data for IP 20591 (Ixpop Polychrome: Ixpop Variety). This sherd represents EDS group A.

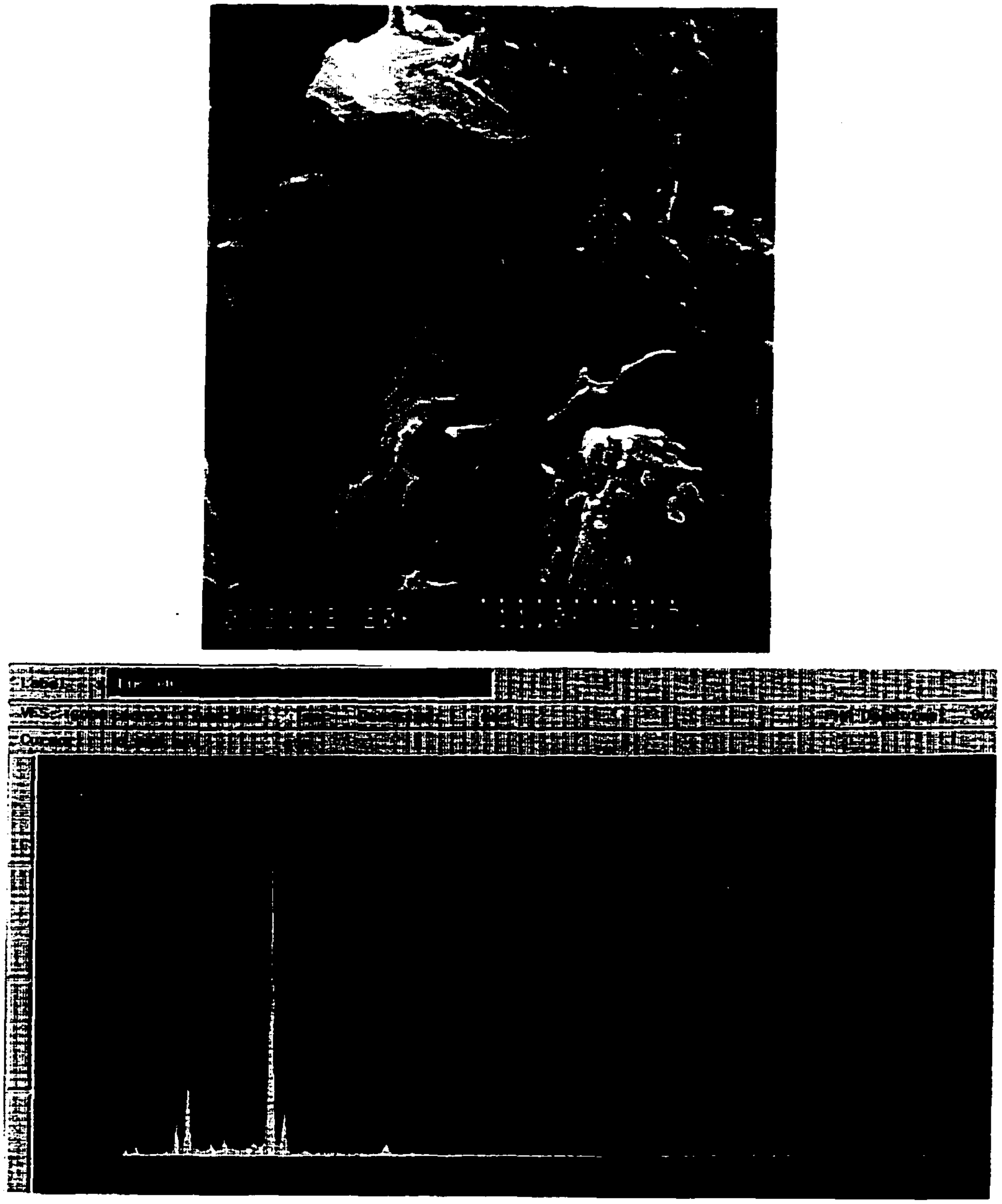


Figure 98: SEM and EDS data for ITR 20463 (Trapeché Pink). This sherd represents EDS group J.

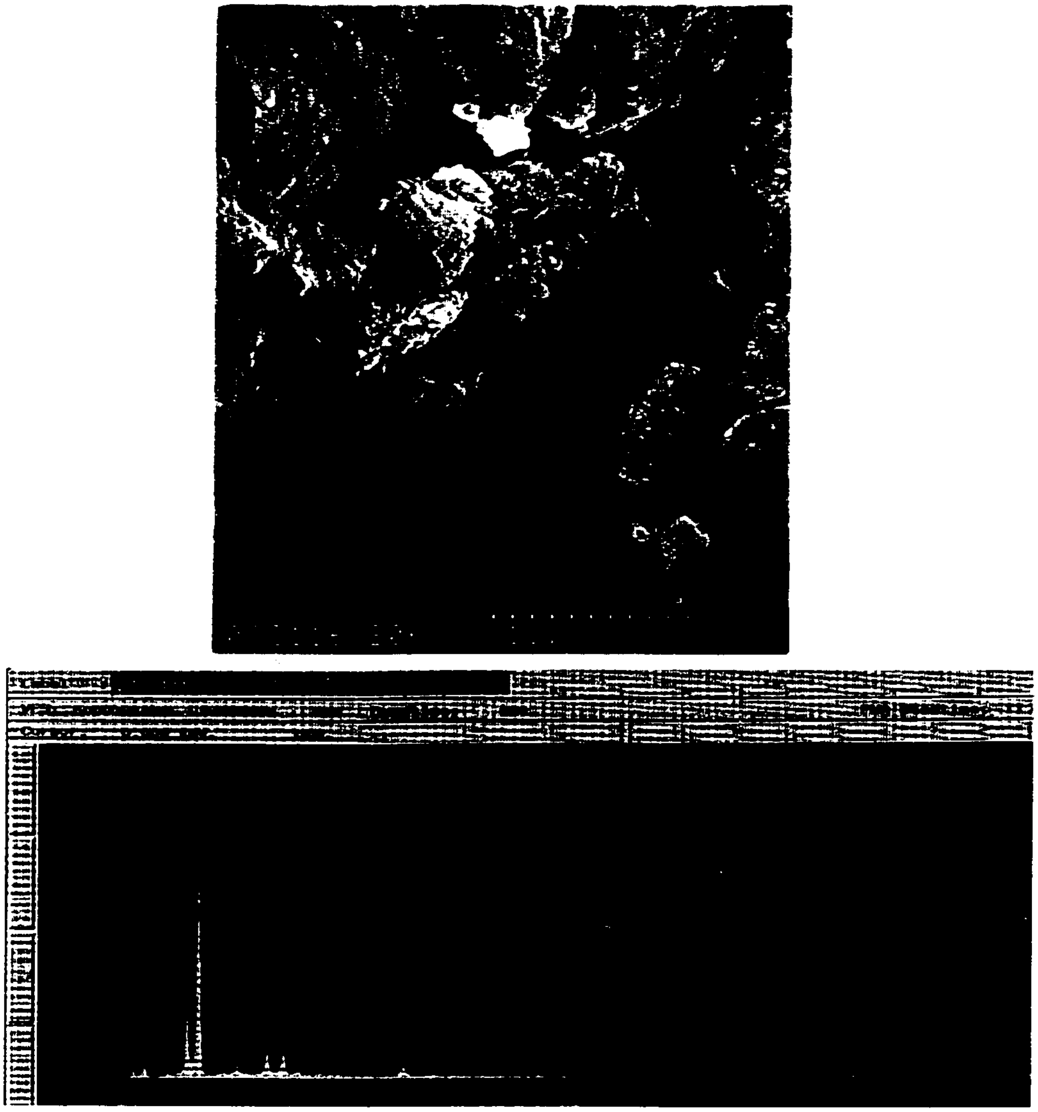


Figure 99: SEM and EDS data for IT 30499 (Topoxté Red: Topoxté Variety). This sherd represents EDS group G.

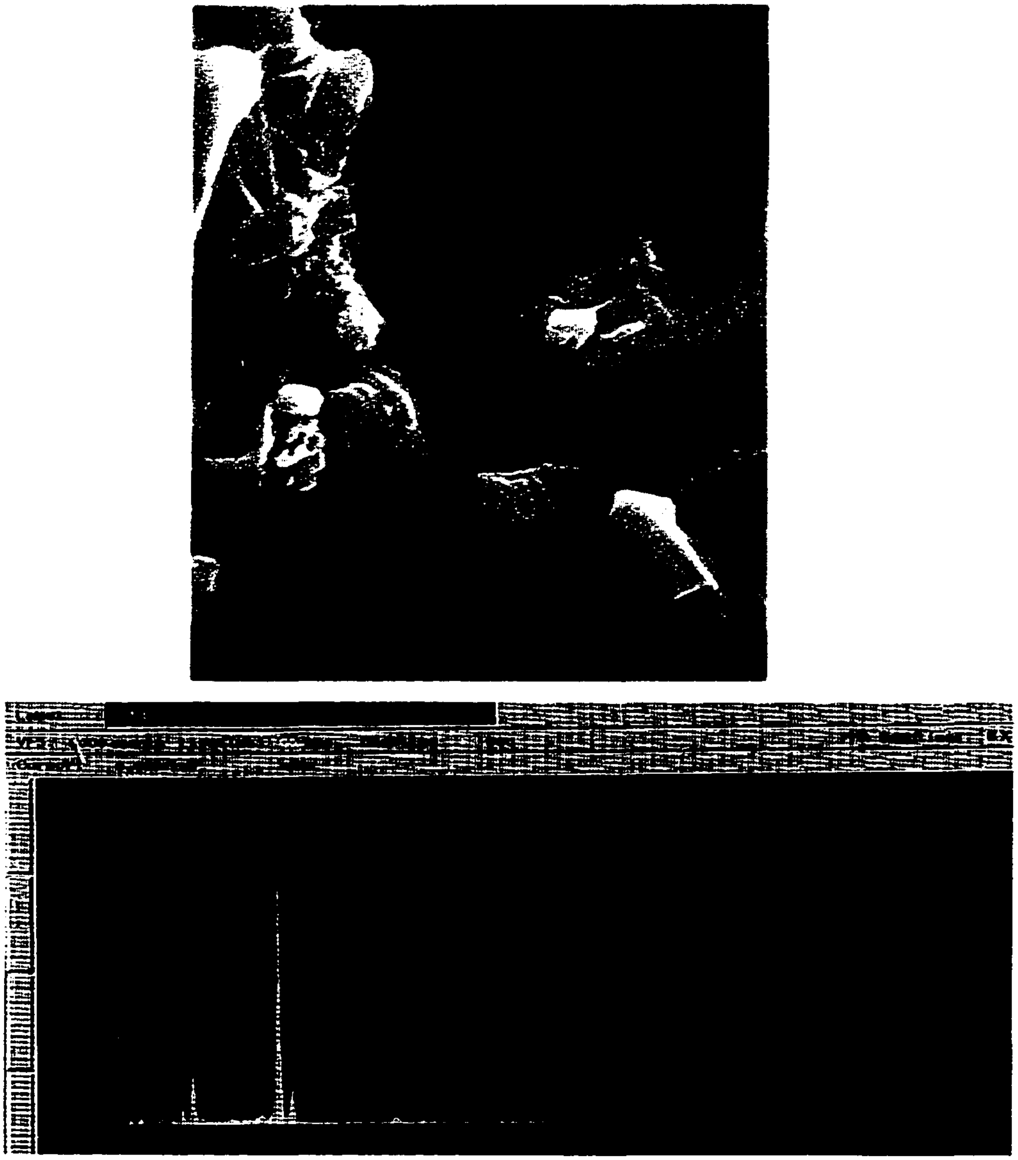


Figure 100: SEM and EDS data for TT 51 (Chompoxté Red-on-paste: Akalché Variety). This sherd represents EDS group F.

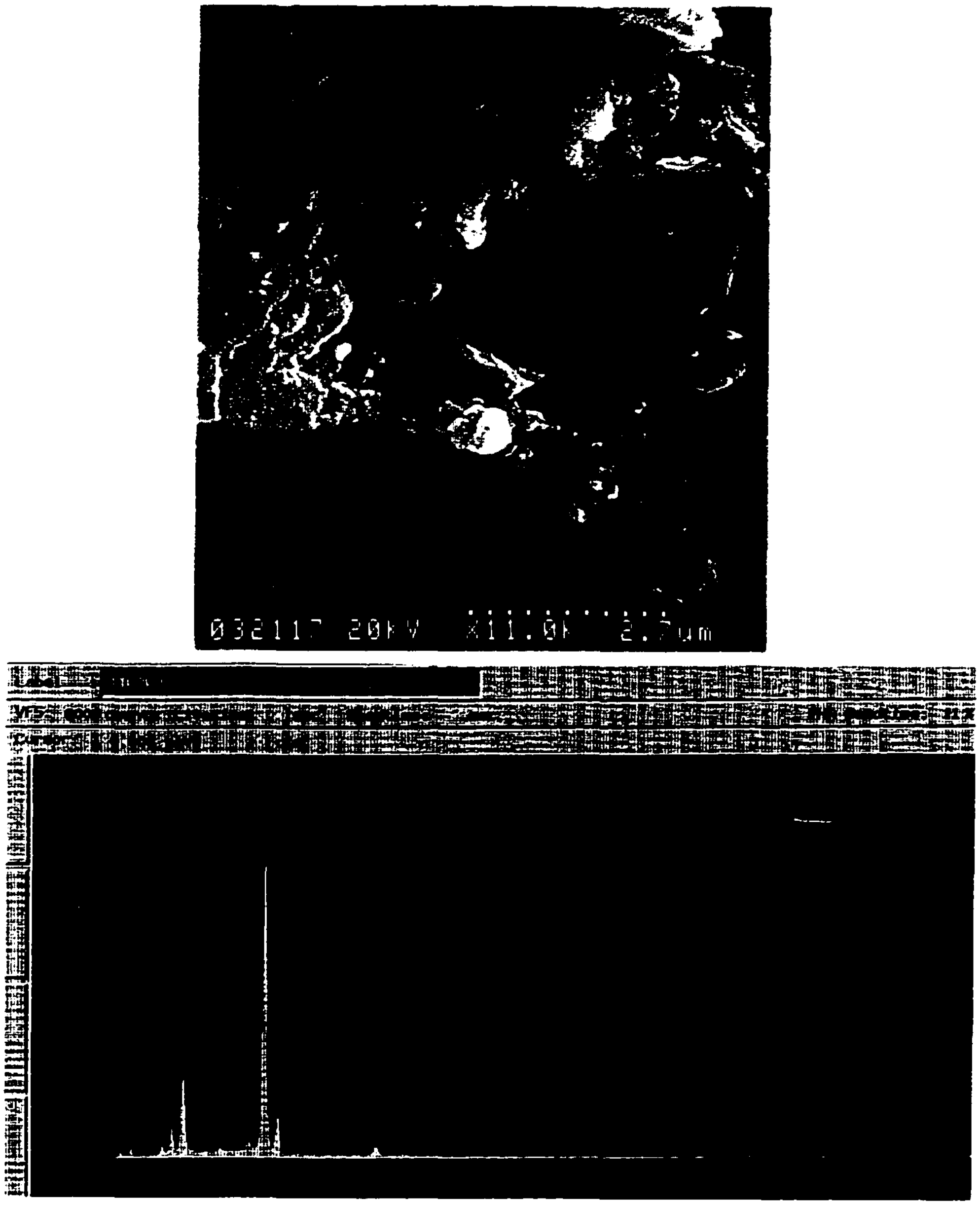


Figure 101: SEM and EDS data for TT 6262 (Chompoxté Red-on-paste: Chompoxté Variety). This sherd represents EDS group F.

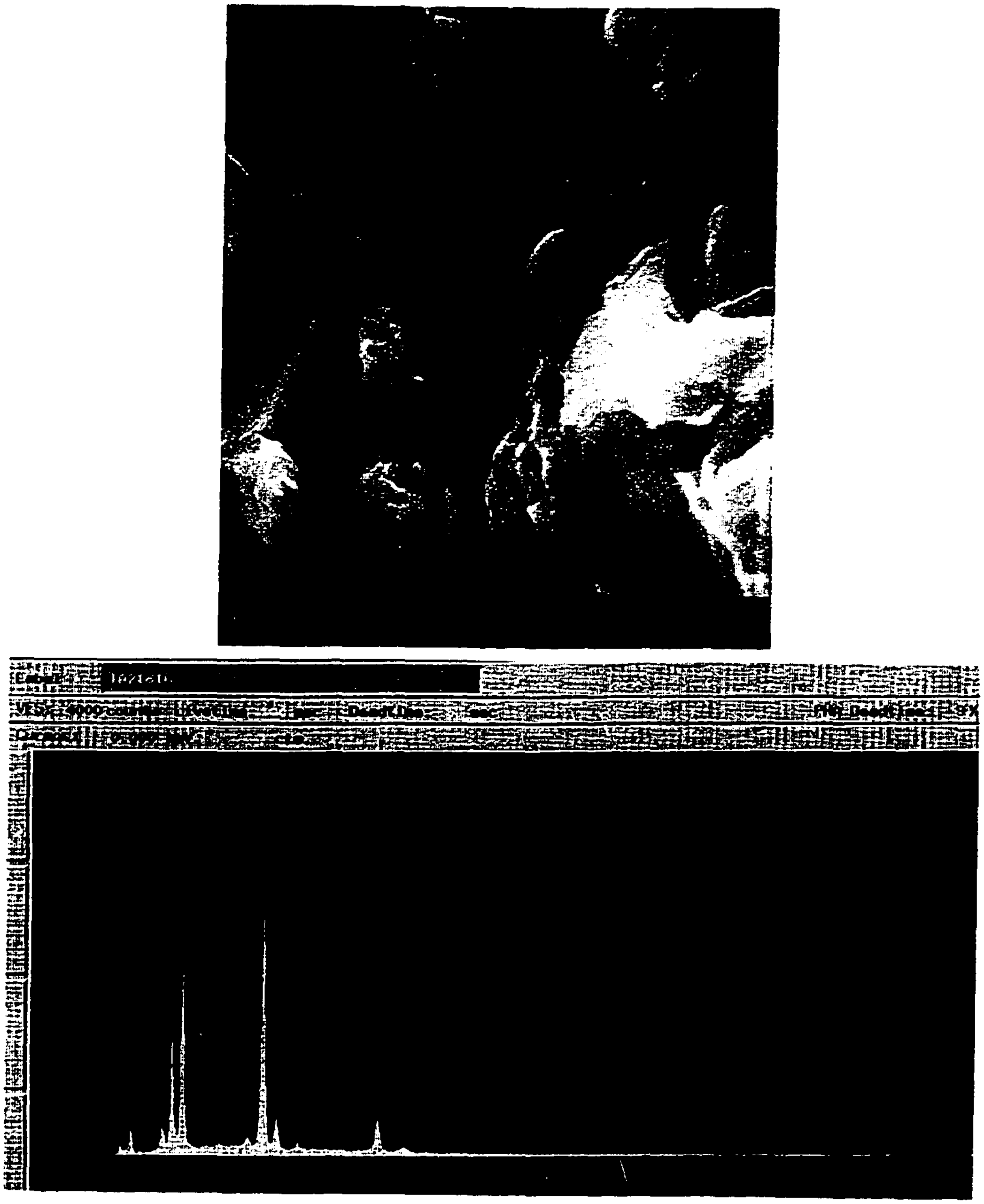


Figure 102: SEM and EDS data for IA 21816 (Augustine Red). This sherd represents EDS group H.

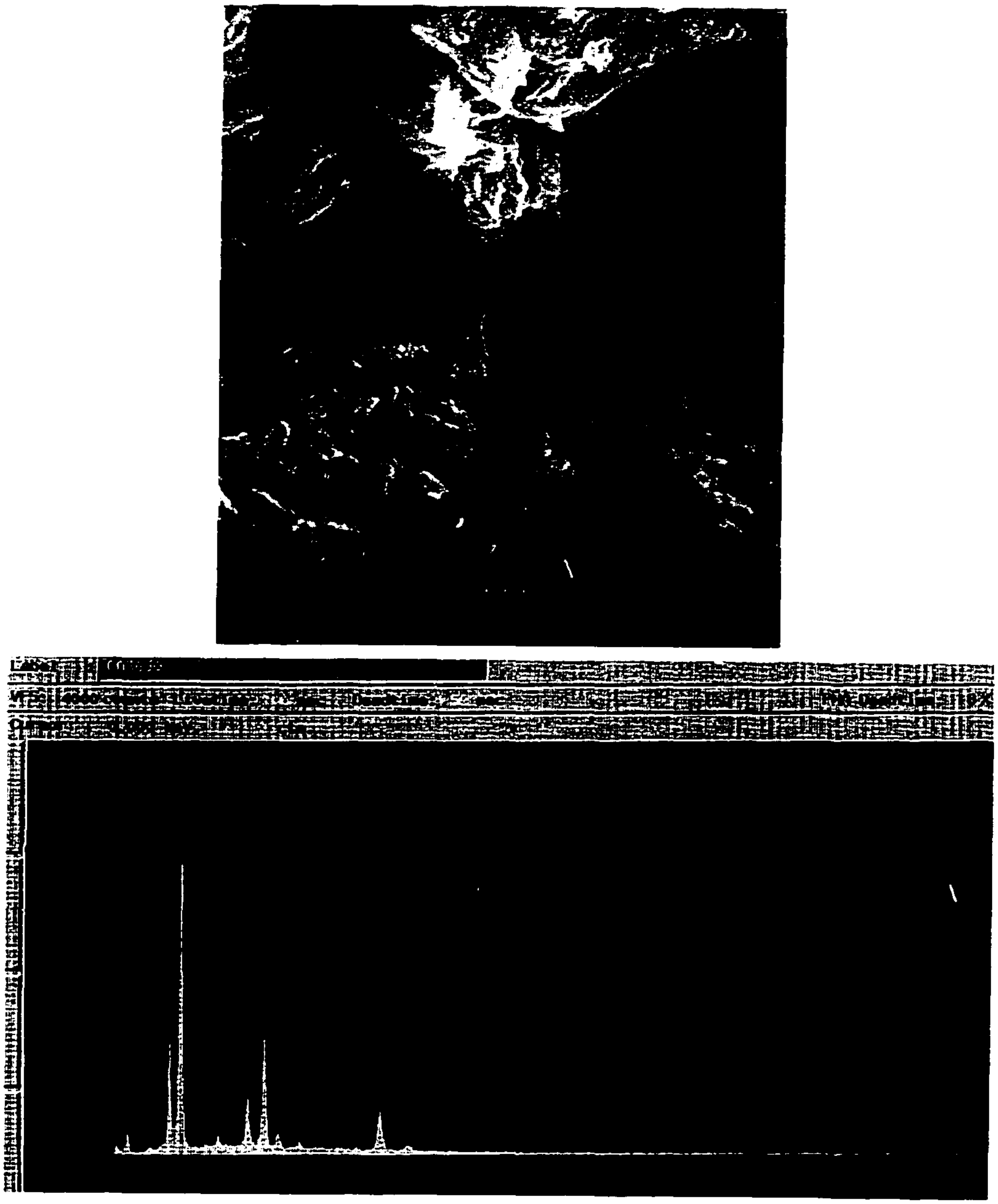


Figure 103: SEM and EDS data for CA 3690 (Augustine Red). This sherd represents EDS group G.

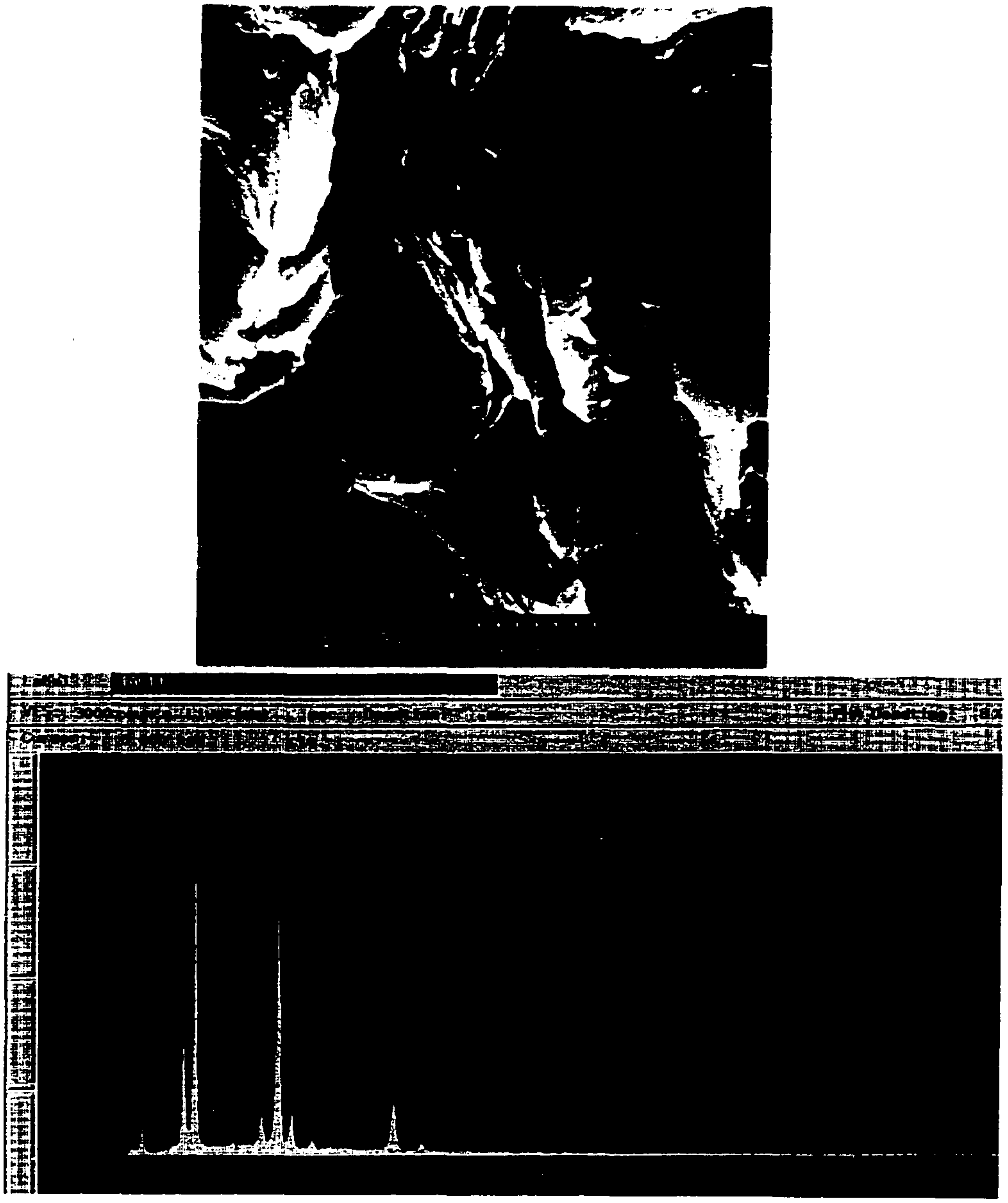


Figure 104: SEM and EDS data for TA 611 (Hobonmo Incised: Ramsey Variety). This sherd represents EDS group C.

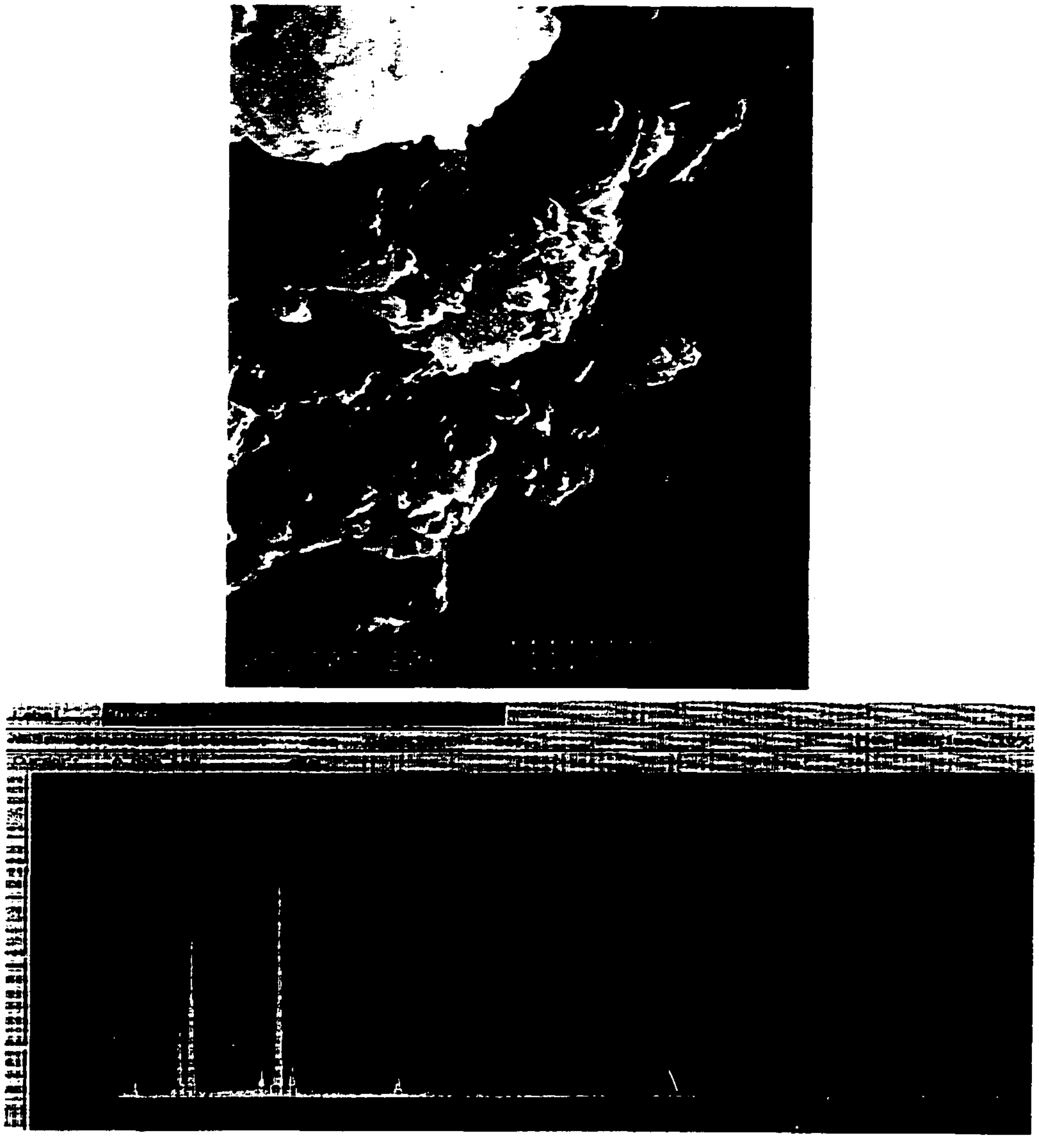


Figure 105: SEM and EDS data for TA 768 (Pek Polychrome). This sherd represents EDS group B.

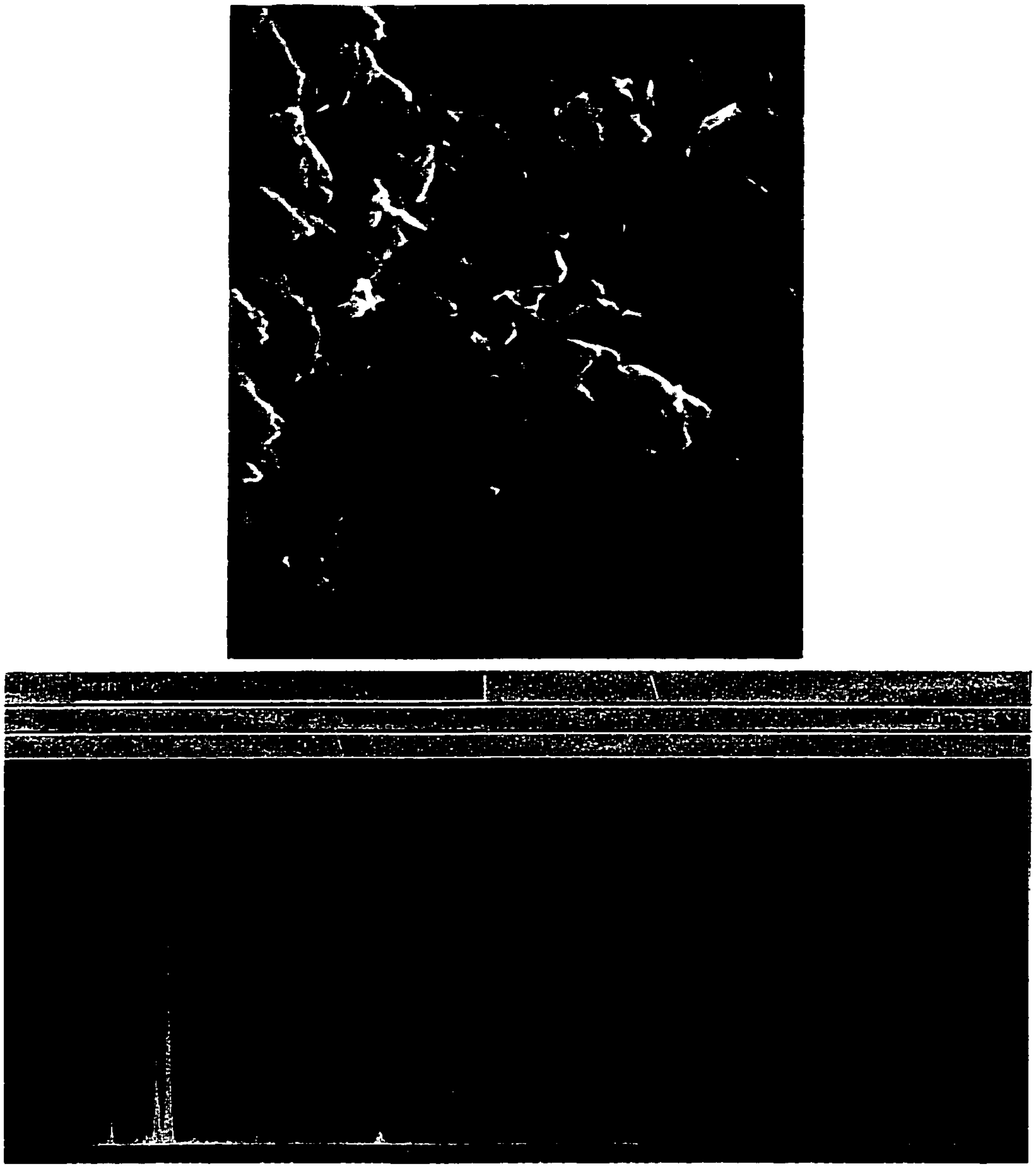


Figure 106: SEM and EDS data for montmorillonite clay sample.

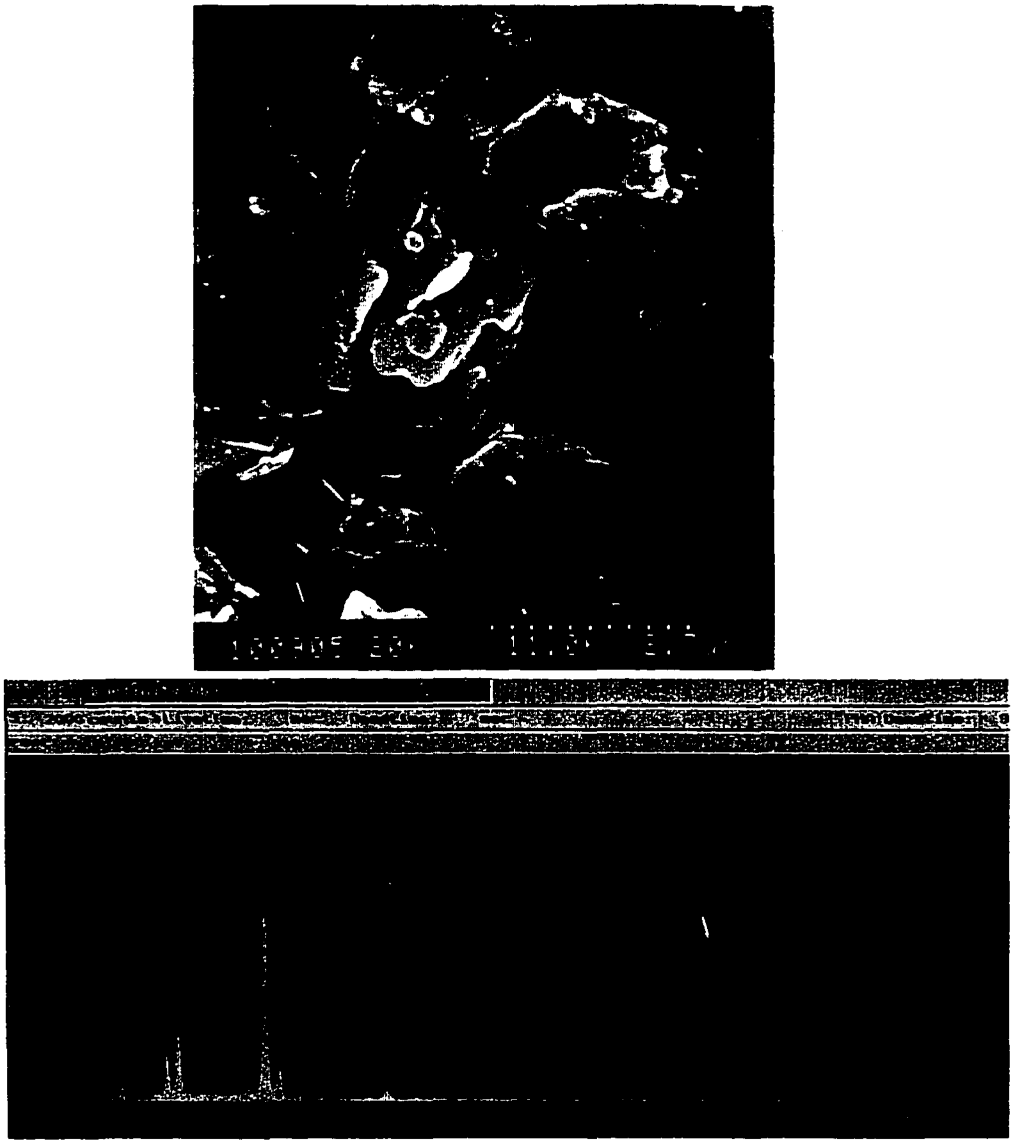


Figure 107: SEM and EDS data for kaolinite clay sample.

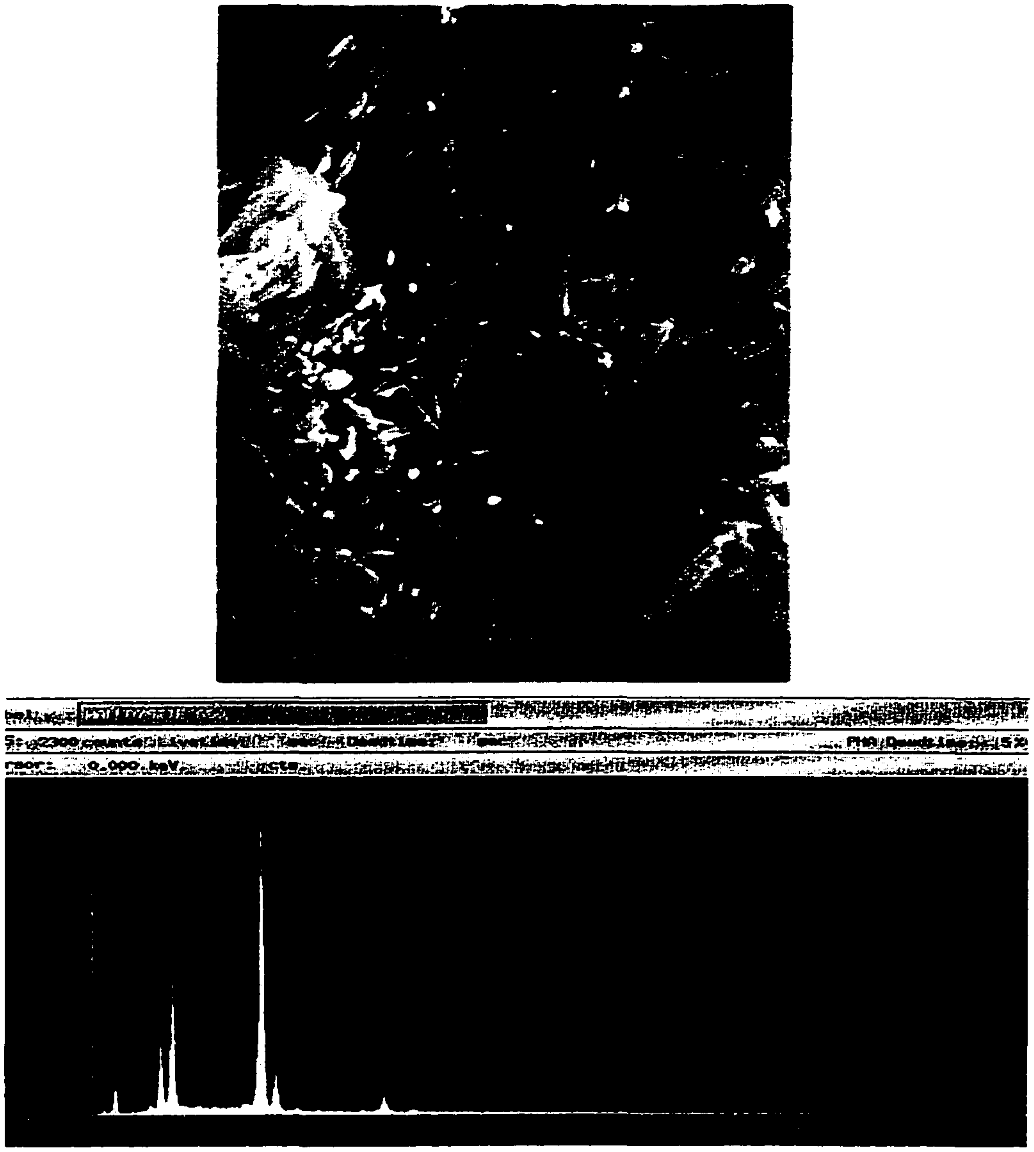


Figure 108: SEM and EDS data for halloysite clay sample.

The three clay minerals and all sherd pastes have the following elements: C, O, Al, Si, Ca, and Fe. This elemental suite is not surprising given that clays are hydrous aluminum silicates with substitutions in the crystalline structure of Mg and Fe ions. The presence of Ca in all of the mineral suites may be the result of an abundance of calcite in the carbonate clays. Differences in sherd paste samples occur with the detection of K, Ti, Na, Cl, and S elements. In order to account for the presence of these five elements in the sherd pastes, I compared raw clay mineral EDS data to the sherd sample data. Montmorillonite clay sample contains C, O, Al, Si, Na, Mg, S, Ca, and Fe elements, the halloysite clay sample has C, O, Al, Si, Mg, K, Ca, Ti, and Fe elements, and that the kaolinite clay sample is identified by the presence of C, O, Al, Si, Mg, K, Ca, Ti, and Fe elements. Thus, all of the elements except Cl can be accounted for by the presence of montmorillonite, kaolinite, and halloysite clay minerals in the sherd samples. Chlorine may result from the presence of halite (NaCl) or sylvite (KCl). These minerals typically result from the evaporation of saline lakes similar to those in the Petén lakes region. During the process of evaporation, calcite, gypsum, and halite occur more commonly than sulfates and chlorines (Klein and Harlbut 1993:577). Therefore, chlorine most likely occurs in the clay pastes because of the presence of evaporitic beds in the Petén lakes region.

All EDS groups may contain halloysite and montmorillonite. Kaolinite may be an additional clay mineral present in groups E, H, I, and J, but the EDS intensity peaks of samples from groups E, H, and J have higher intensities indicating halloysite rather than kaolinite clay minerals. This data corroborates the x-ray diffraction data (Chapter 7, Section III) as to the inclusion of halloysite and montmorillonite clay minerals in the clay paste.

When EDS groups are examined in conjunction with the ceramic groups that are represented by the 10 EDS groups, some interesting patterns occur. Sherds from the Topoxté ceramic group occur exclusively in EDS groups F and I and with Augustine, Paxcamán, and/or Trapeche ceramic group sherds in EDS groups A, B, E, and H. Augustine ceramic group pottery is represented by EDS groups A, B, C, D, E, G, and H. In EDS groups A, B, C, D, E, and H, Augustine ceramic group pottery co-occurs with Paxcamán, Trapeche, Fulano, and/or Topoxté ceramic group pottery and is the sole ceramic group in EDS group G. Paxcamán ceramic group pottery is the sole member of EDS group J and co-occurs with Augustine and/or Topoxté ceramic group sherds in EDS groups A, B, C, D, E, and H. From these data, it is possible to suggest that some Paxcamán, Augustine, and Topoxté ceramic group sherd pastes are chemically different from others. Sherd pastes dominated by pores (EDS Groups G and I) may be distinguished because of the lack of additional minerals. The differences in the clay paste chemical composition as detected by EDS analysis may also reflect differences in clay resources and/or differences of mineral inclusions in the clay paste.

## II. Strong Acid-Extraction ICPS Analysis

I analyzed Petén Postclassic slipped pottery groups employing strong acid-extraction ICPS in order to better understand the chemical composition of the clay paste. The resulting concentrations (measured in parts per million– ppm) measure only the components of the clay paste that are soluble in acids used in the digestion process. The resulting elemental concentrations reflect technological characteristics of the clay matrix as well as its use and postdepositional alteration– or its total history (Burton and Simon 1993:46). As such, my goal is not to determine provenance information, but to suggest possible technological aspects reflected in the elemental compositional groups, through potters' choices and decisions, that may be associated with social identity.

Unlike INAA procedures that measure rare earth and other trace elements, the present strong acid-extraction ICPS analysis includes some rare earth elements as well as major and minor elements likely to be present in the clay paste. "These elements were chosen because they, along with silicon, are the most abundant cations in ceramic pastes and as such they are less susceptible to sampling heterogeneity, they can be measured with high precision, and they have given highly reproducible results" (Burton and Simon 1993:46). The pottery sample used for strong acid-extraction ICPS analysis yielded seven compositional groups based on 30 elements: Be, B, Na, Mg, Al, Si, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Ag, Cd, Sb, Cs, Ba, La, Tl, and Pb. These elements exist in the sherd sample and can be tested by the process of strong acid-extraction IPCS because they can be extracted by the HF and $HNO_3$ digestion process. In addition to being able to be extracted through strong-acid digestion, I use this suite of elements to ensure comparability to other studies that use similar elements and because most of the elements can substitute in the clay structures and/or occur in minerals detected through petrographic analysis.

Below is a description of the 30 elements.

Be- Beryllium is a minor earth element and when it occurs in minerals it is not affected by water, air, acids, or alkalies. Its small cation radius allows it to easily substitute for other cations (such as Al) in silicates. Beryllium compounds are associated with granitic rocks (Day 1963:158-161).

B- Boron is a minor earth element that when in minerals is unreactive to water, oxygen, acids, and alkalies, but will react to other metals to form borides. Boron occurs as a result of the late stages of magmatic crystallization and in evaporite deposits of lake waters. Similar to Be, boron has a small ionic radius and can replace Si in some silicate minerals (Day 1963:188-192).

Na- Sodium is a soft, silvery-white alkali metal element that in minerals oxidizes rapidly and reacts with water. Sodium can occur in aluminohalide minerals, in silicate minerals of igneous rocks such as feldspars, and as soluble salts. Na can substitute for Ca because of its similar size (Day 1963:129-135).

Mg- Magnesium is a major element and in minerals it burns in air and will react in hot water. It appears in metamorphic minerals, evaporitic deposits, and phyllosilicates. Magnesium can replace Ca in the calcite lattice to produce dolomite (Day 1963:162-166).

Al- Aluminum is a major element and as a metal it has an outer protective oxide filmy surface. In minerals, aluminum dissolves in concentrated hydrochloric acid and sodium hydroxide solutions. Aluminum enters into silicate structures because it occurs in four-fold and six-fold coordination. It is abundant in clay minerals and feldspars (Day 1963:193-203).

Si- Silicon results from a reduction of sand with carbon and is a major element. The resulting element only reacts in hydrofloric acid and will dissolve in hot alkalies. In tetrahedra sheets of phyllosilicates, silicon shares three oxygen atoms. It also appears as quartz. Silicon can be replaced by K, Ag, Tl, and Na (Day 1963:225-231).

K- Potassium is a soft white alkali metal element that when in minerals oxidizes in air and reacts in water. It is an abundant element and typically occur as complex halides, silicates such as feldspar and mica, and soluble salts (Day 1963:135-139).

Ca- Calcium is a soft, white alkali earth element that occurs in igneous rocks such as feldspar and granite, as inosilicates, and in sedimentary rocks such as limestone (Day 1963:167-173).

Sc- Scandium is a rare earth element that burns easily and tarnishes in air. It also reacts with water to form hydrogen gas. As one of the most abundant rare earth metals, scandium occurs in granites, granite pegmatites, and as a substitute for Mg of Fe in ferromagnesian minerals (Day 1963:348).

Ti- Titanium minor earth element and in minerals it burns easily, but is only affected by HF, $H_3PO_4$, and concentrated $H_2SO_4$. Titanium occurs in oxide minerals and in igneous and metamorphic rocks (Day 1963:232-234).

V- Vanadium is minor earth element and a shiny, silvery, soft oxyphile metal with a protective oxide surface that only reacts to acids. It mainly occurs as a trace element in siliceous diorites and granites. Because its ionic radius is similar to that of Fe, it will replace Fe in magnetite (Day 1963:263-266).

Cr- Chromium is a metal element and when in minerals it dissolves only in hydrochloric acid and $H_2SO_4$. It occurs in igneous silicate rocks. Chromium can replace $Fe^{3+}$ and Al (Day 1963:291-295).

Mn- Manganese minor earth element that in minerals burns in oxygen, reacts to water, and dissolves in dilute acids. It occurs in igneous rocks, sulphide minerals, and sediments, and is most abundant when iron is present. Manganese can substitute for $Fe^{2+}$, Ca, and Mg (Day 1963:320-325).

Fe- Iron is major earth element and in mineral form it dissolves in dilute acids. It occurs as free metallic iron, in oxide and sulphide minerals, in silicate minerals of igneous rocks, as compounds with oxygen, and in sedimentary rocks. Although iron is resistant to weathering, it can be leached from sediments depending on acidity conditions (Day 1963:327-336).

Co- Cobalt is a minor earth element and as a metal it has a lustrous silvery-blue color and reacts to dilute acids. It can be found in olivines and ilmetite (Day 1963:336-339).

Ni- Nickel is minor earth element that in minerals dissolves only in acids. It occurs in sulphides, dunites, and gabbros. Nickel can also occur as a hydrous silicate mineral in montmorillonite. It does not weather (Day 1963:339-341).

Cu- Copper is a minor earth element that can appear as a reddish metal that is resistant to air and water. Limestone may contain copper as wells as sulphides and ores (Day 1963:142-150).

Zn- Zinc is relatively rare element that found in oxy-salts and sulphides such as sphalerite. It can pass into solution and become deposited in carbonates, silicates, and phosphates (Day 1963:179-183).

As- Arsenic is a brittle metalloid that resists reactions to water, acids, and alkalis. It occurs in magmatic rocks and sulphide minerals (Day 1963:269-271).

Se- Selenium is a silvery-grey metal or a red amorphous powder that burns in air, is unaffected by water, and dissolves in $HNO_3$ and alkalis. It can replace sulfur in some minerals. Selenium occurs in sulphide ores and agricultural soils (Day 1963:286-287).

Rb- Rubidium is a soft white alkali metal element that oxidizes rapidly in air and reacts with water when part of a mineral. It commonly occurs in micas and kaolinite and may substitute for K in pot feldspars (Day 1963:139-140).

Sr- Strontium is a silvery-white, relatively soft alkaline earth "metal" that burns if ignited and reacts with water. Its cation can enter calcium and barium minerals and replaces K in barium minerals. Strontium is found in igneous rocks and silicates of granitic rocks (Day 1963:173-175).

Ag- Silver is a minor earth element that appears as a soft malleable metal that is attacked by sulfur and dissolves in $HNO_3$ and $H_2SO_4$. Silver occurs as pure deposits or in ores of other metals (Day 1963:150-154).

Cd- Cadmium is minor earth element that dissolves in acids when part of a mineral. It is found in calcium minerals (Day 1963:183-185).

Sb- Antimony is a minor earth element that does not react with acids or alkalies when part of a mineral. Antimony occurs most frequently is crystalized magmas with a hexagonal crystallographic structure and in sedimentary rocks (Day 1963:272-274).

Cs- Cesium is a soft, shiny, gold colored alkali metal element that when in minerals oxidizes rapidly in air and reacts with water. Clay minerals commonly adsorb this mineral and it can replace K and Rb in clays (especially kaolinite) (Day 1963:140-141).

Ba- Barium is an alkaline earth element that oxidizes in air and reacts with water. Because it reacts with water and is easily dissolved, barium may be leached from minerals such as pot feldspars (where it substitutes for K) and biotite (Day 1963:176-179).

La- Lanthanum is a rare earth element that in its metal form tarnishes in air and reacts with water to produce hydrogen gas. This element can substitute for Ca in Ca-rich minerals (Day 1963:348-351).

Tl- Thallium is a rare earth element that appears in igneous rocks and silicates. In silicates it can replace K. Because the Tl ionic radius is the same size as that of Rb it can replace Rb in potash feldspars (Day 1963:206-207).

Pb- Lead is a minor earth element that is also a soft, weak, dull grey metal that dissolves in $HNO_3$. Lead results from low-temperature hydrothermal solutions and can occur in sulphates, silicates, and magmatic minerals (Day 1963:244-248).

Cluster analysis using Ward's method was used to graphically portray the degree of compositional grouping present in the sample. I used the SPSS cluster analysis program to analyze the elemental concentrations of the 100 sherd sample.

According to the hierarchical cluster analysis dendrogram, eight clusters exist (see Figure 109). The eight clusters are mixed as to the inclusion of the Fulano, Augustine, and Topoxté ceramic groups. Cluster II has clay pastes that are dominated by pores or sherds with a multitude of mineral inclusions and a smaller quantity of cryptocrystalline calcite. The group of four clusters (IA, IB and IIA and IIB) are distinguished by differences in ceramic groups: IA differs from IB because IB is composed of only Augustine ceramic group sherds (with the exception of on Trapeche sherd) and

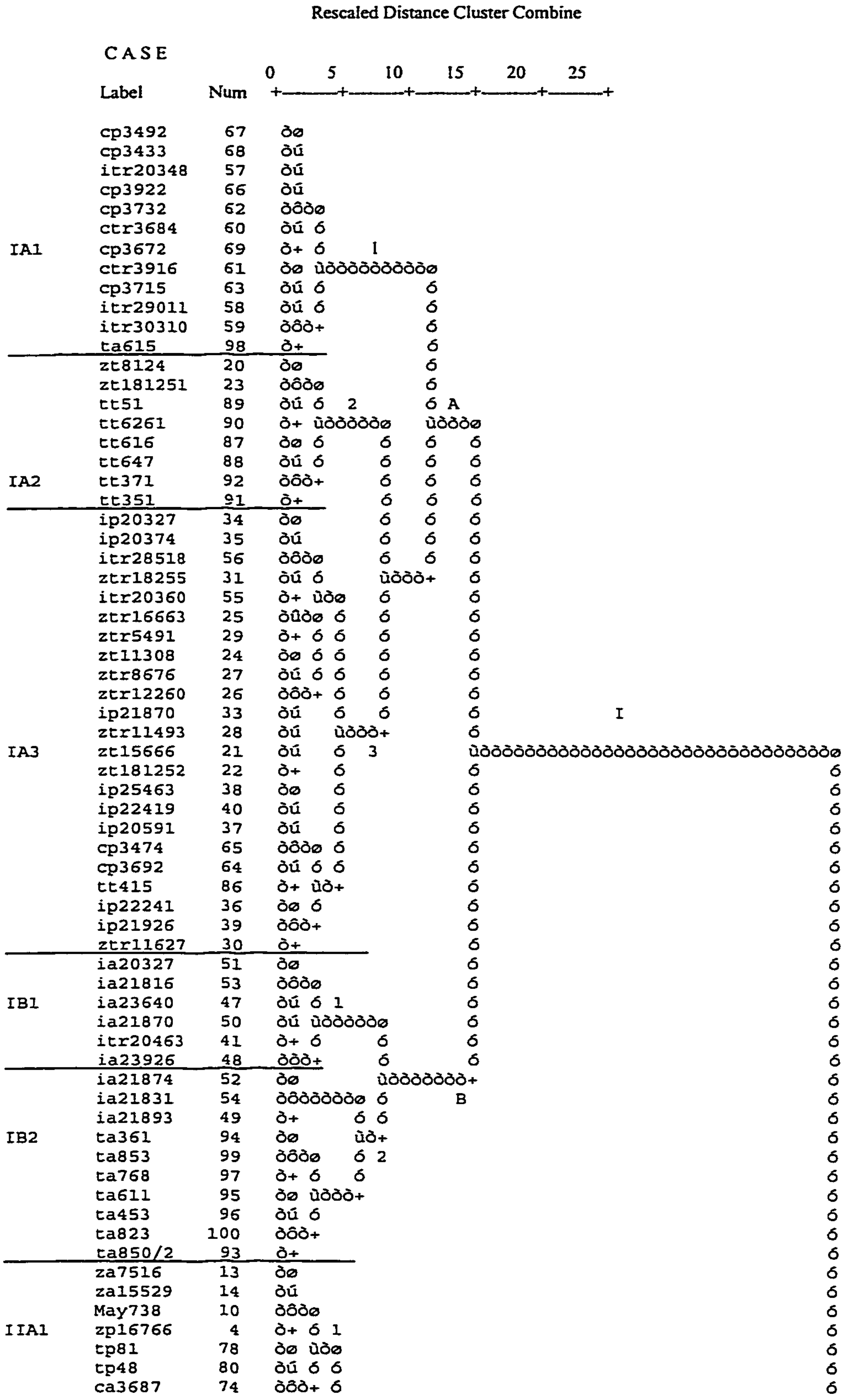


Figure 109: Cluster Analysis of Elemental Concentrations (continued on next page).

```
        zp18069     2   ðú   6                                           6
        ca3480     70   ð+   6      A                                    6
        zp8826      1   ðûðø ùðððððððððððððø                             6
        za8403     12   ð+ 6 6             6                             6
        zp10797     3   ðø 6 6             6                             6
        za18019    15   ðú 6 6             6                             6
        ca3702     73   ðú 6 6             6                             6
        ca3690     76   ðôðûð+             6                             6
IIA2    ca3678     72   ð+ 6  2            6                             6
        tp106      77   ðø 6               6                             6
        tp143      79   ðú 6               6                             6
        zp16625     7   ðú 6               6                             6
        ca3600     71   ðú 6               6                             6
        zp12258     6   ðú 6               6                             6
        zp18024     9   ðú 6               ùðððððððððððððððððððððððððððð+
        zp5491      8   ðú 6               6
        zp18135     5   ðú 6               6              II
        tp520      83   ðôð+               6
        tp516      81   ðú                 6
        tp615      84   ðú                 6
        tp286/1    82   ðú                 6
        ztr12224   32   ðú                 6
        tt6262     85   ð+                 6
        za11446    16   ðûðø  1            6
        zt7181     18   ð+ ùðððððø         6
IIB1    za15419    11   ðø 6     6         6
        zt18294    19   ðôð+     6         6
        zt7133     17   ð+       ùððððððððð+
        it21810    43   ðø       6    B
        it21875    46   ðú       6
        IIB2    it30499    44    ðôðø     6
        it21914    45   ð+ ùððððð+
        it21910    42   ððð+  2
```

Figure 109: Cluster Analysis of Elemental Concentrations.

IIA differs from IIB because IIB is dominated by sherds from the Topoxté ceramic group (except for two Augustine ceramic group sherds). Groups IA and IIA are composed of a mixture of Paxcamán, Fulano, Trapeche, Augustine, and Topoxté ceramic group sherds. The final group of eight clusters (IA1, etc.) is distinguished by finer distinctions of clay pastes included in the above larger groups. Each of these clusters is discussed below.

Group IA1 contains Paxcamán Red and Trapeche Pink sherds from Ch'ich', Trapeche Pink sherds from Ixlú, and one Hobonmo Incised: Hobonmo Variety sherd from Tipuj. These sherd pastes are dominated by cryptocrystalline calcite.

Group1A2 has one Chompoxté Red-on-paste: Akalché Variety sherd and one Pastel Polychrome sherd from Zacpetén and four Chompoxté Red-on-paste: Akalché Variety sherds and two Topoxté Red sherds Tipuj. The clay pastes of this group are characterized by the presence of crystalline, polycrystalline, and cryptocrystalline calcite, hematite, quartz, biotite, chalcedony, and chert mineral inclusions.

Group 1A3 is composed of Picú Incised: Thub Variety and Picú Incised: Picú Variety sherds from Ixlú, Paxcamán Red sherds from Ixlú and Ch'ich', Trapeche Pink sherds from Ixlú and Zacpetén, Xuluc Incised: Tzalam Variety sherds from Zacpetén, Fulano Black sherds from Ixlú, Topoxté Red sherds from Tipuj, and Chompoxté Red-on-paste sherds from Zacpetén. All of these sherds have clay pastes dominated by cryptocrystalline calcite and approximately one-half of the sherds of this group also have biotite inclusions.

Group 1B1 has Augustine Red sherds from Ixlú and one Trapeche Pink sherd from Ixlú. The clay pastes of these sherds are dominated by crystalline calcite.

Group 1B2 is composed of Augustine Red sherds from Ixlú and Augustine Red, Pek Polychrome, and Hobonmo Incised: Ramsey Variety sherds Tipuj. The sherds from Ixlú have clay pastes dominated by pores and the clay pastes from Tipuj have crystalline, polycrystalline, and cryptocrystalline calcite, hematite, quartz, biotite, chalcedony, and chert mineral inclusions in the clay pastes.

Group IIA1 has Augustine Red and Graciela Polychrome sherds from Zacpetén and Augustine Red sherds from Ch'ich', Ixpop Polychrome and Mengano Incised sherds from Zacpetén and Ixpop Polychrome and Paxcamán Red sherds Tipuj, and a Topoxté Red sherd from Zacpetén. The clay pastes in this group are not similar. The Augustine Red sherds from Ch'ich' are dominated by pores and the Paxcamán and Fulano ceramic group sherds are dominated by cryptocrystalline calcite.

Group IIA2 consists of Paxcamán Red, Ixpop Polychrome, Sacá Polychrome, and Macanché Red-on-paste sherds from Zacpetén, Paxcamán Red, Picú Incised: Picú Variety, Picú Incised: Picú Variety, Fulano Black sherds from Tipuj, a Trapeche Pink sherd from Zacpetén, and Augustine Red sherds from Ch'ich', Zacpetén, and a Chompoxté Red-on-paste: Chompoxté Variety sherd Tipuj. The majority of Paxcamán, Fulano, and Augustine ceramic group sherd pastes have crystalline, polycrystalline, and cryptocrystalline calcite, hematite, quartz, biotite, chalcedony, and chert mineral inclusions. The Augustine Red sherds from Ch'ich' have clay pastes dominated by pores and the remaining sherd pastes of these two groups are dominated by cryptocrystalline calcite and

Group IIB1 has an Augustine Red and a Graciela Polychrome sherd from Zacpetén and Chompoxté Red-on-paste: Akalché Variety sherds from Zacpetén. All of the clay pastes have crystalline, polycrystalline, and cryptocrystalline calcite, hematite, quartz, biotite, chalcedony, and chert mineral inclusions.

Group IIB2 is composed of Topoxté Red sherds from Ixlú. The clay pastes of these sherds are dominated by pores.

Using the Ward's method of cluster analysis data as a base for the number of possible elemental compositional groups, I conducted a factor analysis based on the same elemental data. The factor analysis was completed using the SPSS principal component analysis. The variables (elemental concentrations of the sherd samples) were examined with a covariance matrix and varimax rotation. The resulting analysis yielded 30 principal components that account for 100 percent of the total variance (Table 41).

The first eight principal components account for 71 percent of the variance. The first principal component, accounting for 16.7 percent of the variance, consists of Ca, Rb, K, Na, La, Si, and Sc (Table 42). Fourteen percent of the variance is accounted for by principal component 2 that represents Tl, Fe, B, V, Al, and Cu. Principal Component 3, 11.1 percent of the variance, is composed of Be, Cd, and Mn. Approximately 9 percent of the variance is accounted for by Se, Pb, and Ni in principal component 4. Principal component 5 includes Cr and Sr and accounts for 6.83 percent of the variance. Approximately 5 percent of the variance is accounted for in principal component 6 that is composed of Sb and Zn. Principal components 7 and 8 each account for approximately four percent of the variance and are represented by Ag and As, respectively.

Factor analysis of the sample of 100 sherds from the five Petén Postclassic slipped pottery groups produced seven distinct compositional groups when plotting principal components 1 and 2 (Figure 110 and 111). The seven compositional groups also exist in a variety of bivariate elemental plots (Figures 112-115). Figures 112 and 115 show a correlation between Fe and Al and Ti and Fe in the sample. The correlation may be due to differences in clay sources, clay mineral structure and ionic substitution, and/or other undetermined variation. Table 43 lists the mean elemental concentrations for each group. The compositional groups generally correspond to the hierarchical cluster analysis discussed above; however, the groupings based on factor analysis are more specific and will later be shown to correlate to petrographic and stylistic analyses (Chapter 9).

Below is a description of the seven chemical compositional groups that includes data such as the ceramic ware and types of sherds that compose the group as well as the major elements that differentiate the groups. This data is also summarized in Table 44.

Composition Group 1 represents sherds from the Clemencia Cream ware, Topoxté Red type, from the archaeological sites of Ixlú and Tipuj. Sherds in this group have a relatively higher mean concentration of Fe, K, and Al, and relatively lower concentrations of Ca, Sc, and V.

Composition Groups 2 and 3 represents Vitzil Orange-Red ware sherds. While group 2 has sherds from Ch'ich', Ixlú, and Zacpetén, group 3 has sherds from all four archaeological sites in the study. Both groups have relatively high mean concentrations of Fe, Al, and Ti and relatively moderate concentrations of Zn. Group 2 has relatively higher Al, Na, and K mean concentrations and a relatively lower Ca concentration than does group 3. Augustine Red sherds and two Hobonmo Incised: Hobonmo Variety sherds represent compositional group 2. Compositional group 3 consists of Augustine Red, Pek

Table 41: Principal Eigenvalues and Associated Variance

| Component | Total | % of Variance | Cumulative % |
|---|---|---|---|
| 1 | 5.017 | 16.724 | 16.724 |
| 2 | 4.197 | 13.990 | 30.714 |
| 3 | 3.329 | 11.097 | 41.811 |
| 4 | 2.684 | 8.946 | 50.757 |
| 5 | 2.048 | 6.828 | 57.585 |
| 6 | 1.579 | 5.264 | 62.848 |
| 7 | 1.290 | 4.300 | 67.148 |
| 8 | 1.252 | 4.174 | 71.322 |
| 9 | 1.175 | 3.918 | 75.240 |
| 10 | .920 | 3.065 | 78.305 |
| 11 | .853 | 2.844 | 81.150 |
| 12 | .787 | 2.622 | 83.772 |
| 13 | .699 | 2.329 | 86.101 |
| 14 | .623 | 2.078 | 88.179 |
| 15 | .611 | 2.036 | 90.215 |
| 16 | .549 | 1.831 | 92.046 |
| 17 | .441 | 1.471 | 93.516 |
| 18 | .399 | 1.331 | 94.848 |
| 19 | .2887 | .995 | 95.803 |
| 20 | .277 | .923 | 96.726 |
| 21 | .232 | .774 | 97.500 |
| 22 | .223 | .745 | 98.245 |
| 23 | .196 | .653 | 98.898 |
| 24 | .113 | .377 | 99.275 |
| 25 | .008 | .268 | 99.542 |
| 26 | .005 | .151 | 99.693 |
| 27 | .003 | .109 | 99.802 |
| 28 | .003 | .1 | 99.894 |
| 29 | .002 | .006 | 99.955 |
| 30 | .001 | .005 | 100.0 |

Table 42: Rotated Component Matrix and Composition Group Membership

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Ca | .881* | | | .206 | | | | |
| Rb | .859* | | | | | | | |
| K | -.795* | | | | -.279 | | | |
| Na | -.781* | | .392 | | .254 | | | |
| La | .703* | | | | -.228 | | | |
| Si | -.665* | | | | | | .218 | |
| Sc | .576* | -.254 | .257 | .339 | .355 | | | |
| Ti | | .935* | | | | | | |
| Fe | | .929* | | | | | | |
| B | -.206 | .891* | | | | | | |
| V | .346 | .819* | | | | | | |
| Al | -.393 | .798* | | | | -.212 | | |
| Cu | | .528* | .435 | | | .214 | .347 | |
| Be | | | -.716* | | | | | .355 |
| Cd | | -.246 | .691* | | | | | |
| Mn | -.385 | | .650* | | | | | |
| Se | .231 | | | .714* | | | | |
| Pb | | | | -.698* | | | | |
| Ni | | | .240 | -.516* | | .495 | | |
| Co | .317 | -.315 | | -.450 | | | -.421 | -.221 |
| Mg | .387 | -.331 | | -.398 | -.230 | .321 | | |
| Cr | | .221 | .243 | | -.747* | | | |
| Sr | .536 | .227 | | | .617* | | .231 | |
| Ba | -.273 | .545 | | | .570 | | | |
| Sb | | | | | .476 | .637* | | |
| Zn | -.207 | | | | | .611* | | |
| Tl | | -.445 | | .272 | -.225 | .452 | | |
| Ag | | | | | | | .852* | |
| As | | | | | | | | .786* |
| Cs | | -.246 | -.416 | .342 | | -.375 | | -.458 |

* indicates the elements that compose the component

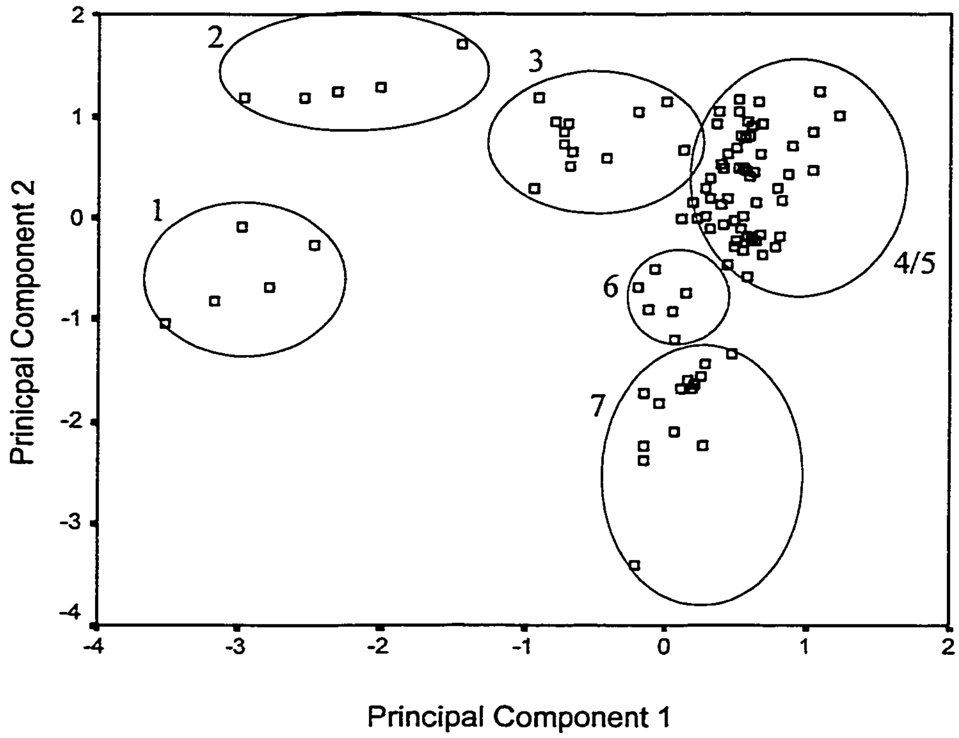


Figure 110: Chemical Composition Groups

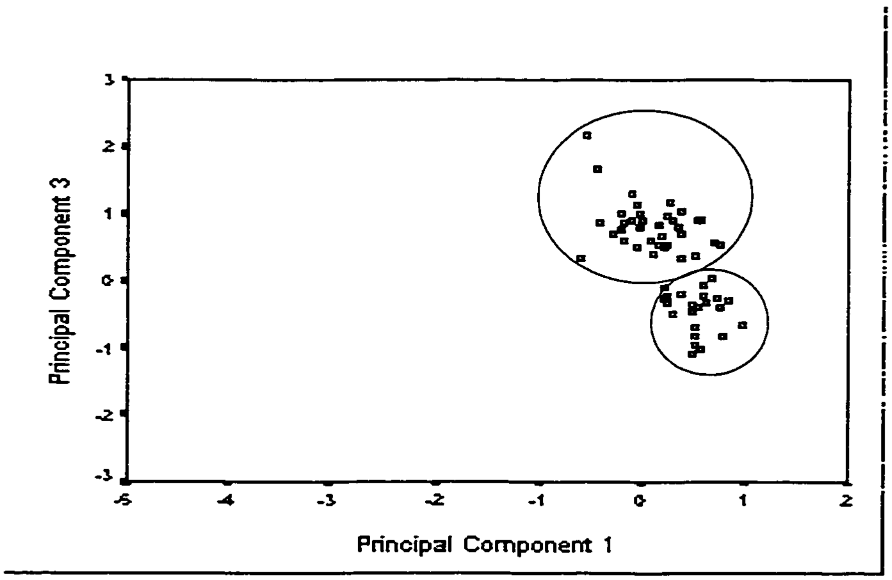


Figure 111: Compositional Groups 4 (upper) and 5 (lower)

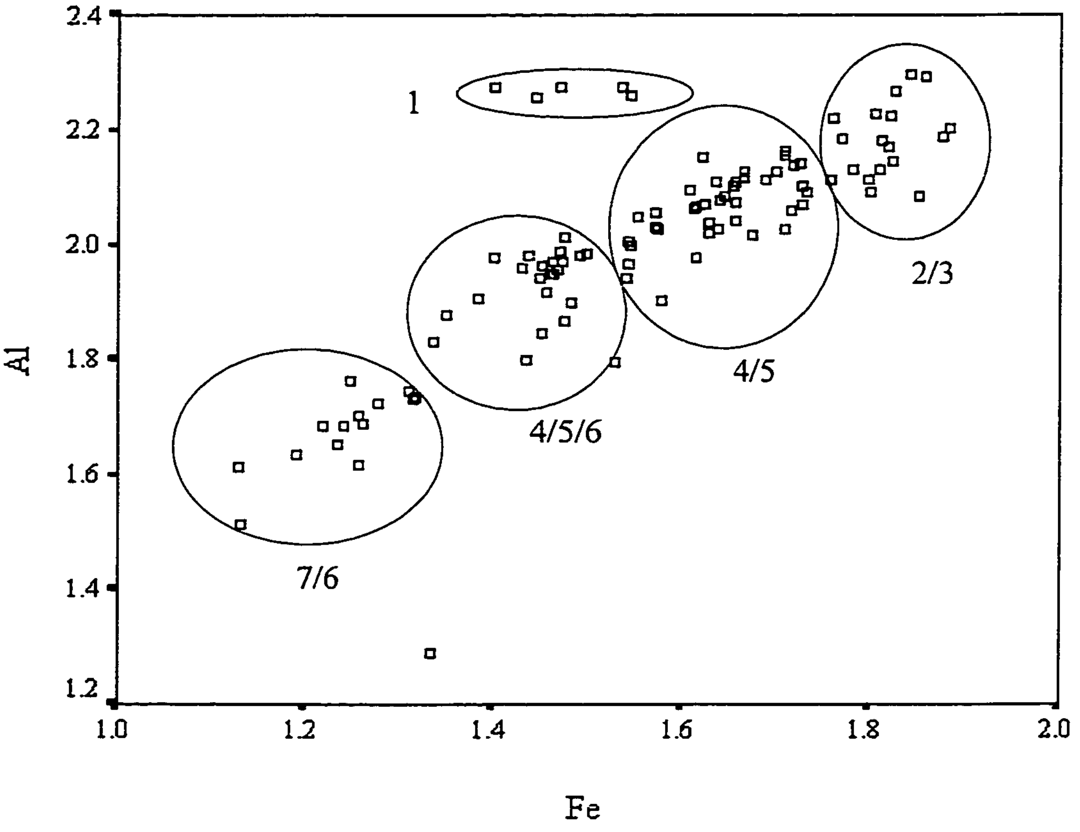


Figure 112: Fe and Al concentrations of the seven composition groups. Element concentrations are plotted as base log 10 values.

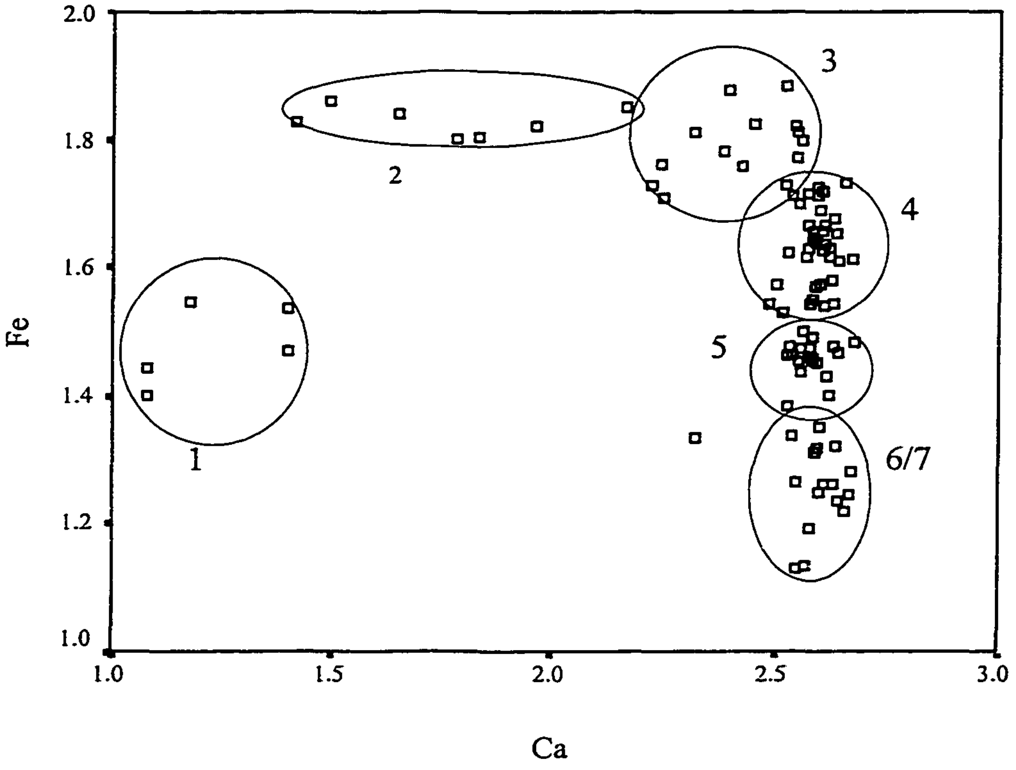


Figure 113: Ca and Fe concentrations of the seven composition groups. Element concentrations are plotted as base log 10 values.

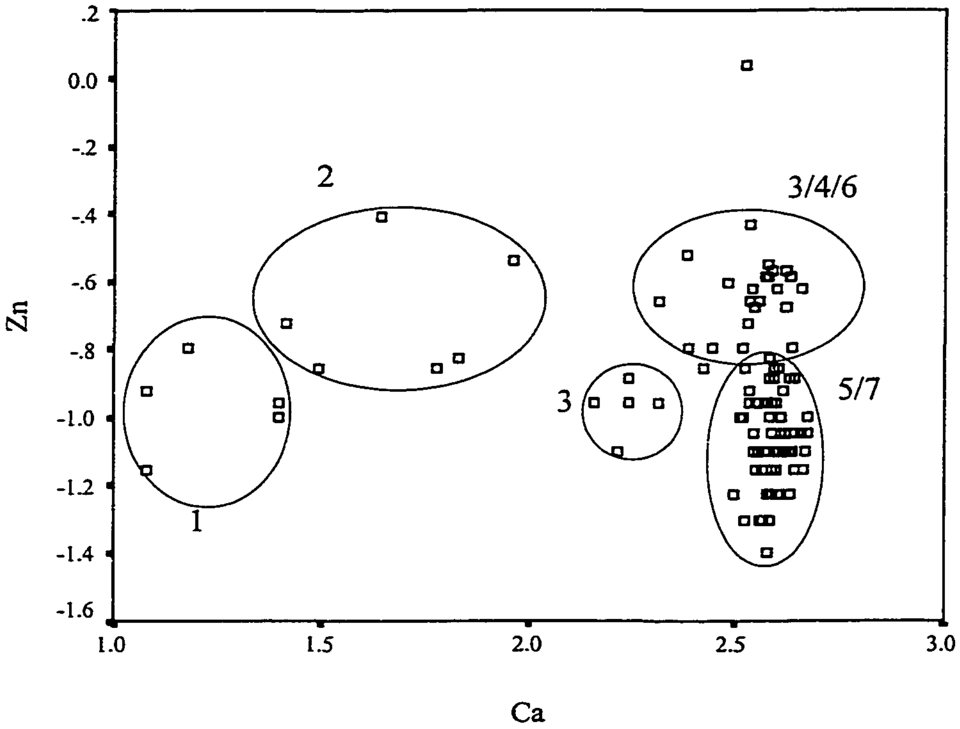


Figure 114: Ca and Zn concentrations of the seven composition groups. Element concentrations are plotted as base log 10 values.

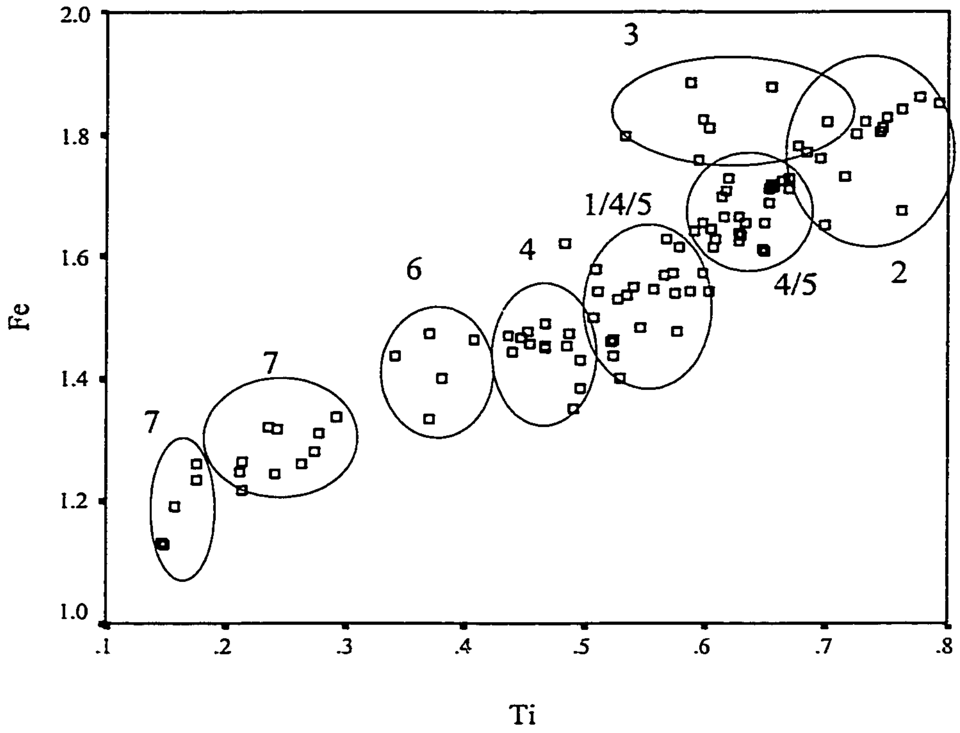


Figure 115: Ti and Fe concentrations of the seven composition groups. Element concentrations are plotted as base log 10 values.

Table 43: Mean Elemental Concentration (ppm) of Compositional Groups (continued on next page)

| | Group 1, n=5 | | Group 2, n=5 | | Group 3, n=24 | | Group 4, x=35 | | Group 5, n=16 | | Group6, n=4 | | Group 7, n=13 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | sd | $\bar{x}$ | sd | $\bar{x}$ | sd | $\bar{x}$ | sd | $\bar{x}$ | sd | $\bar{x}$ | sd | $\bar{x}$ | sd |
| Ca | 27.00 | 6.44 | 119.33 | 125.85 | 297.09 | 106.35 | 376.47 | 52.57 | 397.07 | 28.51 | 333.00 | 84.01 | 405.77 | 43.32 |
| Rb | 22.80 | 8.70 | 37.00 | 12.44 | 57.22 | 11.50 | 66.00 | 4.87 | 67.73 | 2.37 | 64.50 | 6.56 | 65.46 | 3.91 |
| K | 32.40 | 7.02 | 23.67 | 9.95 | 11.83 | 9.10 | 5.24 | 4.08 | 5.13 | 1.68 | 11.75 | 2.99 | 9.23 | 2.89 |
| Na | 25.00 | 1.73 | 14.00 | 6.72 | 1.48 | 3.13 | 1.12 | 1.30 | 1.07 | 1.71 | 2.50 | 1.00 | .54 | .88 |
| La | .02 | .02 | .005 | .008 | .0009 | .004 | 0 | 0 | .002 | .005 | 0 | 0 | .002 | .001 |
| Si | 6.21 | 1.10 | 3.87 | 2.51 | 2.50 | 4.13 | 1.58 | 1.15 | 1.13 | .58 | 1.63 | .33 | 1.39 | .59 |
| Sc | .02 | 0 | .007 | .01 | .008 | .008 | 0 | 0 | .0006 | .003 | 0 | 0 | .003 | .01 |
| Ti | 2.98 | .05 | 5.43 | .46 | 4.30 | .97 | 3.82 | .65 | 3.64 | .61 | 1.97 | .40 | 1.66 | .18 |
| Fe | 30.40 | 4.27 | 65.3 | 5.77 | 55.06 | 13.92 | 38.84 | 8.67 | 35.53 | 8.74 | 21.26 | 4.82 | 17.96 | 2.49 |
| B | .04 | .01 | .08 | .20 | .02 | .02 | .08 | .03 | .02 | .07 | .11 | .22 | .01 | .02 |
| V | .03 | .01 | .16 | .02 | .12 | .02 | .11 | .03 | .11 | .02 | .056 | .02 | .05 | .02 |
| Al | 185.82 | 3.89 | 178.03 | 18.04 | 126.47 | 23.92 | 107.99 | .03 | 102.58 | 23.00 | 45.33 | 19.04 | 49.59 | 8.78 |
| Cu | .032 | .001 | .06 | .01 | .04 | .01 | .05 | .02 | .04 | .01 | .05 | .01 | .03 | .02 |
| Be | .001 | .001 | .002 | .002 | .0008 | .001 | .001 | .002 | .0003 | .0009 | .001 | .001 | .0006 | .00001 |
| Cd | 0 | 0 | 0 | 0 | .002 | .004 | .002 | .004 | .001 | .005 | 0 | 0 | .0007 | .003 |
| Mn | .92 | .11 | 1.51 | .64 | .35 | .42 | .25 | .25 | .14 | .14 | .41 | .29 | .48 | .26 |
| Se | .012 | .013 | 0 | 0 | .003 | .007 | .01 | .02 | .005 | .02 | .01 | .01 | .006 | .02 |

| | Group 1, n=5 | | Group 2, n=5 | | Group 3, n=24 | | Group 4, x=35 | | Group 5, n=16 | | Group6, n=4 | | Group 7, n=13 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | x̄ | sd | x̄ | sd | x̄ | sd | x̄ | sd | x̄ | sd | x̄ | sd | x̄ | sd |
| Pb | 0 | 0 | .032 | .03 | .01 | .02 | .02 | .02 | .005 | .01 | .01 | .02 | .02 | .02 |
| Ni | 0 | 0 | .02 | .01 | .04 | .04 | .03 | .01 | .03 | .01 | .04 | .02 | .03 | .01 |
| Co | 0 | 0 | .02 | .01 | .01 | .01 | .01 | .01 | .01 | .005 | .01 | .01 | .01 | .01 |
| Mg | 8.82 | .88 | 3.67 | 1.75 | 19.08 | 29.04 | 10.44 | 5.11 | 9.4 | 1.45 | 31.50 | 7.59 | 25.00 | 11.61 |
| Cr | .02 | .01 | .057 | .01 | .09 | .05 | .06 | .05 | .06 | .04 | .04 | .04 | .052 | .02 |
| Sr | .11 | .03 | .28 | .23 | .24 | .24 | .85 | .35 | 1.02 | .25 | .31 | .15 | .14 | .10 |
| Ba | 1.59 | .44 | 2.10 | .22 | .96 | .46 | 1.02 | .59 | 1.63 | 1.43 | .49 | .29 | .45 | .32 |
| Sb | .02 | .02 | .04 | .02 | .02 | .01 | .03 | .02 | .023 | .01 | .01 | .01 | .02 | .01 |
| Zn | .11 | .03 | .20 | .12 | .18 | .21 | .11 | .06 | .09 | .04 | .24 | .03 | .14 | .08 |
| Tl | .01 | 0 | .02 | 0 | .02 | .01 | .01 | .01 | .01 | .006 | .01 | .01 | .01 | .01 |
| As | .002 | .004 | 0 | 0 | 0 | 0 | .0008 | .005 | 0 | 0 | .003 | .01 | 0 | 0 |
| Cs | 49.2 | 1.64 | 51.17 | 6.11 | 50.13 | 4.69 | 51.05 | 4.44 | 51.93 | 3.92 | 50.50 | 3.32 | 53.62 | 2.90 |

Table 44: Comparison of ICPS Compositional Groups with Groups formed through Cluster Analysis and EDS analysis and the Ceramic Groups Represented

| **ICPS Group** | **Distinctive Elemental Concentrations** | **Cluster Analysis Groups** | **EDS Groups** | **Ceramic Groups Represented** |
|---|---|---|---|---|
| 1 | Fe, K, Al, Ca, Sc, V | IIB2 | I | Topoxté |
| 2 | Al, Na, K, Ca | IB2, IIA1, IIA2 | C, D, G | Augustine |
| 3 | Al, Na, K, Ca | IB1, IB2, IIA2, IIB1 | A, B, C, D, E, H | Augustine |
| 4 | Ca, Ti, Fe, Al | IA1, IA3, IB2, IIA1, IIA2 | A, B, D, E, H | Paxcamán, Trapeche, Fulano |
| 5 | Ca, Ti, Fe, Al | IA1, IA3, IIA1, IIA2 | A, C, D, H, J | Paxcamán, Trapeche, Fulano |
| 6 | Ca, Zn, Fe, Al, Ti | IA2, IA3 | E, H | Topoxté |
| 7 | Ca, Zn, Fe, Al, Ti | IA2, IA3, IB1 | A, B, E, F, H | Topoxté |

Polychrome, Hobonmo Incised: Ramsey Variety, Graciela Incised: Graciela Variety, and Hobonmo Incised: Hobonmo Variety sherds.

Volador Dull-Slipped ware sherds represent Compositional Groups 4 and 5 from the four sites included in this study. Both groups have relatively high mean concentrations of Ca and moderate mean concentrations of Ti, Fe, and Al. Because compositional groups 4 and 5 have similar mean concentrations, the two groups cannot be separated on bivariate elemental plots of the five elements. Compositional group 4 consists of Paxcamán Red, Ixpop Polychrome, Sacá Polychrome, Macanché Red-on-paste, Picú Incised: Picú Variety, Picú Incised: Thub Variety, Pink, Mul Polychrome, Xuluc Incised: Ain Variety, Xuluc Incised: Tzalam Variety, and Fulano Black sherds. Compositional group 5 includes Paxcamán Red, Ixpop Polychrome, Picú Incised: Thub Variety, Pink, Mengano Incised, and Sotano Red-on-paste sherds.

Compositional Groups 6 and 7 are characterized by Clemencia Cream ware sherds from Tipuj and Zacpetén. Both groups have relatively high elemental concentrations of Ca and Zn and relatively low concentrations of Fe, Al, and Ti; however, group 7 has a slightly higher relative Ca concentration than does group 6. Again, bivariate plots of these five elements do not obviously separate the two groups. Compositional group 6 consists of Topoxté Red and Chompoxté Red-on-paste: Akalché Variety sherds. Compositional group 7 has Topoxté Red, Chompoxté Red-on-paste: Akalché Variety, Chompoxté Red-on-paste: Chompoxté Variety, Pastel Polychrome, Dulces Incised and Canté Polychrome sherds.

The above chemical composition data suggest definite elemental differences of ceramic wares and groups and more minor elemental differences reflected by pottery types. The differences within the three ceramic wares may be the result of the presence of different minerals in the clay paste or the result of ionic substitution in the clay structure. The variation present in the sherd pastes representing the three Petén Postclassic ceramic wares may be the result of the substitution of Fe, K, Ti, Na, and Al in the montmorillonite clay structure. Cationic replacement is highly likely because montmorillonite dioctahedral and trioctahedral layers expand to absorb water (Moore and Reynolds 1997:155). As the layers expand, the interlayer cation can be exchanged as long as the layer charge is restored. Therefore, the differences in the sherd paste chemical composition groups may be the result of the presence of different minerals and/or differences due to cation exchanges in the clay structure itself.

In addition to these data, Rice (1987a:108-110) conducted an INAA study of Paxcamán/ and Topoxté sherds as well as local clays that demonstrate variability at the ceramic group level. Because INAA and ICPS results are not directly comparable (Burton and Simon 1996:405-406), I only cite this study to support the degree of regional variability in the Petén lakes region during the Postclassic period.

As a result of elemental data obtained from EDS, SEM, and strong-acid extraction ICPS examinations, I define seven chemical composition technological style groups. The seven technological style groups (described above) tend to conform to Petén Postclassic ware categories: groups 1, 6, and 7 are Clemencia Cream Paste ware sherds; groups 2 and

3 represent Vitzil Orange-Red ware sherds; and groups 4 and 5 consist of Volador Dull Slipped ware sherds. These differences are not surprising given the differences of the clay pastes of the three wares discussed in Chapters 5, 6, and 7.

In addition to differences that reflect ware categories, various suites of mineral inclusions in the clay pastes also differentiate the seven chemically based technological style groups. Again, differences based on mineral inclusions are not surprising due to the chemical structure of different minerals. The mineralogical differences among groups 1, 6, and 7 are the differences between clay pastes dominated by pores; by clay pastes with calcite, quartz, hematite, chert, and chalcedony; and by pastes with calcite, quartz, hematite, chert, chalcedony, and biotite, respectively. Groups 2 and 3 differ because of the variation between clay pastes dominated by pores and clay pastes with inclusions, respectively. Finally, groups 4 and 5 are differentiated by the presence of chalcedony and biotite in group 4 and the absence of these minerals in group 5.

When "stylistic" data, such as surface treatment and decoration, are examined in conjunction with mineralogical and chemical composition data, some interesting characteristics of each group occur. Group 1 is composed of monochrome slipped Topoxté ceramic group body sherds. Group 2 consists of monochrome slipped sherds and three decorated (black line painted or incised decoration) Augustine ceramic group sherds; forms of group 2 include tripod dishes, collared jars, restricted orifice bowls, and narrow neck jars. Group 3 has black, red, red-and-black, and incised decoration on Augustine ceramic group tripod dish, flanged tripod dish, narrow neck jar, collared jar, restricted orifice bowl, and drum sherds. Group 4 is composed of Paxcamán, Fulano, and ceramic group tripod dish, flanged tripod dish, narrow neck jar, collared jar, restricted orifice bowl, grater bowl, and drum sherds decorated with black, red, red-and-black, or incised decoration with a minority of sherds being monochrome slipped. Group 5 has primarily monochrome slipped Paxcamán, Fulano, and ceramic group sherds with a few black, red, or incised decorated sherds. Vessel forms of this group include tripod dishes, flanged tripod dishes, grater bowls, narrow neck jars, collared jars and restricted orifice jars. Group 6 is composed of Topoxté ceramic group tripod dish, collared jar, narrow neck jar, and drum sherds that are either monochrome slipped or have red or black painted decoration. Group 7 has Topoxté ceramic group tripod dish, collared jar, restricted orifice bowl, and narrow neck jar sherds. These sherds have red, black, red-and-black and incised decoration with a minority of the sherds being monochrome slipped.

The combination of data from "low-tech", mineralogical, and chemical analyses demonstrates that seven Petén Postclassic slipped pottery groups exist and represent differences in technological and stylistic choices. The seven technological style groups demonstrate that choices made by potters with regard to clay, mineral inclusions, form, decoration, and specific knowledge of pottery manufacture influence (the representation of) material culture. These differences may reflect choices made because of environmental constraints as discussed in previous chapters. Although resources may have been restricted, the existence of the seven groups reflects the choices made by

Postclassic Maya potters with regard to raw materials the s/he used.

# CHAPTER 9

# PETÉN POSTCLASSIC TECHNOLOGICAL STYLE GROUPS

In the previous four chapters, I described my sample of Petén Postclassic slipped pottery through typological, "low-tech," mineralogical, and chemical methods of analyses. As a result of each level of analysis, I define preliminary technological style groups that pertain to data gathered in that chapter.

Type-variety analysis, the first level of analysis, yielded two broad typological technological style groups that each have "sub-technological style groups." The first broad technological style group consisted of three divisions based on differences in pastes that reflect the existence of the three Petén Postclassic slipped ware categories: Volador Dull-Slipped ware; Vitzil Orange-Red ware; and Clemencia Cream Paste ware. The second broad technological style group is based on decorative modes and yields five groups of decoration on slipped pottery: red-on-paste; black; red-and-black; fine line incising, and broad line incising.

The second level of analysis, "low-tech" analysis, produced three technological style groups based on slip and clay paste color measurements, refiring experiments, and surface treatment and decoration. The three groups mirror differences of the ware categories previously discussed in the typological technological style groups. "Low-tech" technological style groups reflect the relative variability in paste and slip color and firing technologies. Differences at this level may reflect choices made by Petén

Postclassic Maya potters with regard to resources such as clays, slips, and firing resources.

Mineralogical analysis, the third level of analysis, involved the petrographic and x-ray diffraction analysis of minerals in the clay pastes and slips of the sherds in this sample. I defined four mineralogical groups based on the presence of different paste characteristics or mineral suites of the pastes: 1) clay pastes dominated by voids; 2) clay pastes dominated by cryptocrystalline calcite; 3) clay pastes with quartz, chert, chalcedony, hematite, and calcite mineral inclusions; and 4) clay pastes with quartz, chert, chalcedony, hematite, calcite, and biotite mineral inclusions. Again, the differences in mineral inclusions in the clay paste may reflect differential access to various clay and mineral resources.

The final level of analysis, chemical composition analysis, yielded seven chemical groups based on EDS, SEM, and strong acid-extraction ICPS methodologies. The seven groups reflect differences in ware categories and mineral suites previously described. As with the previous levels of analysis, the differences in the chemical technological style groups may be the result of choices made due to access to resources.

When the technological groups of the four levels of analysis are compared, seven interesting technological and stylistic combinations occur that reflect operational sequence choices and may reflect different social/ethnic identities (see Table 45). The seven Technological Style Groups (TSGs) (discussed below) demonstrate within-group homogeneity and between-group heterogeneity when typological, "low-tech," mineralogical, and chemical characteristics are examined. Below is a discussion of the

Table 45: Comparison of Preliminary Technological Style Group Data

| Type-Variety Wares | "Low-Tech" Groups (relative variability of slip and paste color, firing characteristics, and surface treatment) | Mineralogical Groups [types of inclusions (mineralogical technological style group)] | Chemical Composition Groups |
|---|---|---|---|
| Clemencia Cream Paste | Least | Pores (1) | 1 |
| | | Quartz, chert, chalcedony, hematite, calcite (3) | 6 |
| | | Quartz, chert, chalcedony, hematite, calcite, biotite (4) | 7 |
| | | | |
| Vitzil Orange-Red | Moderate | Pores (1) | 2 |
| | | Cryptocrystalline calcite (2) | 3 |
| | | Quartz, chert, chalcedony, hematite, calcite, biotite (4) | 3 |
| | | | |
| Volador Dull-Slipped | Greatest | Cryptocrystalline calcite (2) | 5 |
| | | Quartz, chert, chalcedony, hematite, calcite, biotite (4) | 4 |

seven different TSGs that includes paste, firing, surface finish and decoration, form, and provenience characteristics of each.

## I. Technological Style Group 1

TSG 1 consists of Topoxté Red pottery from Ixlú (n=17) and Tipuj (n=2). Body sherds of this group are thin and exteriorly slipped with no decoration.

The marly Clemencia Cream Paste ware pastes of TSG 1 range in color from light greenish gray (1 GLEY 7/1) to pink (7.5YR 8/2-3) to light gray and very pale brown (10YR 7/1-4, 8/1-3). Although these clay pastes are dominated by pores (60-80%), they also include small quantities of quartz (less than 1%). XRD analysis of sherds from this group demonstrates that the clay paste is composed of montmorillonite clay minerals. Additional minerals detected by XRD analysis and not by petrographic analysis include gypsum and dolomite. Strong acid-extraction ICPS analysis suggests that TSG 1 is distinctive due to its moderate relative concentrations of Fe and relative low concentrations of Ca and Zn.

Estimated firing temperatures range from 400-650°C. Approximately one half of the sherds exhibit a darker core and are estimated to have been fired below 600°C. The median and modal estimated firing temperature is 600°C with a range of 250°C (400-650°C). Core and interior surface (unslipped) hardness is 3 before and after refiring experiments (Tables 46 and 47).

The slipped surfaces exhibit low luster to "waxy" finishes. Slip colors range from red (10R 5/6-2.5YR 4/8) to light reddish brown and yellowish red (5YR6/4-5/6). Exterior red slip hardness before refiring experiments is 3 and after refiring experiments increases to 4 (Table 48). Although slip hardness is fairly homogeneous for TSG 1, general exterior slip color is heterogeneous (Figure 116). Table 49 provides diversity measurements for richness, evenness, and heterogeneity of exterior slips. When TSG 1 exterior slip colors are compared to general data for Topoxté exterior slips (Table 9 and 10), the slip colors of TSG 1 represent a sample characterized by a high variability with a mixed assemblage of many colors (Table 49). TSG 1 richness indices are higher than other groups, suggesting that the relative number of colors present in Group 1 are higher than those of the entire Topoxté sample. Evenness measurements for Group 1 are similar to those of the entire Topoxté sample. Pre-refired Group 1 exterior slip colors have a higher diversity (heterogeneity) index while the post-refired diversity (heterogeneity) index is similar to the general Topoxté ceramic group. This trend suggests that the original slip color represents a larger range of colors than is present in the Topoxté sample as a whole.

All sherds represent body sherds that range in thickness from 4.88-11.35 mm ($\bar{x}$=5.98 mm, s.d.=1.64).

Table 46: Core Hardness Measurements for Technological Style Group 1

| | Pre Refiring Hardness | Refired Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 2-3 | 3-4 |

Table 47: Interior Surface Hardness Measurements for Technological Style Group 1

| | Pre Refiring Hardness | Refired Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 2-3 | 2-4 |

Table 48: Exterior Surface Hardness Measurements for Technological Style Group 1

| | Pre Refiring Hardness | Refired Hardness |
|---|---|---|
| Mode | 3 | 4 |
| Median | 3 | 4 |
| Range | 2-3 | 2-5 |

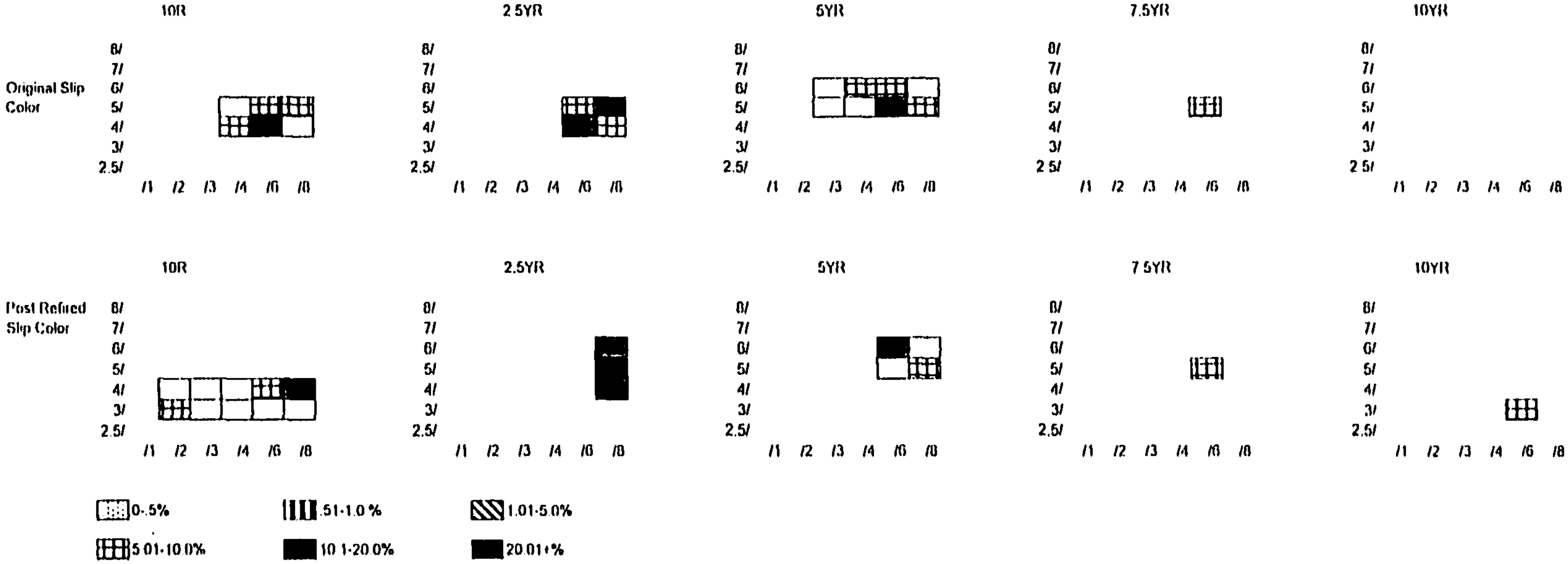


Figure 116: Exterior Slip Color Distribution of Technological Style Group 1

Table 49: Exterior Slip Color Diversity Indices for Technological Style Group 1

| | Sample Size | Total Number of Colors Recorded | Number of Colors Consisting of More than 1.0% of the Sample | Richness | Evenness | Heterogeneity |
|---|---|---|---|---|---|---|
| Original | 19 | 13 | 13 | 2.98 | .83 | .95 |
| Post refiring | 18 | 9 | 9 | 2.12 | .69 | .88 |

TSG 1 sherds were excavated at Ixlú and Tipuj. All Topoxté Red sherds excavated at Ixlú occur in this group. All sherds but one were located in the first three levels of Structures 2022 (open hall), 2023 (temple), 2034 (temple), and 2041 (elite residence). The other sherd was located in level 6d2 (the level of the skull line burial discussed in Chapter 2) of Structure 2023. At Tipuj, both sherds were located in surface collections of Structures 2 (temple) and 3 (open hall).

Small quantities of Topoxté Red sherds from Topoxté Island and from Macanché Island would also fit into this category. Thin Topoxté Red body sherds from Topoxté Island resemble those excavated at Ixlú and a small quantity of thin body sherds (2 mm) with a high percentage of voids in the clay paste also occurring at Macanché Island. These sherds have a low luster finish red slip (7.5 R 7/6 to 5YR 7/4), a pale red paste color (10YR 7/4), and a paste and slip Mohs' hardness of 2-2.5.

## II. Technological Style Group 2

TSG 2 represents Augustine ceramic group sherds from Ch'ich' (n=6), Ixlú (n=9), and Zacpetén (n=6). The majority of the sherds in this group are slipped without decoration; however, three sherds have either black line painted decoration or incisions.

The dark red to yellowish red pastes (2.5YR5/8-5YR 5/6) of this group are dominated by pores with small amounts (less than 1%) of quartz, cryptocrystalline calcite, and hematite. Some long angular pores are the result of the inclusion of sponge spicules (Utgaard, personal communication, 2000). XRD analysis indicates that montmorillonite clay minerals compose the sherd paste and strong acid-extraction ICPS analysis distinguishes this group from TSG 3 (also an Augustine ceramic group) because of its low relative concentrations of Ca.

While the majority of TSG 2 sherds are estimated to have been fired to 600°C, 38% (eight sherds) of the sherds have a dark core and are estimated to have been fired between 300-550°C. The median estimated firing temperature is 600°C with a mode of 300°C and a range of 500°C (300-800°C). As a result of low original firing temperatures, core hardness is 3 and did not change after refiring experiments (Table 50).

Exterior and interior slipped surfaces have matte to low luster finishes and are red (10R 4/6-8 and 2.5YR 5-4/8). The two decorated interior surfaces have a yellowish-red (5YR 5/6-8) primary slip with a matte finish. All slipped surfaces have a hardness of 3 (Tables 51 and 52). When the exterior slip color diversity indices of TSG 2 (Figure 117 and Table 53) are compared to those of the Augustine ceramic group sample (Tables 9 and 10), some differences are noted. Richness indices of Group 2 are low except for a slightly higher index for post-refired sherds. Nevertheless, the overall lower richness numbers as compared to those of the other technological style groups suggest a lower level of variability. Evenness indices of TSG 2 are also considerably lower than those for the Augustine ceramic group, indicating that the slipped surfaces are more homogeneous than other technological style groups.

In addition to monochrome slipped sherds, two Pek Polychrome sherds and two Hobonmo Incised: Hobonmo Variety sherds occur in TSG 2 (Figure 118). Pek Polychrome decoration consist of curvilinear motifs, but the fragmentary nature of the

Table 50: Core Hardness Measurements for Technological Style Group 2

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 1 (3-4) | 1 (3-4) |

Table 51: Exterior Hardness Measurements for Technological Style Group 2

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 1 (3-4) | 2 (3-5) |

Table 52: Interior Hardness Measurements for Technological Style Group 2

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 1 (3-4) | 1 (3-4) |

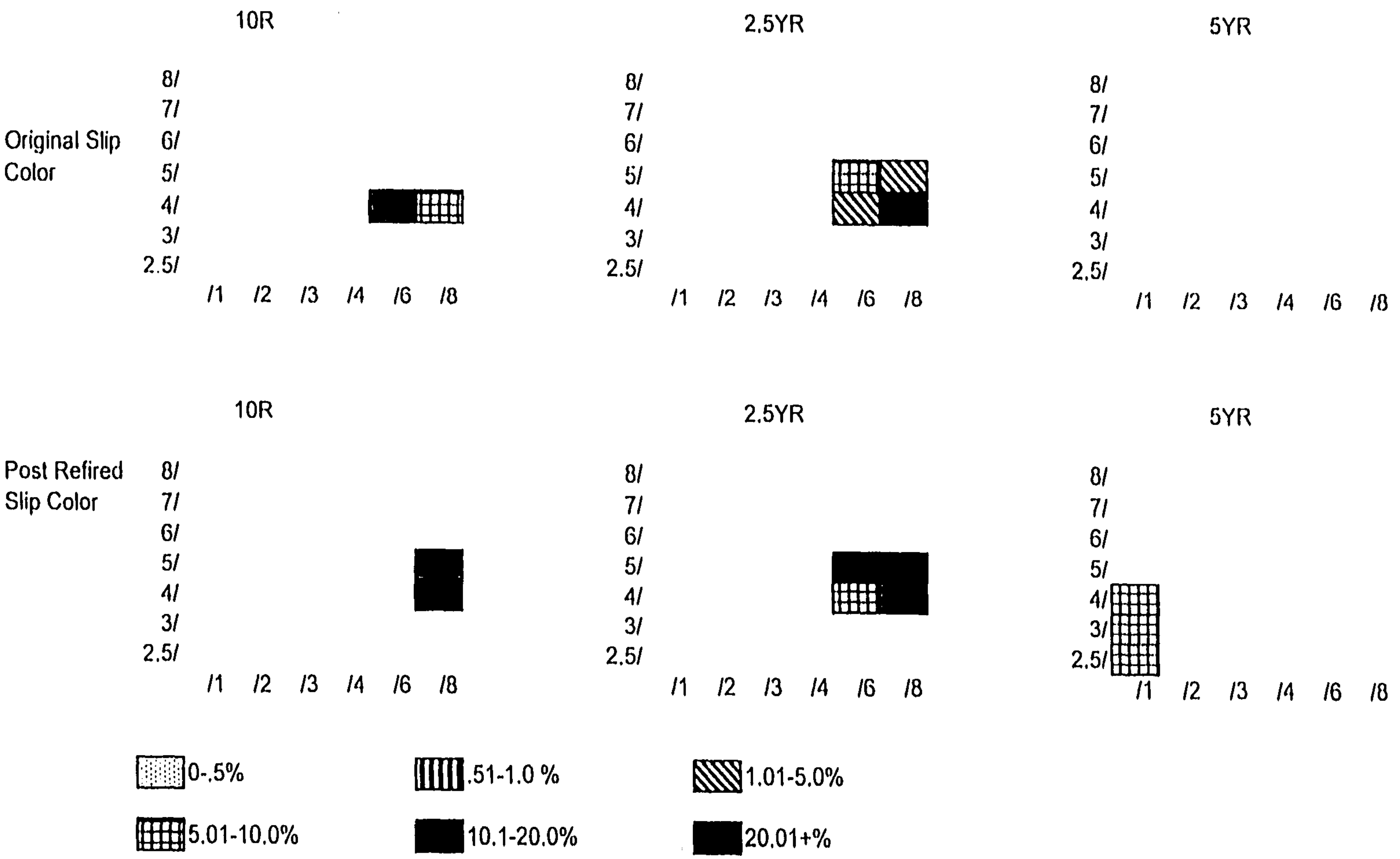


Figure 117: Exterior Slip Color Distribution of Technological Style Group 2

Table 53: Diversity Measurements of Exterior Slip Colors for Technological Style Group 2

| | Sample Size | Total Number of Colors Recorded | Number of Colors Consisting of More than 1.0% of the Sample | Richness | Evenness | Heterogeneity |
|---|---|---|---|---|---|---|
| Original | 21 | 6 | 6 | 1.31 | .53 | .81 |
| Post Refiring | 19 | 9 | 9 | 2.06 | .68 | .89 |

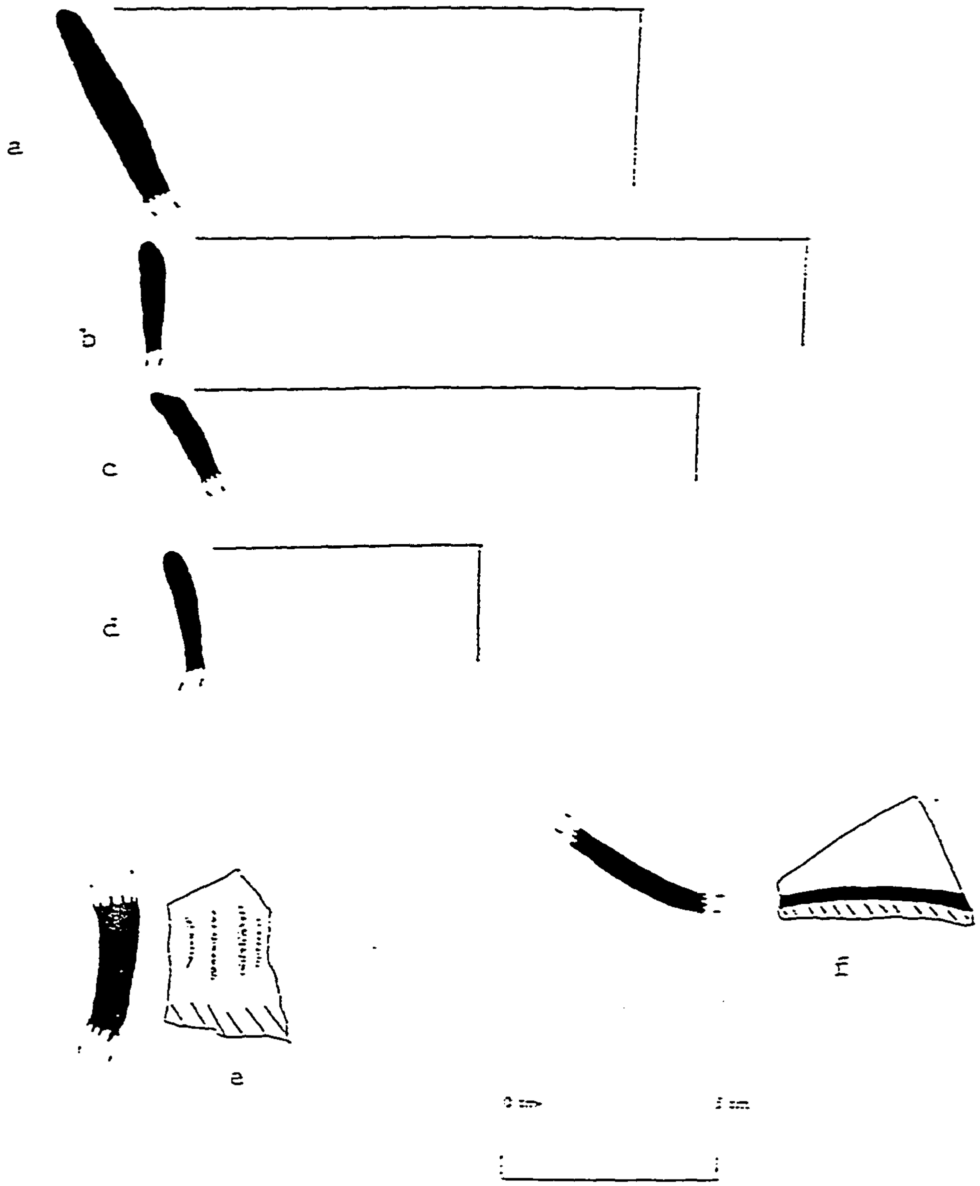


Figure 118: Technological Style Group 2 Sherd Profiles: a-d) Augustine Red; e) Hobonmo Incised: Hobonmo Variety; and f) Pek Polychrome.

sherds does not allow further interpretation. Hobonmo Incised drum sherds have groups of four vertically incised lines and slip begins 4-5 mm below the incisions.

Plates (n=2), collared jars (n=1), restricted orifice bowls (n=1), and narrow neck jars (n=1) occur in TSG 2. Plates from Zacpetén and Ch'ich' have diameters of 24 cm and 26 cm, respectively. The collared bowl from Zacpetén has a rim diameter of 18 cm. The restricted orifice bowl from Zacpetén has a rim diameter of 12 cm and the narrow neck jar from Ixlú has a rim diameter of 20 cm. The remaining 16 sherds represent body sherds from various vessel forms.

Sherds from Zacpetén were located in the first three levels of the following Structures: 719 (elite residence, open hall); 721 (temple); 748 (elite structure); and 764 (temple). Ixlú Structures 2021 (open hall), 2034 (temple), and 2041 (residence) contained TSG 2 sherds in the first three levels. Sherds from Structure 188 (open hall with shrine) at Ch'ich' came from the second level. All sherds in this group come from elite and/or ceremonial contexts.

TSG 2 sherds are also present at Tayasal and Macanché Island. Some Augustine Red and Hobonmo Incised: Hobonmo Variety sherds from Tayasal exhibit a fairly compact red (2.5YR 5-4/8) paste with a predominance of pores and small quantities of inclusions. Exterior slips appear to be thick with a low luster and a darker red color (10R 4/6). A small quantity of Augustine Red sherds from Macanché Island also resemble those previously described.

## III. Technological Style Group 3

TSG 3 represents Augustine ceramic group sherds from Ch'ich' (n=20), Ixlú (n=19), Zacpetén (n=44), and Tipuj (n=50). The majority of sherds in this group are decorated by incising, or by black, or red-and-black painted decoration.

Red (10 R 4/6, 2.5YR 5-4/6-8) to reddish-brown (2.5YR 6/4) to reddish yellow (5YR 5/6) colored pastes contain euhedral, polycrystalline, and cryptocrystalline calcite, quartz, chert, chalcedony, biotite, and hematite inclusions. Five sherds have clay pastes dominated by small cryptocrystalline calcite (50%). XRD analysis demonstrates that montmorillonite clay minerals compose the clay portion of the sherds. In addition to the clay minerals and mineral inclusions listed above, XRD analysis also indicates the presence of gypsum in the clay paste. Strong acid-extraction ICPS analysis separates TSG 3 from TSG 2 because of its higher relative concentration of Ca (calcium).

The majority of sherds are estimated to have been fired to approximately 600°C. Few sherds in this group have a dark core (n=7), but approximately one half of the sherds are estimated to have been fired below 600°C (50 were estimated to have been fired to approximately 300°C and 15 were fired to approximately 550°C). The median estimated firing temperature is 600°C with a mode of 300°C and a range of 500°C (300-800°C). Core Mohs' hardness ranges from 2-4 and does not change when refired to 800 °C (Table 54).

Exterior slipped surfaces are red (10R 5-4/8, 2.5YR 5-4/8) and black (7.5YR 2.1) (Figure 119). Hardness of the exterior slips ranges from 1-5 with a median of 3 (Table

Table 54: Core Hardness Measurements of Technological Style Group 3

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 2-4 | 2-4 |

Table 55: Exterior Slip Hardness Measurements of Technological Style Group 3

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 1-3 | 2-5 |

Table 56: Interior Slip Hardness Measurements of Technological Style Group 3

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 2.5 | 3 |
| Range | 2-3 | 2-5 |

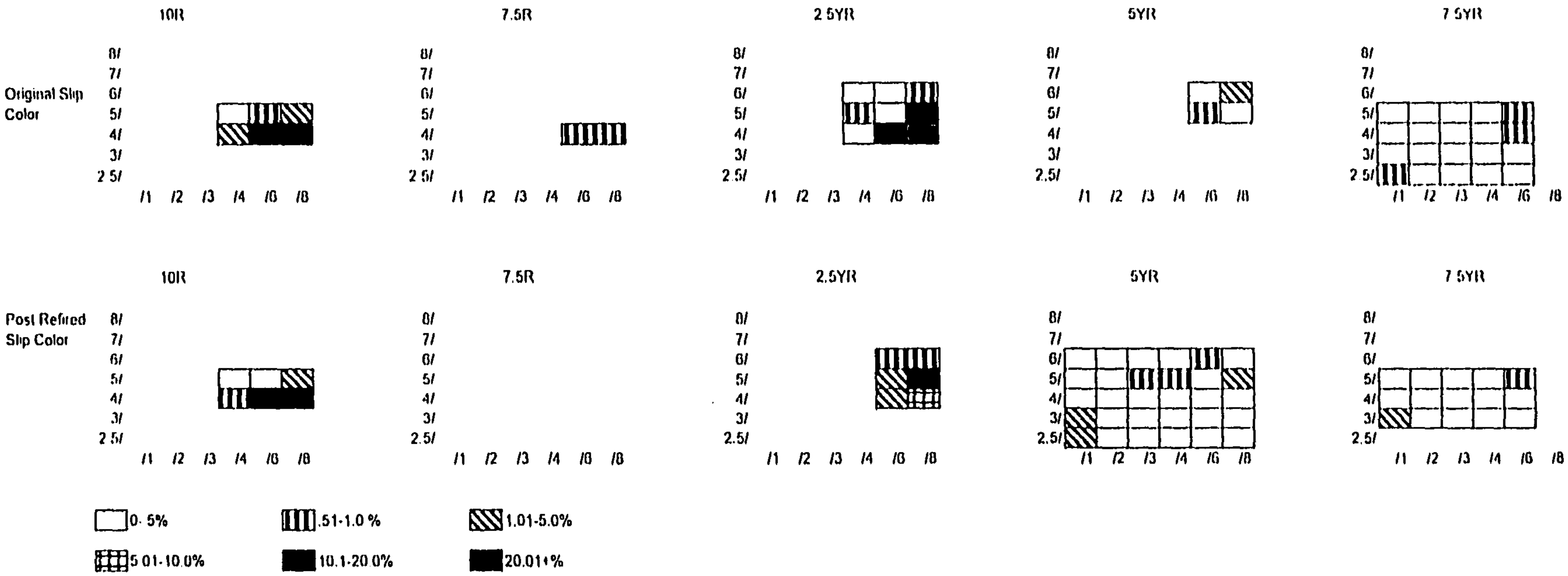


Figure 119: Exterior Slip Color Distribution of Technological Style Group 3

55). Interior slipped surfaces vary more because of the presence of primary slips of decorative panels. Interior red slips are red (10R 4/6 to 2.5YR 5-4/6-8) and primary slips range from light brown and reddish-yellow (7.5YR 6/4-8, 5YR 6/6-8) to very pale brown and yellow (10YR 7-6/4). Interior slip Mohs' hardness ranges from 2-5 with a median of 2.5 (original) and 3 (post-refiring) (Table 56). Exterior and interior slips have matte, low luster, or "waxy" finishes with "waxy" finished sherds occurring most frequently at Tipuj. The richness index of the slip colors of TSG 3 (Table 57) are similar to those of the Augustine ceramic group, suggesting low variability (Table 9 and 10). Evenness indices are lower than those of the Augustine ceramic group and TSG 2 indicating that the exterior slip color of TSG 3 has a smaller range of colors suggesting a better control of firing. Heterogeneity indices suggest that the exterior slips of TSG 3 encompass a wide range of colors similar to those of the Augustine ceramic group sample and TSG 2.

Although decoration areas are highly eroded, some black (Pek Polychrome) or red and black (Graciela Polychrome) painted or incised decoration remains (Figure 120). Pek Polychrome decorative motifs include hooks, plumes, curvilinear lines, and mats. Graciela Polychrome sherds most likely had decorated panels, but because of the fragmentary and eroded nature of the sherds, motifs are not detectable. Hobonmo Incised: Ramsey Variety decorations occur as *ilhuitl* glyphs, mat motifs, and plumes. Hobonmo Incised: Hobonmo Variety drum sherds from Tipuj have a series of four vertical incisions below which red slip begins.

Table 57: Diversity Measurements of Exterior Slip Colors for Technological Style Group 3

| | Sample Size | Total Number of Colors Recorded | Number of Colors Consisting of More than 1.0% of the Sample | Richness | Evenness | Heterogeneity |
|---|---|---|---|---|---|---|
| Original | 129 | 17 | 8 | 1.50 | .43 | .84 |
| Post Refiring | 123 | 18 | 12 | 1.62 | .47 | .85 |

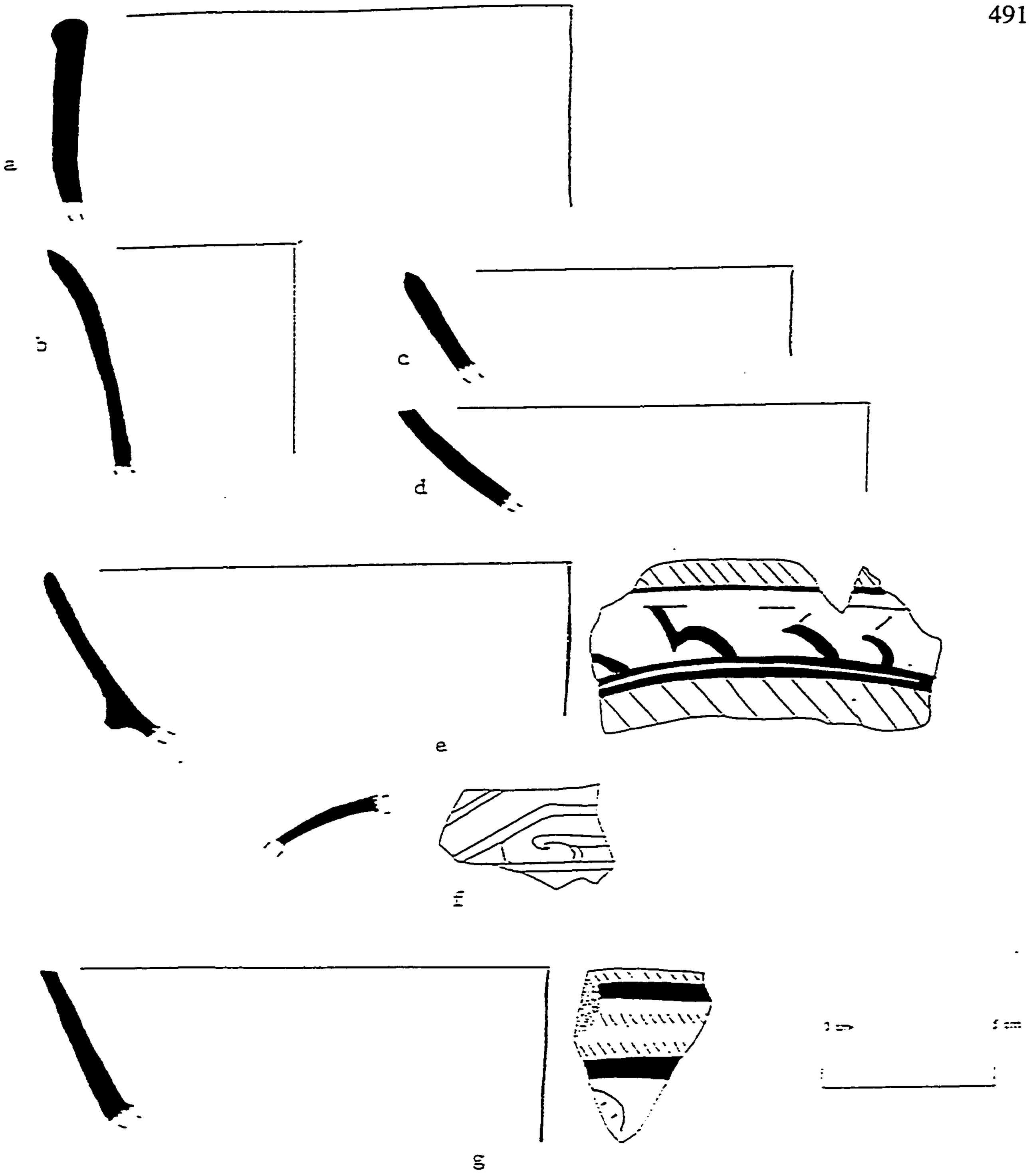


Figure 120: Technological Style Group 3 Sherd Profiles: a-d) Augustine Red; e) Pek Polychrome; f) Hobonmo Incised: Ramsey Variety; and g) Graciela Polychrome.

Tripod plates (n=29), flanged tripod plates (n=2), narrow neck jars (n=15), collared jars (n=23), restricted orifice bowls (n=3), and drums (n=2) occur in TSG 3. Descriptive statistics for the vessel forms appear in Table 58. The vessel rim diameter measurements are similar to those presented in Chapter 6.

Sherds from Zacpetén came from the first three levels of all structures except Structure 664 (residence). TSG 3 sherds also came from level four of Structure 764 (temple) and level 5 of Structures 758 (residence) and 766 (shrine). Sherds from Tipuj were found in all five excavated Postclassic structures and in all levels of Complex 1 at Tipuj. At Ixlú, TSG 3 sherds came from the first three levels the following structures: 2003 (domestic), 2006 (domestic), 2021 (open hall), 2022 (open hall), 2023 (temple), 2034 (temple), and 2041 (residence). TSG 3 sherds appear in the first three levels of Structure 188 (open hall with shrine) at Ch'ich'.

TSG 3 sherds can also be identified at Tayasal, Flores Island, and Macanché Island because of the similarities in the variety of pastes, slip colors, decoration, and vessel forms. Tayasal and Flores Island have a much higher frequency of TSG 3 sherds than does Macanché Island. In addition to their presence in the Petén lakes region, Augustine ceramic group vessels and sherds from Barton Ramie (Sharer and Chase 1976: 291-293) and Colhá (Valdez 1987:212, 216) can also be classified in TSG 3.

Table 58: Descriptive Statistics for Rim Diameters (cm) of Technological Style Group 3

| | Mean | Mode | Median | Standard Deviation | Range |
|---|---|---|---|---|---|
| Tripod Plate (n=29) | 26.38 | 24 | 26 | 4.33 | 20-44 |
| Flanged Tripod Plate (n=2) | 29 | NA | 29 | 1.41 | 28-30 |
| Narrow Neck Jar (n=15) | 21.60 | 24 | 22 | 7.10 | 8-34 |
| Collared Jar (n=23) | 26.91 | 28 | 28 | 5.42 | 16-36 |
| Restricted Orifice Bowl (n=3) | 21.67 | 20 | 20 | 2.89 | 20-25 |
| Drum (n=2) | 14.50 | NA | 14.5 | 2.12 | 13-16 |

## IV. Technological Style Group 4

TSG 4 has sherds from the Paxcamán (n=126), Fulano (n=7), and Trapeche (n=41) ceramic groups from Ch'ich' (n=24), Ixlú (n=41), Zacpetén (n=75), and Tipuj (n=33). The majority of the sherds are decorated with incisions, or red, black, or red-and-black painting.

The light and pale brown (7.5YR 6/4, 5/3, 10YR 7-5/3) to pale yellow (2.5Y 7/3) to gray (2.5Y 5/1) pastes of this group are characterized by the presence of euhedral, polycrystalline, and cryptocrystalline calcite, pores, biotite, chalcedony, chert, quartz, and hematite minerals and shell. XRD analysis of sherds from TSG 4 demonstrates that montmorillonite is the primary clay mineral and that gypsum also occurs in the sherd paste. Strong acid-extraction ICPS analysis separates this group from TSG 5 (also a Volador Dull-Slipped ware group) because of slightly higher relative Fe and Zn concentrations.

Most sherds of TSG 4 have estimated firing temperatures of approximately 550°C. While the majority of the sherds are estimated to have been fired to temperatures from 550°- 800°C, 45 sherds (26%) have estimated firing temperatures that range from 300-500°C. These sherds exhibit a dark core that disappears when fired to 800°C. Paste Mohs' hardness ranges from 2-5 with a median of 3 (Table 59).

Exterior slips of this group vary more than most TSGs because Group 4 consists of red (10R 4/6, 2.5YR 5-4/4-8) Paxcamán ceramic group slips, dark gray to black (7.5R 3/1, 7.5YR 3/1, 5 YR 2.5/1) Fulano ceramic group slips, and "pink" (2.5YR 5/6-4, 7.5YR 6-5/6), Trapeche ceramic group slips (Figure 121). These slips have matte, low luster, or occasional "waxy" finishes with Mohs' hardnesses that range from 2-5 with an original hardness median of 2 that increases to 3 when refired to 800°C (Table 60). Interior slips demonstrate a similar color variability due to the inclusion of the three pottery groups and the presence of primary slips in the decorative panels of some sherds. Interior surface hardness resembles that of exterior slips described above (Table 61).

As would be expected from the variety of ceramic groups and types included in TSG 4, richness indices (Table 62) are also higher than most other TSGs and higher than those of the Paxcamán, Fulano, and Trapeche ceramic group richness measurements (Table 9 and 10). Although richness indices indicate a higher degree of variability in the number of colors present, evenness measurements are lower than those of the Paxcamán, Fulano, and Trapeche ceramic groups. The evenness indices resemble those of TSG 3 and suggest a more homogeneous sample. Conversely, heterogeneity indices suggest a wide range of colors resembling most other TSGs in this study and the Paxcamán, Fulano, and Trapeche ceramic groups.

Two-thirds of the sherds in TSG 4 are decorated with black (Ixpop Polychrome and Mul Polychrome), red (Macanché Red-on-paste, Sotano Red-on-paste, and Picté Red-on-paste), red-and-black (Sacá Polychrome) or incised (Picú Incised and Xuluc Incised) decoration (Figure 122). Typical black decorative motifs include hooks, plumes, stepped pyramids, circles with connecting lines, possible reptilian motifs, and variations of the *Lamat* glyph. Black-and-red decorative elements include hooks, plumes, embedded triangles, as well as other eroded geometric shapes. Red decoration typically appears as circles, hooks, curvilinear mat motifs, birds painted in negative relief (the background is red), stepped pyramids, and *ilhuitl* motifs. Incised decorative elements include the *ilhuitl*

Table 59: Core Hardness Measurements of Technological Style Group 4

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 2-3 | 2-5 |

Table 60: Exterior Slip Hardness Measurements of Technological Style Group 4

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 3 |
| Median | 2 | 3 |
| Range | 2-4 | 2-5 |

Table 61: Interior Slip Hardness Measurements of Technological Style Group 4

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 3 |
| Median | 2 | 3 |
| Range | 2-3 | 2-5 |

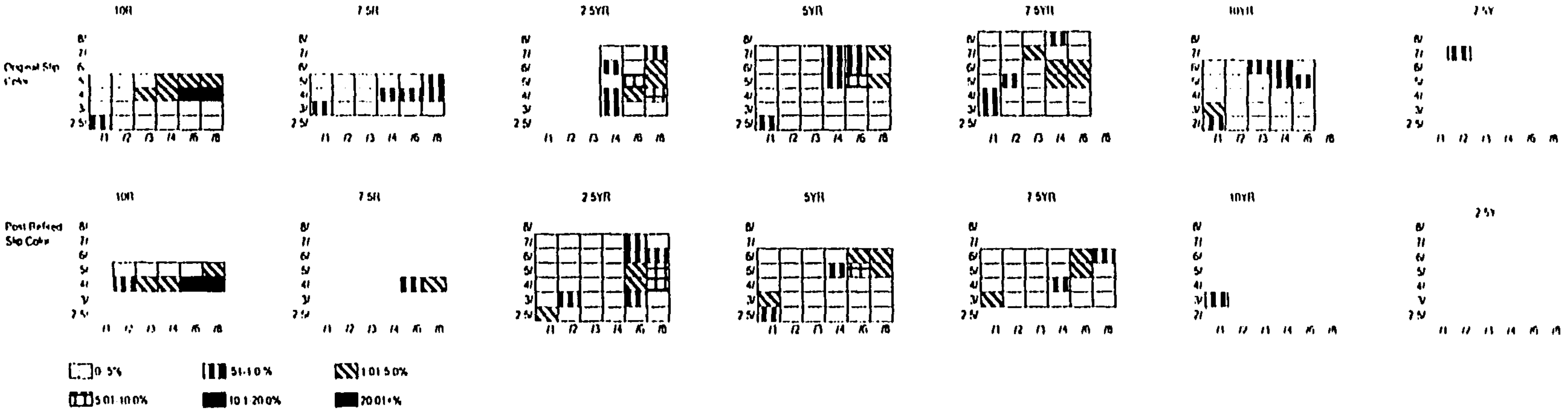


Figure 121: Exterior Slip Color Distribution of Technological Style Group 4

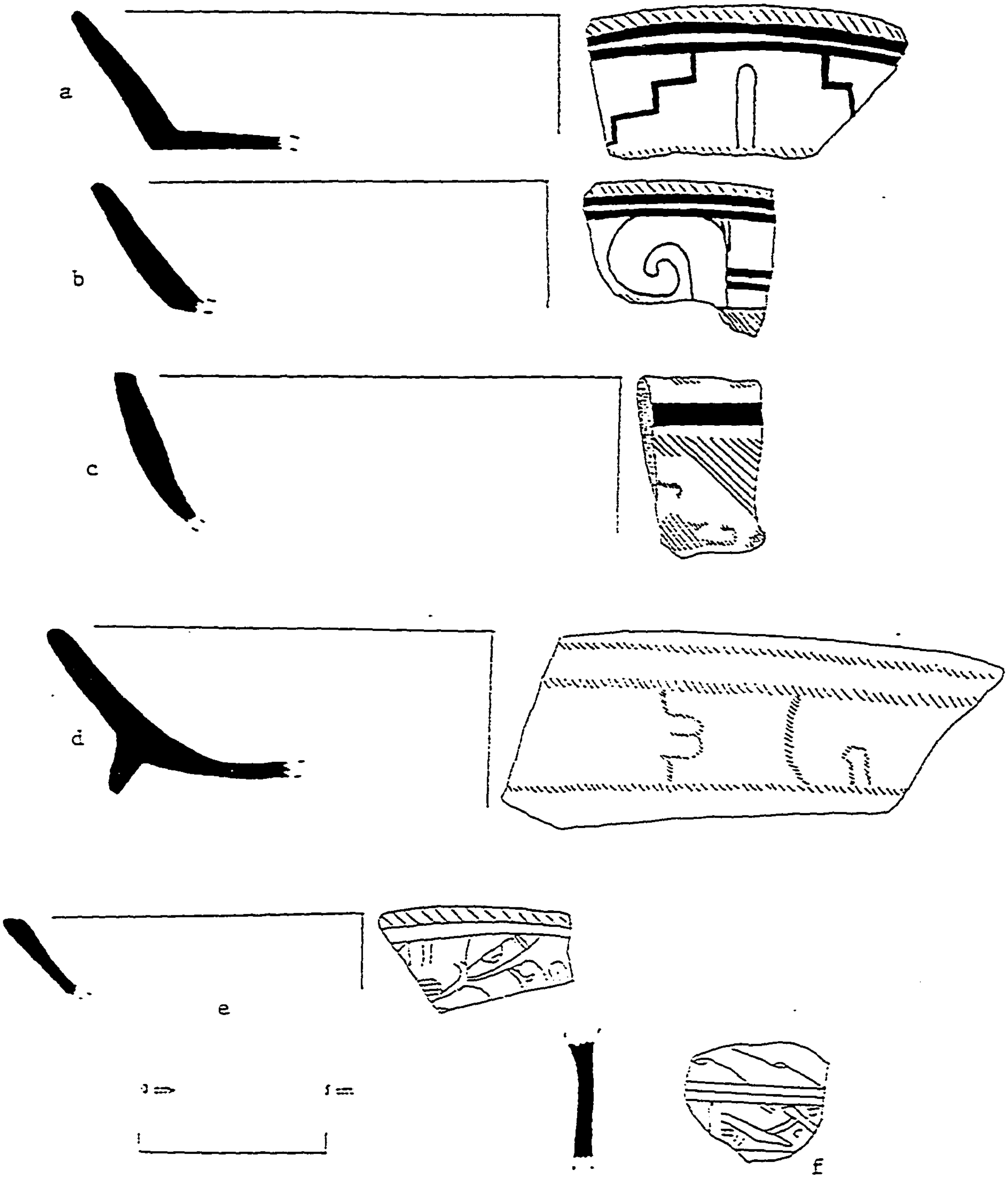


Figure 122: Technological Style Group 4 Sherd Profiles: a-b) Ixpop Polychrome; c) Sacá Polychrome; d) Macanché Red-on-paste: Macanché Variety; and e-f) Picú Incised: Picú Variety.

Table 62: Diversity Measurements of Exterior Slip Colors for Technological Style Group 4

| | Sample Size | Total Number of Colors Recorded | Number of Colors Consisting of More than 1.0% of the Sample | Richness | Evenness | Heterogeneity |
|---|---|---|---|---|---|---|
| Original | 159 | 48 | 21 | 3.81 | .61 | .92 |
| Post Refired | 171 | 31 | 19 | 2.37 | .50 | .92 |

motif, embedded triangles, hooks, plumes, circular elements, mat motifs, birds, and a possible split representation of the RE glyph.

TSG 4 consists of tripod plates (n=69), flanged tripod plates and bowls (n=4), collared jars (n=18), narrow neck jars (n=21), grater bowls (n=6), restricted orifice bowls (n=7) and drums (n=1)–in other words all of the Postclassic forms. Rim diameter measurements are within the range discussed in Chapter 6 and presented in Table 63.

Sherds from this group occurred in the first three levels of all structures; however, no sherds from Structures 602 (temple), 614 (oratorio), and 1002 (oratorio) at Zacpetén are included in this technological style group. They also occurred in levels 1-8 of Structure 719 (residence) at Zacpetén. TSG 4 sherds were located in the first three levels of all the structures at Ixlú [no sherds came from Structures 2010 (open hall) or 2017 (open hall)]. Sherds from this group were also located in level 6d2 (the level of the skull line burial) of Structure 2023. Sherds from Ch'ich' were located in the first three levels of Structure 188. Tipuj's TSG 4 sherds came from all levels and structures except for Structure 4 (open hall).

TSG 4 sherds also occur at Tayasal, Macanché Island, Topoxté Island, and Flores Island. All of these archaeological sites have black painted and incised types of the Volador Dull-Slipped ware. Of the black and incised types with hook or mat motifs, only a few have crystalline calcite, biotite, or chalcedony that are detectable by a hand lens. Sherds with red-and-black decoration exist in very small quantities at Macanché Island and Flores Island (n=14, each) and two sherds occur at Tayasal. All decorative motifs are eroded. Red decorations at Tayasal, Flores Island, and Macanché Island occur as

Table 63: Descriptive Statistics for Rim Diameters (cm) of Technological Style Group 4

| | Mean | Mode | Median | Standard Deviation | Range |
|---|---|---|---|---|---|
| Tripod Plate (n=69) | 24.78 | 22 | 24 | 3.96 | 14-34 |
| Flanged Tripod Plate/Bowl (n=4) | 24.50 | 20 | 21 | 7.72 | 20-36 |
| Narrow Neck Jar (n=21) | 20.33 | 14 | 20 | 7.29 | 11-38 |
| Collared Jar (n=18) | 24.89 | 32 | 28 | 8.55 | 6-34 |
| Restricted Orifice Bowl (n=7) | 17.57 | 10 | 14 | 10.98 | 9-40 |
| Drum (n=1) | 16 | NA | NA | NA | 16 |
| Grater Bowl (n=6) | 26.00 | 28 | 27 | 2.53 | 22-28 |

embedded triangles, hooks, and plumes. Therefore, I would include most of these sherds in Group 4 with the caveat that petrographic analysis was not possible. In addition to pottery from the Petén lakes region, vessels from Barton Ramie and Punta de Chimino described in Chapter 5 may also be included in this group.

## V. Technological Style Group 5

TSG 5 is also composed of Paxcamán (n=63), Fulano (n=7), and Trapeche (n=32) ceramic group sherds from Ch'ich' (n=21), Ixlú (n=31), Zacpetén (n=31), and Tipuj (n=18). The majority of the sherds in this group are monochrome slipped.

The gray (1GLEY 4/1, 10YR 6/1, 2.5Y 6-5/1) to very pale brown (10YR 7/3) pastes are dominated by cryptocrystalline calcite with lesser amounts of hematite, shell, and pores. XRD analysis of the clay pastes in TSG 5 demonstrates that montmorillonite is the primary clay mineral and that gypsum also occurs in the clay paste. Strong acid-extraction ICPS analysis distinguishes TSG 5 from TSG 4 because of lower relative concentrations of Fe and Zn.

One-half of the sherds in this group have dark cores. Seventy percent of the sherds in TSG 5 have firing temperatures between 300-550°C with the remaining 30 percent of sherds being fired between 600-700°C (only 6 sherds are fired above 600°C). Median core Mohs' hardness is 3 with a range from 2-5 (Table 64).

Exterior slip colors vary from red (10R 5-4/6-8, 2.5YR 5-4/6-8) to black (2.5Y 2.5/1) to "pink" (2.5YR 5/6, 7.5YR 7-6/4, 10YR 6/2) (Figure 123). The variation in slip colors reflects the inclusion of the Paxcamán, Fulano, and Trapeche ceramic groups.

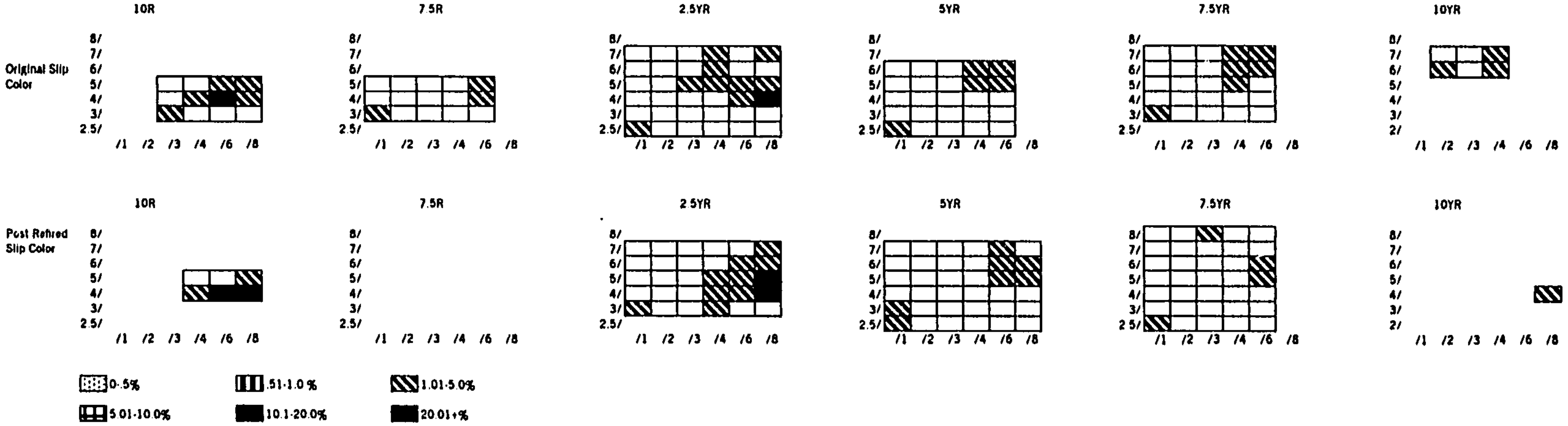


Figure 123: Exterior Slip Color Distribution of Technological Style Group 5

Interior slipped surfaces demonstrate a similar variety of colors with the addition of light gray to very pale brown primary slip colors (10YR 7/2-3) indicating the decorated sherds of this group. Exterior and interior Mohs' hardness ranges from 2-5 with pre-refiring mean hardness of 2 and a post-refiring mean hardness of 3 (Tables 65 and 66).

Diversity indices for TSG 5 (Table 67) differ slightly from those of TSG 4 and from the Paxcamán, Fulano, and Trapeche ceramic groups described in Chapter 6 (Table 9 and 10). Richness measurements are higher than those for the three ceramic groups and slightly lower than that of the original fired surfaces of TSG 4. Conversely, after refiring the sherds to 800°C, the richness index for TSG 5 is higher than that of TSG 4 suggesting that the exterior slips of TSG 5 have a slightly higher variability in color. Evenness indices are also slightly higher than those of TSG 4, but lower than the three ceramic groups that compose TSG 5. This demonstrates that while a mixed assemblage of slip colors exists in this group, the diversity is not as great as that of the Paxcamán, Fulano, and Trapeche ceramic groups. Finally, heterogeneity indices are identical to those of TSG 4 and only slightly higher than those of the three ceramic groups suggesting a wide range of colors in the technological style group.

The majority of the sherds in this group have a monochrome slip with matte, low luster, and "waxy" finishes (Figure 124). Thirty-two percent of the sherds are decorated with black (Ixpop Polychrome), red (Macanché Red-on-paste), red-and-black (Sacá Polychrome), or incised (Picú Incised and Mengano Incised) decorations. The majority of the decorated sherds (79%) have black painted decoration with hook, stepped pyramid,

Table 64: Core Hardness Measurements of Technological Style Group 5

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 2-3 | 2-5 |

Table 65: Exterior Slip Hardness Measurements of Technological Style Group 5

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 3 |
| Median | 2 | 3 |
| Range | 2-3 | 2-5 |

Table 66: Interior Slip Hardness Measurements of Technological Style Group 5

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 3 |
| Median | 2 | 3 |
| Range | 2-3 | 2-5 |

Table 67: Diversity Measurements of Exterior Slip Colors for Technological Style Group 5

| | Sample Size | Total Number of Colors Recorded | Number of Colors Consisting of More than 1.0% of the Sample | Richness | Evenness | Heterogeneity |
|---|---|---|---|---|---|---|
| Original | 93 | 34 | 34 | 3.53 | .65 | .92 |
| Post Refiring | 97 | 27 | 27 | 2.74 | .60 | .92 |

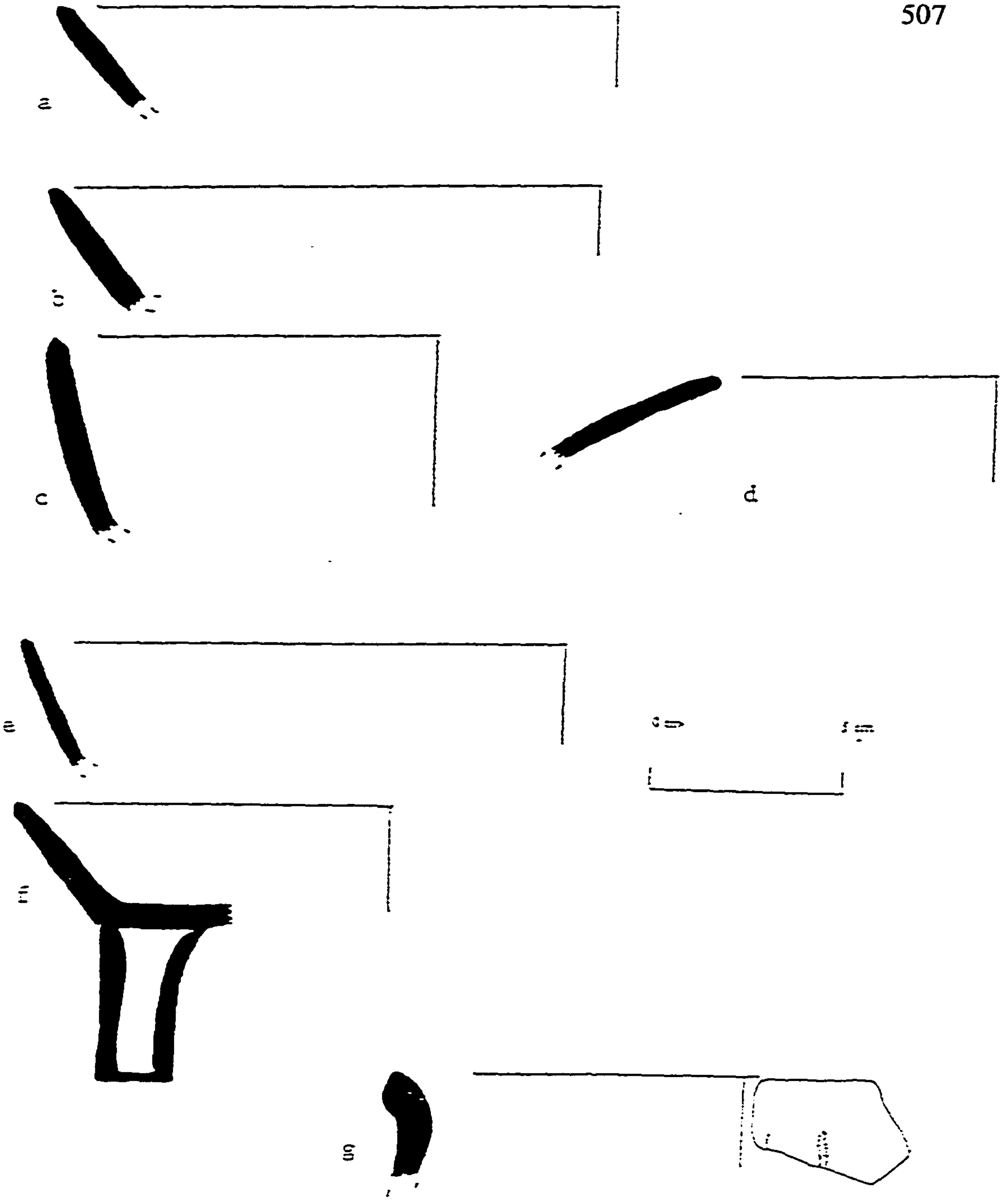


Figure 124: Technological Style Group 5 Sherd Profiles: a-d) Trapeche Pink; and e-f) Xuluc Incised: Tzalam Variety.

*Lamat* glyph, and other eroded design motifs. The three Sacá Polychrome sherds are fragmentary and eroded with only circumferential bands denoting a decorative area. Macanché Red-on-paste decorative motifs (n=2) consist of hooks and Picú Incised: Picú Variety and Mengano Incised decorations occur as circumferential bands of repeated mat motifs.

Tripod dishes (n=38), flanged tripod dishes (n=3), grater bowls (n=3), narrow neck jars (n=6), collared jars (n=7), and restricted orifice bowls (n=2) occur in TSG 5. With the exception of tripod dishes and flanged tripod dishes, TSG 5 rim diameters are slightly smaller, but within the range of the standard deviation (Table 68). Tripod plates and flanged tripod dish diameter means are slightly larger than TSG 4, but again are within the standard deviation range of Group 4.

TSG 5 sherds from Zacpetén were excavated in the first three levels of Structures 601 (raised shrine), 603 (sakbe), 605 (oratorio), 606 (open hall), 719 (residence), 720 (statue shrine), 721 (temple), 732 (residence), 747 (residence), 758 (residence), 764 (temple), and 765 (raised shrine). In addition to the first three levels of excavation, TSG 5 sherds also came from excavation levels 4 and 7 of Structure 719 and level 4 of Structure 758. All structures but Structure 2006 (residence), 2010 (residence), 2015 (open hall), and 2020 (oratorio) at Ixlú had sherds from this group in the first three levels. Ch'ich' Structure 188 (open hall with shrine) and Tipuj's Structures 1 (oratorio), 2 (temple) and 3 (open hall) also had these sherds in the first three levels of excavation.

TSG 5 sherds also exist at Tayasal, Flores Island, and Macanché Island. In general, most Paxcamán, Fulano, and Trapeche ceramic group sherds with the ceramic

Table 68: Descriptive Statistics for Rim Diameters (cm) of Technological Style Group 5

| | Mean | Mode | Median | Standard Deviation | Range |
|---|---|---|---|---|---|
| Tripod Dish (n=38) | 25.11 | 22 | 25 | 3.91 | 16-36 |
| Flanged Tripod Dish (n=3) | 26.67 | NA | 26 | 3.06 | 24-30 |
| Narrow Neck Jar (n=6) | 17.00 | 10 | 12 | 10.94 | 8-36 |
| Grater Bowl (n=3) | 24.00 | 22 | 22 | 3.46 | 22-28 |
| Collared Jar (n=7) | 32.29 | 30 | 32 | 3.55 | 28-38 |
| Restricted Orifice Bowl (n=2) | 15 | NA | 15 | 1.41 | 14-16 |

paste and mineral inclusions described above are monochrome slipped. Nine sherds from the three sites are decorated with black or red painted designs in the form of hook motifs. I would also include the gray and black paste Paxcamán sherds and vessels from Barton Ramie (Sharer and Chase 1976:295), the gray compact paste Paxcamán sherds and vessels from Punta de Chimino (Foais 1996:721-726), and the Paxcamán sample from Colhá (Valdez 1987:224) in TSG 5.

## VI. Technological Style Group 6

TSG 6 represents Topoxté ceramic group sherds from Zacpetén (n=22) and Tipuj (n=15). The sherds are either monochrome slipped (Topoxté Red) or decorated with red paint that is darker than the red slip color (Chompoxté Red-on-cream).

Cryptocrystalline calcite dominates the very pale brown (10YR 8/2-4, 7/3-4) to light brownish gray (10YR 6/2) to white (10YR 8/1) marly pastes of this group. Small quantities (less than 3 %) of euhedral and polycrystalline calcite, quartz, hematite, and biotite minerals also occur in the sherd pastes. XRD analysis indicates that montmorillonite is the primary clay mineral and that gypsum minerals are also in the sherd paste. Strong acid-extraction ICPS analysis distinguishes this group from TSGs 1 and 7 (other Clemencia Cream Paste ware groups) because of its slightly higher relative concentrations of Zn and Ca.

The majority of sherds in TSG 6 (63%) were estimated to have been fired below 600°C (10 were estimated to have been fired to 300°C, 4 were fired to an estimated 500°C, and 9 were fired to an estimated 550°C). Only nine sherds were estimated to have been fired to 600°C and five were fired to an estimated 650°C. Although a large range of estimated firing temperatures exists with a mode of 300°C, only six sherds have a darker core. Core Mohs' hardness is 3 and does not change after refiring experiments (Table 69).

Exterior and interior slips are red (10R 5-4/6-8, 2.5YR 5/8) with matte to low luster finishes. Decorated sherds have motifs painted directly on the paste or a creamy primary slip (10YR 8-7/2-3) with a similar color as the paste color. Exterior slip Mohs' hardness ranges from 1.5-4 with a median of 2 or 3 (pre- and post-refiring, respectively) and interior slipped surfaces have a median hardness of 2 with a range of 1.5-3 (Tables 70 and 71).

TSG 6 original exterior slip color diversity (Figure 125) and richness measurements are lower than those of TSGs 1 and 7 and the Topoxté ceramic group; however, the post-refiring richness is higher than any other Topoxté group (Table 72). This indicates that the original slip colors were less variable and perhaps the result of a better controlled firing process. In support of this statement, when the same sherds were refired to 800°C, the exterior slip colors became more variable. Evenness indices are higher than those of TSGs 1 and 7 and the Topoxté ceramic group suggesting a mixed assemblage of colors. Heterogeneity indices are similar to those of TSGs 1 and 7 and higher than those of the Topoxté ceramic group also indicating a wide range of colors.

Banded and unbanded red (10R 4/4-6, 7.5R 3/6) painted decoration is darker than the exterior red slip. Curvilinear lines, parentheses, and *ajaw* glyphs encompass the decorative motifs of the TSG 6 (Figure 126). One unslipped drum fragment with three

Table 69: Core Hardness Measurements of Technological Style Group 6

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 3 |
| Median | 3 | 3 |
| Range | 2-3 | 2-3 |

Table 70: Exterior Slip Hardness Measurements of Technological Style Group 6

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 2 |
| Median | 2 | 3 |
| Range | 2-3 | 1.5-4 |

Table 71: Interior Slip Hardness Measurements of Technological Style Group 6

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 2 |
| Median | 2 | 2 |
| Range | 2-3 | 1.5-3 |

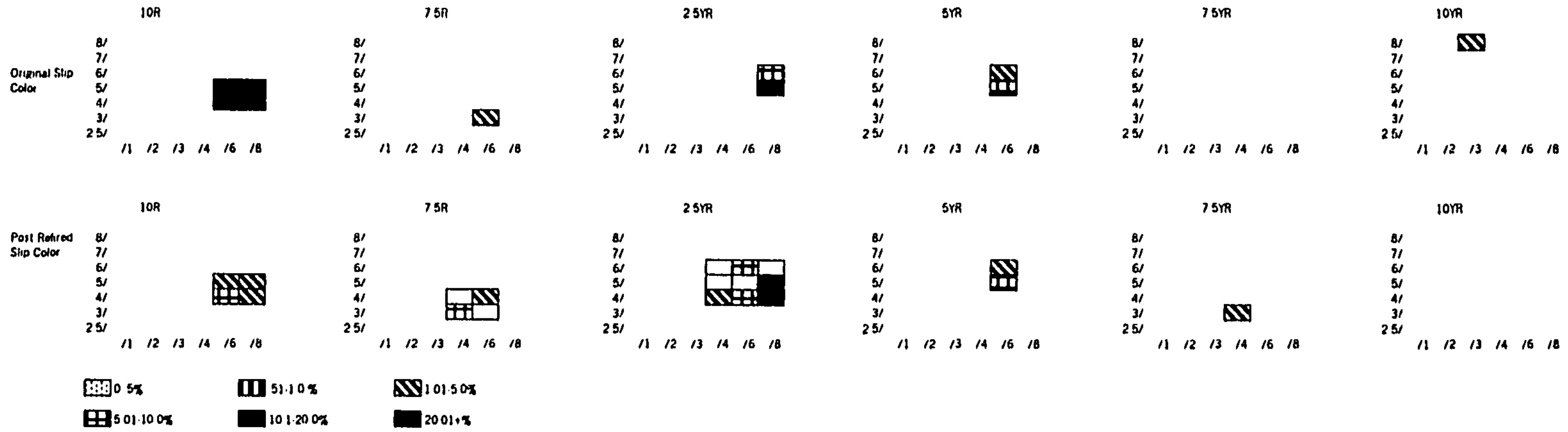


Figure 125: Exterior Slip Color Distribution of Technological Style Group 6

Table 72: Diversity Measurements of Exterior Slip Colors for TSG 6

| | Sample Size | Total Number of Colors Recorded | Number of Colors Consisting of More than 1.0% of the Sample | Richness | Evenness | Heterogeneity |
|---|---|---|---|---|---|---|
| Original | 28 | 9 | 9 | 1.70 | .90 | .94 |
| Refired Slip | 32 | 14 | 14 | 2.47 | .91 | .92 |

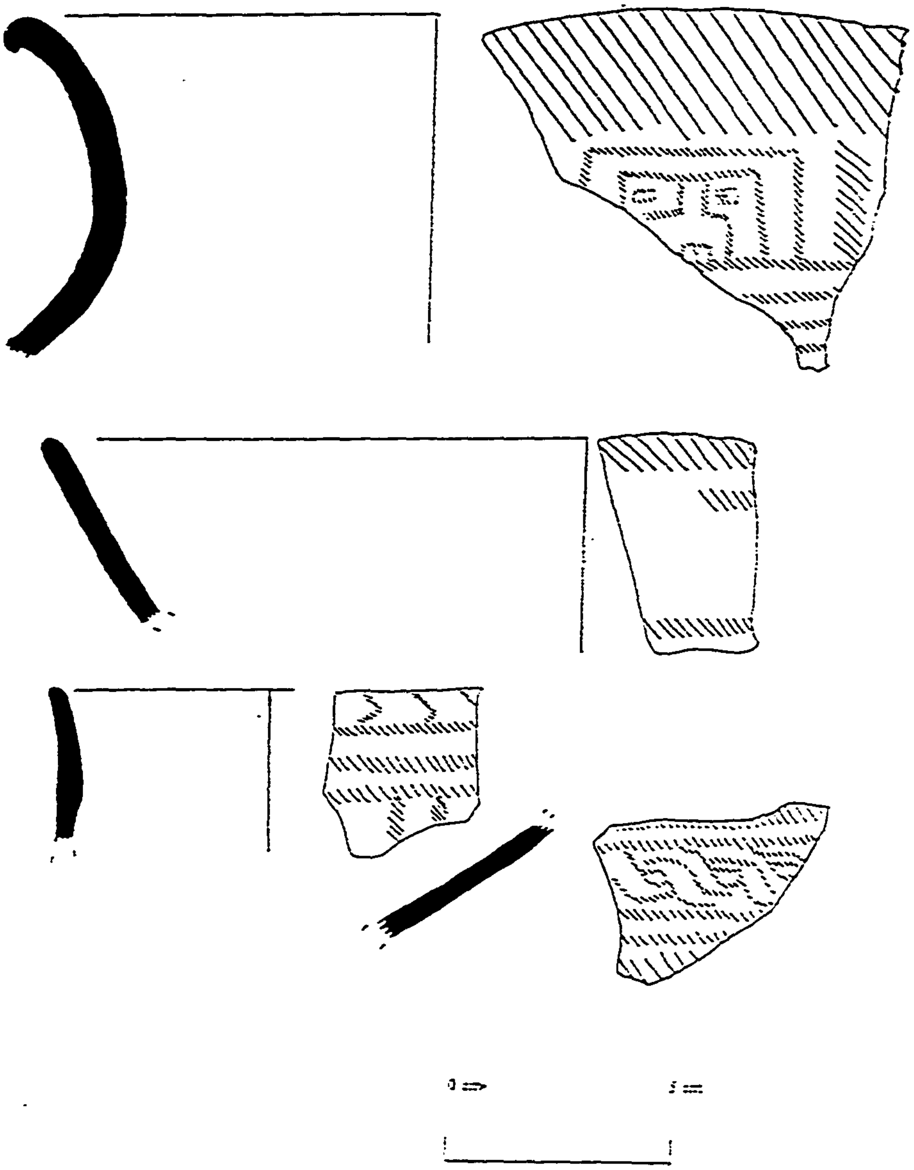


Figure 126: Technological Style Group 6 Sherd Profiles: Chompoxté Red-on-paste: Akalché Variety.

vertical incisions below the rims is also included in this group.

Vessel forms represented by this group include tripod plates (n=11), collared jars (n=2), narrow neck jars (n=2), and drums (n=1). Rim diameter descriptive statistics appear in Table 73. Tripod plates and collared jars have small rim diameter means of 22.7 cm and 20 cm, receptively. These means resemble those at Macanché Island and Topoxté Island. Too few narrow neck jars and drums occur for comparison.

TSG 6 sherds were excavated from the first three levels of Structures 606 (open hall), 615 (open hall), 664 (residence), 719 (residence), 721 (temple), 732 (residence), 748 (unknown), 758 (residence), 765 (raised shrine), and 767 (open hall), as well as from level 5 of Structure 719 at Zacpetén. Sherds from Tipuj were excavated from the first two levels of Structures 1 (oratorio), 2 (temple), and 3 (open hall).

Sherds from Tayasal, Macanché Island, and Topoxté Island were also included in TSG 6 because of decoration and paste similarities. The two Chompoxté Red-on-paste: Chompoxté Variety and four Topoxté Red sherds from Tayasal have marly pastes that lack euhedral calcite. Various Chompoxté Red-on-paste sherds from Macanché Island and Topoxté Island also have pastes that lack euhedral calcite as well as similar decorative motifs described above.

## VII. Technological Style Group 7

TSG 7 also includes Topoxté ceramic group sherds from Zacpetén (n=33) and Tipuj (n=34). The majority of sherds in this TSG have black (Pastel Polychrome), red (Chompoxté Red-on-paste), and red-and-black (Canté Polychrome) painted decoration as

Table 73: Descriptive Statistics for Rim Diameters (cm) of Technological Style Group 6

| | Mean | Mode | Median | Standard Deviation | Range |
|---|---|---|---|---|---|
| Tripod Dish (n=11) | 22.7 | 22 | 22 | 2.87 | 18-28 |
| Collared Jar (n=2) | 20 | NA | 20 | 8.49 | 14-26 |
| Narrow Neck Jars (n=2) | 13 | NA | 13 | 7.07 | 8-18 |
| Drum (n=1) | 8 | NA | NA | NA | 8 |

well as some undecorated sherds.

White, pink, and very pale brown (7.5YR 8-7/3, 10YR 8-7/1-3) marly pastes contain euhedral, polycrystalline, and cryptocrystalline calcite, hematite, quartz, biotite, chalcedony, and chert minerals. XRD analysis demonstrates that montmorillonite is the primary clay mineral and that gypsum is also present in the clay paste. Strong acid-extraction ICPS analysis separates this group from TSGs 1 and 7 because of lower relative concentrations of Al, Fe, and Ti.

Dark cores are uncommon (12%) and this is reflected in a wide range of firing temperatures (300-700°C). The median estimated firing temperature was 550°C with slightly less than one-half of the group being estimated to have been fired between 600-700°C. Although a large portion of the sherds in this sample were estimated to have been fired at relatively high temperatures, 21 sherds were estimated to have been fired to approximately 300°C. The median Mohs' hardness of the original core is 3 and changes to 2 when refired to 800°C (Table 74).

Undecorated exterior and interior surfaces are slipped red (10R 5-4/4-8, 2.5YR 5-4/6-8). Decoration panels have a very pale brown (10YR 8-7/2-3) to red (2.5YR 5/8) primary slip. The slipped surfaces have a matte, low luster, or "waxy" finish with a median hardness of 2 and 2.5 (pre- and post-refiring experiments, respectively) (Tables 75 and 76). Exterior slips demonstrate a moderate degree of variation as seen in the diversity of slip colors (Figure 127) and in richness indices. The variability decreases when all sherds are fired to 800°C and the indices are within the same range as TSG 1 and the Topoxté ceramic group (Table 77). Evenness and heterogeneity indices also resemble

Table 74: Core Hardness Measurements of Technological Style Group 7

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 3 | 2 |
| Median | 3 | 2 |
| Range | 2-4 | 2-3 |

Table 75: Exterior Slip Hardness Measurements of Technological Style Group 7

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 2 |
| Median | 2.5 | 2 |
| Range | 2-3 | 2-4 |

Table 76: Interior Slip Hardness Measurements of Technological Style Group 7

| | Pre Refiring Hardness | Post Refiring Hardness |
|---|---|---|
| Mode | 2 | 2 |
| Median | 2 | 2 |
| Range | 2-3 | 2-4 |

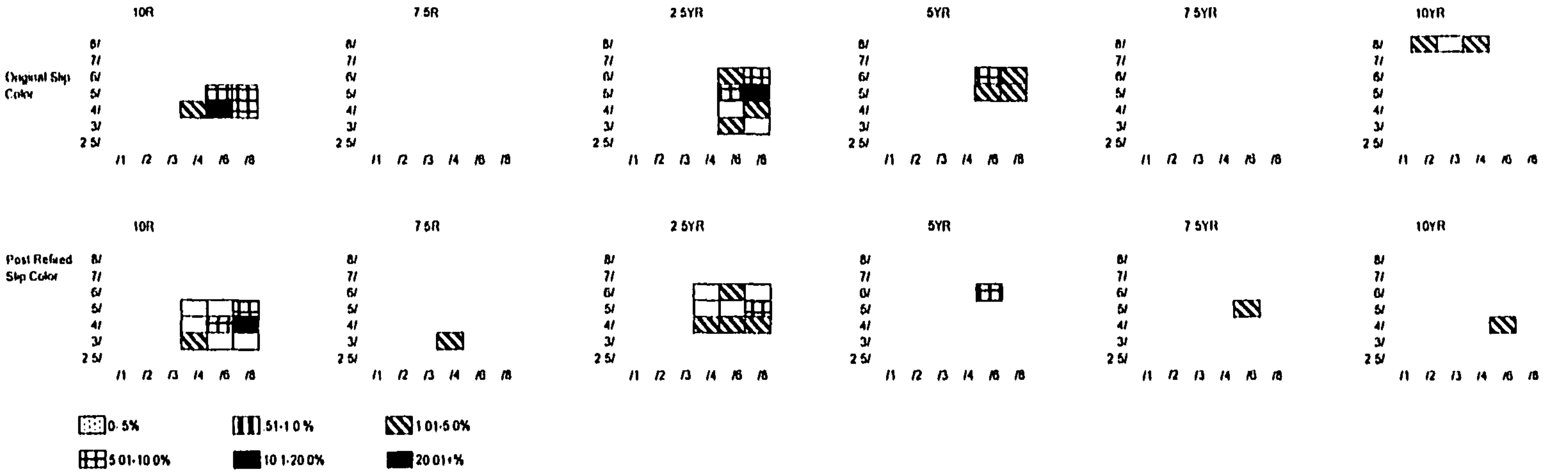


Figure 127: Exterior Slip Color Distribution of Technological Style Group 7

Table 77: Diversity Measurements of Exterior Slip Colors for Technological Style Group 7

| | Sample Size | Total Number of Colors Recorded | Number of Colors Consisting of More than 1.0% of the Sample | Richness | Evenness | Heterogeneity |
|---|---|---|---|---|---|---|
| Original | 56 | 18 | 18 | 2.41 | .85 | .96 |
| Refired Slip | 63 | 15 | 15 | 1.89 | .75 | .83 |

those of TSG 1 and the general Topoxté ceramic group. The diversity indices indicate a mixed assemblage of slip colors.

In addition to monochrome slipped sherds (Topoxté Red), black (Pastel Polychrome), red (Chompoxté Red-on-paste) and red-and-black (Canté Polychrome) painted decorations occur on sherds from TSG 7 (Figure 128). Black decoration typically occurs as hooks and parentheses motifs. Although most red-and-black painted decorations are eroded, one sherd has a black curvilinear decoration surrounded by red dots. Unlike black and red-and black painted decorations, red motifs appear in positive and negative painting. Decorative motifs include stepped pyramids, stepped pyramids encircled by small red dots, circles, birds, plumes, mats, and possible aquatic creatures.

Tripod plates (n=28), collared jars (n=8) , restricted orifice bowls (n=3), and narrow neck jars (n=8) occur in TSG 7. Descriptive statistics for the rim diameters of these forms are presented in Table 78. Most vessel rim diameters are similar, with the exception of tripod plates that have slightly larger rim diameters.

TSG 7 sherds from Zacpetén were excavated from the first three levels of Structures 601 (raised shrine), 603 (sakbe), 606 (open hall), 664 (residence), 719 (residence), 732 (residence), 747 (residence), 748 (unknown), 758 (residence), 764 (temple), 765 (raised shrine), and 767 (open hall) as well as from level 5 of Structure 719 and level 4 of Structure 758. Sherds from Tipuj were excavated from the first three levels of Structures 1 (oratorio), 2 (temple), 3 (open hall) and 4 (open hall).

Pastel and Canté Polychrome sherds from Macanché Island and Topoxté Island would also be included in TSG 7. In addition to the polychrome types of this group, I would include Chompoxté Red-on-paste sherds that have euhedral calcite in the clay

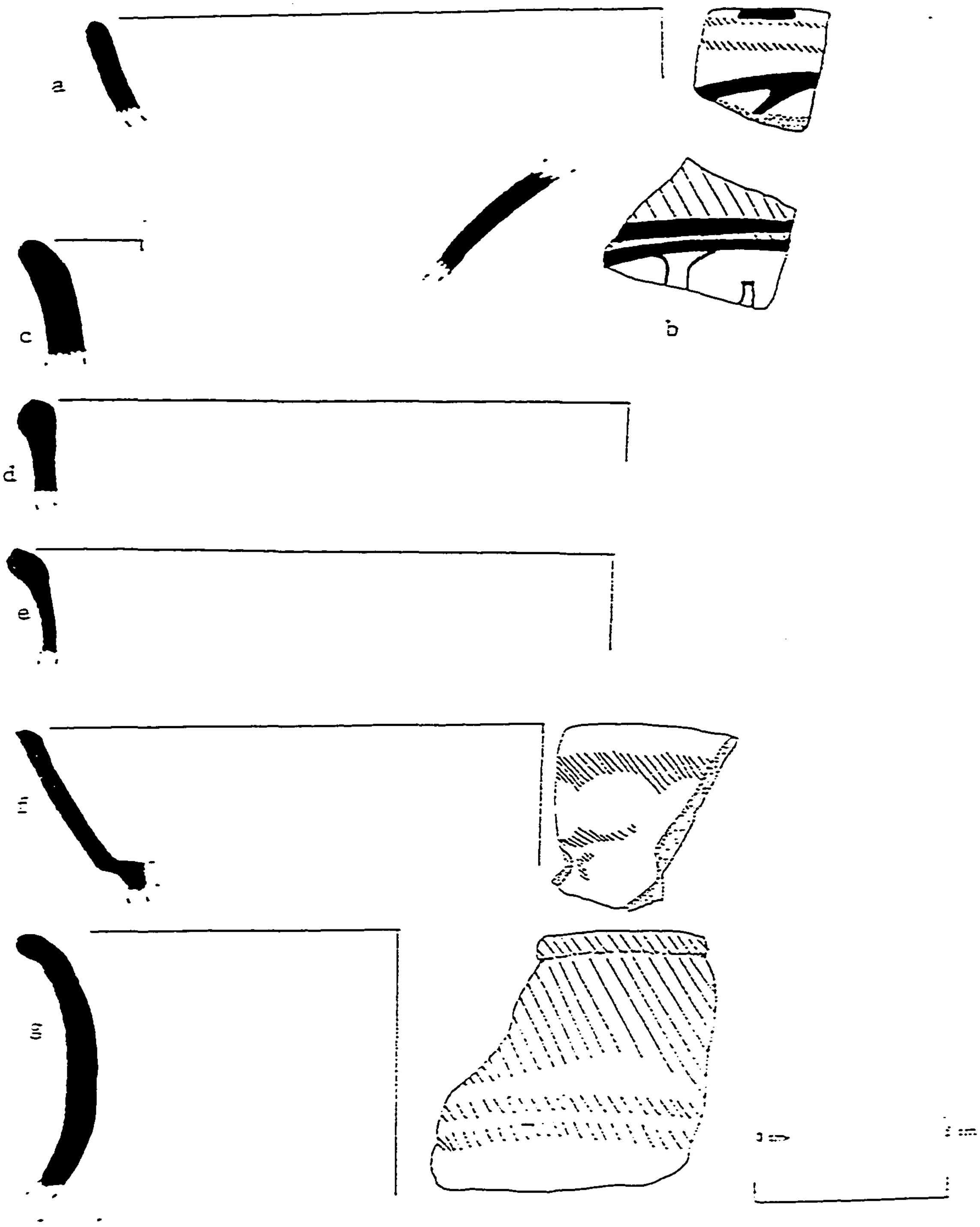


Figure 128: Technological Style Group 7 Sherd Profiles: a) Canté Polychrome; b) Pastel Polychrome; c-e) Topoxté Red; f) Chompoxté Red-on-paste: Chompoxté Variety; and g) Chompoxté Red-on-paste: Akalché Variety.

Table 78: Descriptive Statistics for Rim Diameters (cm) of Technological Style Group 7

| | Mean | Mode | Median | Standard Deviation | Range |
|---|---|---|---|---|---|
| Tripod Dish (n=28) | 23.93 | 26 | 24 | 3.20 | 18-28 |
| Collared Jar (n=8) | 22.00 | NA | 25 | 11.41 | 4-34 |
| Restricted Orifice Bowl (n=3) | 23.33 | NA | 22 | 4.16 | 20-28 |
| Narrow Neck Jar (n=8) | 24.25 | 20 | 22 | 5.70 | 18-32 |

paste. However, to ensure correct identification, petrographic examination needs to be conducted to ensure the presence of biotite, chalcedony, and chert in the clay paste.

In sum, the combination of clay paste characteristics, inclusions, and decorative attributes result in seven technological style groups. The technological style groups combine choices made by potters such as clay, mineral, and pigment resource selection as well as general knowledge of the potter as seen in firing technologies and decorative motifs. The existence of technological styles based on the above three criteria demonstrates that the Kowoj and the Itzá made technological and stylistic choices in the manufacturing of pottery that reflect their separate social identities (Figure 129). Petén Postclassic slipped pottery was created with different types of clay pastes, inclusions, and decoration and these choices reflect the compatibility of technological and stylistic choices as defined by cultural groups. The differences reinforce existing social structures present in other forms of material culture. The next chapter will discuss how and why these technological style groups reflect Petén Postclassic Maya social/ethnic groups during the 17th century.

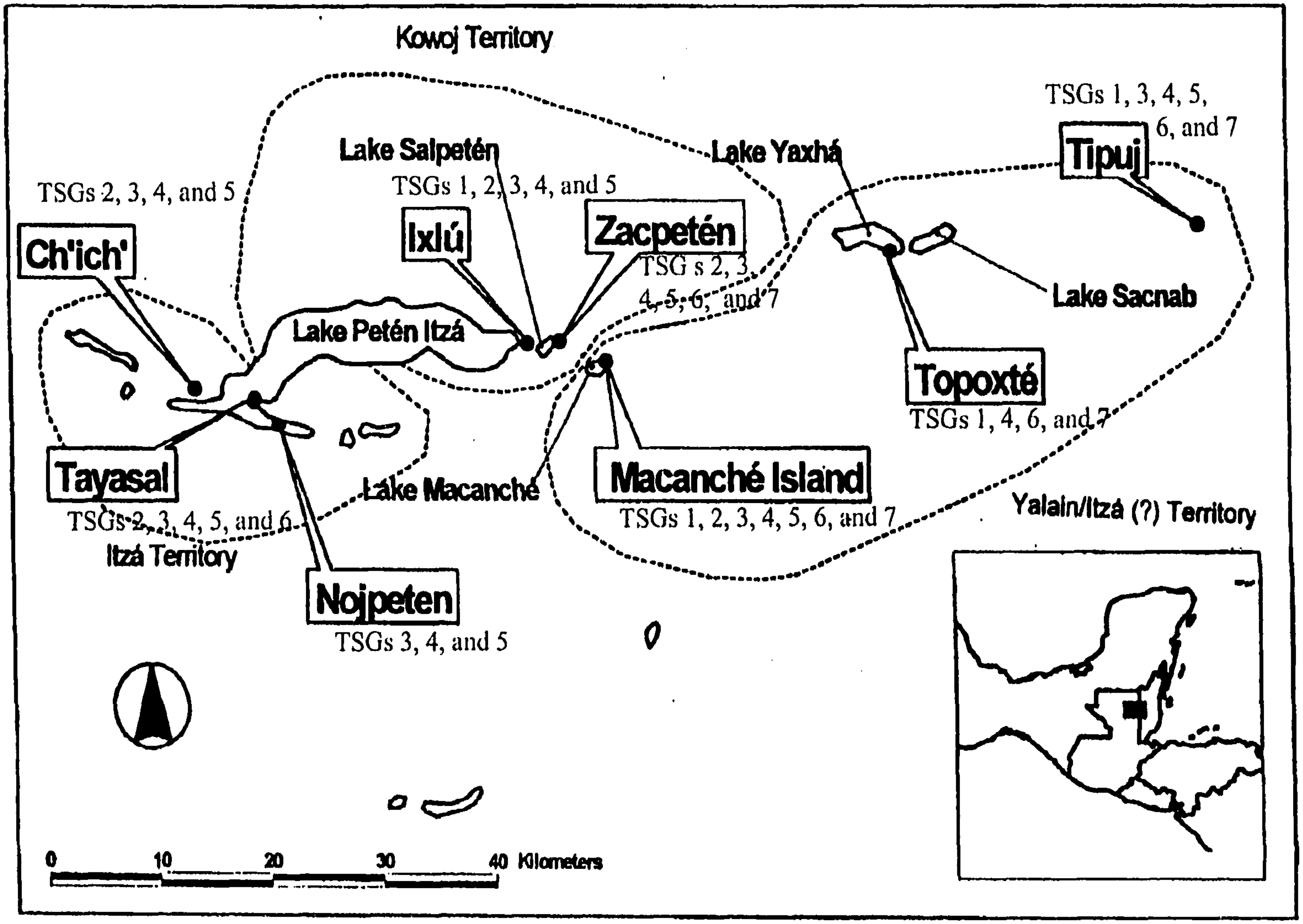


Figure 129: Technological Style Groups and Their Presence at Archaeological Sites in the Study.

# CHAPTER 10

# INTERPRETATION OF PETÉN POSTCLASSIC SLIPPED POTTERY TECHNOLOGICAL STYLES AND THEIR RELATION TO SOCIAL GROUPS IN THE PETÉN LAKES REGION

"Low tech," mineralogical, and chemical analyses distinguish the seven technological style groups (TSGs) described in Chapter 9. When these characteristics are examined together with ethnohistorical, architectural, burial, and decoration color and motif data from archaeological sites in Petén and northern Yucatán, I can suggest which social group may have produced which technological style. This is because technological styles result from choices made by Postclassic Petén Maya potters within a social structure that embodies their identity. The existence of technological style characteristics, embedded in structure and agency, allows the archaeologist to study materials such as clay and mineral inclusions and patterns of pottery manufacture such as vessel form and decoration as practice. As such, the patterns of manufacture are not merely "'added on' in order to signal group identity," but are choices made by the potter "by which a sense of group identity is formed and transformed as being coeval with and identical to the process by which a sense of technique is formed and transformed" (Dietler and Herbich 1988:247). A sense of group identity may have been important in Postclassic Petén because of the unstable conditions brought on by wars, changing social boundaries, and changing positions of dominance. As such, Maya potters, as well as other members of Maya society, may have continually constructed and reconstructed their identity by creating and recreating their social structures through daily activities such as pottery manufacture (Giddens 1984:17).

As a daily activity, pottery manufacture becomes a social activity when the choices made during the manufacturing process are examined as a social phenomenon. The patterns of manufacture (choices) are made in a specific manner, under the umbrella of the Postclassic Maya social structure and are reproduced. As such, patterns of manufacture may be reproduced without the potter being fully cognizant of the set of "rules" or operational sequences established through the mediation of structure and agency. For example, a clay source may be continually used without question because one social group does not have access to clays in another territory or because it is customary to use that source. "These dispositions of choice and perceptions of the possible in the technical domain are interwoven with similarly formed patterns of choice and perceptions in the domain of social relations and cultural categories in ways that evoke and reinforce each other such that they come to be perceived as 'natural'" (Dietler and Herbich 1998:246). Therefore, clusters of traits of Postclassic Petén pottery technological styles, architectural designs, and burial practices are compatible with the social structures and they reflect the social identity and history of the culture that produced them.

According to ethnohistorical documents, Petén Postclassic social/ethnic groups, primarily the Itzá, Yalain, and Kowoj, contested socio-political boundaries and changed alliances (Jones 1998). If boundaries were established because of this unrest, access to resources may have influenced the choices that Maya potters made during manufacturing because some social groups may not have access to specific resources within another social group's territory. Choices based on resources include clays, pigments, and fuel for firing.

## I. Pottery Wares

The seven Petén Postclassic slipped pottery technological styles correlate to the three archaeologically recognized wares: Clemencia Cream Paste ware (TSGs 1, 6, and 7); Volador Dull-Slipped ware (TSGs 4 and 5); and Vitzil Orange-Red ware (TSGs 2 and 3). The ware distinctions are partially based on differences in clay paste colors, "cream," gray, and red, respectively, suggesting the existence of at least three different resources used for pottery manufacture. Although archaeologists have not located the different clay resources, discussion of the distribution of sherds made from these clays in the Petén lakes region provides information as to why there are differences in technological styles and who produced the different technological styles.

First, pottery of Clemencia Cream Paste ware is made from marly clays with very little iron content. A petrographic and x-ray diffraction examination of clays from the Yaxhá area and sherds made from the Clemencia Cream Paste ware suggest that Clemencia Cream Paste ware pottery was made from local clays near Yaxhá. Late Classic "cream" paste pottery from Yaxhá suggests that these clay resources may have been used before the Postclassic period (Hermes et al. 1996). Postclassic Clemencia Cream Paste ware pottery is found primarily at sites in the eastern portion of the central Petén lakes region–Zacpetén, Macanché Island, Topoxté Island, and Tipuj. Some sherds appear at sites to the west (Ixlú and Tayasal); however, they do not occur in any appreciable quantity. According to Jones (1998:Map 5 and 6), the ethnohistoric data suggest that the Yalain and/or Kowoj occupied the eastern portion of the Petén lakes region in the Late Postclassic period (see Figure 1). Archaeological evidence, civic-ceremonial and burial, also indicates Kowoj affiliation. Therefore, I would suggest that the Clemencia Cream Paste ware clay source existed in the Yalain and/or Kowoj territory and pottery made from that clay was traded mainly within that territory.

Second, in contrast to the Clemencia Cream Ware pottery, Vitzil Orange-Red ware pottery is made of coarse high-iron clays with calcite, quartz, chert, chalcedony and biotite mineral inclusions. This pottery is found most prominently at archaeological sites in the western portion of the central Petén lakes region–Ch'ich', Tayasal, and Nojpeten. In addition to these three sites, Vitzil Orange-Red ware pottery is prominent at Tipuj in Belize. The majority of slipped Postclassic pottery at Barton Ramie is also Vitzil Orange-Red ware pottery (Sharer and Chase 1976). Although Vitzil Orange-Red ware sherds appear at all sites in the Petén lakes region, they do not constitute the majority of the sherds in the various pottery collections at all sites. Therefore, differential distribution may reflect social identity and trade patterns. According to Jones (1998:Map 4, 19-22), the Itzá controlled the western end of the Petén lakes region and the Mopan may have controlled the corridor between Lake Petén Itzá and Tipuj as a result of defeating the Itzá three times in battle. Architectural and burial information from the sites in this area suggest that differences in material culture from the west to the east indicate occupation by different social groups. Therefore, I would suggest that pottery made from the Vitzil Orange-Red ware clays and traded primarily to sites within the Itzá and/or the Mopan territory reflects pottery made from resources controlled by the Itzá and/or the Mopan.

The third pottery ware, Volador Dull-Slipped, represents a third possible clay resource or set of resources. I am unable to conclude that clays used to make pottery of this ware were controlled by a specific social group because pottery made from this clay appears in appreciable quantities through the Petén lakes region. I also believe that these gray-to-brown firing clays with frequent inclusions of lacustrine snail shells, came from lakeshores and were not difficult to obtain given that most Petén Postclassic sites are located near lakes. One possible manufacturing area may occur in the area of Macanché Island. Low-fired gray pottery at Macanché Island has a distinct sulfur odor when broken (Rice 1987a) and Lake Macanché has a high magnesium sulfate content. Pottery with the same odor occurs at Tipuj and Zacpetén, suggesting that Macanché Island potters traded their pottery to the inhabitants at Tipuj and Zacpetén.

## II. Inclusions

The presence and/or absence of minerals and voids in the clay paste also reflects choices made by the Petén Postclassic potter because the presence/absence of inclusions affects the properties of the clays during manufacture and firing. On the basis of petrographic analysis of 273 sherds, I suggest that three categories of inclusions indicate potter's choices during manufacture: 1) the abundance of pores in the clay paste; 2) the presence of angular or oval-shaped minerals in the clay paste; or 3) the presence of a multitude of minerals that may naturally occur in the raw clay. These categories demonstrate that Postclassic Maya potters chose to alter the natural clay source (1 and 2) or to use it in its raw state (3).

Some clay pastes from the Clemencia Cream Paste and Vitzil Orange-Red wares from Ixlú, Zacpetén, and Tipuj are dominated by voids. The absence of clastics suggests that the potters eliminated (through sieving and/or levigating the clays) most minerals from the raw clay and added either organic material, evaporitic minerals, and/or sponge spicules. When the clays with these intentionally added inclusions were fired, the inclusions burned out leaving voids or pores. In addition to this cultural manipulation of the raw clay, the abundance of voids may be the result of post-fire leaching of calcite in acidic soils. Interestingly, sherds with this type of clay paste are not decorated. The resulting fired sherd pastes are relatively harder than other Clemencia Cream Paste and Vitzil Orange-Red ware sherds. These sherds represent thin-walled vessels. I believe that these sherds were manufactured in the Early/Middle Postclassic period, and as such, it may be possible that Postclassic Maya potters were trying to emulate hard Late Classic compact pastes. Many of these compact pastes were the result of volcanic ash tempered clay pastes that were characteristic of the Late Classic period. The volcanic ash tempered clay pastes continued into the Early Postclassic period and occasionally occur in the Paxcamán and Trapeche ceramic groups. Therefore, it is not unlikely that Postclassic potters were also attempting to create pottery with the same hard compact paste in the Clemencia Cream Paste and Vitzil Orange-Red wares.

Some Volador Dull-Slipped and Vitzil Orange-Red ware clay pastes from Zacpetén and Tipuj are dominated by the presence of euhedral calcite or quartz minerals in the absence of appreciable quantities of other minerals. An examination of gray clay from Zacpetén and clay samples from the area of the archaeological site of Yaxhá indicates that these raw clays are not dominated by either euhedral calcite or rounded quartz minerals. Although it is possible that the "correct" clay resources were not sampled, I suggest Petén Postclassic Maya potters intentionally added these minerals to a raw clay that was sieved and/or levigated to rid it of most minerals. Potters may have added angular minerals to a "clean" clay to modify the clay properties when it was "wet or dry as well as during firing" (Rice 1987b:407). By altering the mineral content of the original raw clay and adding angular and relatively large minerals to the clay paste, Petén Postclassic Maya potters manipulated the properties of the clays in order to successfully create tripod dishes and collared jars.

Finally, the majority of clay pastes of the three ceramic wares and from all four sites (Ch'ich', Ixlú, Zacpetén, and Tipuj) have relatively similar suites of minerals with the exception of the presence of biotite in some sherds. I suggest that Petén Postclassic potters may not have altered the raw clays, but successfully used them in their natural state to manufacture pottery. The presence of biotite in some clay pastes may indicate additional clay resources with biotite or that biotite was intentionally added to the clay (although highly unlikely); however, I believe that the presence of biotite reflects different clay resources because of the low frequency of biotite in the clay pastes. Therefore, while Petén Postclassic Maya potters may not have been altering these clays, they may have selected clays from at least two resources for each ware based on the presence of biotite in the sherd pastes. One clay resource may have been weathered from a non-biotite parent rock, whereas another clay resource may have been the result of weathering of biotite. The idea that there were at least two resources is further demonstrated because pastes with biotite are typically decorated while those lacking biotite are typically undecorated. Thus, Petén Postclassic Maya potters were intentionally choosing different clay resources for different decorative modes and technological styles.

Data from the clay paste mineralogy may suggest that potters from the eastern portion of the Petén lakes region tended to alter their clays during the manufacturing process. This idea is speculative for two reasons: 1) the lack of excavations in the western portion of the Petén lakes region and 2) the lack of thin-sections of pottery collected from excavations at Tayasal and Nojpeten. However, if this distinction exists, it suggests that Yalain, Kowoj, and/or Mopan potters made choices as to the types of minerals to include or to exclude in the clay pastes. If Yalain or Mopan potters were attempting to emulate the hardness of Late Classic clay pastes or to continue the technological traditions (volcanic ash tempered pottery) of the Late Classic period, it may suggest that they occupied the area longer because they were trying to duplicate regional technological features. Potters who utilized clay resources without modifying the clays, as is typical of Late Postclassic pottery, may not have been familiar with the clay and mineral resources of the area and used what was available without modification. The use of Late Postclassic unmodified clays may also signify a decline in standards of manufacture due to socio-political uncertainty such as wars and migrations. Nevertheless, it is evident that Petén Postclassic potters occasionally manipulated the raw clay resources during pottery manufacture.

## III. Slips and Firing

Slip characteristics also demonstrate choices made by Petén Postclassic Maya potters. Some earlier Postclassic ceramic groups (Trapeche and Augustine) have "waxy" slipped surfaces whereas later Postclassic ceramic groups (Paxcamán and Topoxté) slipped surfaces rarely have a "waxy" surface finish. The "waxiness" of the slipped surface is most likely due to a creamy over-slip and heavy burnishing or the application of a substance after firing. Preclassic Sierra Red pottery slips resemble the "waxy" slips of some Postclassic pottery types. Gifford (1976:85) states that the "waxy" slip of the Sierra Red pottery is a result of a double slip and polishing.

I believe that this type of slipped surface was an attempt by earlier Petén Postclassic potters to emulate Late Classic polychrome gloss-slipped surfaces. Obviously the Postclassic surfaces are not identical to those of the Late Classic period, and this difference may be due to the difference in available resources and the lack of knowledge on the part of Postclassic potters. However, the "double-slipping" of the Trapeche ceramic group and the "waxy" nature of some of the slips of the Trapeche and Augustine ceramic groups at Tayasal, Ixlú, Zacpetén, and Tipuj is intentional. In addition to slipped surfaces, some sherds have a black painted and/or fireclouded rim that resembles those of Late Classic polychrome pottery. If these types of surface finishes are indicative of early Postclassic Maya potters attempting to recreate Late Classic polychrome surfaces, it may also suggest that people at these archaeological sites may have lived in the Petén lakes region early in the Postclassic period. Jones (1998:10) suggests that the Itzá/Yalain may have occupied the Petén lakes area, including Tipuj, in the early Postclassic. Thus, the slips may be part of Itzá/Yalain technological styles and therefore social identity.

The variability in slip colors in all of the ceramic groups demonstrates that while Petén Postclassic potters attempted to create red or black slips, they were not able to achieve a slip color that was similar on all vessels. I suggest two possible causes of this variation: 1) potters were using local resources and were unfamiliar with slip characteristics and/or firing technology, or 2) potters had a limited amount of resources for firing pottery.

The variability in slip colors may reflect that Maya potters initially may have been unfamiliar with the minerals used for slips. Resources in the Petén lakes region may also have varied across the landscape such that the pigment used for the red slip at Ch'ich' and Zacpetén may not have been the same or potters in the different communities had a different knowledge of the effect of slips on the air dried vessel and during firing. Petén Postclassic potters may have known how to make red or black slips; however, they may not have been able to control the firing conditions in order to produce a "standard" slip color.

In addition to general slip color variability, firecloud color indicates that Petén Postclassic Maya potters may have been unfamiliar with Petén slips/clays and firing technology. First, when potters can control the firing environment (e.g., constant temperatures and atmosphere, stacking, and proximity to the flame), few vessels show evidence of fireclouding. Fireclouding is fairly common on Petén Postclassic slipped pottery (especially Volador Dull-Slipped and Vitzil Orange-Red ware pottery) suggesting that the potters could not or did not control the firing environment. Second, firing temperatures were not uniform in the Petén lakes region (see Chapter 6). This is evident in the presence of tan and black fireclouds on pottery vessels (primarily tripod dishes). Tan fireclouds occur when the estimated firing temperature is below 550°C while black fireclouding occurs when the estimated firing temperature approaches 600°C or higher. Because tan and black fireclouding are most prevalent at Tipuj and Zacpetén, I suggest that potters who manufactured this pottery may not have had an extensive knowledge of firing technologies to control fireclouding during firing.

One reason that Petén Postclassic potters may not have been able to control firing conditions is because of differential access to fuel for firing. It is likely that during the

Postclassic period wood, grass, bark, palm fronds, and other agricultural by-products were difficult to obtain. Due to population concentrations and the placement of sites on islands and other defensible locations, land in the immediate vecinity of places of pottery manufacture may have been cleared of wood and grass essential for firing of pottery. While the Petén lakes region was not deforested during the Postclassic period, potters may have had to travel a distance to obtain hard wood for firing making manufacturing of pottery more "expensive." As a result this "cost," potters may have used whatever resources were readily available such as corn cobs and stalks. Specific firing resources, such as hard woods for firing, also may have been restricted due to reinforcement of social boundaries. Thus, some potters may have had differential access to resources for firing. Because estimated firing temperatures are relatively low for this sample of Petén Postclassic pottery, I suggest that the potters were not obtaining hard woods to achieve high temperatures. On the other hand, high firing temperatures with calcite based clays proves detrimental to fired pottery–the vessels crumble due to the conversion of calcite to carbon dioxide and lime. While high firing temperatures may not have been desired, the variability of estimated firing temperatures suggests that the Petén Postclassic Maya potters used a variety of resources for firing resulting in different slip and paste colors or had poor control of the firing environment.

## IV. Pigments and Decoration

In addition to clay resources and slips, an examination of pigment resources may also suggest which social group created what technological style. The primary pigments used on Petén Postclassic slipped pottery are black and red. Again, the creation of territorial boundaries of warring social groups may have restricted access to pigments influencing choices with regard to decoration color. I believe that the iron-based mineral(s) used to paint red decoration on the pottery may have been restricted due to territorial boundaries and/or geological resources. These iron-based mineral may occur in the well-drained tropical soils of the Petén lakes region, as an authigenic component of clay fractions, as nodules of magnetite, pyrite, or hematite, and/or associated with gypsum (found near Zacpetén). The darker red painted designs may be the result of the use of specular hematite. The red color present in design panels is generally darker than the exterior red slip color which may suggest that two different pigments were being used for manufacture of pottery. Pottery with red or red-and-black painted decoration (Macanché Red-on-paste, Sacá Polychrome, Picté Red-on-paste, Sotano Red-on-paste, Chompoxté Red-on-paste, and Canté Polychrome) occurs most prominently at sites in the eastern portion of the central Petén lakes region. Again, ethnohistorical and archaeological data suggest that this area was controlled by the Kowoj, Yalain, and/or Mopan. Red-and-black decoration occurs almost exclusively at the archaeological sites of Macanché Island, Topoxté Island, Zacpetén, and Tipuj. Therefore, the red pigment used for painted decoration, but not for slips, may have been located in a territory controlled by the Kowoj, Yalain, and/or Mopan.

Although it is possible that the red pigment used to paint decorative motifs in design panels of Petén Postclassic slipped pottery may have been restricted due to socio-political boundaries and/or geological location, the use of red and red-and-black decoration may relate to differences that reinforce the ancestral identity of the social groups. As noted previously, the Kowoj state that they had ancestral ties to Mayapán.

One way to examine this is through the colors of pottery and the decorative motifs at Mayapán. If such correlations exist, they may reinforce the connections of the Petén Kowoj with their ancestral homeland. One of the most telling similarities is the color of the slips and decoration used on Postclassic pottery from northern Yucatán. Most of the Postclassic pottery at Mayapán in the Hocaba (A.D. 1200-1300) and Tases (A.D. 1300-1450) periods is either slipped red and incised, has red painted decoration, or has red-and-black painted decoration. At Tulum and Tancah, the majority of the Late Postclassic pottery is slipped red and incised. Smith (1971:30) and Sanders (1960) note the similarities between Tulum and Mayapán with regard to pottery slip color and decorative motifs.

In addition to the color of the slipped surfaces, decoration motifs and elements at Mayapán and Tulum also appear at archaeological sites in the eastern portion of the Petén lakes region. These decoration motifs include the *ajaw* glyph, embedded chevrons, terraces/stepped pyramids, and the *ilhuitl* glyph.

In contrast to red and red-and-black painted pottery, Postclassic pottery from Chich'en Itza is dominated by the overwhelming presence of black painted decoration and black slipped and incised pottery (Chung and Morales 2000). Decorative motifs include feathers, reptilian motifs, and flowers (Brainerd 1958). Sites on the east coast of Yucatán, in Quintana Roo, lack black decorated pottery.

The presence/absence of decoration color and decorative motifs at Mayapán, Chich'en Itza, and Tulum and archaeological sites in the Petén lakes region suggests that color and motif correlations may reflect more than differential access to resources. Although resources are important and can limit the possibility of choices a potter may make, references to ancestral ties on pottery may provide the best manner by which the archaeologists can interpret the choices available to a potter and the association of those choices with social identity.

## V. Socio-Political History and Geography

Although choices made by the Petén Postclassic Maya potter based on different zones of resources (clay, mineral, pigment, and wood for firing) may aid in answering a portion of the question of why different technological styles may have existed, a discussion of the socio-political history and geography will further establish which social/ethnic group may have produced what technological style. This section interprets the socio-political situation as suggested by ethnohistorical and archaeological data and incorporates the choices previously discussed to suggest which social group may have produced which technological style and why they may have been produced.

Beginning in the Late Terminal Classic to Early Postclassic (ca. A.D. 900-1100) period in the Petén lakes region, new social groups entered and brought with them L-shaped and C-shaped bench structures (D. Rice 1986:326). Although we do not currently know who these people were, this type of architecture together with a similar ceramic "complex" (Paxcamán, Trapeche and Augustine ceramic groups) appears at sites throughout the Petén lakes region with the exception of Topoxté Island. At this time, three social groups, the Itzá, Yalain, and Mopan, may have been present in the Petén lakes region. Schele and Grube (1995) and Rice et al. (1996) believe that the Itzá may have had a migration of portions of their population to Petén throughout the Postclassic period leaving the possibility that the Itzá were present in the Petén lakes region in the

Early Postclassic period. The Yalain may also have been present at eastern sites in the Petén lakes region at this time (Jones 1998:Map 6). In addition to the Itzá and Yalain, Jones (1998:433n47) states that the Mopan "appear to have occupied Petén and Belize long before the Itzas." Although there may have been some conflict and boundary issues, the presence of similar pottery (Augustine, Trapeche, and Paxcamán) at all sites seems to suggest that either everyone was making similar pottery or that trade of vessels and/or ideas was common.

Based on archaeological and ethnohistorical data, I believe that the Itzá were in the Petén lakes region during the Early Postclassic period and occupied territory from Ch'ich' (and perhaps farther to the west) to Ixlú and perhaps farther east to Tipuj. Their presence would account for the introduction of the Trapeche, Augustine, and Paxcamán ceramic groups and the presence of long range and C-shaped structures at the sites of Ch'ich' and Tayasal and perhaps the Quexil Islands. In contrast to Ch'ich' and Tayasal, architecture from the sites of Ixlú, Zacpetén, Yalain, Macanché Island, and Tipuj is different, and I believe that these sites may have been occupied by the Yalain and/or the Mopan. At this time, Topoxté Island was not occupied (Hermes and Noriega 1997). A similar ceramic complex suggests open trade, equal access to resources, and similar pottery manufacturing and firing technologies that resulted in common technological and stylistic "choices."

The Middle Postclassic period (ca. A.D. 1100-1300) became more socio-politically complex. During this period another social group, most likely the Kowoj, entered the central Petén lakes region and may have displaced the Itzá, Yalain, and/or Mopan social groups from Topoxté Island and/or Zacpetén. Hermes and Noriega

(1997:757-758) state that the Topoxté islands were occupied at this time by a social group that built civic-ceremonial architecture similar to that at Mayapán.

Architecture on Topoxté Island (the largest of the five islands) resembles the temple assemblage arrangement at Mayapán (Bullard 1970:255-267; Hermes and Noriega 1997; Johnson 1985:162-163; Rice 1988:241). The highest point of Topoxté Island has a series of temples, open/colonnaded halls, altars, and stelae built on terraces at various elevations (Bullard 1970:255). The temple (Structure C) faces west with an altar directly in front. Parallel to the temple are two colonnaded halls (Structures D and E) with a smaller south-facing temple perpendicular to Structure E. Perpendicular and to the south of the temple is another colonnaded hall (Structure B) that faces north.

Bullard notes that the main temple (Temple C) is built on a higher terrace that elevates it above the surrounding open halls. The temple has a series of three terraces with balustraded stairways that lead to the superstructure (Bullard 1970:259). The temple superstructure is composed of a back room with a bench and front room. Its two rooms are separated by two columns and two columns also occur at the front entrance (Bullard 1970:Figure 4). The front room was littered with censer fragments while very few sherds were found in the back room (Bullard 1970:262).

The collection of pottery used for this study comes from Bullard's excavations of Temple C and from Guatemalan excavations of the area around Structure C and excavations of Structures D and E.

Similar Mayapán-like civic-ceremonial architecture (temple assemblages) also appears at Zacpetén (Pugh 1997, 1999, 2000) and Tipuj. Zacpetén's Group A and C civic-ceremonial architecture also resembles temple assemblages present at Mayapán.

"Not only do these groups contain the largest Postclassic structures at the site, they conform to plans that are identical to Mayapán architectural groupings called 'temple assemblages'" (Rice, Rice, and Pugh 1997:240). Group A consists of a "temple (Str. 602) fac[ing] west with an oratorio (Str. 605) to its north facing in the same direction. In front of the temple are numerous small shrines (Str. 607, Str. 1001). Statue fragments were associated with Str. 607, the shrine closest to the temple. At a right angle to the temple and oratorio on the north side of the plaza is an open hall, Str. 606a" (Rice, Rice, and Pugh 1997:241). This ceremonial group also has a *sakbe* connecting the open hall to the southern edge of the plaza, a second open hall, and a large shrine/platform that faces the second open hall on the southern side also occur in Group A (Rice, Rice, and Pugh 1997:240). Stucco from Structure 606 has red pigment and stucco from Structure 605 has black pigment (Pugh, personal communication 2000).

The temple assemblage of Group C consists of a west-facing temple (Str. 764) and an oratorio (Str. 1002), two small shrines (Str. 766) in front of the temple, and an open hall to the south and at a right angle to the temple (Rice, Rice, and Pugh 1997:241). Stucco from the exterior of the temple was painted with red lines and stucco from the floor had black pigment (Pugh, personal communication 2000). Based on these characteristics, Rice, Rice, and Pugh (1997:252) state that although "Sakpeten is listed as a Yalain community [in Spanish documents], we believe that the two Mayapán-style temple assemblages at the site mark the presence of Kowoj or Kowoj-affiliated occupants late in the site's history."

Complex I at Tipuj may also be related to the temple assemblages at Mayapán, Topoxté, and Zacpetén; however, many differences should be noted. Structure 2 is a temple with an interior altar. It faces west into the platform plaza and is defined by non-balustraded steps that access the temple top (Jones, Kautz, and Graham 1986). To the north of the temple and facing in the same direction appears Structure 1. This structure faces a feature, perhaps a low platform, that faces Structure 1. While Structure 1 may represent an oratorio, extensive excavations and analysis have not been carried out, and as a result, little information is known about its internal structure. Structure 3 occurs to the south of the temple and appears to be a hall and Structure 4 appears to be a colonnaded hall that occurs directly across from and faces into Structure 1. The alignment of Structures 1 and 4 with a smaller altar/shrine resembles a basic ceremonial complex (Pugh, personal communication 2000). The addition of Structure 2 (temple) and Structure 3 (open hall) may be a variant of a basic temple assemblage; however, the alignment of these structures does not correlate to those of Mayapán, Topoxté, or Zacpetén. Therefore, while a comparison to Mayapán, Topoxté, and Zacpetén is tempting, it should be done with caution because of the lack of interpretation from the excavation data. Based on the civic-ceremonial data and the presence of Clemencia Cream Paste ware pottery at Tipuj, I suggest that the site is occupied by Kowoj and/or Mopan in the Middle Postclassic period.

In addition to similarities in civic-ceremonial architecture, interment patterns demonstrate that a social group other than the Itzá may have occupied some of the sites around Lakes Salpetén and Yaxhá. Individual skull burials and ossuaries at Topoxté Island and Zacpetén appear in conjunction with Mayapán-like temple assemblages. In opposition to individual skull burials and ossuaries, rows of crania, *tzompantli*, were documented at Macanché Island (Rice 1986:264), Ixlú, and Chich'en Itza (Ruppert 1952).

Rows of crania occur in the Petén lakes region in the ethnohistorically defined territory of the Yalain (Jones 1998:Map 3).

Around this same time, Clemencia Cream Paste ware, especially Chompoxté Red-on-paste and Canté Polychrome pottery, appears at sites in the eastern portion of the Petén lakes region and Tipuj. I believe that these traits (civic-ceremonial architecture, interments, and pottery) represent Kowoj social identity and Kowoj occupation at Topoxté, Zacpetén, and Tipuj.

The archaeological sites of Yalain, Macanché Island, and possibly Ixlú may have been occupied by the Yalain during the Middle Postclassic period. Architecture at these sites is different from that of Topoxté Island, Zacpetén, Tipuj, Ch'ich', and Tayasal. Yalain, Ixlú, and Macanché Island, have similar Postclassic architectural groupings that are dissimilar to the civic-ceremonial complexes at Mayapán, Topoxté Island, and Zacpetén. The basic pattern, present at Yalain, involves a south-facing open hall facing two north-facing smaller open halls with a shrine between the larger and smaller open halls (D. Rice, personal communication 2000).

At Ixlú, this assemblage has an east-facing temple to the west of the large open hall. Ixlú has additional Postclassic complexes composed of open halls, temples, and oratorios that may represent a variant of the basic ceremonial group, but none of the complexes resemble those at Mayapán, Topoxté, and Zacpetén. Structures 2023 (temple) and 2022 (open hall) have red painted stucco on the exterior surfaces.

Limited excavations from Macanché Island suggest that the structure on the raised platform may have been an open hall with a possible L-shaped bench (Rice 1987a:Figure 23; Pugh, personal communication 2000). Two or more smaller halls may have faced the larger open hall. D. Rice (personal communication 2000) states that the combination of open halls and shrines/oratorios is typical of architecture seen in the Itzá/Yalain region.

Macanché Island and Ixlú have Clemencia Cream Paste ware pottery (mainly Topoxté Red), but in smaller quantities than that of Zacpetén and Tipuj. The presence of this pottery suggests that the inhabitants of these sites (perhaps Yalain) may have had trading relations with the Kowoj.

The western portion of the Petén lakes region was occupied by the Itzá in the Middle Postclassic period. The archaeological sites of Ch'ich' and Tayasal have a different architectural pattern. Postclassic architecture at Ch'ich' and Tayasal consists of a series of halls and shrines with occasional oratories that are more similar to civic-ceremonial architecture at Chich'en Itza than at Mayapán, Topoxté Island, Zacpetén, Ixlú, Yalain, and Tipuj (Rice et al. 1996). Chich'en Itza architecture is dominated by colonnaded halls and the presence of ball courts (Ruppert 1952). Unfortunately, more excavations are needed in the Itzá territory in the Petén lakes region before correlations can be made. In addition to architecture patterns, these archaeological sites have few (less than 10) Clemencia Cream Paste ware sherds.

This information (civic-ceremonial architecture, interment, and pottery) suggests that the Kowoj did not trade with the Itzá, creating an east-west dichotomy indicating that social boundaries may have existed limiting trade. If territorial boundaries are becoming less fluid, potters' choices may also be changing due to the restriction of resources available within a specific socio-political territory. This may be indicated by the presence of three zones of clay resources (red, gray, and "white" clays) and a variety of red slip colors with a variety of surface finishes.

The Late Postclassic period (ca. 1350-1697) is a period during which socio-political groups of the Petén lakes region were changing alliances, changing dominance relations, and experiencing the repeated migrations of social/ethnic groups from northern Yucatán and possibly elsewhere. Established and defended boundaries and migrations of population bases may have further restricted trade and access to resources needed for pottery manufacture and firing.

According to their histories, additional populations of Itzá and Kowoj from northern Yucatán migrated into the area during the Late Postclassic period. Hermes and Noriega (1997:762) state that a new social group moved to Topoxté Island and began remodeling the structures of the main plaza on Topoxté Island. This may indicate a new migration of Kowoj because the building types were not changed but only refurbished. People occupying this site continued to make Clemencia Cream Paste ware pottery and not importing any appreciable quantities of other Petén Postclassic pottery wares. Sometime around A.D. 1450, Hermes and Noriega (1997:762-763) state that Topoxté was abandoned along with the manufacturing of Clemencia Cream Paste ware pottery. This date corresponds to the date of the migration of the Kowoj from northern Yucatán to Petén. Debate exists as to the abandonment of Topoxté at this date, but if it was abandonded, its population may have relocated to other Kowoj towns such as Zacpetén.

In A.D. 1525, Cortés traveled through Petén on his way to Honduras (Cortés 1976:219-285). At this time, he stated that the Itzá were centered at Nojpeten and that they were ruled by the Kan Ek' lineage. Therefore, the Itzá were a strong presence in central Petén by at least the last half of the 15th century. The archaeological sites of Ch'ich', Tayasal, and Nojpeten were within the Itzá territory. In addition to these towns, the Itzá controlled, or at least had influence over, the towns of Yalain and Tipuj due to marriage alliances and Yalain may have served as an outpost area for the Itzá to protect them against Spanish invasions (Jones 1998:167) .

The Itzá also had a strong presence at Tipuj during the Late Postclassic period. AjChan, an Itzá noble and father of a famous Itzá diplomat of the same name, was a resident of Tipuj and led at least one decisive battle over Yalain, probably in the late 17th century (Jones 1998:56). In addition to the presence of AjChan, Itzá compound names resulting from intermarriage commonly occurred at Tipuj as documented in Pérez's 1655 *matrícula* (Jones 1989:14).

To complicate matters, the Itzá are said to have had a series of three wars with the Mopan (dates unknown), the result of which found the Mopan victorious (Jones 1998:21, 101). These battles allowed the Mopan to temporarily regain control of the corridor to Tipuj. Therefore, while the Itzá may have had a strong presence at Tipuj, the population may have been a mix of Itzá and Mopan.

The site of Ixlú may have been included in Itzá and/or Kowoj territory throughout the Postclassic period. The lack of a large Late Postclassic population evident by the paucity of Late Postclassic pottery suggests that it was not occupied by a large population (similar to Zacpetén) and may not have been occupied during the entire Postclassic period.

The Kowoj appear to have occupied the site of Zacpetén (Pugh 1999) and possibly sites along the north shore of Lake Petén Itzá (Jones 1998:Map 3). Although more excavations are needed to determine the extent of the Kowoj in the Petén lakes region, Spanish documents state that the Kowoj were present at Zacpetén until just before

A.D. 1697 when the Itzá and the Spanish attacked.

## VI. Technological Choices and Social Identity

I believe that some Kowoj traditions/customs begun at Topoxté Island around A.D. 1000 continued at Zacpetén after Topoxté Island was abandoned. I believe that a "hallmark" signature of the Kowoj was red-on-paste decoration. It began on Clemencia Cream Paste ware pottery with the florescence of Chompoxté Red-on-paste pottery. After the Topoxté islands were abandoned in A.D. 1450, this pottery type was no longer produced, but an analogous pottery type–Macanché Red-on-paste–began. I suggest that the Kowoj at Zacpetén recreated Chompoxté Red-on-paste decoration on local clays, the gray pastes of Volador Dull-Slipped ware pottery, to reinforce their social/ethnic identity. Macanché Red-on-paste pottery, found almost exclusively at Zacpetén, is a Late Postclassic type and as such may reflect this practice. In addition to its presence at Zacpetén, 28 sherds were identified at Macanché Island, four sherds at Nojpeten, and eight sherds at Tayasal. This distribution suggests that the Kowoj traded limited quantities of Macanché Red-on-paste pottery into Itzá/Yalain territory. Trade of this pottery may have occurred early in the Late Postclassic period while the Itzá/Yalain were allied through marriage to the Kowoj. In addition to the earlier trade of limited quantities of Macanché Red-on-paste pottery to the west and eastern lakes, Cowgill (1963) notes a large quantity of Tachís pottery (similar to Macanché Red-on-paste pottery but with "purplish" decoration instead of red) at Nojpeten. This may suggest trade with Kowoj or that a faction of Kowoj were living on Nojpeten (the latter being highly unlikely). Nevertheless, red-on-[gray] paste pottery is rare outside of Zacpetén and I suggest that this indicates Kowoj social identity.

In addition to red-on-paste decoration, I also believe that red-and-black decoration may indicate Kowoj social identity for the same reasons stated above. Sacá Polychrome pottery (Volador Dull-Slipped ware) may be an attempt to recreate Canté Polychrome pottery (Clemencia Cream paste ware). Canté Polychrome was most prevalent at Topoxté Island and also occurred at Zacpetén and Tipuj (2 sherds). However, Sacá Polychrome pottery exists almost exclusively at Zacpetén (18 sherds occur at Macanché Island, two sherds at Tayasal, and 14 sherds at Nojpeten). Again, this type of pottery may exist at these three sites because of marriage ties and trade relations in the early 1600s. Red-and-black decoration also occurs almost exclusively at Mayapán in northern Yucatán. Therefore, I suggest that red-on-black decorated pottery may also indicate Kowoj social identity and after the abandonment of Topoxté Island at approximately A.D. 1450, the Kowoj of Zacpetén recreated this decorative mode in order to reinforce social/ethnic identity.

Because operational sequences, choices of manufacturing materials and techniques reflect the socio-political situation of the Postclassic period in Petén, I suggest that the seven technological styles described in Chapter 9 reflect Petén Postclassic social/ethnic identities. I believe that Clemencia Cream Paste ware pottery was produced at and traded from the Kowoj site of Topoxté from the Early to early Postclassic periods (ca. A.D. 1100-1450). "[T]he Topoxté Islands do not share in the other Petén Postclassic ceramic traditions. No Trapeche group sherds, for example, were found at Topoxté, and no Chilo Unslipped; only one sherd was tentatively classified as Augustine, and only three sherds were identified as being of probable Yucatecan manufacture. The inhabitants of the Topoxté Islands, in short, seem to have sent some of the pottery throughout a relatively broad territory in Petén [and elsewhere], but to have brought in very little in return" (Rice 1986:278). Topoxté can be defined as a Kowoj site because Topoxté's architecture (temple assemblages) resembles that of Mayapán (the ancestral homeland of the Kowoj) (Pugh, personal communication 2000). Thus, it is possible to suggest that the Clemencia Cream Paste ware pottery produced at Topoxté Island reflects Kowoj identity because of architectural, burial, and pottery decoration similarities to Mayapán, the Kowoj ancestral homeland. In addition to these similarities, Clemencia Cream Paste ware pottery is found more frequently at sites with temple assemblages within the Kowoj territory as defined ethnohistorically by Jones (1998:17-19). Therefore, Clemencia Cream Paste ware pottery (TSGs 1, 6, and 7) reflects Kowoj social/ethnic identity.

Kowoj identity may also be defined by red-and-black and red painted decoration that appears in TSGs 3, 4, 6, and 7. Although red-and-black painted pottery is rare, its distribution is distinctive. Two characteristics of material culture in the Maya lowlands support this proposition. First, red and red-and-black decorated pottery occurs most frequently at Topoxté Island (a Kowoj site) and in the ethnohistorically defined Kowoj territory as well as more frequently at Mayapán than at Chich'en Itza. Second, temple structures at Zacpetén, Topoxté, Ixlú, and Mayapán (Kowoj sites) have red and red-and-black painted stucco (Bullard 1970; Pugh, personal communication 2000; D. Rice, personal communication 2000). While the presence of painted stucco may be the result of preservation, painted stucco is not reported at other archaeological sites in the Petén lakes region.

Itzá social identity is more difficult to define through technological style data because most of the sites excavated have thus far been in Kowoj territory. However, Itzá social identity may be reflected through the use of black decorative painting on Vitzil Orange-red ware pottery (TSGs 2 and 3) and on Volador Dull Slipped/Snail Inclusion ware pottery (TGSs 4 and 5). These technological style groups occur most commonly in ethnohistorically defined Itzá territories. Additionally, reptilian motifs occur more commonly in Itzá defined territory, the western portion of the Petén lakes region (Rice 1983, 1989). Serpent (*Kan*) motifs may signal the Kan Ek' lineage of the Petén Itzá (Rice, Rice, and Pugh 1997:59). Further research into Itzá archaeological sites will contribute to the discussion of technological styles that reflect Itzá social identity.

# CHAPTER 11

# CONCLUSIONS

Historical, ethnohistorical, and architectural data suggest that multiple social groups occupied the Petén lakes region of Guatemala during the Postclassic (A.D. 950-1524) and Contact (A.D. 1524-1700) periods. Through a comparison of pottery technological style data with civic-ceremonial architectural and burial data from the archaeological sites of Ch'ich', Tayasal, Ixlú, Zacpetén, Macanché Island, and Topoxté Island in Petén and Tipuj in Belize, I suggest what Petén Postclassic slipped pottery technological styles represent which social/group and at which sites the technological styles appear. Thus, my study of technological styles of the Itzá and Kowoj of Petén suggests that Petén Postclassic potters produced and reproduced pottery technological styles as part of the social identities.

Technological style groups 1, 6, 7 and the red-and-black decorated pottery from Technological Style Groups 3 and 4 represent Kowoj identity. These technological styles are most common at Zacpetén, Macanché Island, and Topoxté Island, they occur less frequently at Ixlú and Tipuj, and are rare at Ch'ich' and Tayasal. In addition to their site location, some intra-site proveniences also occur. Although Kowoj technological styles exist at most excavated structures at Zacpetén, Ixlú, and Tipuj, they are concentrated most heavily in temples, open halls in temple assemblages, oratorios, shrines, and elite residences. This may suggest that pottery that is most important in displaying social identity is related to ritual functions associated with elite and/or ritual structures.

Technological Style Groups 2 and 3 and black line decoration of Technological Style Groups 4 and 5 may represent Itzá social/ethnic identity because of the presence of reptilian *(kan)* motifs that may reflect the ruling Kan Ek' lineage of the Petén Itzá. These characteristics are abundant of these technological style groups at Ch'ich', Tayasal, and Tipuj and are almost absence at Zacpetén, Macanché Island, and Topoxté Island (Technological Style Groups 2 and 3 only). Sherds that represent these technological style groups occur in all types of excavated buildings except oratorios.

In order to identify patterns of Postclassic technological styles from pottery at sites in the Petén lakes region, I conducted several kinds of analysis (described in detail in Chapter 4) to gather technological and stylistic data: type-variety analysis, "low-tech" analyses; petrographic analysis; x-ray diffraction analysis; EDS and SEM analyses; and strong-acid extraction ICPS analysis. From the data gathered by these methodologies, I inferred technological styles that reflect the choices made by potters during the process of manufacture that may indicate restricted resources and potter knowledge.

The first step of analysis consisted of a typological examination of all Postclassic slipped sherds from all of the sites in this project. A detailed description of the five Postclassic slipped pottery groups (Paxcamán, Fulano, Trapeche, Topoxté, and Augustine) and three ware categories (Volador Dull-Slipped ware, Clemencia Cream ware, and Vitzil Orange-Red ware) appears in Chapter 5. Variations in the painted and incised decorations, the presence and absence of decorative motifs, the number of form categories, and the firing and slip technology occurred differentially throughout the Petén lakes region. Although the differences were not numerous, variations in pastes, slips, and decorations of the various types and varieties demonstrated that technological style analysis goes beyond stylistic and type-variety analyses to suggest that the combination of the choices available to a potter may ultimately reflect the social/ethnic identity of the Postclassic social groups in the Petén lakes region.

"Low-tech" analysis, the second level of analysis to determine the existence of Postclassic technological style groups, included the examination of a sample of 551 sherds from Ch'ich', Ixlú, Zacpetén, and Tipuj. I examined the slip colors (using Munsell Soil Charts), the degree of dark coring and core color, the hardness of the exterior surface, interior surface, and the paste (using the Mohs' hardness scale), the estimated firing temperatures (using an electric kiln), the form measurements, and the surface treatment and decoration of these sherds (detailed results are presented in Chapter 6). The resulting qualitative and quantitative data based on paste, slip, and decoration characteristics allowed me to refine the groups preliminarily defined in the previous typological analysis. I defined three technological style groups based on the differences in slip and paste color variability, firing technology, and surface treatment. These "low-tech" technological styles correlate to the three Petén Postclassic slipped ware categories (Volador Dull-Slipped, Vitzil Orange-Red, and Clemencia Cream Paste wares). From this data, it is possible to observe technological and stylistic choices made by the Petén Postclassic Maya potters in order to mediate their social reality.

Chapter 7 presents data obtained through mineralogical analyses–the third level of analysis. I examined all of the sherds through binocular microscopy to observe the gross modal differences in paste categories. As a result of the differences in the various pastes, I selected a sample of 273 sherds for further petrographic thin-section analysis to better identify slip characteristics and non-plastic inclusions, minerals, and rock fragments in the clay paste as well as slip characteristics. In addition to identifying the presence of various minerals, I also recorded the abundance, association, granulometry, and shape of the minerals and other inclusions in the clay paste. Ternary charts of the percentage of various mineral inclusions and pores, as well as other qualitative data, elucidated differences in each ware category based on the abundance of pores, chalcedony, and biotite.

Because petrographic thin-section analysis cannot identify clay minerals by their optical properties, I examined 15 sherds and five raw clay samples by x-ray diffraction. Data from the raw clay and sherd samples demonstrated that the raw clays and clay pastes of the sherds were composed of montmorillonite and halloysite clay minerals. In addition to the identification of the clay minerals, x-ray diffraction analysis demonstrated the extent to which calcite is a dominant mineral component of the raw clays and the sherd samples.

Because the clay mineralogy of the sherds in the sample were very similar, I defined four mineralogical technological style groups based on inclusions in the clay pastes of the sherds in this study. The first mineralogical technological style group includes Augustine and Topoxté ceramic group sherds that have clay pastes dominated by pores. The second group consists of Paxcamán, Trapeche, and Augustine ceramic group sherds with clay pastes dominated by cryptocrystalline calcite. Paxcamán, Trapeche, Fulano, Augustine, and Topoxté ceramic group sherds with quartz, chert, chalcedony, hematite, and calcite mineral inclusions comprise the third mineralogical technological style group. Finally, the fourth mineralogical technological style group is composed of

Paxcamán, Trapeche, Fulano, Augustine, and Topoxté ceramic group sherds with quartz, chert, chalcedony, hematite, calcite, and biotite mineral inclusions. The four technological styles based on mineral inclusions in a clay paste reflect some technological choices made by the Petén Postclassic Maya as to the material for the manufacture of slipped pottery.

The fourth and final level of analysis involved the chemical characterization of the clay pastes of 100 sherds that represented the variability described in previous chapters. A combination of EDS and SEM analyses and strong-acid extraction ICPS analysis of major, minor, and trace elements with multivariate statistics (Ward's Cluster Analysis and Principal Component Analysis) resulted in seven chemical composition technological style groups based on clay paste elemental characteristics (detailed results appear in Chapter 8). The elemental frequencies suggest that clay paste compositional differences correlate to ceramic ware categories and mineral inclusions. This is not surprising given the visual differences of clays used to produce the various vessels and the different suites of mineral inclusions in the different clay pastes.

When the "low-tech" data are combined with the mineralogical and chemical data, some interesting differences occur that reflect variation in chemical and mineralogical composition, stylistic (painted and/or incised decoration), and formal categories.

The description of the seven technological style groups with regard to paste color, mineral inclusions, distinctive elemental concentrations, estimated firing temperatures, Mohs' hardness measurements, surface treatment and decoration, form measurements, provenience in the Petén lakes region, and occurrences throughout the Maya lowlands appears in Chapter 9.

Group 1 represents Topoxté Red pottery from Ixlú and Tipuj. The body sherds of this group are thin and exteriorly slipped with no decoration. Petrographically, this group is distinguished by voids in a marly clay paste. A few quartz inclusions can be seen, but they do not occur in any significant quantity. Chemical analyses suggest that this group is distinctive due to its moderate relative concentrations of Fe (iron) and Ti (titanium), and low relative concentrations of Ca (calcium) and Zn (zinc).

Group 2 represents Augustine sherds from Ch'ich', Ixlú, and Zacpetén. Tripod dishes, collared jars, restricted orifice bowls, and narrow neck jars occur in this group. The majority of the sherds are slipped without decoration, and three sherds have either black line decoration or incisions. Petrographically, voids also predominate the clay paste. Chemical analyses distinguish this group from group 3, also composed of Augustine ceramic group sherds, because of its low relative concentrations of Ca (calcium).

Group 3 again represents Augustine sherds, but they are from the sites of Ch'ich', Ixlú, Zacpetén, and Tipuj. Jars and tripod dishes dominate the form categories with the exception of one drum sherd. Two-thirds of the sherds in this group are decorated by incisions, black, and red-and-black motifs. Decorative motifs include plumes, birds, mats, and the *ilhuitl* glyph. Petrographically, these sherds share an abundance of calcite and quartz inclusions. Chemical analyses separate this group from group 2 because of its high relative concentration of Ca (calcium).

Group 4 has Paxcamán, Trapeche, and Fulano ceramic group pottery from Ch'ich', Ixlú, Zacpetén, and Tipuj. Tripod dishes, collared bowls, flanged plates and bowls, jars, grater bowls, and drums occur in this group. Two-thirds of these sherds are decorated with incisions or black, red, or red-and-black decorations that are geometric, mat, bird, or *ilhuitl* motifs. The other one-third are slipped without decoration. Petrographically, this group has a calcite rich clay paste that is characterized by the presence of voids, biotite, chert, chalcedony and quartz. Chemical analyses separate this group from group five, also composed of the same ceramic groups, because of lower relative concentrations of Be (beryllium), Cd (candidum), and Mn (manganese).

Group 5 has a similar mix of Fulano, Trapeche, and Paxcamán sherds from Ch'ich', Ixlú, Zacpetén, and Tipuj as does Group 4. However, ninety percent of these sherds represent slipped but undecorated plates and jars. Petrographically, the clay matrix is dominated by calcite. Chemical analyses separate this group from group 4 because of its higher relative concentrations of Be (beryllium), Cd (candidum), and Mn (manganese).

Group 6 represents Topoxté ceramic group sherds from Zacpetén and Tipuj. The sherds represent bowls, plates, and jars. The majority of the Topoxté ceramic group sherds have red decoration with motifs that are either two parentheses or a depiction of the *ajaw* glyph. Petrographically, this group has a marly clay paste that is dominated by cryptocrystalline calcite with the presence of a few (< 3%) euhedral and polycrystalline calcite and biotite inclusions. Chemical analyses distinguish this group from groups 1 and 7 (other Topoxté ceramic groups) because of it slightly higher relative concentrations of Fe (iron) and Ti (titanium).

Group 7 has Topoxté ceramic group sherds from Zacpetén and Tipuj. Plate, bowl, and jar forms predominate this group. The majority of these sherds are decorated with red, red-and-black, or black painted decoration. Petrographically, these sherds have a marly paste with calcite, chert, quartz, chalcedony, and biotite inclusions. Chemical analyses separate this group from groups 1 and 6 (other Topoxté ceramic groups) because of lower relative concentrations of Al (aluminum), Fe (iron), and Ti (titanium).

In addition to technological style data, Chapter 10 describes various civic-ceremonial architecture, burial, and polychrome pottery color and design motif data that occurs in the Maya lowlands and its relation to the archaeological sites in this study. Based on the data from multiple lines of material culture, I suggested that Clemencia Cream Paste ware pottery and pottery with red-and-black and red-on-paste decoration indicates Kowoj identity. Although Itzá social identity is more difficult to identify due to the lack of excavation in the Petén lakes region, I suggested that Vitzil Orange-Red ware pottery with black decoration and reptilian motifs on Petén Postclassic pottery wares may represent Itzá social identity. The existence of technological styles based on the above criteria demonstrates that the Kowoj and the Itzá made technological and stylistic choices in manufacturing of pottery that reflected their separate social identities. Petén Postclassic slipped pottery was created with different types of clay pastes, inclusions, and decoration and these choices reflect the compatibility of technological and stylistic choices as defined by cultural groups and reinforced by existing social structures present in other forms of material culture.

As a result of my analysis of Petén Postclassic slipped pottery, technological styles of this pottery demonstrate that: 1) technological and stylistic choices have a social context; 2) technology and style are social reproductions of Postclassic society; 3) some technological and stylistic choices were more compatible than others within Postclassic Maya society; 4) technology affects style; and 5) these compatible choices reinforced the existing technology and social ideology.

Technological and stylistic choices have a social context because they are products of producers who are active social agents in a social structure ( Dietler and Herbich 1998; Lemonnier 1992). The operational sequence (choices) that resulted in the different Postclassic Maya technological styles reflected the social context of the culture because the pottery was created from interrelated choices of matter, energy, specific knowledge, etc., learned in social settings that "guide the perception of an acceptable range of variation and choice" (Dietler and Herbich 1998:250; Lemonnier 1992). Because potters are part of a larger social group and social structure, they "understand" the group ideologies that are structured and systematic of their social/ethnic group. Thus, through practice, potters display, form, and transform the social context of technological and stylistic choices.

Because technological and stylistic choices are embedded in a social context, they are also social reproductions of Petén Postclassic society. The seven technological styles described above reflect technological and stylistic changes that may be the result of different/new social groups of the Postclassic period. The technological styles in the Petén lakes region are associated with two distinct socio-political groups that describe very different origin and migration myths and histories. Although Robertson (1970) described an "International Style" that occurs throughout the Maya lowlands, the Petén Itzá and Kowoj used specific symbols, colors, and pottery pastes that have resulted in the differentiation of seven technological styles of pottery. The differences between the two social groups and between Postclassic and earlier cultural periods are also reflected in other elements of material culture such as ritual pottery, civic-ceremonial architecture, and burial practices. Because the mental construction of being a member of Petén Postclassic Maya society and more specifically a member of the Itzá or Kowoj socio-political group appears in multiple lines of material culture, the technological styles of Postclassic slipped pottery serve as symbols of social/ethnic identity.

In order for the technological styles of Petén Postclassic slipped pottery to be perpetuated, the technological and stylistic choices must be compatible with Postclassic Maya society. Archaeologists can determine which technologies and styles were most compatible by examining the changes from the Late/Terminal Classic period to the Postclassic period. Changes are most notable in the presence of the flat-bottomed tripod dish, the collared jar, the flanged collared jar, and various ritual and censer vessel forms. Although some forms continue from the Late/Terminal Classic period, such as the jar, Postclassic Maya potters have changed some rim shapes (e.g., outflaring rims of collared jars). In addition to the changes in form, different pastes were used in the Postclassic period. The volcanic ash tempered paste of the Late/Terminal Classic period begins to disappear during the Early Postclassic and is gone by the Late Postclassic period. Orange, cream, and gray snail inclusion pastes are commonly used throughout the Postclassic period suggesting that Postclassic potters changed the source of clays used in pottery manufacture. Decorative motifs are also vastly different from those of the Late/Terminal Classic period. The Late Classic elaborate ceremonial polychrome designs with glyphic texts change to occasional pseudo-glyphs and other motifs not dominant in the Late/Terminal Classic period indicating a change in decoration. Compatibility of technological and stylistic choices within Postclassic Maya society can also be seen in the similarities between some design motifs (triangles, *ilhuitl* glyphs, etc.) and form characteristics (tripod dishes, jars, and censers) present in the Petén lakes region and northern Yucatán (the ancestral homeland of the Itzá and Kowoj). These changes demonstrate some choices that were more compatible than others during the Postclassic period in Petén, Guatemala.

The presence of technological styles in the Petén lakes region also demonstrates that technology affects style because technologies are performances or behavioral events and "their styles are the symbols through which communication occurs. The relationships among the formal elements of the technology establish its style, which in turn becomes the basis of a message on a larger scale" (Lechtman 1977:13). Technologies also affect styles because the resulting product is a reflection of the attitude of the producer toward the product and the attitude of the community toward the technology and the product with regard to compatibility of the product in the existing social melieu (Lechtman 1977:10). While a multitude of technological alternatives for the production of an object exist, cultures tend to select a technology compatible with and perhaps restricted by its social and physical environment (Sackett 1982:72-73). As such, the chosen technology is a behavioral performance that results in a style and a cultural message (Lechtman 1977:12). Technological behaviors not only moderate "between society and the natural world" but act "as an important vehicle for creating and maintaining a symbolically meaningful environment" (Lechtman 1977:17).

Finally, technological styles demonstrate that compatible choices reinforced the existing technology and social ideology of Petén Postclassic society. Because potters are agents acting in a specific social milieu that they have "not created nor can control," the resulting product may reflect social, political, and/or economic structures particular to the potter's culture that may also occur in other forms of material culture (Shanks and Tilley 1987:148). These reflections of Petén Postclassic technology and social ideology are most notable in the differences of clay sources, decoration colors, design motifs, and forms previously discussed. Technological and stylistic choices illuminate the Petén Itzá and Kowoj social structure and social practice because social structure and potter agency are mediated through the practice of pottery production making pottery production a social activity through which compatible choices are reinforced (Dietler and Herbich 1998:238).

As a result of my analysis of technological styles, I demonstrated that Itzá and Kowoj potters produced and reproduced pottery technological styles that reflected their social environment and displayed their social identities during the Postclassic and Contact periods. Through the analysis of the Mayas' choices of technologies and styles, it is also possible to suggest the extent to which social representations are reflected in the performance of technological and stylistic action, and so aid in defining Itzá and Kowoj social/ethnic identities to refine our understanding of the settlement and socio-political relations in the Petén during the Postclassic and Contact periods.

This study of Petén Postclassic slipped pottery technological style groups and their relationship to the socio-political groups that may have produced them is based on archaeological and ethnohistorical data. My combination of type-variety, "low-tech," mineralogical, and chemical analyses with ethnohistorical data allows me to go beyond an analytical description of Petén Postclassic pottery to further our understanding of the socio-political complexity of the Postclassic period.

My research builds on over 75 years of analysis of Maya pottery. Maya archaeologists, like those studying cultures world-wide, rely on classification procedures such as the type-variety system to begin their studies of pottery and provide regional chronological sequences (e.g., Adams 1964, 1971; Ball 1977; Bullard 1970; Gifford 1976; Sabloff 1970, 1975). Most of these studies are centered around a typological description of excavated pottery and archaeologists situate pottery from that excavated site in time and space. Some scholars (e.g., Gifford) believe that the classification of pottery in the type-variety system allows the archaeologist to gather information concerning social and economic uses of the pottery. These scholars believe that the type-variety system is not an artificial construct and that the ceramic groups, types, and varieties aid in the understanding of cultural reality because the kinds of pottery that are produced are reflections of societal activities. However, a ceramic study based solely on typology rarely addresses issues beyond classification. My study of ceramic typologies emphasizes ware level, allowing me to obtain information about paste attributes and surface finishes that aid in the definition of technological styles and basic choices made by the Petén Postclassic potter.

In addition to typological studies, many past and present examinations of Maya pottery have relied on style to draw conclusions as to production and exchange. Studies based on design element analysis elucidate different ceramic styles based on color a degree of exactness with lines. For example, Beaudry (1984) uses swimming figures, monkey, glyphs, and geometric figures to establish 16 design layout categories of Late Classic polychrome from Copán. Houston, Stuart, and Taube (1989) and Houston and Taube (1987), Grube (1986), MacLeod (1990) have studied the primary standard sequences of "Codex style" pottery to determine who the pot belonged to and what it might have contained. In addition to information concerning the vessel, work has been conducted to suggest the provenience of these vessels (Marcus 1983) as well as their context and broader significance as pottery bearing Maya codices (Robiscek and Hales 1981). In addition to determining the existence of "stylistic workshops," other works combine decoration with chemical paste data to suggest that different pastes and styles indicate "workshops." For example, Reents-Budet, Bishop, and MacLeod (1994) correlate Late Classic "workshop"styles and ceramic paste data with social groups and Hodge and Minc (1991, 1993) suggest different Late Aztec pottery workshops based on stylistic elements and differences in the chemical composition of the pottery.

Because of the lack of anthropological theory, one may come to the conclusion that the different pottery styles simply represent different classificatory types of pottery. As such, some of the stylistic information could easily appear in a ceramic report based on type-variety analysis because many of the works do not go beyond a simple description of what constitutes a style, and the who's and why's creation and perpetuation of the style. My study differs from these because I use the theory of technological style to answer anthropological questions about how and why people may have decorated and made their pottery in a specific manner.

Another topic of much of Maya pottery research is the elucidation of statistically "real" pottery groups based on the chemical analysis of paste structures. The main interest of scholars who use Instrumental Neutron Activation Analysis (INAA) is to use multivariate data to identify lowland Maya areas of production and trading spheres. From these data, scholars interpret the relationships of people and the pottery they produced and traded. For example, the Maya Fine Paste Ceramic Project (Bishop, Harbottle, and

Sayre 1982; Sabloff 1970, and others) examined the clay composition of Fine Orange pottery from the Usumacinta and Pasión River areas to determine the presence of different production sites. They determined that two general areas were used for clay resources–upstream and downstream (Bishop and Rands 1982). Most of these bulk methods of analysis address archaeometric methods of pottery analysis rather than answering anthropological questions about its manufacture and use. Unlike INAA methodologies, my use of ICPS chemical characterizations tests the variability in chemical signatures to indicate the differences in technological choices in order to infer behavior characteristics of the potter.

Unfortunately, mineralogical analysis of pottery has lagged behind chemical analyses. Shepard (1956, 1958) was one of the first to systematically employ petrographic thin-section analysis in pottery studies including an examination of northern Yucatán pottery. From her work with northern Yucatán pottery and other pottery types in the Maya region, she established the standard of petrographic analysis. Although many of her colleagues did not find her work important enough to include in a site's main report, her petrographic analyses did appear as appendices. These continue to influence work done by Maya archaeologists including work presented in this study. Perhaps Shepard's most influential contribution is her concern with history and ecology and how the potter interacted with her/his raw materials and with other aspects of her/his natural and socio-political environment. It was Shepard's concern with the details of petrographic analyses that allowed her to answer questions about production locations and chronologies. My use of mineralogical analysis builds on Shepard's contributions by demonstrating that choices of resources made by Petén Postclassic potters can be investigated by petrographic analysis.

Although much of Maya ceramic research focuses on chemical and mineralogical analyses, some scholars employ "low-tech" levels of analyses in combination with chemical and mineralogical analyses to obtain the fullest complement of data. One can often obtain as much information through "low-tech" analyses alone as from chemical or mineralogical analyses. For example, Rice's (1983, 1987a, 1989) examination of Late Postclassic pottery utilizes decorative styles, paste composition, and data obtained from "low-tech" analyses to explain a complex messaging system that existed in the Petén lakes region. The differences in decorative motifs and design templates demonstrate that the Petén Postclassic Maya potters created different styles that made social interaction more predictable by supplying visual information that reinforced social differentiation and by signifying and maintaining political boundaries. For example, Rice (1983) stated that pottery affiliated with the political realm of Topoxté is a red-on-cream decoration that is painted, unbanded, unpaneled, and has unspecific representations of serpent motifs. On the other hand, pottery that represent social groups at Macanché Island, Ixlú, and Zacpetén has a black-on-cream decoration that is incised, banded, paneled, and depicts reptiles in profile, in split image, or in a RE-glyph with bands of mat design. Although not all of these observations still hold (see above), it is this type of analysis and interpretation on which I base this study.

In general, Maya ceramic analysis seems to suffer from a need to obtain results that indicate chronology through typology and socio-economic behavior through archaeometry, without considering other levels of analysis. My integrative approach demonstrates that it is possible to obtain valuable and complementary data from all levels of analysis (classification to chemical analysis). The breadth of these data allow me to suggest who made the pottery and why as well as interpret some choices made by the potter during the manufacture of pottery that may have been influenced by the socio-political situation. This goes beyond simple classification or the concept of a production zone to answer anthropological questions about the Maya who produced and exchanged Petén Postclassic slipped pottery.

Although my research shows the utility of technological style studies in the identification of social/ethnic groups in the Petén lakes region of Guatemala, Postclassic scholars will benefit from a better understanding of the socio-cultural ties between social groups in the Petén lakes region and northern Yucatán during the Postclassic period with additional research. My research and that of Proyecto Maya-Colonial suggests a distinctive constellation of cultural patterns and traits that appear as an east-west dichotomy in the Petén lakes region resulting from the presence of various social groups. This same pattern (east-west) may also be present in northern Yucatán during the Postclassic period and may further support the origin and migration histories of the Petén Itzá and the Kowoj (Roys 1957). In order to fully appreciate the possibility of an east-west division of socio-political groups in Petén and northern Yucatán and to determine the extent of inter-regional interactions that have thus far been ignored, a re-examination of the published record of artifacts (specifically ceramics) from northern Yucatán as well as data from current archaeological projects is needed.

In addition to a re-examination of data from northern Yucatán, to fully understand the complexity of social and political organization of the social groups in the Petén lakes region in the Postclassic period, more archaeological excavations are needed.

Jones (1998) has suggested that up to six social groups may have co-existed in the Petén lakes region during the 17th and 18th centuries. To date, extensive excavations have taken place mainly in Kowoj territory. Excavations that involve clearing and test-pit sampling of a number of civic-ceremonial and domestic structures in the Itzá and Yalain territory as well as that to the north, south, and east of the Petén lakes will add more architectural, burial, and pottery data. With the addition of pottery data, as well as data from other forms of material culture from archaeological sites in these regions, the association of technological styles with social/ethnic groups will undoubtably become clearer.

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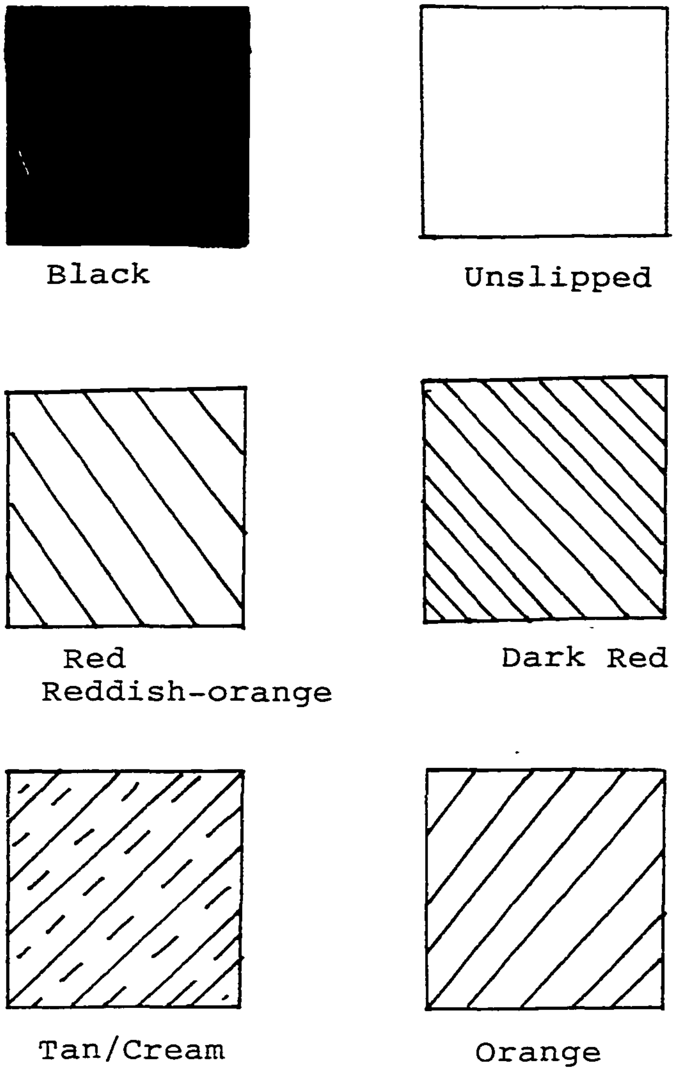
# APPENDIX



Key to Conventions Used in Slipped Pottery Illustrations.

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