Baking Pot Codex Restoration Project, Belize

Research Year: 2003
Culture: Maya
Chronology: Late Classic
Location: Belize
Site: Baking Pot

Table of Contents

Abstract
Resumen

Section I

Discovery of Tomb 2, Baking Pot, Belize
Tomb 2

Section II - Harriet Beaubien
Excavation of the Artifacts
Goals of Conservation and Technical Analysis
Description of the Artifacts
Goals of the Project
Artifact Conservation
Stabilization for Transport
List of Components

Conservation of Artifact R at SCMRE
Technical Study of Paint Flakes
Paint Layer Composition
Ground Layer Composition
Painting Technique and Decorative Scheme
Indicators of the Original Substrate(s)
Preliminary Interpretation of the Artifacts
Object Types
Contributions to Technical Studies of Maya Painting Traditions
List of Figures
Sources Cited

Abstract

During the 2002 field season a decayed stuccoed artifact was uncovered in a tomb at the site of Baking Pot. Initially, we believed that the painted stucco could be the remains of an ancient Maya codex. After funds were secured, Harriet Beaubien traveled to Belize to recover the material and bring it to the Smithsonian Institute for conservation and analysis. After more than a year of painstaking study Beaubien determined that the artifact was not a codex, but rather a number of smaller artifacts, similar in style and composition to gourds found at Cerén, El Salvador.

Resumen

Durante la temporada 2002, se encontró un artefacto de estuco en mal estado de preservación en una tumba de Baking Pot. En un principio, pensamos que el estuco pintado podrían ser los restos de un códice maya. Una vez asegurados los fondos necesarios, Harriet Beaubien viajó a Belice para recuperar el material y llevarlo al Instituto de Conservación de la Smithsonian para su conservación y análisis. Después de más de un año de arduos estudios, Beaubien llegó a la conclusión de que el artefacto no era un códice sino un número de artefactos más pequeños, parecidos en su estilo y composición a las calabazas que se encontraron en Cerén, El Salvador.

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Discovery of Tomb 2, Baking Pot, Belize

The epicenter of Baking Pot is formed by two large architectural complexes (Groups 1 and 2) that are linked by a 200 meter long causeway (sacbe). Group 1 lies at the north end of the causeway and is comprised of three large courtyards enclosed by monumental architecture (Figure 1, below). Structure E, located in the central plaza (Plaza 2) of Group 1, consists of a tripartite structure that resembles an E-Group complex. The primary structure (Str. E central) is a 15 meters tall pyramid that is flanked to the north and south by two 6 meter high platforms (Str. E north and E south).

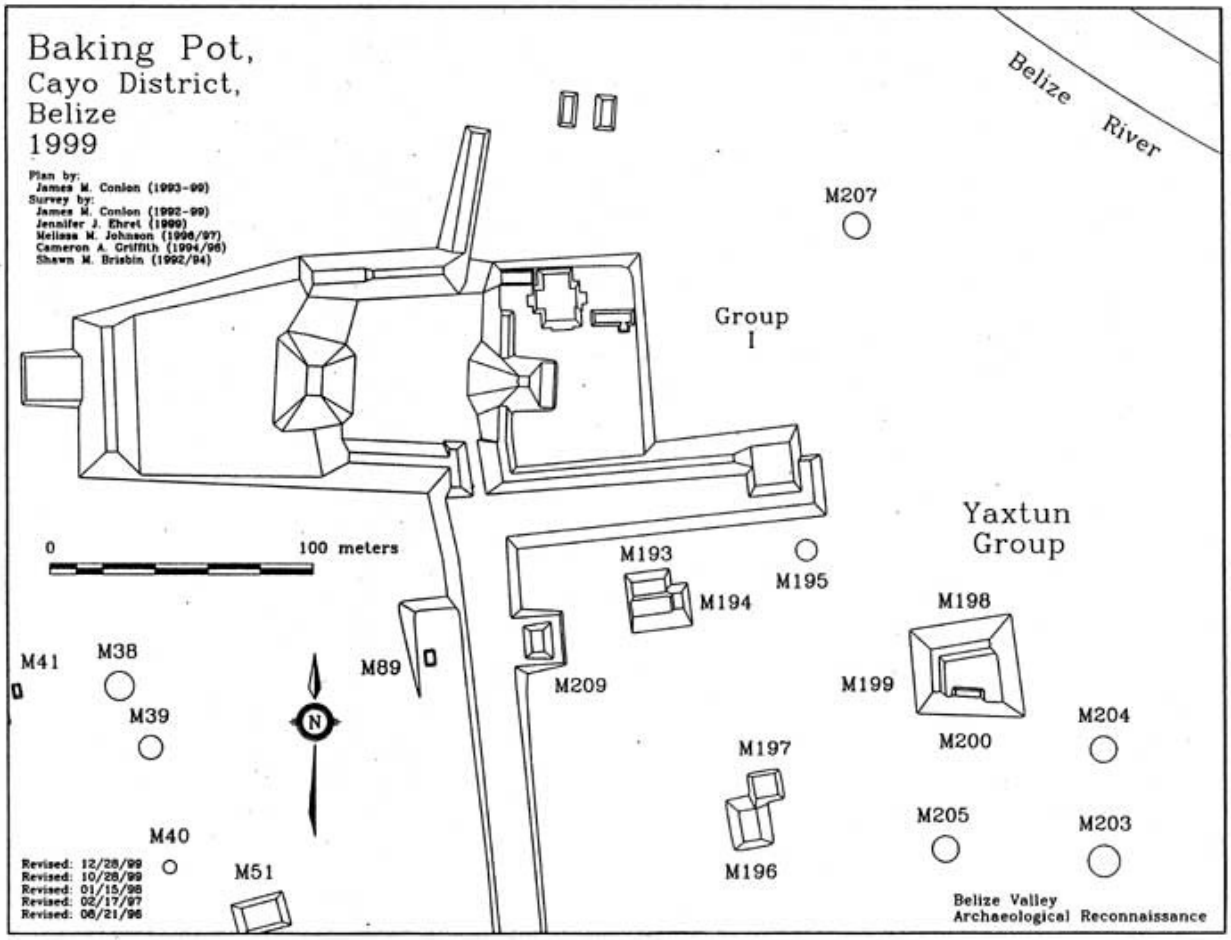

Figure 1. Map of Group 1, Baking Pot [Map: Jim Conlon].

Work commenced on Str. E in June of 2002. The first excavation was axially located at the summit of the mound, and measured 2m × 3m. This unit was later extended 1.5 meters to the west, 1 meter to the east, and 2 meters to the south. The excavation revealed traces of a poorly preserved plaster surface, but no evidence of a masonry super structure. This suggests that in its final form the summit of Str. E had a small

building platform that may, or may not, have supported a perishable superstructure. Due to erosion, bioturbation and structural collapse, it was impossible to determine the actual size of the building platform.

Excavation below the floor of the terminal phase platform penetrated several 4-6 cm thick layers of chert flakes that had been deposited above the capstones of two tombs. Both tombs were oriented north to south and were constructed of limestone blocks that were cemented together with lime plaster.

Tomb 2

Tomb 2 was located adjacent to the eastern wall of Tomb 1, a slightly later interment than Tomb 2. The capstones were 96 cm below the natural ground surface and four layers of chert flakes, scattered in 2 - 4 cm thick layers, were recovered between the top of the tomb and the surface of the platform. A rough count of the chert suggests that between 4000 to 5000 flakes were deposited above the capstones. Unlike Tomb 1, Tomb 2 was filled with dirt. This feature probably saved the burial from being destroyed by looters who attempted to vandalize the structure on a Saturday evening when we were absent from the site. The burial chamber was constructed with crudely cut limestone blocks and capped by several larger limestone slabs. The chamber measured 2.4 meters long, 0.9 meters wide, and 1.2 meters in height.

The skeletal remains in Tomb 2 were not very well preserved. Despite their poor condition the individual was female and over 45 (Kokkalis, personal communication). The individual had a number of abscesses and carries on 8 of her 13 remaining teeth. The position of the bones indicated that the burial had a north-south orientation with head to the south (Figure 2, below).

Although Tomb 2 contained less jade objects than Tomb 1, the burial had a large number of interesting and unique grave goods. Inside the chamber there were 8 ceramic vessels, a single, painted, mother of pearl shell, two plain mother of pearl shells, 12 carved spondylus shells, two canine pendants, two jade beads, more than a dozen small jade fragments that were glued onto the carved shell objects, a single jade earflare, a fragment of hematite, as well as two perishable stucco objects with painted designs.

Twelve, pink, spondylus shells were discovered under the skeletal remains. Many of these were elaborately carved while some were simple beads and earflares. The two large spondylus earflares, approximately 8 cm in diameter, were found on either side of the skeleton, one close to the skull and the second closer to the pelvis. These flares had separate plugs (3 cm in diameter) that likely extended through the ear lobes. Numerous thin jade fragments were discovered near the flares, suggesting that the jades were probably once glued to the shell to give the effect of solid jade earrings.

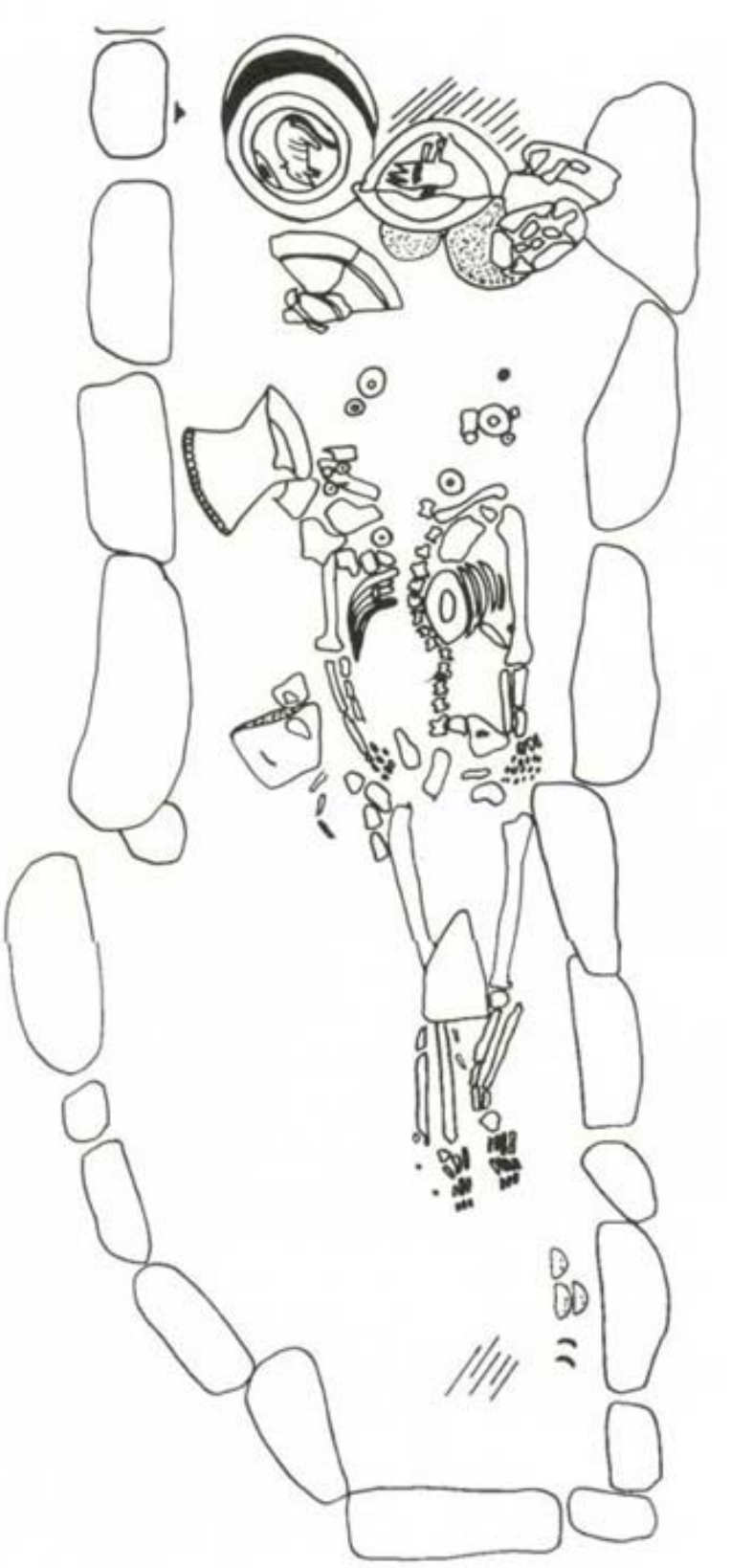

Figure 2. Plan of Tomb 2 [Drawing: Nasario Puc].

Two shells, carved in a form that resembles the "Mundo Maya" logo, were discovered on the eastern section of the grave, near the pelvic area of the skeleton (Figure 3, shown below). These shells were less than 2 cm long and less than 0.3 cm thick. The function of these objects is unknown, but it is possible that they served as pendants. It is also possible they were sewn or glued onto the individual's attire.

Figure 3. Image of shells in shape of Mundo Maya logo [Photo: CMA, 15 September 2004].

Two carved shell objects of unknown function were also discovered (Figure 4 and Figure 5, shown below). Each object is comprised of two sections, and while the relationship between these two pieces cannot be functionally determined, the image suggests the orientation. The upper piece is an unusual shape, with a square top and a concave lower section that allowed for easy fitting with a flat, circular piece. One side has a stylized mollusk, depicted somewhat like a coyote, crawling out of its shell (Taube, personal communication, 2005). The shell iconography is similar to expressions of bivalve shells in Teotihuacán murals, and is usually depicted in the watery border sections. The creature is depicted in profile with outstretched arms, similar in style to animals depicted at Teotihuacán and Cacaxtla (Taube and Headrick, personal communication, 2005). Its' eye is made from a small jade chip that was still in place when the shells were uncovered. On the opposite side, the carved image is a serpent, with an open jaw and large eye orbit. Taube and Headrick believe that the serpent image and associated chevron border look strongly Teotihuacano, although there are similarities with Cacaxtla as well. Both images can be related to the watery underworld,

appropriate, considering their location inside a tomb. In addition, the placement of these images on a Spondylus shell further strengthens their connection to the underworld.

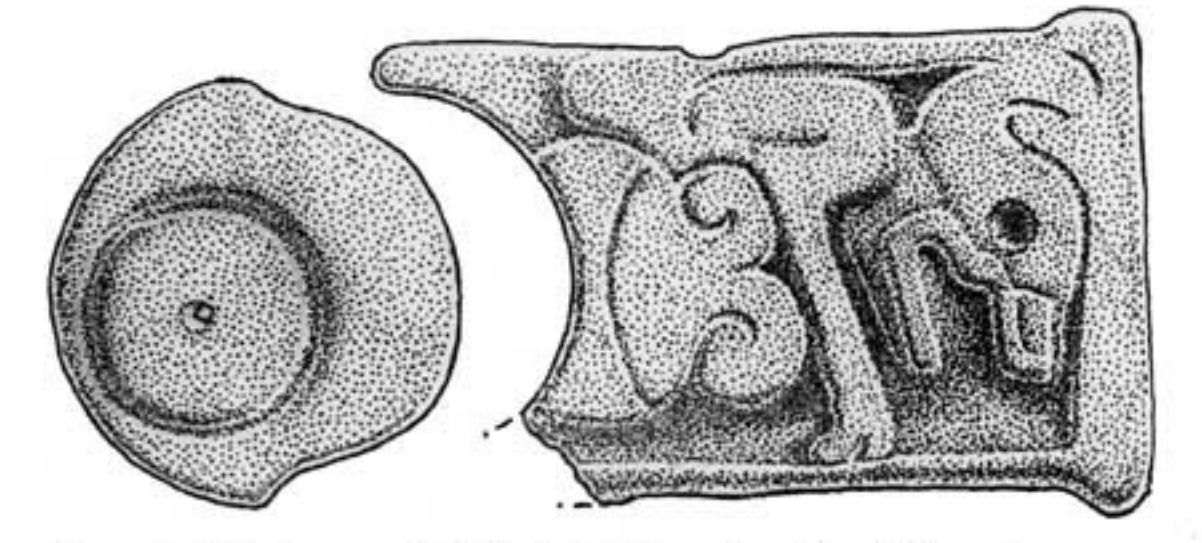

Figure 4. Side A, carved shell with Teotihuacán style shell creature [Drawing: Gustavo Valenzuela].

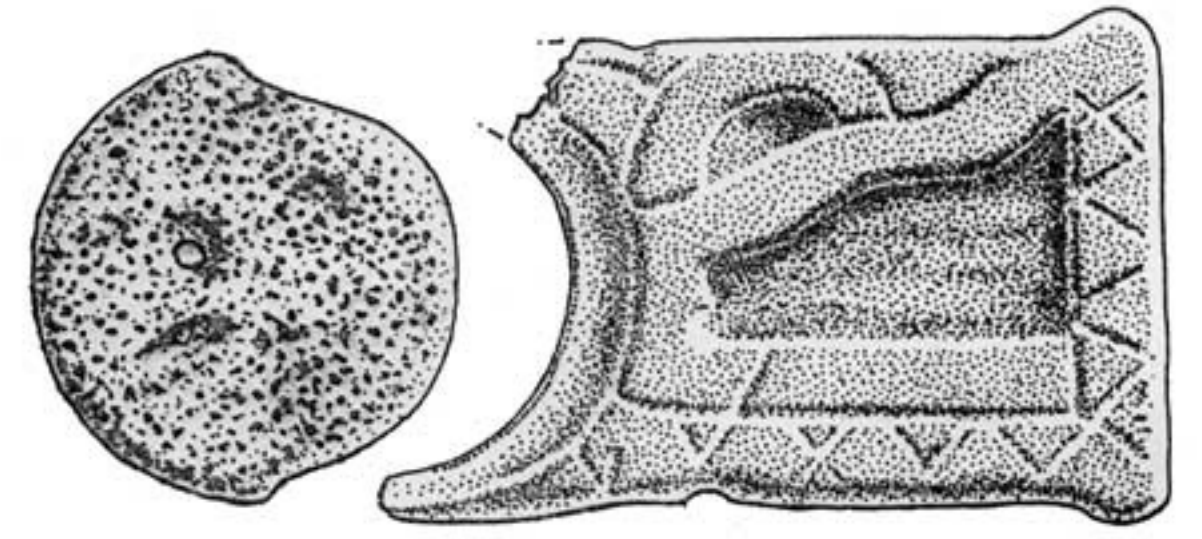

Figure 5. Side B, carved shell with Teotihuacán style serpent [Drawing: Gustavo Valenzuela].

Another shell object was finely carved in the form of a typical Maya face (Figure 6, below). This object was discovered face up in the west central section of the tomb. The

profiled face has a small mother of pearl shell fragment flanking a small circular piece of pyrite that forms the eye. The face on the shell is looking to the left, mouth slightly open, recessed chin, but no hair detailed. The function of this shell object is unknown, although it may have been used as decoration for clothing.

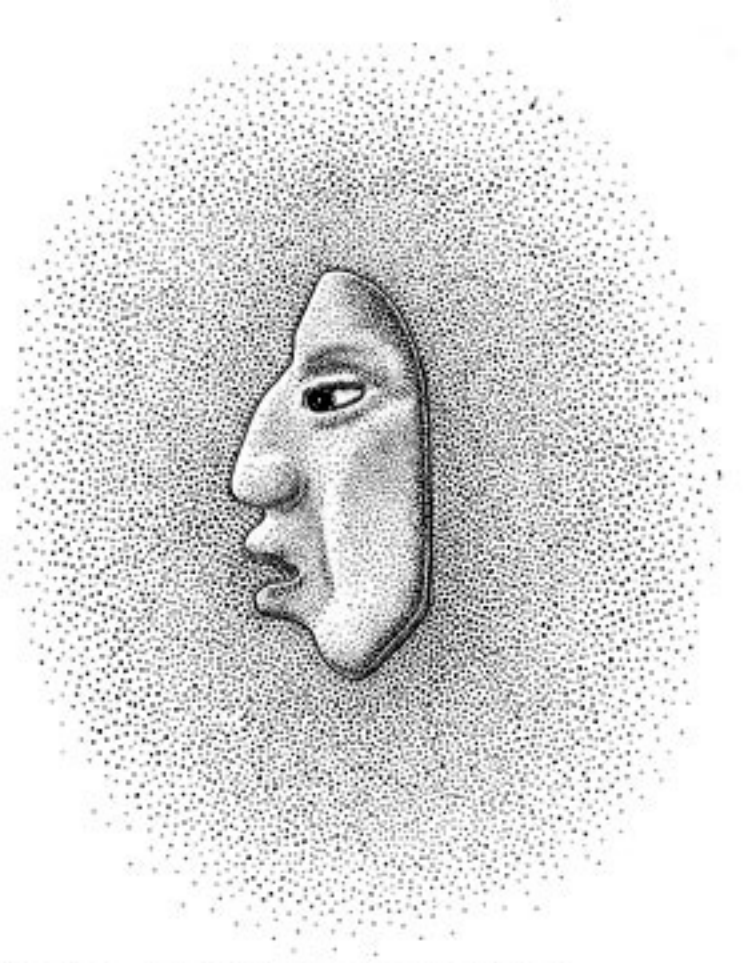

Figure 6. Shell profile of human face [Drawing: Gustavo Valenzuela].

Several other pink spondylus shell items of various sizes and shapes, and a single, orange colored, shell spindle whorl, were also found with the carved shells. The former objects had no recognizable forms thus it is difficult to determine their function. Along the north end of the chamber were two complete, 8 cm long, mother of pearl shells. One of these shells had two holes carved through it, while the second had three holes. North of these shells were two canine teeth which also had suspension holes carved through them. It is possible that all these objects were used on one necklace or that they were attached to a perishable item, like clothing, that decomposed in the tomb. Beneath these items we discovered more fragments of painted stucco, but unlike the stucco on the southern side of the tomb (to be discussed below), only traces remained of this

material. We removed the fragments of green and red paint and gave them to Harriet Beaubien for analysis.

Two jade beads and a single jade earflare were discovered in the tomb. The jade earflare is 2.6 cm in diameter and was located on the southeastern corner of the chamber, away from the location of the skull. The skull appears to have been moved from its original location, so it is therefore quite possible that this earflare was also moved from its original position sometime in the past. The two jade beads were located near the left humerus and were likely worn as part of a necklace. One of the beads had two holes drilled through it, while the other had three.

The eight ceramic vessels included five Saturday Creek Polychrome dishes, two Sotero Red-brown vessels, and a bichrome censer. The Sotero Red-brown vessels were discovered on the southern side of the tomb. All of the polychromes had painted animal figures on the inside of the vessels. Three of these vessels were stacked one on top of the other on the southeastern corner of the tomb, and the other two were stacked above a monochrome vase and bowl in the southwestern corner of the tomb.

The uppermost Saturday Creek Polychrome dish was broken into several sections, and parts of it were scattered throughout the tomb. Most interestingly, pieces of this dish were found in association with the Terminal Classic censer, suggesting that it may have been moved during the intrusion into the Tomb. This vessel contains the image of a waterlilly jaguar (Reents-Budet, personal communication) and appears to have been placed above a second Saturday Creek Polychrome vessel with a bird figure (Figure 7 and Figure 8). The third, fourth, and fifth polychromes were located east of the latter dish, and were stacked on top of one another. The uppermost vessel had the image of an armadillo painted on it, the second vessel had a painting of a dead deer (with the tongue hanging out), and the third vessel contained the image of two snakes rapped around the inner perimeter of the vessel with their heads and tails appearing in the center of the dish (Figure 9, Figure 10 and Figure 11).

Directly underneath the vessel with the bird figure and the polychrome of unknown design were two Sotero Red-brown vessels. The vessel closest to the skull was a bowl, while the one farthest south was a vase. Inside the vase were the remains of a stuccoed object of unknown design. The stucco was painted red, green, black, and white and several partial designs were noted on the crumbled remains. A second, larger, area with stuccoed remains was uncovered underneath the two Sotero vessels. The second stuccoed material measured approximately 30 by 40 cm. It consisted of several layers of stucco painted in green, white, red, black and yellow paint. Several flakes had images of possible glyphs and other presently undetermined designs. In an effort to preserve these remains the layers of stucco were collected and analyzed by Harriet Beaubien of the Smithsonian Institute. Her results are discussed below.

Figure 7. Polychrome dish: Waterlilly Jaguar [Drawing: Gustavo Valenzuela].

Figure 8. Polychrome dish: Bird [Drawing: Gustavo Valenzuela].

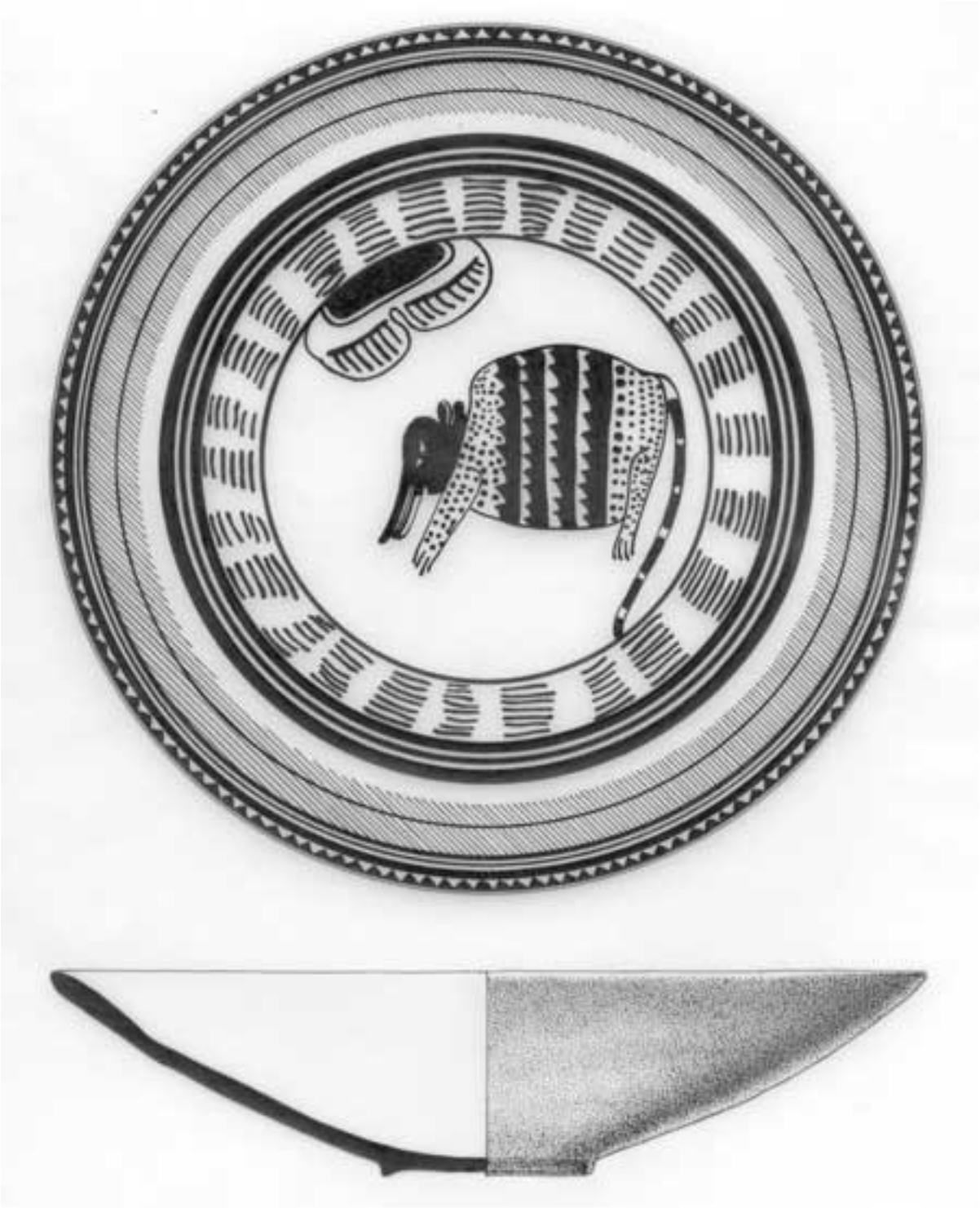

Figure 9. Polychrome dish: Armadillo [Drawing: Gustavo Valenzuela].

Figure 10. Polychrome dish: Deer [Drawing: Gustavo Valenzuela].

Figure 11. Polychrome dish: Serpents [Drawing: Gustavo Valenzuela].

Excavation of the Artifacts

The excavation of Tomb 2 was overseen by Carolyn M. Audet, field director for the Baking Pot Archaeological Project. With the removal of fill dirt in the chamber, Artifacts R and T were exposed as concentrations of paint fragments on the floor surface of the tomb, at the southern and northern ends of the burial respectively. Artifact S was found as a collection of loose fragments inside ceramic vessel #8 at the southern end. These items were excavated after a telephone consultation with Harriet F. (Rae) Beaubien on 28 July 2002. Artifact R was removed using a block-lifting technique. A tree root encountered in the sub-floor soil matrix disrupted the block, so it was removed in two segments (Portions A and B). The crumbly soil matrix prevented Artifact T from being lifted in a block; the paint fragments were separated and stored in a container. In the case of Artifact S, the paint fragments no longer retained any orientation and were simply removed for storage in another container. These items were transported from the site to the BVAR Laboratory in San Ignacio for safekeeping.

With the successful acquisition of funding from the Foundation for the Advancement of Mesoamerican Studies, Inc. (FAMSI) [Audet 2003], Audet and Beaubien established a collaboration through the Smithsonian Center for Materials Research and Education [SCMRE]. Under the aegis of SCMRE's Archaeological Conservation Program, Beaubien and post-graduate fellow, Claudia G. Chemello undertook the conservation and technical analysis, respectively, of archaeological remains of the painted/decayed artifacts.

Goals of Conservation and Technical Analysis

Description of the Artifacts

The artifacts, identified as Artifacts R, S and T survive only as paint fragments. The material to which the paint had originally been applied is absent, and is presumed to have been of organic origin, now decayed. All fragments are extremely fragile and break with minimal pressure. As a result, they are generally extremely small, most with a surface areas of a few square millimeters.

All of the paint fragments are made up of two principal layers: a pigmented layer, and a preparation or ground layer to which the pigment layer is well attached. A variety of colors were noted during preliminary examination, including various shades of green, red and white, plus blue and black. Six different types of ground, distinguishable by color and surface texture, were noted, including white (4), red and light brown; the red ground was subsequently determined to be an intermediate layer with the brown.

Our assumption is that fragments forming a discrete paint layer are presumed to have a ground layer in common, although their pigment applications may differ according to areas of the design. Texture observed on the exposed surface of a ground layer is a possible indicator of the original now-decayed organic substrate material. Stacked fragments oriented ground-to-ground would suggest that they had been applied to each

side of a shared substrate, while fragments oriented paint-to-paint would suggest contact between two painted components (either of the same object or two different objects).

Goals of the Project

The goals of treatment were to identify the artifact(s) through an investigation of structure and decoration, to reconstruct as much as possible of individual paint layers, and to stabilize and protect the remains for future study and long term preservation [see Audet 2003]. These activities would focus on Artifact R components, as the largest most complete deposit.

The goals of the technical study were to identify the composition of the paint and ground, to elucidate technical aspects of the decorative process, and to determine the original organic substrate, from evidence preserved in the loose paint flakes.

The features of the paint fragments and the deposits themselves, as well as their excavated condition, bear some resemblance to a paint deposit excavated in 1989 at the site of Cerén, El Salvador, initially thought to be the remains of a codex [Beaubien 1993]. While these were identified through conservation and technical study to be the remains of a painted gourd (others were subsequently found at the site), they provided the first evidence of this class of artifact. Information derived from the treatment and technical study of the Baking Pot artifact(s) will similarly be used to draw inferences about their nature. Because of the unusual survival and even rarer archaeological recovery of painted organic artifacts, these remains offer valuable evidence to add to the growing body of knowledge about these types of objects from Mesoamerican contexts [Shepard 1946; Grant 1999; Fash et al. 2001; Beaubien and Beaudry-Corbett 2002].

Artifact Conservation

Stabilization for Transport

Preliminary conservation was undertaken by Beaubien between 6 and 12 May 2003 in San Ignacio [Beaubien and Chemello 2003]. Additional disruption to Artifact R had occurred during its time in storage (Figure 12). Loose fragments scattered around the two blocks were collected and fragile features on the deposit surfaces were judiciously consolidated. To stabilize the blocks, a protective plaster cap was constructed around their sides and top. The blocks were inverted and extraneous soil matrix was removed (Figure 13). The components of Artifact R, along with fragments from S and T, were then securely packed. With proper clearance from the Department of Archaeology in Belmopan, they were hand-carried to SCMRE for further conservation and study.

Figure 12. Artifact R/Portion B prior to stabilization. The block is disrupted by a small root, seen jutting out on the lower left side. [Photo: HFB, 7 May 2003].

Figure 13. Portions A and B inverted after plaster jacketing. The soil pedestal has been trimmed on Portion A (right). [Photo: HFB, 10 May 2003].

List of Components

Artifact R (South end of the Burial)

Portion A (northern)

soil block/paint flakes in plaster jacket (24cm × 24cm × 8cm)

small chunk (in plaster collar) with adherent paint flakes

paint flakes in 6 3×5-inch bags

Portion B (southern)

soil block/paint flakes in plaster jacket (34cm × 24 cm × 10cm)

paint flakes in 4 3×5-inch bags

Other Components:

paint flakes in 1 bag (3×5 inch)

small matrix chunks and 2 small bags of dirt, with some paint flakes (plastic box)

Artifact S (South end of the Burial), collected within ceramic vessel #8

paint flakes in 1 small container

Artifact T (North end of the Burial)

paint flakes in 1 small container

Conservation of Artifact R at SCMRE

The treatment strategies utilized for the Cerén artifacts formed the basis for the conservation materials selection and the steps proposed in the condition report and conservation workplan [Beaubien and Chemello 2003].

In selecting conservation materials and methods to achieve these goals, the issues of long term stability and reversibility were weighed carefully, particularly if the materials were to be introduced into or be in direct contact with original parts. Materials also needed to work effectively in environments that might not be well controlled for humidity, temperature, light, earthquake protection, or pests. Inherent features of the artifact materials, such as highly fragmentary state and possible water sensitivity of the paint flakes, also had to be considered as they would affect the choice of conservation materials and techniques.

Conservation actions were carried out by Beaubien at SCMRE, beginning first with Artifact R/Portion B (November 2003 to February 2004) [Beaubien 2004]. The block was excavated in its inverted orientation. A 5cm-thick layer of sub-floor matrix soil was removed, containing white bits of calcium carbonate and bits of charcoal; no paint flakes were encountered. It terminated quite cleanly at a layer of white compact crumbly material (the underside of the floor), interrupted only by 1cm-thick plant root angling across the entire block. This had pushed the floor out of plane and probably contributed to the block's disruption during lifting.

Deposit on the floor

Little deposit material was present on one half, corresponding to an area where ceramic vessels had rested on the floor. Excavation focused on the other half, where the deposit was approximately 3-4cm deep. As the whitish floor material was removed, paint fragments were exposed in several areas (Figure 14, below). At this point, a grid was defined in order to be able to document their location. Eight grid squares, in two rows of four, were created, with the root lying along the top border of grids 5 through 8.

As excavation of the deposit progressed and paint flakes were encountered, they were cleaned in situ in order to define their extent, orientation or other features that might define a paint layer. No continuous layers were found. Instead, paint flakes occurred either in discrete clusters or were randomly scattered. These were treated as possible to retain their association and to remove them as an entity using a variety of reversible lifting techniques. The excavated painted remains are described below, grouped according to ground color using terminology defined by Chemello in her technical study (see Section IV). Distribution by grid location, original stratigraphic position, and possible relationships are discussed for each.

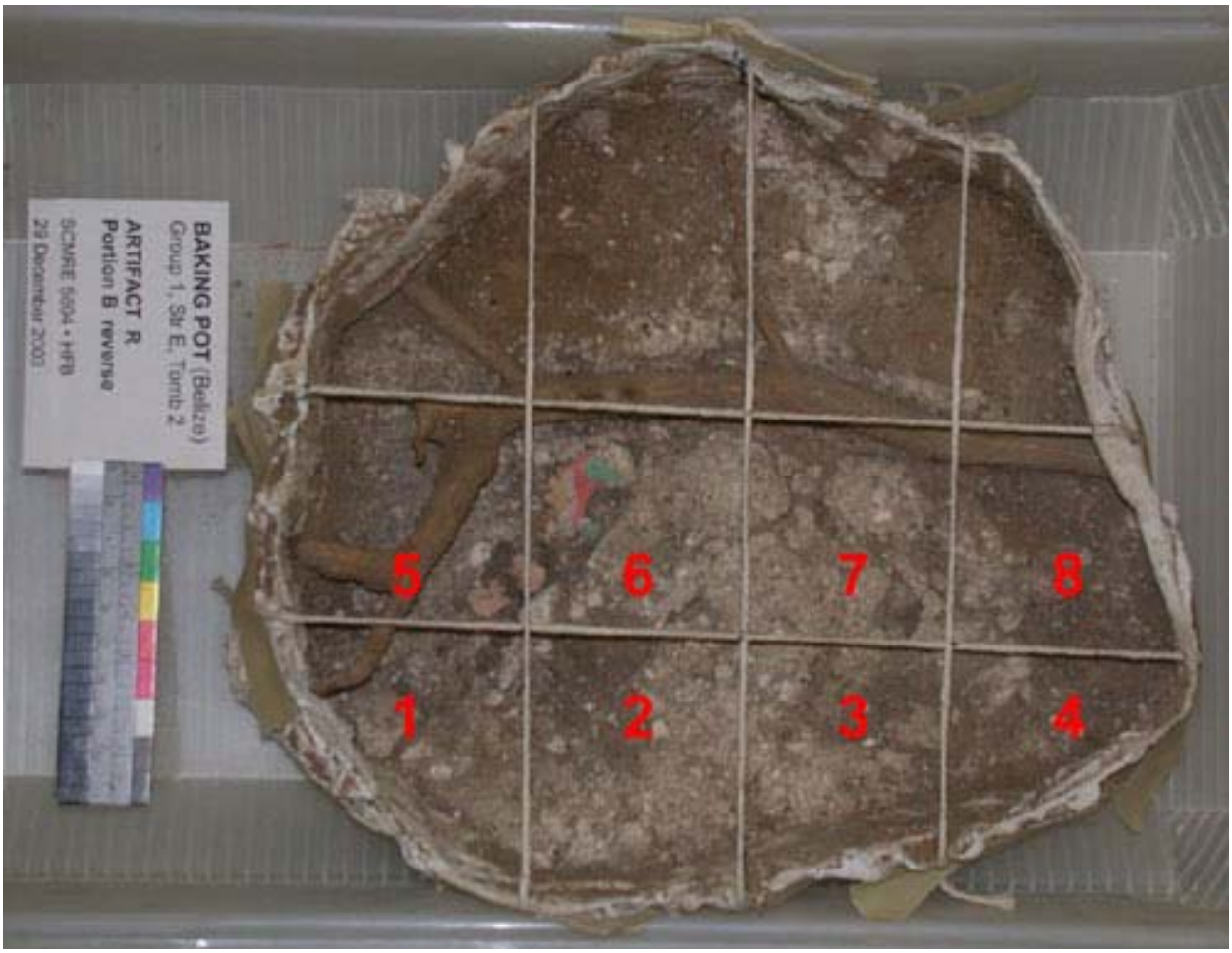

Figure 14. Portion B (inverted), with the first expanses of paint exposed by removal of floor material. The deposit to be excavated occurs only in the area defined by grid squares 1-8. [Photo: HFB, 29 December 2003].

- *Polychrome painting on cream ground*

  The paint flakes on cream ground had color patterns of bright green, salmon red and pink, yellow and white; the use of black lines was not found. The ground appears to be primarily of the smooth variety, although further examination may yield examples of the rough variety as well. Fragments of this type were found primarily in B-5, 6 and 7. The two most intact patches of paint were found lying on top of the floor and are possibly related to the same object (Figure 15). However, their orientations differed (paint-side-up and -down, respectively); their relationship is currently unclear.

- *Polychrome painting on white ground*

  Most of the fragments excavated from the block were of this type, with green the prevalent color, and design elements in olive green, salmon red, brick red and

white, with black lines. Fragments of this type were found in all grid locations from B-1 through B-8, with the greatest concentration in the four-corner area of B-1, 2, 5 and 6, and in B-7. The most intact patches of paint were found oriented paint-sides-down, possibly connecting (Figure 16). Lying between them and the floor were crumbly shell fragments and some deposit soil.

- *Monochrome painting on white ground with red flecks*

  Flakes with red-flecked white ground were only painted with faded green. This fragment type was concentrated in B-7 and 8, intermixed with soil chunks that indicate significant disturbance in these areas. As an example, the most intact patch of paint was found in a vertical orientation (Figure 17, shown below, and Figure 18).

- *Monochrome painting on brown ground (with or without red intermediate layer)*

  Only bright green paint was used with the brown ground types. The flakes were found only in grid B-5, and particularly near the edge of the block (Figure 19 and Figure 20, shown below). The most intact patches occurred in paint-side-up orientation, with some deposit soil occurring between the fragments and the floor surface.

Other than the paint flakes, there were two notable components of the deposit, both of which may shed light on now-degraded substrate materials. One was a thin layer of dark pink and white fibrous crumbly fragments, which may be the degraded remains of shell. These occur extensively in grid B-6, extending into B-5, and just into B-1, 2 and 7. It is possible that at least one of the paint layers (possibly associated with the brown ground) decorated this type of material. The other component is a dark brown compact material, noted as a 2.5mm thick layer lying just above the floor in cross-section on the sides of Portions A and B during preliminary stabilization in Belize. It was also found lying on the floor in contact with the underside of paint cluster B-5.4, and may represent the remains of that paint layer's organic substrate.

Portion A has not yet been excavated. While it is possible that its deposit may contain better preserved constituents, their general character is not expected to differ significantly from that of the constituents found in Portion B. However, additional paint layer expanses would be expected to provide more insight into the decorative scheme of the artifact(s).

Figure 15. Paint patches with cream grounds: B-5.4 (1.5cm × 2.5cm) and B-6.4 (2cm × 4cm). [Photo: HFB, 5 January 2004].

Figure 16. Paint patches with white ground: B-1.2 (1cm × 3cm) and B-1.2b (1.5cm × 1.5cm). [Photo: HFB, 14 January 2004].

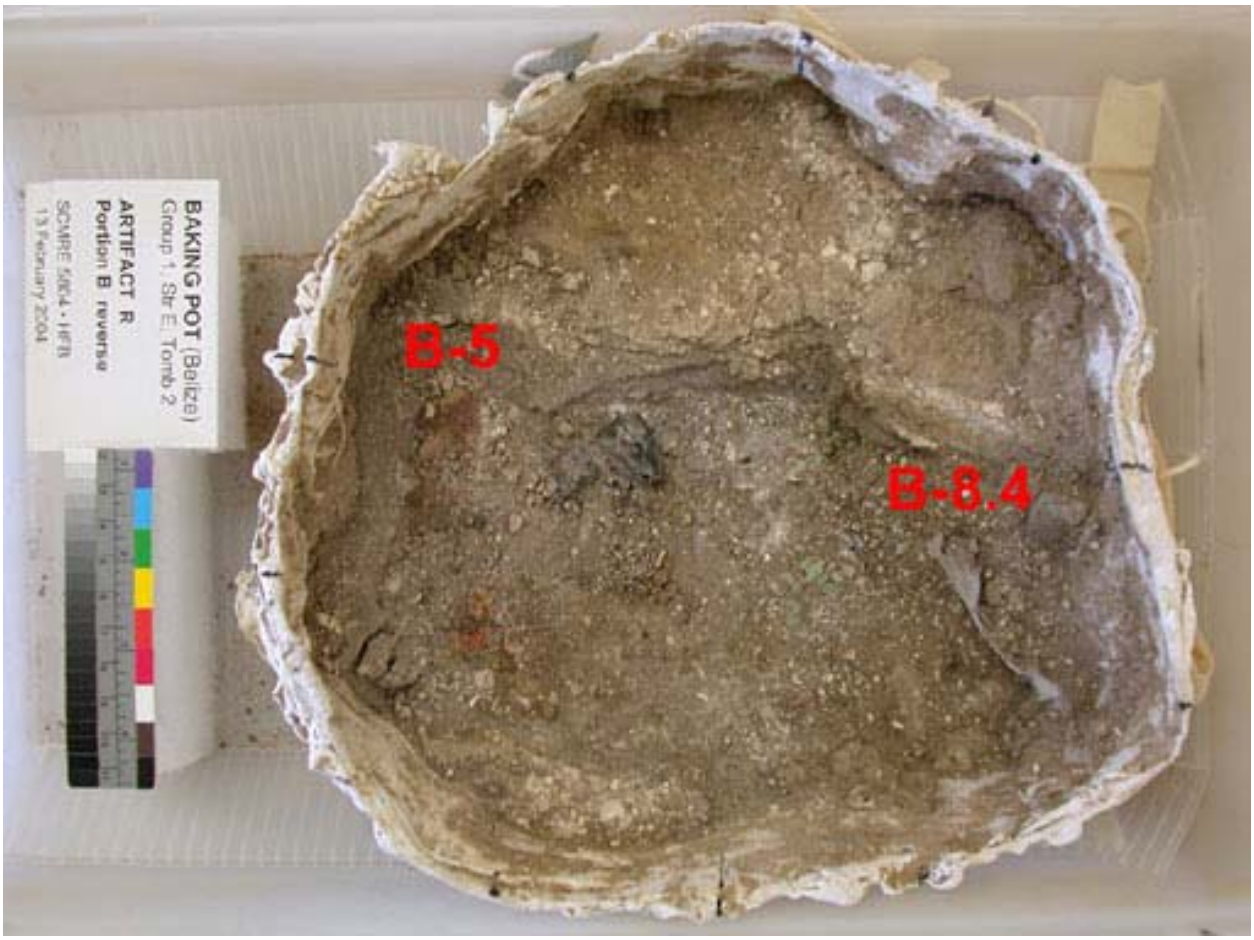

Figure 17. Portion B, showing in situ paint patches. The largest one with red-flecked white ground – B-8.4 (1.5cm × 5cm) – was faced with tissue to hold the flakes together. Flakes of the brown-with-red ground type appear in grid 5. [Photo: HFB, 13 February 2004].

Figure 18. Paint patch B-8.4 lifted, showing its red-flecked white ground surface. [Photo: HFB, 13 February 2004].

Figure 19. Paint patches with brown grounds: B-5.2 (0.75cm × 2.5cm), lying above other flakes of the same type visible in Figure 6. [Photo: HFB, 13 January 2004].

Figure 20. Tray containing paint flakes associated with Portion A. Those with brown grounds are grouped in the left column; those with cream grounds are in the two others. [Photo: CGC, 16 December 2003].

Technical Study of Paint Flakes

The technical study was carried out at SCMRE using the 13 containers of paint flakes, 11 associated with Artifact R, and 1 each for Artifacts S and T [Chemello 2004] (Figure 21). The following chart shows the types of paint color and ground, referenced to artifact, documented from examination of hundreds of disassociated fragments.

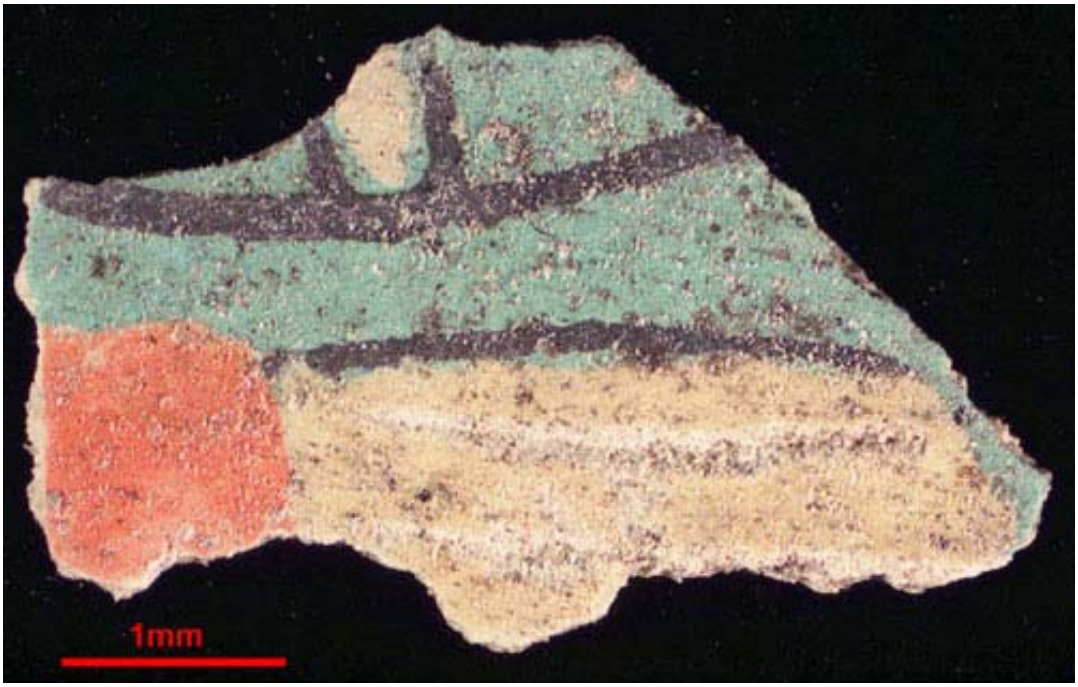

Figure 21. Paint flake (on white ground) with bright green, salmon red, cream, white and black paints, from Artifact S. [Photo: CGC, 9 March 2004].

Figure 22. Paint flake (on white ground), showing the decorative technique in cross-section. [Photo: CGC, March 2004].

PAINT	GROUND				
	White	White + red flecks	Cream, smooth	Cream, rough	Brown +/- red
Green, bright	R S T		R – T	R – –	R – T
Green, faded		R – –	R – –	R – –	
Green, olive			R – –		
Blue			R – –	R – –	
Red, salmon	R S T		R – T	R – –	
Red, brick	R S T				
Red, bright*	– – T				
Yellow			R – T	R – –	
Cream	R S T		R – –		
White	R S T		R – T	R – –	
Black	R S T		R – T	R – –	

Approximately 80 flakes, representative of each pigment and ground type per location, were selected for analytical procedures. Compositional information was derived from optical microscopy of paint flakes and embedded cross-sections; energy dispersive x-ray spectroscopy [EDS] and scanning electron microscopy [SEM] of mounted flakes (for elemental information and high-magnification imaging, respectively); x-ray diffraction [XRD] (mineralogical information); Fourier transform infrared spectroscopy [FTIR] (general organic constituents) and gas chromatography/mass spectrometry [GC/MS] of one sample (organic identification). Information about the painting technique relied primarily on microscopy, especially of cross-sections. Inferences about the nature of the original substrate were based on microscopy observations and FTIR analysis.

The range, grouped by ground type, is illustrated as follows: white (Figure 22, Figure 23 and Figure 24); white with red flecks (Figure 25); smooth cream (Figure 26); rough cream (Figure 27); and brown with red intermediate layer (Figure 28 and Figure 29).

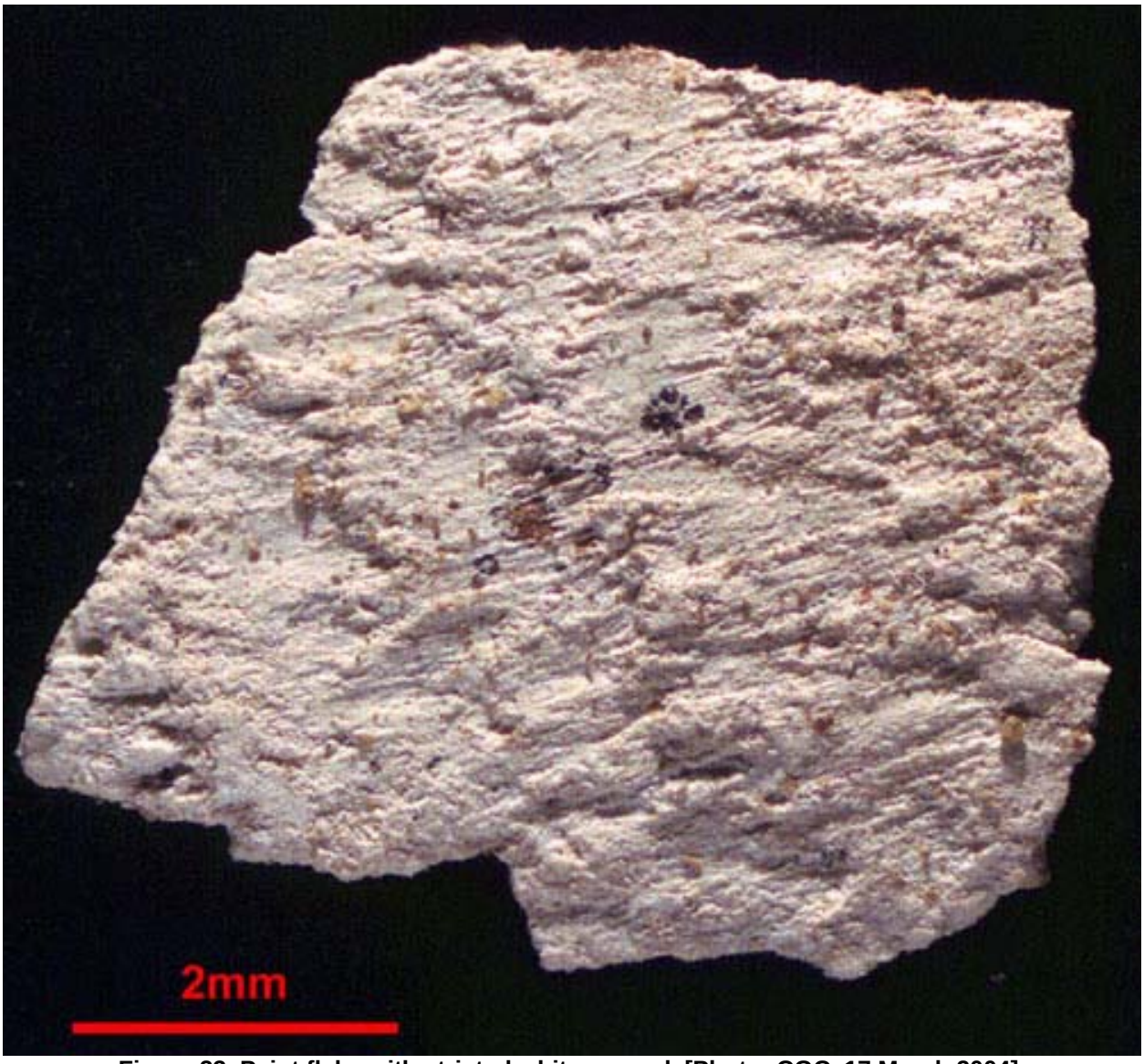

Figure 23. Paint flake with striated white ground. [Photo: CGC, 17 March 2004].

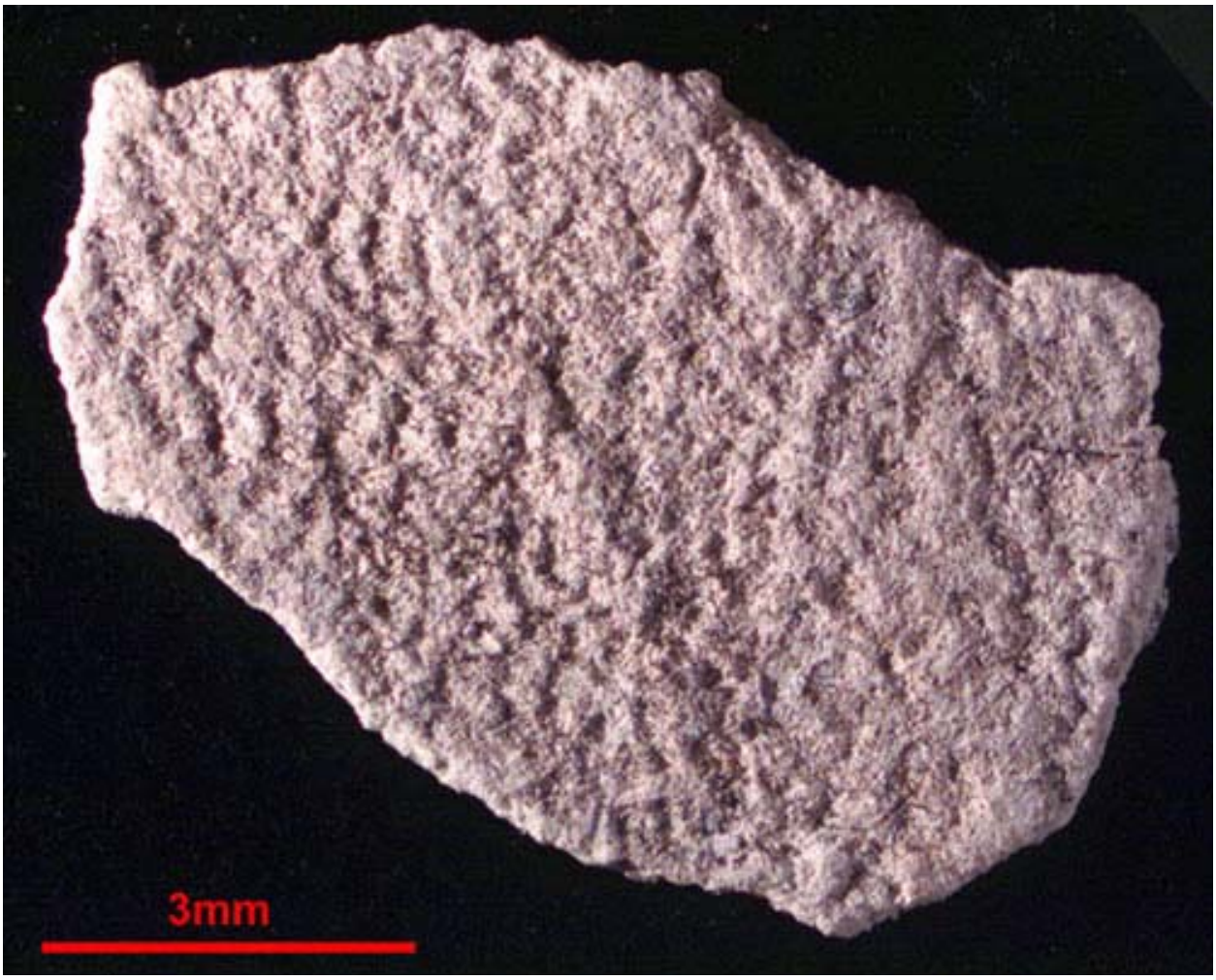

Figure 24. Paint flake with dimpled white ground, from Artifact S. [Photo: CGC, 17 March 2004].

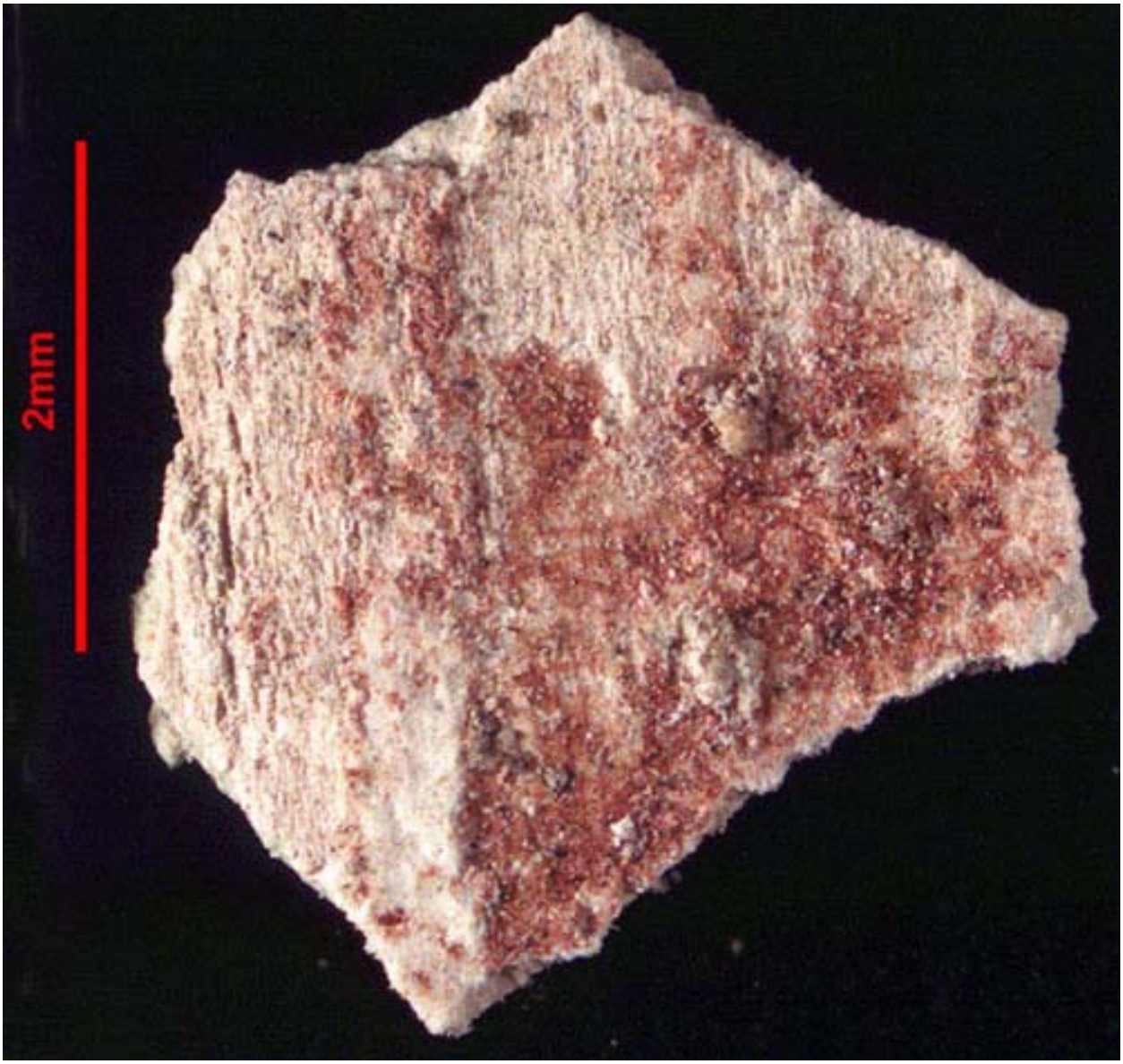

Figure 25. Paint flake with red-flecked white ground. [Photo: CGC, 9 March 2004].

Figure 26. Paint flake with smooth cream ground. [Photo: CGC, 17 March 2004].

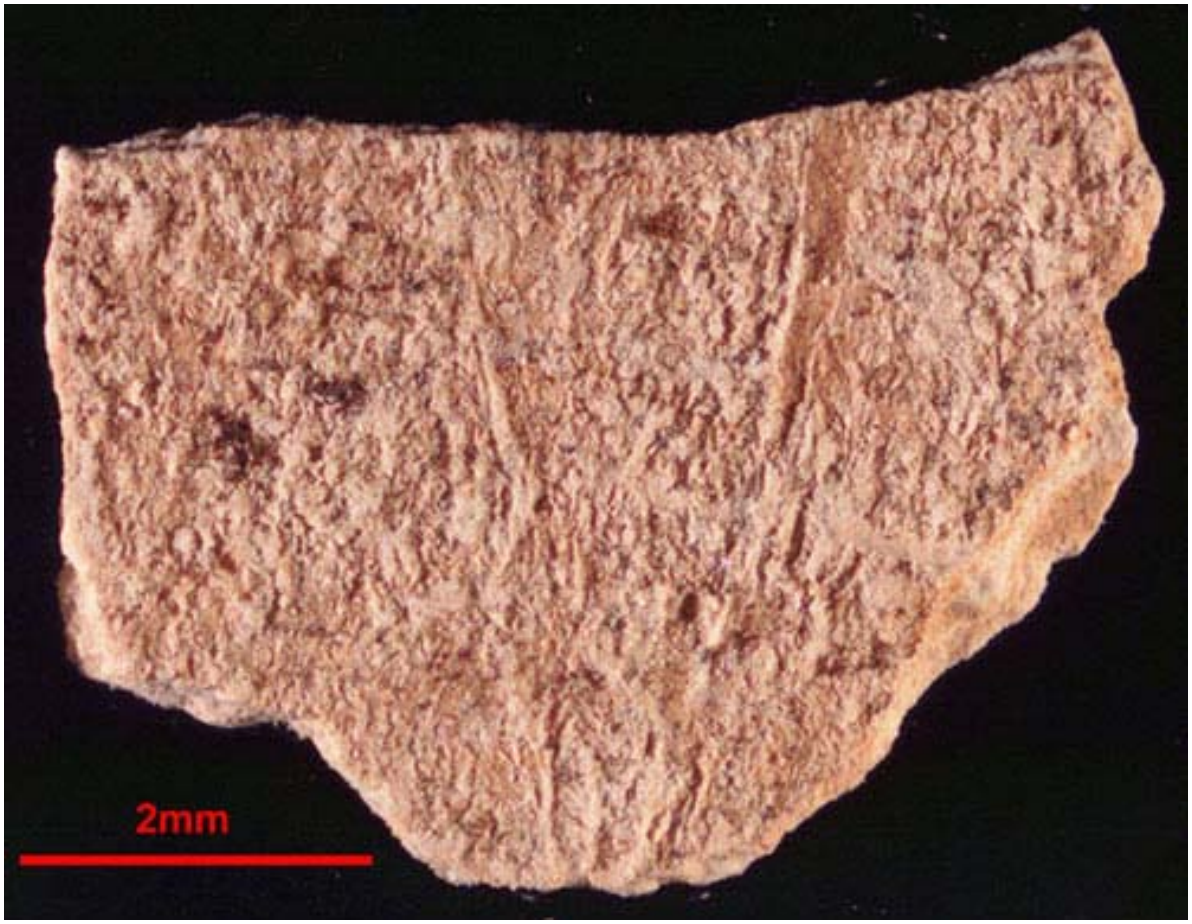

Figure 27. Paint flake with rough cream ground. [Photo: CGC, 17 March 2004].

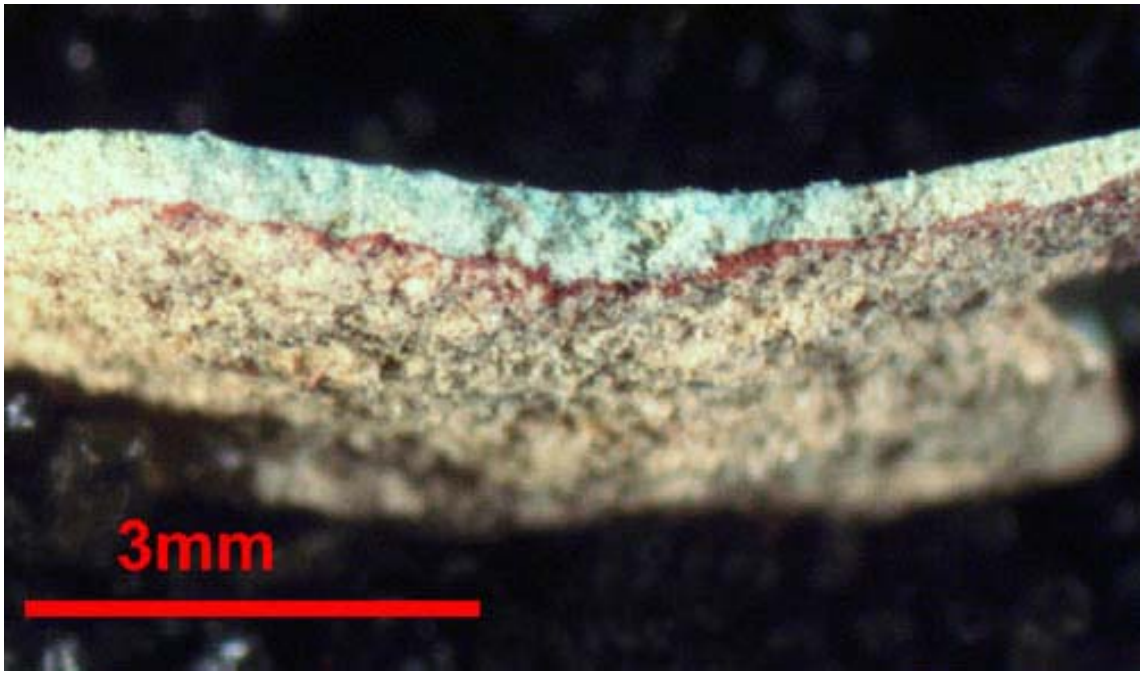

Figure 28. Paint flake in cross-section, with brown ground and an intermediate red layer. [Photo: CGC, March 2004].

Figure 29. Paint flake with brown ground. [Photo: CGC, 17 March 2004].

Paint Layer Composition

Paints are typically composed of a combination of colorants, bulk additives, liquid carrier and binder. The analyzed paint layers contained colorant minerals in combination with significant quantities of various calcitic minerals; clay minerals and quartz (likely naturally occurring impurities) were also prevalent.

The colorants represent a diverse palette, sometimes mixed to produce different hues. Pseudomalachite [$Cu_5(PO_4)_2(OH)_4$] and malachite [$Cu_2CO_3(OH)_2$] formed the basis for all greens, and occurred with azurite [$Cu_3(CO_3)_2(OH)_2$] in the blue. Goethite [Fe^3+O(OH)] was added to modify the olive green, and was the basis for the yellow and cream paints. Cinnabar [HgS] was the colorant for the most common red (salmon); the brick red was hematite [Fe_2O_3], and a mixture was present in the bright red, which occurred only as a small splotch on one fragment. The black was carbon-based, probably a plant charcoal.

All of the mineral constituents were generally finely crushed, with grain size of less than 15µm; this is considered microcrystalline, i.e., having a texture between 10-200µm [Bates and Jackson 1980:396]. The paint preparation of colors was coarser when used in monochromatic applications (on brown and red-flecked white grounds), than in polychromatic ones. A significant component of all paints, however, was "cryptocrystalline calcite" – areas in which crystals or grains are too small to be recognized as separate grains using ordinary magnification, i.e., less than 1µm [Bates and Jackson 1980:183]. Cryptocrystalline calcite is usually a good indication of a lime plaster technique, in which calcium carbonate raw materials have been processed with heat (calcining) and slaked (combined with water) [Shepard 1946; Hansen 2000].

Distinct calcium carbonate grains were also found, indicative of either impurities or additives. The presence in the white paint of aragonite, the least stable of the calcium carbonate minerals [Boynton 1980:29], suggests deliberate addition, either as a bulking material or colorant, possibly originating from ground shell.

The role of the binder in a paint mixture is to cohere the paint components, enhance working properties, and adhere the paint film to the substrate [Hansen et al. 1993: xv]. Binding media are often naturally occurring organic substances, such as exudates from bark or plants [Littmann 1960]; for example, such materials were identified in mural paintings from Bonampak [Magaloni et al. 1995a]. Analysis by FTIR detected no organic binder in the paint layers, but should be considered inconclusive; even if present, organic binding media may occur at levels below the technique's detection limits. It is more likely that slaked lime served to bind the paint components and impart permanence, as Shepard [1946:273] concluded in her study of paints from various objects at Kaminaljuyu, including perishable objects; with such use, organic binders might be unnecessary [Fletcher 2002].

Ground Layer Composition

The cream, white and brown grounds all contained significant quantities of various calcitic minerals, clay minerals and quartz, similar to those detected in the paints. Grain size of the component minerals, generally larger than the paints, varied with each type of ground, but all were less than 100µm (considered microcrystalline). "Cryptocrystalline calcite" was a significant component, as with the paint layers. In general, the rough cream and the smooth cream were the most homogenous and finely textured of all the ground types. The white ground with red flecks had less finely ground grains. The brown ground was the coarsest, least homogenous and crumbly. The red ground, found occasionally as an intermediate layer with the brown ground, contained hematite as a colorant, ground more coarsely than the same mineral used in the paint.

FTIR analysis detected no organic component within the ground layers that might indicate use of organic binders, such as have been found elsewhere [Magaloni et al. 1995b]. As with the paint layers, it is more likely that slaked lime functioned as a binder, cementing the ground particles. The clay minerals detected in the ground layers may

have been part of the calcareous or pigment raw materials, or deliberately added later to modify certain properties of the mixture [Hansen 2000].

Painting Technique and Decorative Scheme

Fragments forming a discrete paint layer are presumed to have a ground layer in common, although the decorative paint scheme may vary across the surface, or differ from one side to the other of an object. The ground was applied to the object surface, followed by application of discrete non-layered paint colors. There were no discernible tool marks in the paint or ground layer to indicate how they were applied, with the exception of the black painted lines (see below); use of a brush is assumed. The paint surface is very smooth, but without specific evidence of burnishing.

Polychrome decoration

A varied palette of paint colors was used on three different ground types – smooth cream, rough cream and white. The colors were applied in a fairly even layer, which in most of the samples averaged approximately 20µm in thickness; the ground layers ranged between 80 and 150µm in thickness. The colors did not bleed into the ground or into adjacent colors, indicating that one material was relatively dry before another was added; they only overlapped slightly at design edges.

Nine colors were documented on samples with the smooth cream ground: bright green, faded green, olive green, blue, salmon red, yellow, cream, white and black. Seven colors were documented on samples with the rough cream ground: bright green, faded green, blue, salmon red, yellow, white and black. The designs were generally rendered as curvilinear color areas (see Figure 15 and Figure 20).

In the case of the white ground, six colors were documented (see Figure 16 and Figure 21). The most common were bright green, salmon red, white and black; cream and brick red also occurred. The bright green had a consistent thickness of about 20µm. The salmon and the brick reds were the thinnest of all, averaging 4µm and 7µm respectively; other colors ranged between 6 and 45µm.

Finely delineated color areas were created using a decorative technique unique to this ground type, visible in the several cross-sections (see Figure 22). Bright green paint was applied to the ground, leaving voids for other colors. A white paint, containing a large amount of aragonite, was applied in the voids to bring the level up to that of the green, often overlapping slightly at the edges. This white area was sometimes painted over with salmon red in an extremely thin layer. Black, when it occurred (most frequently on the bright green), was applied into a fine groove that had been incised into the underlying color and, in some cases, into the ground. The slight curvature at the base of the grooves provides an indication of a specialized tool for this pigment application.

Monochrome decoration

Green was the color of choice in the monochromatic applications, utilized in conjunction with two ground types.

The red-flecked white ground was painted with the faded green color (the same color, used on a cream ground, is seen in the lower right column in Figure 20). This ground type had an uneven surface upon which the paint layer was applied; as a result, the paint layer exhibited varying thickness. It may have been applied to the ground before it was fully dry, resulting in some blending of the color with the ground at the interface.

The brown ground averaged approximately 150µm in thickness, at the thick end of the range. In cross-section, an intermediate thin grainy red-colored layer was occasionally detected, and may represent a highly localized application of red on what is otherwise a brown ground (see Figure 20, Figure 28, and Figure 29). It measured no more than about 50µm. (Note: a number of fragments preserved only this red layer, with remnants of a crumbled-off brown portion.)

Bright green was the only color used in conjunction with the brown ground. It was considerable thicker and more variable in the brown-only samples, between approximately 60-150µm in some samples, and approximately 250µm in other examples. On red-and-brown samples, it was between 50 and 75µm. In both cases, some of the green particles blended in with the upper part of the ground, possibly indicating that the ground layer was not fully dry or leveled when the green paint was applied.

Indicators of the Original Substrate(s)

The underside of the paint flakes provided some evidence of the original (now decayed) object that had originally been decorated. Features such as surface texture (impressed in the still-wet ground layer by the object surface at the time of application), and accretions or stains (exuded by the substrate) were analyzed.

Only one of the ground types had a smooth surface, the smooth cream (Figure 26). Its lack of textural features suggests a material such as a gourd exterior.

The other ground types displayed several different textures. The rough cream ground had a fibrous texture (Figure 27). Objects such as gourds possess one smooth and one fibrous veined surface, and it is possible that the flakes with cream-colored grounds represent the inner and outer surface of a painted gourd. (Note, however, that the elaborate decorative approach apparent for both ground types does not parallel the approach exhibited by the Cerén gourds, the interiors of which were always monochromatic.)

The white ground was distinguished by several textures (Figure 23 and Figure 24). The more common one was striated, suggesting wood or fibrous materials. Other flakes had a dimpled surface, created by a raised bumpy texture on the object surface. It is possible that these textures represent different types of objects, although they share a polychromatic color scheme.

The striated texture also characterized the red-flecked white ground, similar to that of the white-only version (Figure 25). The red flecks produced the only evidence of organic constituents with FTIR; carbohydrates were detected and confirmed further with GC/MS. These may be naturally occurring plant gums, transferred or exuded from the surface of the original object prior to its decay. The monochromatic color scheme suggests that these flakes represent an interior or underside of an object, the exterior of which might have had a polychrome-on-white decorated surface.

The brown ground (including those with the red intermediate layer) was too granular and coarse to preserve a distinctive texture (Figure 29). However, it appears to have been applied to an object with a very irregular surface, which may have provided a key for the poorly compacted material. The unevenness of the object's surface resulted in a paint layer of varying thickness, in order to achieve a smooth paint surface. The monochromatic color scheme suggests that the flakes are probably the remains of one discrete painted object or a particular side of an object, characterized by a coarse texture, and perhaps one that did not warrant a fine painting technique.

Preliminary Interpretation of the Artifacts

The primary deposit (Artifact R) occupied an area, approximately 30cm × 40cm, on the tomb floor near the head of the interred individual. The initial hypothesis was that the paint fragments constituted the remains of a codex (the term used to describe the form of the ancient Mesoamerican book). This was based on at least one relatively continuous, flat expanse of paint that was fractured but maintained relative orientation. In several areas, there were occurrences of stacked fragments, which suggested that there may have been multiple layers of paint. How this deposit related to the two other small discrete groups of paint flakes – one inside a ceramic vessel near the head of the interred individual (Artifact S), the other near the feet of the individual (Artifact T) – was unclear.

Object Types

Based on Beaubien's excavation of Artifact R portion B, and Chemello's technical investigation of disassociated paint flakes (originating from Artifact R, as well as those collected as Artifacts S and T), we offer the following preliminary interpretations.

Assuming a painting approach, in which a particular decorated surface – and possibly an entire decorated object – shares a common type of ground or preparation layer, the

major distinctions in ground color, texture, thickness and morphology offer persuasive evidence of more than one painted organic object. Neither the decorative approaches, nor the disposition of paint flakes within the deposit, suggest that the paint flakes represent the remains of a codex, based on the examples known to date.

The decorative approaches, extrapolated on the basis of the few "islands" of paint excavated from Artifact R/B and selected disassociated fragments, include one in which curvilinear blob-like areas of color are scattered on a green background, and another with a finer rendition of colored shapes using fine black lines. When combined with monochrome green surfaces, these decorative schemes are reminiscent of those of painted gourds excavated at the site of Cerén (El Salvador) [Beaubien and Beaudry-Corbett 2002], or of painted wooden furnishings in the tomb of Ruler 12 at Copán (Honduras) [Fash et al. 2001].

In combination with the numerous disassociated fragments, the excavated "islands" would seem to represent still-intact portions of larger paint layers. However, their paint-side-up or -down orientation and distribution in the deposit are not consistent relative to each other, suggesting disruption of the deposit in the past, if not just from the time of discovery. Alternatively they may represent many small or partially decorated objects.

By far comprising the large group of fragments, Artifact R is characterized by the full assortment of paint and ground colors and types. In general, the three different ground colors argue for application on at least three different objects. Textural differences in similarly colored grounds, such as the two cream-colored grounds, may reflect use on an object whose inside and outside surfaces have distinctive characteristics. Gourds are an example, with the fruit shell having a smooth exterior and fibrous interior. Striated patterns seen in at least one of the ground types suggest the use of wood, particularly in combination with organic residues identified as plant gums (as on the red-flecked white ground). The flakes on brown ground may have decorated a highly textured shell, based on their characteristics and the concentration in a thin layer of fragments resembling degraded shell, excavated in that area of the deposit (Portion B). With further analysis, the thin compact dark brown layer may also indicate an organic substrate material.

The second largest group of paint fragments, designated Artifact S, was collected from the interior of a ceramic vessel, situated in the region of Artifact R. The deposit is only made up of paint flakes with dimpled white ground, a type also documented in Artifact R. This deposit may represent an object extending from the area of Artifact R across the ceramic vessel, such that portions would subsequently collapse within it.

The smallest group of paint fragments of the three groups, Artifact T, was collected on the tomb floor near the feet of the interred individual. The flakes from Artifact T represent three different ground types and a variety of colors, also found in Artifact R; only flakes with rough cream and red-flecked white ground types are absent. The quantity is small enough that they are more likely to have been displaced from the Artifact R deposit in some kind of tomb disturbance than to be separate objects.

Contributions to Technical Studies of Maya Painting Traditions

Technical information derived from this study about the paint and ground, as well as decorative approaches, adds significantly to available information about ancient Mesoamerican painting traditions. While the palette of colors includes mineral colorants that have had documented use in mural painting, post-fire painting on ceramics, and decoration of now-decayed organic artifacts [e.g. Magaloni et al. 1995; Fletcher 2002; Beaubien and Beaudry-Corbett 2002], the surprising discovery was the use of a little-known copper phosphate, pseudomalachite, as the predominant green on the Baking Pot objects. There are a few published studies of this mineral's use elsewhere [Scott 2002; Naumova and Pisareva 1990; Newman and Derrick 2002]. However, its use in Mesoamerica has not heretofore been recorded, although another occurrence was identified in analyses of paint flakes from decayed organic artifacts excavated at Santa Rita Corozal, Belize [unpublished analyses carried out in 1990 by Beaubien, SCMRE #5168]. It is possible that pseudomalachite may occur more frequently than is reported. Its visual similarity to the much more common malachite raises the prospect of erroneous identification of green paints based on assumption rather than mineralogical analysis. Alternatively, its identification at Baking Pot may represent localized or specialized use. Either of these scenarios indicates the need for further technical investigation.

List of Figures

Figure 1. Map of Group 1, Baking Pot [Map: Jim Conlon].

Figure 2. Plan of Tomb 2 [Drawing: Nasario Puc].

Figure 3. Image of shells in shape of Mundo Maya logo [Photo: CMA, 15 September 2004].

Figure 4. Side A, carved shell with Teotihuacán style shell creature [Drawing: Gustavo Valenzuela].

Figure 5. Side B, carved shell with Teotihuacán style serpent [Drawing: Gustavo Valenzuela].

Figure 6. Shell profile of human face [Drawing: Gustavo Valenzuela].

Figure 7. Polychrome dish: Waterlilly Jaguar [Drawing: Gustavo Valenzuela].

Figure 8. Polychrome dish: Bird [Drawing: Gustavo Valenzuela].

Figure 9. Polychrome dish: Armadillo [Drawing: Gustavo Valenzuela].

Figure 10. Polychrome dish: Deer [Drawing: Gustavo Valenzuela].

Figure 11. Polychrome dish: Serpents [Drawing: Gustavo Valenzuela].

Figure 12. Artifact R/Portion B prior to stabilization. The block is disrupted by a small root, seen jutting out on the lower left side. [Photo: HFB, 7 May 2003].

Figure 13. Portions A and B inverted after plaster jacketing. The soil pedestal has been trimmed on Portion A (right). [Photo: HFB, 10 May 2003].

Figure 14. Portion B (inverted), with the first expanses of paint exposed by removal of floor material. The deposit to be excavated occurs only in the area defined by grid squares 1-8. [Photo: HFB, 29 December 2003].

Figure 15. Paint patches with cream grounds: B-5.4 (1.5cm × 2.5cm) and B-6.4 (2cm × 4cm). [Photo: HFB, 5 January 2004].

Figure 16. Paint patches with white ground: B-1.2 (1cm × 3cm) and B-1.2b (1.5cm × 1.5cm). [Photo: HFB, 14 January 2004].

Figure 17. Portion B, showing in situ paint patches. The largest one with red-flecked white ground – B-8.4 (1.5cm × 5cm) – was faced with tissue to hold the flakes together. Flakes of the brown-with-red ground type appear in grid 5. [Photo: HFB, 13 February 2004].

Figure 18. Paint patch B-8.4 lifted, showing its red-flecked white ground surface. [Photo: HFB, 13 February 2004].

Figure 19. Paint patches with brown grounds: B-5.2 (0.75cm × 2.5cm), lying above other flakes of the same type visible in Figure 6. [Photo: HFB, 13 January 2004].

Figure 20. Tray containing paint flakes associated with Portion A. Those with brown grounds are grouped in the left column; those with cream grounds are in the two others. [Photo: CGC, 16 December 2003].

Figure 21. Paint flake (on white ground) with bright green, salmon red, cream, white and black paints, from Artifact S. [Photo: CGC, 9 March 2004].

Figure 22. Paint flake (on white ground), showing the decorative technique in cross-section. [Photo: CGC, March 2004].

Figure 23. Paint flake with striated white ground. [Photo: CGC, 17 March 2004].

Figure 24. Paint flake with dimpled white ground, from Artifact S. [Photo: CGC, 17 March 2004].

Figure 25. Paint flake with red-flecked white ground. [Photo: CGC, 9 March 2004].

Figure 26. Paint flake with smooth cream ground. [Photo: CGC, 17 March 2004].

Figure 27. Paint flake with rough cream ground. [Photo: CGC, 17 March 2004].

Figure 28. Paint flake in cross-section, with brown ground and an intermediate red layer. [Photo: CGC, March 2004].

Figure 29. Paint flake with brown ground. [Photo: CGC, 17 March 2004].

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