Photogrammetry at Lapa do Picareiro: Innovative Techniques for Recording Spatial Information at a Paleolithic Site

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ABSTRACT

Archaeology as a practice is destructive. Once an area of interest has been excavated, any information that has not been recorded is lost. Many dating methods also require the destruction of the sample to obtain results. Until recently, information obtained from digital piece proveniencing systems, drawings, and pictures have made up the spatial record. With the development of photogrammetric techniques, recording spatial data has become more accurate, faster, and more efficient than previous methods used in Archaeology. This poster shows the results of photogrammetric work done in the field at Lapa do Picareiro. This Middle and Late Paleolithic site offers the unique opportunity to apply photogrammetric techniques to archaeological subjects inside of a cave with depositions dating to the transition from Neanderthals to Anatomically Modern Humans. Photogrammetry was applied to the site in order to provide annual spatial information for artifact context and tracking site change. This poster shows the results of three-dimensional models of not only cave surfaces, rock layers, and geological stratigraphy, but also of faunal remains destroyed for isotope analysis. The end result, beyond digitally recording spatial information, is the recreation of artifacts and space with the use of another recent technological development: three dimensional printing.

BACKGROUND

Lapa de Picareiro is a Middle and Late Paleolithic archaeological site located in a cave in central Portugal. The cave, which sits atop a mountain accessible only by goat trail, presents a unique set of problems for recording archaeological site context. These problems include, but are not limited to, accurately recording space in low light conditions, getting heavy spatial technology equipment up to the cave and back down, and being able to integrate the spatial information digitally into a predetermined local coordinate system. Piece proveniencing, LiDAR, and photographs, and drawings have all been used to try to solve these problems, but each fall short in some way. Photogrammetry was introduced into the excavation as another form of recording space. This poster shows the results of the work done in the 2015 summer field season applying photogrammetry to these problems.

MATERIALS

In the field, photogrammetry requires a camera to take photographs, markers to identify control points, and a total station to record the markers x, y, and z coordinates in the local grid. All of this equipment was already present for other purposes in the excavation so no extra material was needed. In the field, pictures were taken in a dome pattern around the area of interest until all viewpoints were recorded. Post-collection work requires a photogrammetric program. For our desired results, we used Agisoft PhotoScan.

RESULTS

Models were created for multiple different aspects of the cave in 2015. A previously closed off room was excavated in the back of the cave during the 2015 field season and a model was created to provide context to the piece proveniencing carried out in the area. This model, which can be fully manipulated with a computer, is shown as three figures on this poster; The top view (Fig. A), the front view (Fig. C) and a view from the front rotated 45 degrees to cave east (Fig. D). An image created to give spatial context to material remains in the back room was created using the a model and piece plots from the total station (Fig. B). The black dots are material from Layer "O" hearths. The green dots are material collected from Layer "T" hearths. Another model was created for a layer of large clasts which makes up the area facing cave east (Fig. E). This is your last chance to edit the model into various systems. Once your model is complete, export the file as a .STL. This is a STereoLithography file, used for printing. From Physical to Digital and Back Again: A Mandible’s Journey

DISCUSSION

The 2015 field season produced multiple models. It was the first year photogrammetry was used and as such acted as an experimental year for the technology at the site. Low lighting affected the model clarity as well as a lack of suitable control points. Although usable, the models produced are all low resolution. The work done for 2015 has been invaluable for setting up the large photogrammetric work to be done in the 2016 season. Annual Photogrammetric work will be done on the entire site to compare future annual LiDAR scans. The end goal will be to compare accuracy and resolution between the two methods of recording space.