

# Continued Documentation of Monuments at Lamanai and Initial Computational Photography

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## Introduction

Between the 29<sup>th</sup> of June and the 2<sup>nd</sup> of July, 2019, the authors of this report documented the carved monuments found at Lamanai as part of excavations conducted at the site under the direction of Dr. David M. Pendergast (1974–1988) (see Pendergast 1975, 1977, 1981a, 1981b, 1984, 1986a, 1986b). The first author serves as epigrapher for the Lamanai Archaeological Project (1998–present), whereas the second author served in the capacity of computational photographic expert with the Belize Valley Archaeological Reconnaissance Project. The 2019 documentation efforts were conducted as part of the Lamanai Archaeological Project, under the direction of Dr. Elizabeth Graham (2000, 2004, 2008). This report constitutes the third instalment, wherein the first reported on work conducted at the site in 2016 (Helmke 2017) and the second in 2017 (Helmke 2018). Both of the latter, as well as the present report, have been formally submitted to the Director of the Institute of Archaeology in Belmopan.

The purpose of this research effort is to continue the documentation of the monuments including their physical properties and state of preservation, to secure photographs of these *in situ*, as well as to ascertain the original provenience and current position of each at the site. Also in keeping with the goals of the previous seasons, the work aims to finalize templates that are used in the drafting of new line drawings of the site's extant corpus of monuments. In 2019, many of the inked drawings were checked against original monuments, correcting minor errors and finalising the line drawings. These new drawings are part of an on-going research effort, by the first author and Dr. Pendergast, who are preparing a full-length paper on the carved monuments of the site, for publication. This study will provide scholars and interested readers with the context and description of each monument found at the site, as well as line drawings, accompanied by photographs of selected details, and a text providing up-to-date iconographic, and where applicable, epigraphic analyses.

The study follows up on initial photographic documentation work conducted in 2003, by Stuart Laidlaw (Lecturer, photography & digital imagery) of the Institute of Archaeology of University College London, in England. The present efforts are also envisioned as building upon the foundation set by the wonderful, three-part study of Stela 9, published in 1988 that provided a detailed review of the context, epigraphy and iconography of this important monument (Pendergast 1988; Closs 1988; Reents-Budet 1988). Since these publications, the field of epigraphy has steadily matured and it is now a suitable time to prepare new drawings that are more attuned to details of paleography and epigraphy. The resulting publication will provide updated analyses of the monuments, which while somewhat technical—given the nature of the subject matter—will be written as an approachable text that can be enjoyed by tour guides and tourists alike.

## Objectives

During the 2019 field season, the objectives were threefold:

- The first consisted of correcting the drawings produced of the monuments by examining these against the original monuments, using artificial raking light. This work was conducted by Helmke.
- The second entailed the intensive photographic documentation undertaken by Pawlowicz for computational processing, especially for 3D Structure From-Motion Photogrammetry and Virtual Reflectance Transformation Imaging (VRTI). This constitutes a pilot study to assess the amenability of the Lamanai corpus to be subjected to these methods.
- The third was the *in situ* mapping of selected monuments, especially fragmented stelae that were relocated in the overgrown portions of the site in 2017, as well as to map the distribution of stair risers in Plaza 5, at the foot of Structure N10-42. This work was conducted by Helmke with the assistance of the rangers.

## Method & Results

### *Line Drawings (Iconography & Epigraphy)*

Concerning the first objective, the drawings of Stela 2, Panel 1, Altars 1 and 2 as well as the risers of the hieroglyphic stair, which is to say Steps 1, 2, 3, 4 and 5, were all corrected in the field by examining the drawings against the original monuments. This work was divided between the Visitor's Centre where Panel 1 as well as Steps 2 and 3 are now on exhibit, and the archaeological site itself, where Stela 2, the altars and the remaining steps remain to this day. As part of this process, the two fragments of Altar 1 that are stored in the archaeological bodega were conjoined with the altar itself to confirm that these are part of this monument and to establish their position on the monument. This allowed us to secure a complete photographic record and establish the position of the textual elements preserved on both of these fragments vis-à-vis the larger glyphic text along the perimeter of the altar (Figure 1).

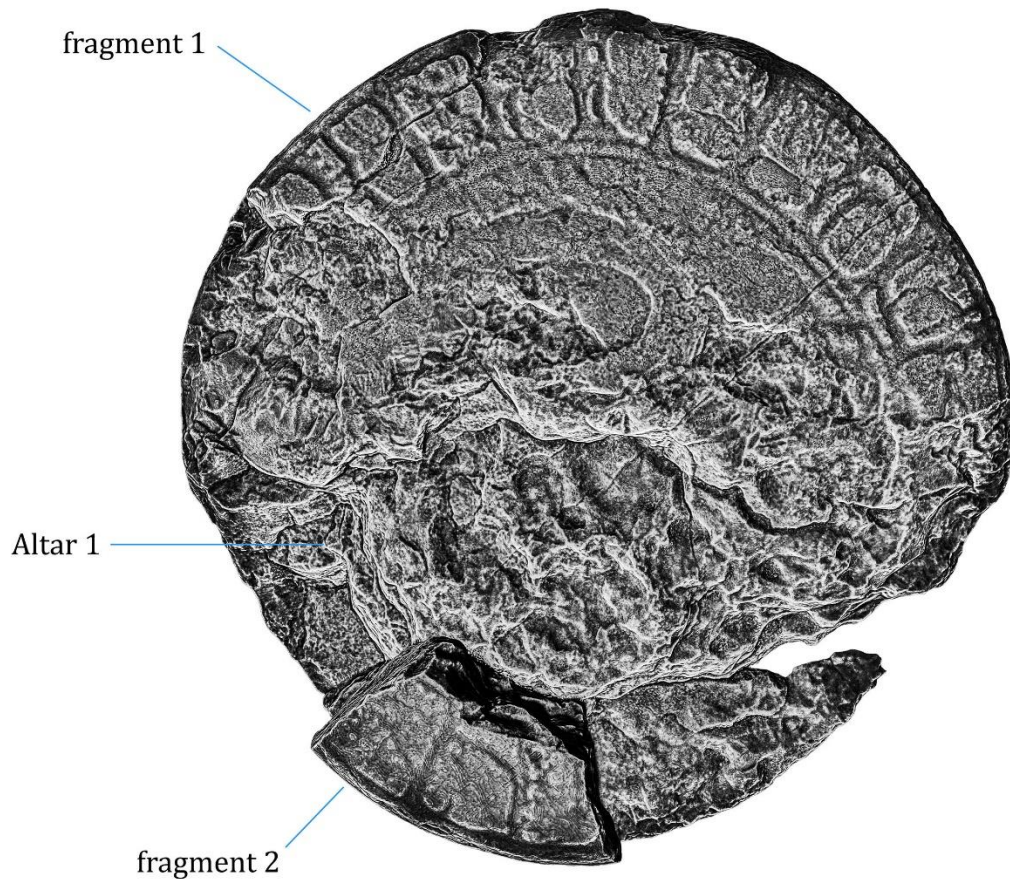
During the correction process the monuments were examined both using natural daylight as well as using artificial raking light (using LED flashlights at 200 and 1000 lumen). This was undertaken in the early mornings or early evenings, in order to highlight sculptural details. In so doing, details could be highlighted thereby confirming tracings made in the drawings or prompting minor corrections, which were then applied to the drawings at the close of the field season.

A field sketch was also produced of Stela 1 in the Visitor's Centre using artificial light to prepare a formal drawing of the monument, transferring the line features to a template generated by the RTI documentation (see Figure 2).

### *Computational Photography*

During the days spent by the second author at Lamanai, three photographic/computational methods were evaluated for use in imaging and recording carved monuments at Lamanai. High-powered raking light photography (a 600W remote flash) was used for photography of several of the monuments in the Lamanai Visitor Center. The high power of the flash allowed for the use of just the bare flash bulb, eliminating the need for a concentrating reflector or diffuser. This meant that the light source was as close to a point source as possible, improving the shadow relief obtained in the photographs. The high light intensity also allowed the light source to be positioned further away from the monuments than is typical for raking light photography, reducing the drop-off of light intensity with distance. The images were then

further enhanced using computational photography techniques to even out the light intensity, and enhance details on the images.



**Figure 1:** Radiance scaling view of the 3D model of Altar 1, showing the two rearticulated fragments of the altar (photography and model by L. Pawlowicz).

Structure from Motion (SfM) photogrammetry – Multiple photographs of each monument were taken from different positions and angles, and then processed into 3D models with photorealistic textures. The resulting models can then be used to generate a variety of outputs:

- Orthographic photorealistic images of the surface of each monument, useful as a templates for drawings without the distortive effects of perspective generated by close-up photographs.
- 3D models that can be viewed on a computer, displayed online, or used to create 3D models for educational and interpretive purposes.
- The models can be manipulated to extract visual representations and enhancements of their geometry. An example of this is a technique called Radiance Scaling, which shades the model depending on the concavity/convexity of the surface.
- The models can also be used as a basis for Virtual Reflectance Transformation Imaging, described below.





**Figure 2:** Stela 1, 3D model-derived imagery. Orthographic image (left), Radiance Scaling view (right) (photography and model by L. Pawlowicz).





**Figure 3:** Sample imagery from Virtual RTI. Lighting from upper left (left). Lighting from lower left (middle). View derived from RTI normals (right) (photography and model by L. Pawlowicz).

The limitations of lighting in the Lamanai Visitor Center, along with restricted space, limited the final resolution of models generated from the monuments there. In 2022, we will experiment with alternate lighting options to improve on these results

Virtual Reflectance Transformation Imaging – Some 3D model viewing software allows for adjustment of the lighting angle, similar to the use of raking light in accentuating details. However, the computational requirements for high-resolution models make this a slow and poorly-controlled process. Reflectance transformation imaging (RTI)<sup>1</sup> is a method for virtual relighting of objects that is much faster and easier to use. Normally, RTI datasets are generated by taking multiple photographs of an object from a fixed position, with varying lighting angles. The size and position of the monuments at Lamanai prevented this method from being used. However, the second author has created software and a workflow to generate RTI datasets from the 3D models, a process called Virtual RTI (V-RTI), and this was used on monuments both inside the Visitor Center, and on the Lamanai grounds. The first author is using this interactive virtual lighting method as an aid in viewing details for the drawings. While useful, these V-RTI datasets are of somewhat lower resolution than that obtainable by regular RTI; we hope to use the latter in 2022 to obtain higher-resolution data for limited areas of some of the monuments.

<sup>1</sup> For more details see: <http://culturalheritageimaging.org/Technologies/RTI/>



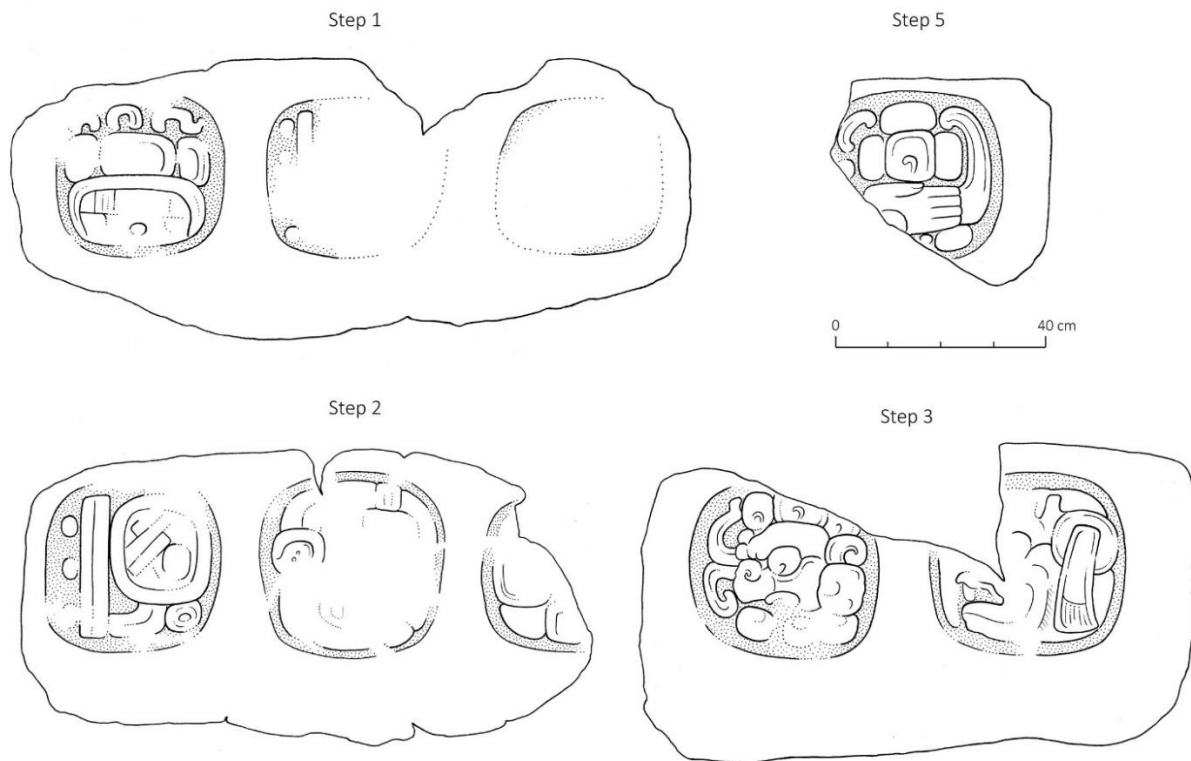


**Figure 4:** Enhanced raking light images of Stela 9. Light from left (left); Light from right (right) (photographs and enhancements by L. Pawlowicz).

Examples of the data imagery obtained include:

- Stela 1 – The 3D model used to create an orthographic image (Figure 2 left) and Radiance Scaling image (Figure 2 right). Examples of imagery generated by V-RTI at different lighting angles and RTI modes for Stela 1 are shown in Figure 3. Similar views were obtained for most of the other monuments imaged.
- Stela 9 – Enhanced raking light images from both the left and right sides are shown in Figure 4.
- Altar 1 – A 3D model was created, and can be viewed at <https://skfb.ly/o6rPV> (Figure 1).

The final objective of the season entailed the mapping of selected monuments, to update existing plans and also to obtain a record of the distribution of fragments in instances where monuments are highly fragmentary. The monuments that were recorded in plan were Stela 6 and Stelae 7/8 that are located in parts of the site that are still overgrown by rainforest. These monuments are located at the end of a small causeway that leads from Str. N10-11 to N10-55. More specifically, Stela 6 is located at the foot of the small Structure N10-63 whereas the commingled fragments of Stelae 7/8 are just a few meters to the west, along the southern end of platform N10-54. Small provisional baselines were established at both locations and offsets were measured from these to produce the plan drawings, drawn to scale at 1:10.



**Figure 5:** Drawing of a selection of risers of the hieroglyphic stair of Lamanai (drawings by C. Helmke).

The other plan that was produced covers the location of the carved stair risers that together formed part of the hieroglyphic stair of Lamanai dedicated in AD 623 and naming the ruler *K'ahk' Ujo'l Yopaaht* (Helmke 2018: 5-6, 2020: 275, 277). The plan was produced to show the current location of the remaining risers at the base of Str. N10-42 (inc. Step 1 and 4) as well as to plot the positions of the risers that have since been moved to the Visitor's Centre (i.e. Step 2 and 3). The risers had evidently already been displaced in antiquity by the ancient Maya themselves (Pendergast 1984: 7), and it is possible that these could have formed part of two different monuments. This is suggested in part, given that Step 4 appears to be of different proportions (the riser itself), whereas the intaglio sculpture of the medallions are also rendered differently, have diverging physical properties and the style appears to be slightly earlier than the other steps—which form a coherent set, in terms of materials, physical properties, metrics and paleographic features (i.e. Steps 1, 2, 3 & 5) (Figure 5). Furthermore, Step 5 was found within the Early Colonial church, whereas Step 4, at the time of discovery, had been displaced onto the plaza and laid with



its carved surface upwards, at the foot of another large, though plain, stair riser (Pendergast 1984: 7). Together these formed what appears to be a crude stela and altar complex. This pairing was also delineated by a low course of small facing stones to further demarcate this assemblage as significant ritual space. Based on examinations conducted in both 2017 and 2019 we conclude that Step 4 is located more or less where it was found, whereas the plain riser (which had received the field designation of Stela 10) has been further displaced, another 6.5 m to the SW, along the base of Str. N10-42.

Given that four of the five risers were found at the foot of Str. N10-42, we continue to entertain the possibility that the hieroglyphic stair once graced a basal course of the grand axial stair of that structure. Certainly, the positioning of Step 1 to the south and Step 3 to the north also agree with the syntactic parameters of the original text, as these respectively provide the start and closing sections of the text. The plan was produced at a scale of 1:20 by taking offset measurements with a retractable steel tape measure along a baseline oriented to the architecture of Str. N10-42, specifically the lowest visible basal course.

### **Future Seasons**

What remains within the purview of a future season, planned for the summer of 2022, is to complete the RTI documentation of the remaining monuments, including Altar 2, Steps 3 and 5, and to complete a more comprehensive documentation of Stela 9 as well as to document a small miscellaneous monument stored in the bodega, including smaller portable objects that are also incised, such as the carved bones artefacts (see Pendergast 1981a: Figs. 23 & 25). In so doing, new templates can be generated and drawings of the can be produced, thereby completing the photographic and epigraphic documentation of the corpus of carved monuments and objects at Lamanai. A final recommendation would be to see Steps 2 and 3 to be the focus of new curation efforts, and for these steps to be displayed according to their original orientation. Adding small explanatory panels with the drawings produced as part of this effort would also be a welcome addition that would benefit both the local population and the tour guides.



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## References Cited:

Closs, Michael P.

- 1988 The Hieroglyphic Text of Stela 9, Lamanai, Belize. *Research Reports on Ancient Maya Writing*, No. 21: 9-16.

Graham, Elizabeth A.

- 2000 Collapse, Conquest and Maya Survival at Lamanai, Belize. *Archaeology International*, Vol. 4: 52–56.
- 2004 Lamanai Reloaded: Alive and Well in the Early Postclassic. *Research Reports in Belizean Archaeology*, Vol. 1: 223–242.
- 2008 Lamanai Historic Monuments Conservation Project: Recording and Consolidation of New Church Architectural Features at Lamanai, Belize. Report Submitted to *the Foundation for the Advancement of Mesoamerican Studies, Inc.*:  
<http://www.famsi.org/reports/06110C/06110CGraham01.pdf>.

Helmke, Christophe

- 2017 Report on the Photographic Documentation of Carved Monuments at Lamanai. *Report on the 2016 Investigations at Lamanai*, edited by Elizabeth Graham, pp. 108–115. Institute of Archaeology, University College London, London.
- 2018 Continued Documentation of Carved Monuments at Lamanai. *Report on the 2017 Investigations at Lamanai*, edited by Elizabeth Graham, pp. 3–10. Institute of Archaeology. University College London, London.
- 2020 Under the lordly monarchs of the north: The Epigraphy of Northern Belize. *Ancient Mesoamerica*, Vol. 31 (2): 261–286.

Pendergast, David M.

- 1975 The Church in the Jungle: The ROM's First Season at Lamanai. *Rotunda*, Vol. 8 (2): 32–40.
- 1977 Royal Ontario Museum Excavation: Finds at Lamanai, Belize. *Archaeology*, Vol. 30 (2): 129–131.
- 1981a Lamanai, Belize: Summary of Excavation Results, 1974-1980. *Journal of Field Archaeology*, Vol. 8 (1): 29–53.
- 1981b Lamanai, Belize: 1981 Excavations. *Mexicon*, Vol. 3 (4): 62–63.
- 1984 Excavations at Lamanai, Belize, 1983. *Mexicon*, Vol. 6 (1): 5–10.
- 1986a Historic Lamanai: Royal Ontario Museum 1985 Excavations at Lamanai, Belize. *Mexicon*, Vol. 8 (1): 9–13.
- 1986b Under Spanish Rule: The Final Chapter in Lamanai's Maya History. *Belcast Journal of Belizean Affairs*, Vol. 3 (1-2): 1–7.

1988 Lamanai Stela 9: The Archaeological Context. *Research Reports on Ancient Maya Writing*, No. 20: 1–8.

Reents-Budet, Dorie

1988 The Iconography of Lamanai Stela 9. *Research Reports on Ancient Maya Writing*, No. 22: 17–32.