3D Scan Data for Selected Clovis-Age Artifacts from the Gault Site (41BL323), Central Texas, USA

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Abstract

On August 19, 2016, selected Clovis artifacts from the Gault site (41BL323) were scanned in advance of a large collaborative research project. These data were collected using a NextEngineHD running ScanStudioHD Pro, and were post-processed in Geomagic Design X 2016.0.1. All data associated with this project have been made publicly available (open access) and are accessible in Zenodo under a Creative Commons Attribution license, where they can be downloaded for use in additional projects and learning activities. These data have the capacity to augment a variety of research designs spanning the digital humanities, applications of geometric morphometrics, and many others. Additionally, these scans will augment a wide range of comparative research topics throughout the Americas and beyond. Reuse potential for these data is significant.

Keywords: Clovis, Projectile Points, 3D.

1. Overview

The Gault Site (41BL323), located in Central Texas, USA (Figure 1), is a large, open-air site with an extensive, stratified sequence encompassing a near-complete regional prehistoric sequence. Dense deposits of Clovis-age stone tools, manufacturing debris, and associated faunal material (e.g., mammoth, horse, and bison) have been systematically excavated from the site Collins (2002). Overall, the Gault Clovis assemblage is comprised of approximately 600,000 artifacts, around ninety-five percent being lithic material; most recovered from nine major excavation blocks from less than three percent of the entire site. Recently published studies of the Gault Clovis materials include an analysis of incised stones Lemke et al. (2015), Clovis blade technology Williams (2016), Clovis Flake analysis Velchoff Littlefield (2015),

and Optically Stimulated Luminescence ages of the Clovis component in Area 15 [Rodrigues et al. \(2016\)](#). Current analytical investigations include microscopic use-wear, geomorphological, paleomagnetic, microfossil, and starch grain analyses. Other investigations include the identification of family and/or species from fragmented faunal remains using ZooMS (Zooarchaeology by Mass Spectrometry) [Keenan Early \(2016\)](#); [Buckley et al. \(2008\)](#).

Figure 1: Map of the Gault site indicating those areas where Clovis-age deposits were discovered. The 3D scanned Clovis points were recovered from areas 4, 7, and 8.

Lithic analysis remains ongoing and the addition of other analytical approaches, in this case, that employ 3D meshes helps to advance discussions of shape variation that occurs among these artifacts; many of which are regularly used in studies of shape using 2D data [Buchanan and Collard \(2010\)](#); [Buchanan et al. \(2011, 2007, 2012, 2013\)](#). There are many components of shape that are difficult—if not impossible—to characterize using traditional orthogonal approaches [Shott and Trail \(2012\)](#); [Shott \(2011\)](#), and are more accurately captured and analyzed in their native 3D format [Shott \(2014, 2015\)](#). These attributes can be couched in a variety of theoretical frameworks [Hosfield \(2009\)](#); [Costin \(2001, 2005\)](#); however, evolutionary archaeology remains *de rigueur* for geometric morphometric studies of lithic artifacts [Lycett \(2015\)](#). While the production of 3D data are labor and time-intensive (although see [Ahmed et al. \(2014\)](#)), the benefits can be seen in their contribution to conservation [Kuzminsky and Gardiner \(2012\)](#), participatory digital archaeology [Morgan and Eve \(2012\)](#), and dynamic illustrations [Magnani \(2014\)](#); [Carlson \(2014\)](#). Furthermore, with the ability to convert these 3D scans (Figure 2) into printed replicas, new avenues in public outreach and education can be explored [Means et al. \(2013\)](#).

Figure 2: 3D scan of GAULT 41BL323 LOT1040-113. *This is a 3D figure that can be rotated, measured and otherwise quantified. To activate the figure, this article must be downloaded to your computer. Activate the figure by clicking on the image, then click/drag to rotate.*

1.1. Context

While the detailed context of these artifacts is discussed elsewhere [Collins \(2002, 2007\)](#); [Bradley et al. \(2010\)](#); [Rodrigues et al. \(2016\)](#); [Speer \(2014\)](#); [Waters et al. \(2011\)](#), an abbreviated listing is included in Table 1, and in each of the Zenodo entries. Three Clovis points were recovered from Area 8 (2621-1, 36-42, and 191-174). Two further points, 2643-15 and 1323-1, were recovered from areas seven and four respectively. Finally, Clovis points 2624-1 and 1040-113 were recovered from the surface.

1.2. Temporal Coverage

To date, a total of six luminescence ages associated with the Clovis deposits have been reported; four from Area 15 [Rodrigues et al. \(2016\)](#), and two from Area 8 [Waters et al. \(2011\)](#). These ages fit within the known age range for the Clovis period, approximately 13,500 to

Table 1: Context of Scanned Artifacts

Artifact No.	Description	Provenience
2621-1	Clovis Pt	Area 8
36-42	Clovis Pt	Area 8
2643-15	Clovis Pt	Area 7
191-174	Clovis Pt	Area 8
2624-1	Clovis Pt	Surface
1323-1	Clovis Pt	Area 4
1040-113	Clovis Pt	Surface (Area 8)

12,800 cal BP [Holliday \(2000\)](#); [Meltzer \(2009\)](#) (Figure 3).

2. Methods

Selected artifacts were scanned using a NextEngineHD running ScanStudioHD Pro. Scan data were collected at the highest HD setting using eight divisions, then trimmed, aligned, fused and polished in ScanStudioHD Pro before being exported as ASCII.stl and ASCII.ply files prior to post-processing [Galeazzi et al. \(2014\)](#); [Weyrich et al. \(2004\)](#). Those data were then imported into Geomagic Design X, where the final meshes were aligned and processed.

2.1. Steps

To align each scan, a reference vector was inserted, followed by a reference point at the confluence of the vector and the mesh (using a projection) at the central base. A plane was inserted using the pick point and normal axis function, utilizing the vector as the normal axis, and the projected point as the pick point. Both elements (reference vector and reference point) of reference geometry were then utilized in an interactive alignment, with the reference vector as the moving vector, and the reference point as the moving point (Figure 2). Alignment has proven to be an important factor in downstream analyses, particularly when making the transition from Design X and Control to SolidWorks or other CAD-based platform [Selden Jr. \(2015\)](#) like those used to generate the 3D puzzles (Figure 4).

Post-processing of each 3D mesh began with the healing wizard function in Design X, correcting problematic issues with non-manifold poly-vertices, folded poly-faces, dangling poly-faces, small clusters, small poly-faces, non-manifold poly-faces, crossing poly-faces, and small tunnels. The rewrap function was then used to render the final mesh. Upon completion of post-processing, each mesh was decimated by 50 percent prior to saving then export as an ASCII.ply. Decimation of the mesh decreases file size while increasing ease of use on standard computers.

2.2. 3D Puzzles

In addition to the 3D models, one 3D cardboard puzzle was created (for GAULT 41BL323 LOT1040-113 [Selden Jr. \(2016a\)](#)) to augment the on-site efforts of the interpretive staff by providing a physical model through which visitors can interact with the digital proxy. These cardboard puzzles were generated using Autodesk 123D Make [Autodesk \(2015\)](#), and the plans for the cardboard puzzles (Figure 5) accompanied the uploads to [Zenodo](#). Those plans can

Figure 3: Luminescence age range associated with the Clovis-age deposits from the Gault Site. All dates ($n = 6$) were combined using the C_Combine function in OxCal v.4.2.4 (Bronk Ramsey 1995).

be downloaded, glued to cardboard, then cut out to create a tangible model of a Clovis point. These files were uploaded to [Zenodo](#) in .pdf format, and are also compatible with most laser cutters.

3. Data Description

3.1. Collection Name

3D Scans from the Gault Site

3.2. Data Type

Decimated meshes

3.3. Format Names and Versions

ASCII.ply (mesh)

Figure 4: Aligned 3D mesh for GAULT 41BL323 LOT1040-113 showing reference planes.

3.4. Creation Dates

August 19, 2016

3.5. Dataset Creators

Robert Z. Selden Jr.

3.6. Language

English

3.7. License

Creative Commons Attribution

Figure 5: Modeled 3D puzzle of GAULT 41BL323 Lot1040-113 Selden Jr. (2016a) created with Autodesk 123D Make at a uniform scale.

3.8. Repository Location

3D Scans from the Gault Site

- GAULT 41BL323 LOT2621-1 (Selden Jr. 2016d)
(<https://doi.org/10.5281/zenodo.163947>)
- GAULT 41BL323 LOT36-42 (Selden Jr. 2016g)
(<https://doi.org/10.5281/zenodo.163942>)
- GAULT 41BL323 LOT2643-15 (Selden Jr. 2016f)
(<https://doi.org/10.5281/zenodo.163944>)
- GAULT 41BL323 LOTAM191-174 (Selden Jr. 2016c)
(<https://doi.org/10.5281/zenodo.163945>)
- GAULT 41BL323 LOT2624-1 (Selden Jr. 2016e)

(<https://doi.org/10.5281/zenodo.163946>)

- **GAULT 41BL323 LOTNH1323-1** (Selden Jr. 2016h)
(<https://doi.org/10.5281/zenodo.163948>)
- **GAULT 41BL323 LOT1040-113** (Selden Jr. 2016b)
(<https://doi.org/10.5281/zenodo.61413>)

3.9. Data Publication Date

October 31, 2016

4. Reuse Potential

Those data from this project have long-term and wide-ranging reuse potential, of which many applications may (likely) not yet have been contemplated. While the primary purpose of this endeavor was to document these resources for use in additional analytical and outreach efforts, one of the projectile points has since been modeled as a 3D puzzle that can be cut out using materials that are easily acquired by most (i.e., a cardboard box).

These data have significant reuse potential in the sciences and digital humanities where they can augment both qualitative and quantitative studies. They also hold promise for clarifying questions of the shape, form, size and asymmetry of these artifacts, which can be addressed in analyses of asymmetry and geometric morphometrics.

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The 3D model used in Figure 2 was generated as a .ply in **Design X** and converted to a .u3d in **DAZ Studio**.

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