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# 3D Scan Data for Selected Clovis-Age Artifacts from the Gault Site (41BL323)

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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 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 is significant.

## Keywords

Clovis — Projectile Points — 3D — The Gault Site

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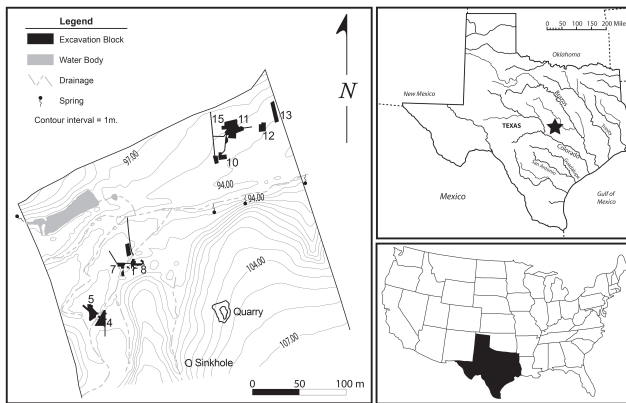
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## 1. Overview

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 [1]. 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 [2], Clovis blade technology [3], Clovis flake analysis [4], and Optically Stimulated Luminescence ages of the Clovis component in Area 15 [5]. 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) [6, 7].

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 [8, 9, 10, 11, 12]. There are many components of shape that are difficult—if not impossible—to characterize using traditional linear and orthogonal approaches [13, 14], and are more accurately captured and analyzed in their native 3D format [15, 16]. These attributes can be couched in a variety of theoretical frameworks [17, 18, 19];



**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.

however, evolutionary archaeology remains *de rigueur* for geometric morphometric studies of lithic artifacts [20]. While the production of 3D data are labor and time-intensive (although see [21]), the benefits can be seen in their contribution to conservation [22], participatory digital archaeology [23], and dynamic illustrations [24, 25]. Furthermore, with the ability to convert these 3D scans (Figure 2) into printed replicas, new avenues in public outreach and education can be explored [26].

### 1.1 Context

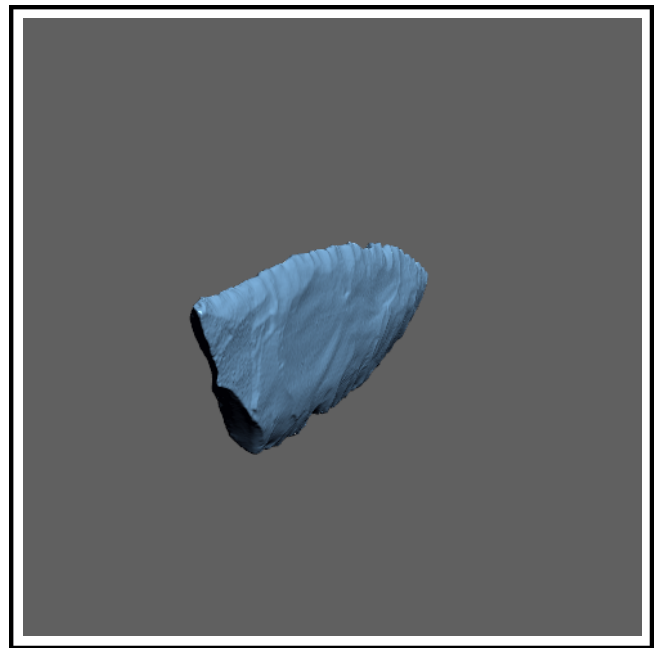
While the detailed context of these artifacts is discussed elsewhere [1, 27, 28, 5, 29, 30], an abbreviated listing is included in Table 1, and in each of the Zenodo entries [31, 32, 33, 34, 35, 36, 37]. Three Clovis points were recovered from Area 8 (2621-1, 36-42, and 191-174). Two further points, 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.

**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)

### 1.2 Temporal Coverage

To date, a total of six luminescence ages associated with the Clovis deposits have been reported; four from Area 15 [5], and two from Area 8 [30]. These ages fit within the known age range for the Clovis period, approximately 13,500 to 12,800 cal BP [38, 39] (Figure 3).



**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.

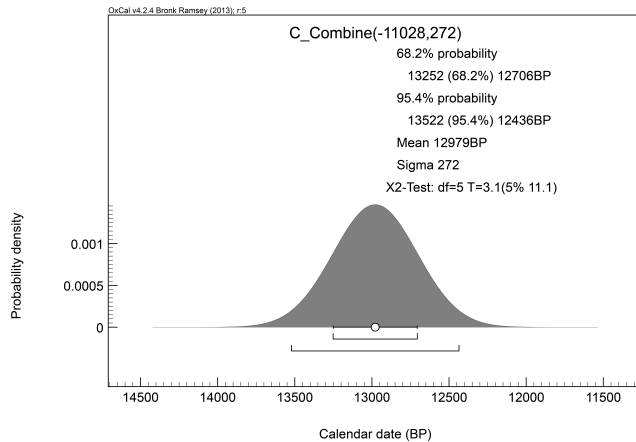
## 2. Methods

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 [41, 42]. 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 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 [43] 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



**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 [40].

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.

### 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)

#### 3.4 Creation Date

August 19, 2016

#### 3.5 Dataset Creator

Robert Z. Selden Jr.

#### 3.6 Language

English

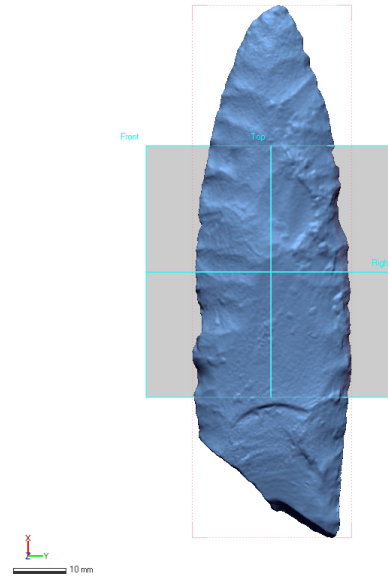
#### 3.7 License

Creative Commons Attribution

#### 3.8 Repository Location

3D Scans from the Gault Site

- GAULT 41BL323 LOT2621-1 [32] (<https://doi.org/10.5281/zenodo.163947>)
- GAULT 41BL323 LOT36-42 [36] (<https://doi.org/10.5281/zenodo.163942>)



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

- GAULT 41BL323 LOT2643-15 [35] (<https://doi.org/10.5281/zenodo.163944>)
- GAULT 41BL323 LOTAM191-174 [34] (<https://doi.org/10.5281/zenodo.163945>)
- GAULT 41BL323 LOT2624-1 [33] (<https://doi.org/10.5281/zenodo.163946>)
- GAULT 41BL323 LOTNH1323-1 [31] (<https://doi.org/10.5281/zenodo.163948>)
- GAULT 41BL323 LOT1040-113 [37] (<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.



**Figure 5.** Modeled 3D puzzle of GAULT 41BL323 Lot1040-113 [44] created with Autodesk 123D Make at a uniform scale.

#### 4.1 3D Puzzles

In addition to the 3D models, one 3D cardboard puzzle was created (for GAULT 41BL323 LOT1040-113 [44]) 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 [45], and the plans for the cardboard puzzles (Figure 5) accompanied the uploads to Zenodo. Those plans can 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.

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