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Collecting Rocks on the Frontier: Investigating the Geodiversity Significance of Historical Building Stones and Rock Collecting at the Maxey Homestead, Northwest Texas, USA

Stance Hurst *, **Doug Cunningham** and **Eileen Johnson**

Museum of Texas Tech University, 3301 4th St, Lubbock, TX 79415, USA; eileen.johnson@ttu.edu (E.J.)
* Correspondence: stance.hurst@ttu.edu

Abstract: The geoheritage importance of the stones used in the construction of buildings in urban landscapes has been documented by several scholars around the world. Building stones can provide an ex situ cross-section of a region's geodiversity and illuminate its cultural significance. Research at the historic Maxey Homestead (1902–1907), located along the eastern escarpment of the Southern High Plains near Post, Texas, has uncovered a rock collection gathered from local sources. In addition, rocks from the eastern escarpment were used to construct and decorate a house in 1938 (~9 km to the north) after the Maxeys moved from their original homestead. A combination of GIS and 3D mapping using an unmanned aerial vehicle were used to assess and analyze the geodiversity significance of the rock collection and rock-decorated house. Rock collecting and the use of local stones in building construction provide insights into the geodiversity of the Southern High Plains' eastern escarpment and the historical geoheritage of northwest Texas in the early 20th century. The results of this study also demonstrate the importance of examining non-urban and historical landscapes for elucidating the significance of geodiversity to past peoples.

Keywords: historical geoheritage; rock house; Southern High Plains; Texas; building stones

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1. Introduction

Scholars examine the representation of geodiversity and its geoheritage significance by studying building stones [1–3]. Building stones that are used as tiles, large slabs, or bricks to construct prehistoric and historic structures can reveal an ex situ geoarchive of the Earth's history [4], serve as an index of a landscape's geodiversity [5], promote geoheritage awareness [6,7], and symbolize community identity [8–10].

Identifying building stone source locations on the landscape provides insights into the geodiversity of a landscape, builders' selection choices, and how builders use stone in architectural design. Corbí et al. [5] have created a geo-itinerary to identify the sources of local stone used in historical buildings with their natural outcrops and quarry locations across the Nueva Tabarca Island of Spain. The prepared surfaces of building stones can provide scholars and tourists with cross-sectional views of fossils and demarcate weathering processes.

Baucon et al. [11] examined ichnofabrics (sediments altered by organisms) in Piazza della Vittoria building stones in Genova, Italy. Builders used these stones containing ichnofabrics as part of building designs. Baucon et al.'s [11] research results revealed not only the scientific value of studying building stones but also the stories they can tell to the public about the Earth's geological history.

Careddu et al. [12] and Lezzerini et al. [13] made significant strides in understanding the historical geoheritage value of building stones. Careddu et al. [12] looked at how Sardinian granite rock was used by the Romans during the Middle Ages and today, while Lezzerini et al. [13] studied the historic use of building stones in the construction of medieval buildings in Pisa, Italy.

Building on this previous work, this paper examines the cultural significance of geodiversity to past peoples as a contribution towards the development of historical perspectives on the significance of geodiversity. Historical geoheritage can be delineated as an aspect of geoheritage in that the significance of a landscape's geodiversity is examined in relationship to people of the recent past. In historical geoheritage, both historical records and archaeology can be used to make connections between the landscape's geodiversity and its impact on people of the recent past. Building stones, then, are an ex situ manifestation of the geological landscape.

The focus of previous studies on building stones has been on their use and significance in formal architecture within urban settings [14]. Vernacular architecture is global in extent but has a local to regional expression. The many styles are based on local needs or reflect local traditions and generally employ available construction materials. Studying building stones used in vernacular architecture can provide a cross-section of local geodiversity and reveal its regional geoheritage significance [15]. The Maxey Homestead and Maxey Rock House, located along the Southern High Plains' eastern escarpment near Post, Texas (USA), are used as a case study to delineate the geodiversity represented by the building stones and to explore the overall geoheritage significance.

Foundational to geoheritage is the relationship between the Earth's history, landscapes, and peoples [16–18]. This paper, then, explores the cultural significance of geodiversity to past peoples as a contribution towards the development of historical perspectives on the significance of geodiversity at the vernacular or colloquial level. The significance of a landscape's geodiversity is examined in relationship to the people of the recent past. Both historical records and archaeology can be used to make connections between the landscape's geodiversity and its impact on past peoples.

2. Research Area

The Maxey Homestead is located within the historic U-Lazy-S Ranch, a 335 km^2 cattle ranch located along the eastern escarpment edge of the Southern High Plains and the westernmost Rolling Plains of Texas (Figure 1). The Southern High Plains is located in northwestern Texas and northeastern New Mexico, with the Rolling Plains immediately to the east. Escarpments along three sides define the Southern High Plains, while to the south the region merges with the Edwards Plateau (Stockton Plateau portion) without an obvious break.

The Southern High Plains is an expansive plateau with approximately 25,000 small lake basins (fresh-water playas) and 40 salinas (saline depressions with brackish water) [19]. The northwest to southeast trending river valleys (draws) are tributaries of the Red, Brazos, and Colorado Rivers that flow through the Rolling Plains and into the Gulf of Mexico [20,21]. The headward erosion of the Southern High Plains' eastern escarpment during the Pleistocene epoch has exposed Triassic-age mudstones, sandstones, and conglomerates of the Dockum Group [22], and the gravels, aeolian sediments, and Caprock caliche layer that comprises the Miocene–Pliocene-age Ogallala Formation [23,24].

In contrast to the flat Southern High Plains, the eastern escarpment breaks are rough, broken lands formed from the incision and erosion of the differentially resistant Ogallala Formation sediments and Triassic sandstone bedrock [25]. The South Fork of the Double Mountain Fork of the Brazos River flows through the U-Lazy-S Ranch. The topographic breaks are drained by the numerous tributaries of the upper Brazos River.

The Comanche people were removed from the region in 1874 through US military action [26]. Later, buffalo hunters hunted the remaining herds of bison to near extinction by 1879 [27]. Anglo-American cattle ranchers then migrated into the region, establishing large ranches to take advantage of the vast grassland plains. In 1879, Jim and Finis Lindsey were the first to begin open-range cattle ranching on what would become the U-Lazy-S Ranch [28]. Abraham Nave and James McCord purchased 1500 head of cattle and the Lindseys' range rights in 1881 to establish the Nave-McCord Cattle Company and the Square and Compass Ranch [29]. After two decades, the Square and Compass Ranch was sold to J.B. Slaughter in 1901 to become the U-Lazy-S Ranch. Today, the historic U-Lazy-S Ranch is organized into four sections, each operated by different family members [29].

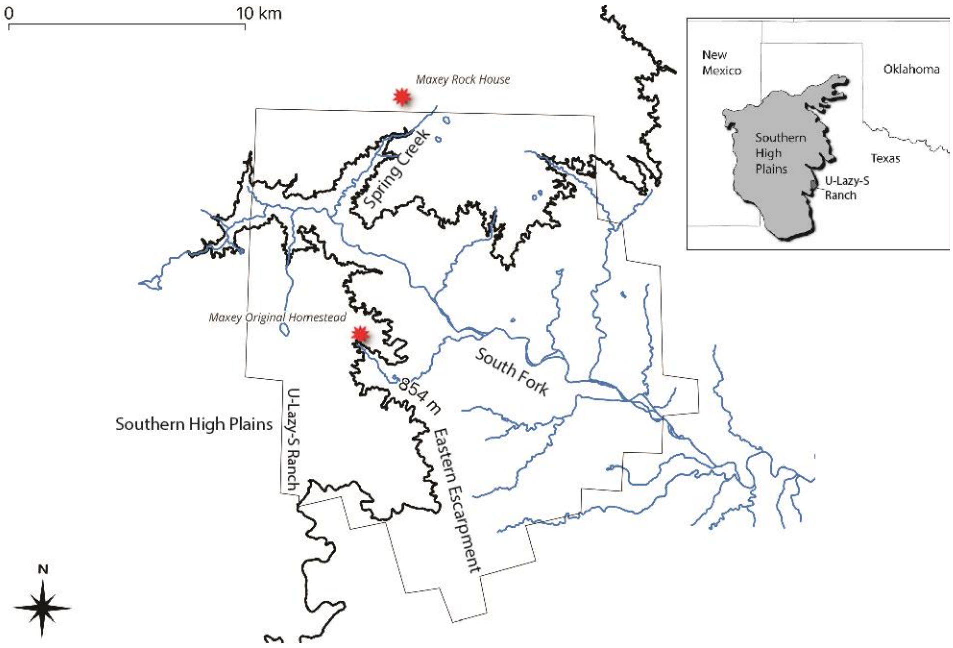

Figure 1. Location of the Maxey Homestead and Rock House along the eastern escarpment edge of the Southern High Plains.

3. Maxey Homestead and Maxey Rock House

In 1902, Joseph Franklin (Frank) Maxey and his brother Samuel Frederic Maxey claimed two sections of land within the U-Lazy-S boundaries through the Texas 1895 Homestead Act. The two sections were located on the Southern High Plains at the eastern escarpment edge (Figure 1). The Maxey brothers and their families first constructed a dugout and some fence line to surround their property. In 1903, they gained the title to the two sections of land. The Maxey families further developed their property by building a two-room wood-framed house (box and strip style), cultivating six acres of land, building a tank for holding water for their cattle, and completing three miles of barbed wire fencing. After these initial improvements, Samuel Maxey and his family moved to Wichita Falls, Texas. J.F. Maxey, his wife Belle, and their six children remained on the homestead until 1907, when Maxey sold his sections of land to J.B. Slaughter and moved his family closer to a nearby school [30].

Fieldwork conducted (2013–2014) at the Maxey Homestead consisted of a metal detector survey and the excavation of features. This work uncovered a collection of ~2000 objects that provide important insights into what life was like for the Maxey family. Domestic items included oil lamp burners, stove parts, cans, cooking utensils, and ceramic bowls. Fired gun cartridges (very common) and wagon hardware were also found [31]. One thing stood out from the field research—Frank Maxey was interested in the local geology and was a rock collector.

Two separate rock clusters were found near where the wood-structured house was located (Figures 2 and 3). The rocks were river-worn cobbles along with marine fossils, which were only available because they eroded out of the older rock layers along the eastern escarpment. These rocks and fossils were transported at least a half mile up to the Maxey Homestead from down where these rocks were exposed. The collection of river-worn cobbles was similar to the ones that modern rock collectors create and polish with rock tumblers.

Figure 2. Excavation of the rock collection feature at the Maxey Homestead (41GR933).

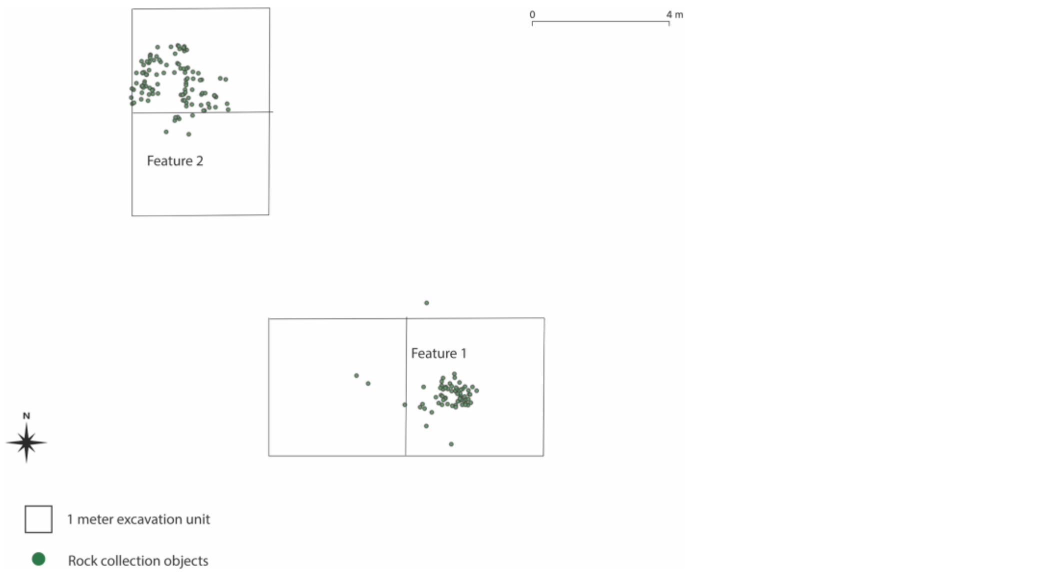

Figure 3. Map of the rock collection objects found during the excavation of the two rock collection features at the Maxey Homestead (41GR933). The squares depicted in the figure are the 1 m^2 excavation units used to map and collect the rock collection objects.

The granddaughters of J.F. Maxey (Ora Beth White, Jane Mason, and Diane Graves) were found to be still living in the region. Oral interviews and archival research provided further information about the Maxey Homestead, as well as information about a new farm and ranch that Maxey moved his family to in 1914. This new farm and ranch was located near the headwaters of Spring Creek ~9 km from the original homestead. A house was constructed there with several add-ons, a cellar, and a garage. In 1938, the exterior of the original wood-framed house was updated by rocking it with cement and incorporating local sources of stone into the cement. J.F. and Belle Maxey celebrated their 50th wedding anniversary in 1939 at the Rock House with family (Figure 4).

Figure 4. J.F. and Belle Maxey celebrating their 50th wedding anniversary with family and friends at the Rock House in 1939.

4. Geological Framework

Multiple Southern High Plains geological formations are exposed in the escarpment region below the original Maxey Homestead location and the Rock House (Figure 5).

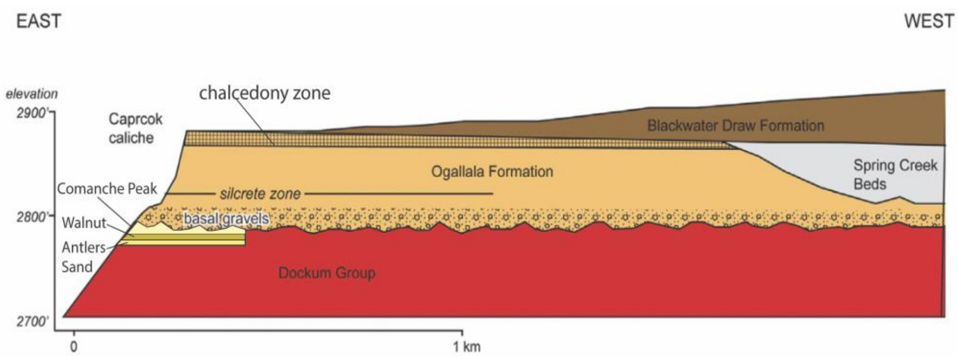

Figure 5. Cross-section of the geological formations exposed along the eastern escarpment of the Southern High Plains at the historic U-Lazy-S Ranch (Modified from McCoy (2011:10).

The Dockum Group is delineated by two alluvial depositional sequences, one of which, the Cooper Canyon Formation, is exposed [22,32]. The Cooper Canyon Formation typically contains laminated siltstone, massive red mudstone, horizontally bedded conglomerate, parallel-laminated sandstone, and laminated or rippled siltstone.

Cretaceous-age beds exposed along the southern and southeastern sections of the Southern High Plains in the research area are the Antlers Formation of the Trinity Group and the Walnut and Comanche Peak formations of the Fredericksburg Group (Brand, 1953).

The Antlers Formation consists of white to purple unconsolidated sand and gravel with moderately well-cemented to fine-to-coarse-grained quartz sand and sandstone [33]. In the study area, the Antlers Formation is interbedded with green clay and pink siltstone and also includes well-rounded quartz pebbles and claystone clasts from the underlying Dockum Group [34].

The Walnut Formation consists of light gray to light tan, calcareous shale, fine to medium-grained sandstone, fossiliferous sandstone, and light gray, argillaceous limestones. The Walnut Formation contains most of the marine fossils found within the research area. It grades upward into the thicker, more massive, light gray, argillaceous limestones and interbedded marls of the Comanche Peak Formation [33]. The Comanche Peak Formation is a light gray, thinly bedded argillaceous limestone [34]. Its exposure is more limited in comparison to the Antlers and Walnut formations within the research area.

The Ogallala Formation formed with gravels derived from the mountains to the west (present-day New Mexico), filled paleo-valleys that drained the mountains (ancestral Red, Brazos, and Colorado River systems), and aeolian sediments derived from paleo-valleys capped paleo-uplands, and eventually buried the drainage systems [23,35]. Deposition ceased with the incision of the Pecos River in the late Pliocene [24]. On the Southern High Plains, this event resulted in the long-term stability of the landscape and the development of the Ogallala Caprock caliche. This highly resistant pedogenic calcrete, up to 2 m thick, was primarily responsible for the configuration and size of the Southern High Plains and was a major factor in its topographic flatness [20].

The basal section of the Ogallala Formation contains large clasts of basalt, brown siltstone, chalcedony, chert, petrified wood, silcrete, quartzarenite (referred to as Potter Member quartzite), purple quartzite, and other quartzites [36]. The Rocky Mountains in New Mexico are the source of many of the gravels; however, erosion of the upper section of the Ogallala Formation has exposed locally formed silcrete and chalcedony layers deposited as angular clasts alongside the other gravels within the research area [36,37].

Silcrete formed within the upper section of the Ogallala Formation throughout the research area [38]. The silcrete, locally known as Macy silcrete, is most commonly formed within a single lens 10–50 cm thick, with an undulating upper surface and irregular basal surface. Up to three separate silcrete lenses, however, were documented at some localities. The silcrete ranged in color from light red to white, and grain sizes range from sandstone to pebble [38].

Geodiversity of the Maxey Landscape

Maxey obtained the rock used in rocking the house from eroding surface exposures. The exact location of these rock collection areas is unknown. Mapping the geodiversity of the geological landscape surrounding the house provides an important context for identifying the probable source locations and frequency of rocks available for use.

An area of 93.63 km^2 between the Maxey Homestead and Maxey Rock House has been delineated to investigate the geodiversity of the surrounding landscape that Maxey occupied (Figure 6). The surface exposure of each of the geological formations is calculated based on the 1:250,000 scale Geologic Atlas of Texas, Lubbock Sheet [39]. The Dockum Group is exposed over the widest area of 31.88 km^2, representing 34.04% of the total area. The Ogallala Formation is the second largest, with an area of 13.43 km^2, representing 14.34% of the landscape. The basal Ogallala gravels are exposed as secondary gravel deposits eroded out of the basal section of the Ogallala Formation. They can be found as lag gravel deposits on the exposed Dockum Group [36]. The Trinity and Fredericksburg groups are only a small percentage, less than 1% (0.52%) of the total area, represented by 0.52 km^2. The rest of the surface area of the region (48.91 km, 51.08%) is covered by nonrock-bearing layers.

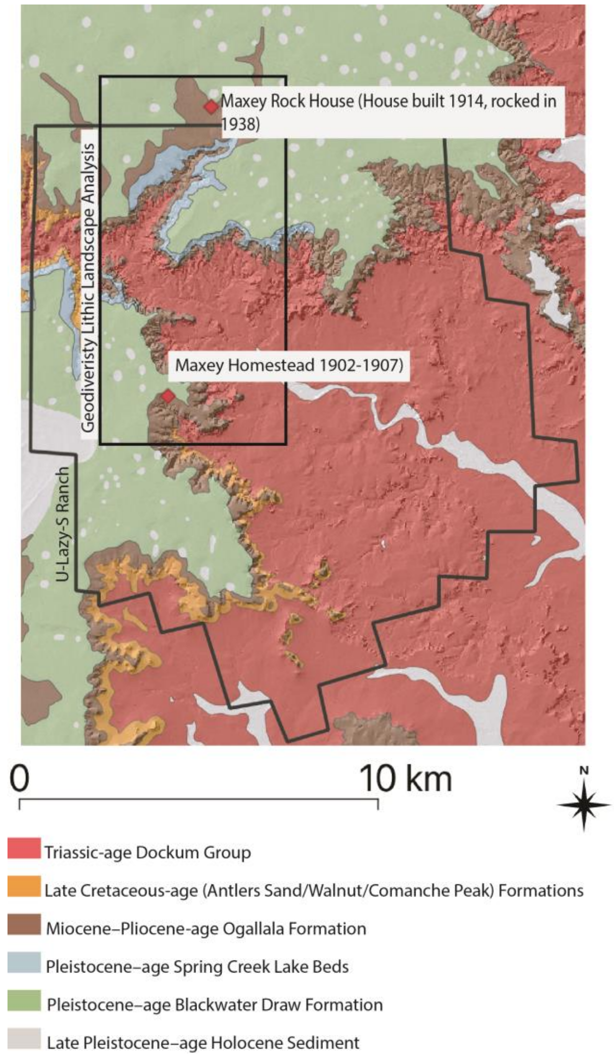

Figure 6. Spatial distribution of the exposed geological formations between the Maxey Homestead (41GR933) and Rock House along the eastern escarpment of the Southern High Plains.

5. Documentation and Analysis Methodology

A 3D photogrammetric model of the Maxey Rock House was created for documentation and analysis. Images were captured using a DJI Inspire UAV with a 16-megapixel (4600 × 2584) Zenmuse X5 camera, and a Nikon DSLR 7100 24.1 megapixel with a fixed 28 mm lens. The images were imported into Agisoft Metashape 1.8.1 for photogrammetric processing. Alignment was the first step and the following parameters were used: accuracy (highest), generic preselection (yes), reference preselection (source), key point limit (60,000), tie point limit (40,000), guided image matching (no), and adaptive camera model fitting (no). The images were aligned by finding 65,163 common points between the images. In the second step, a dense cloud consisting of 215,142,900 points was created using Metashape's following parameters: quality (high) and filtering mode (aggressive). In the third step, a mesh and texture map was generated, resulting in 35,522,855 polygon facies and a 4036 × 4036 resolution texture map. Each rock of the exterior wall was georeferenced using Metashape's GIS shapefile polygon tool. The source and type of rock were recorded along with the area m^2 of each rock.

Excavation of the rock collection features at the Maxey Homestead followed the Lubbock Lake Landmark methodology of excavating each 1 m^2 unit within stratigraphic layers or 10 cm arbitrary levels if the stratigraphic layer is <10 cm. All excavated sediment was collected every 2.5 cm sublevel for dry screening through 1/16" mesh. Each rock was identified and weighed for analysis.

6. Results

6.1. J.F. Maxey Rock Collection

A total of 180 rocks were documented as part of the two Maxey rock collection features. Feature 1 (F4JK8-1) comprised 68 rocks and Feature 2 (F4JK8-2) contained 112 rocks (Table 1). The two rock clusters were 3 m apart (Figure 3). The rocks in Feature 1 were clustered in an area of 65 × 72 cm and the rocks in Feature 2 in an area of 40 × 35 cm.

Table 1. Source of the rocks in the J.F. Maxey Rock collection at 4JK Locality 8, Maxey Homestead.

		Feature 1 (4JK8-1)		**Feature 2 (4JK8-2)**	
Source	**Rock Type**	**Count**	**%**	**Count**	**%**
Antlers Formation	fossils	-	-	1	0.89
	quartzite cobble	2	2.94	6	5.36
	sandstone	-	-	1	0.89
Dockum Group	iron concretion	1	1.47	5	4.46
	sandstone	6	8.82	7	6.25
	sandstone concretion	3	4.41		-
Ogallala Formation	chalcedony cobble	6	8.82	5	4.46
	chert cobble	1	1.47	2	1.79
	granite cobble	-	-	1	0.89
	gypsum	-	-	1	0.89
	Macy silcrete	-	-	6	5.36
	quartzite cobble	32	47.05	12	10.71
	shale	-	-	1	0.89
Walnut Formation	fossils	2	2.94	42	37.5
	fossiliferous sandstone	14	20.58	19	16.96
	sandstone	1	1.47	2	1.79
Unknown Source	shale	-	-	1	0.89
Total		68	100	112	100

Feature 1 primarily consisted of quartzite cobbles from the Antlers and Ogallala formations, an iron concretion, and sandstone concretions from the Dockum Group. It also contained pieces of sandstone from the Dockum Group and Walnut Formation, chalcedony cobbles, a chert cobble from the Ogallala Formation, fossils, and fossiliferous sandstone from the Walnut Formation.

Feature 2 also consisted of a variety of materials, including quartzite cobbles from the Antlers and Ogallala Formations, iron concretions from the Dockum Group, and sandstone from the Antlers Formation, Dockum Group, and Walnut Formation. Chalcedony cobbles, chert cobbles, silcrete, and shale came from the Ogallala Formation. Fossils and fossiliferous sandstone from the Walnut Formation were also present.

Significant differences existed in the composition of the two features. Feature 2 comprised 42 (37.5%) marine fossils from the Walnut Formation, while only two (2.78%) were found in Feature 1 (Table 1). Feature 1 contained a concentration of well-rounded quartzite cobbles from the Ogallala Formation (n = 32, 44.4%), while they were more limited in number within Feature 2 (n = 12, 10.71%). Maxey may have sorted his clusters partially by rock type.

Exposures of the Antlers and Walnut formations can be found nearby, off the edge of the nearby escarpment (Figure 7). Gravels from the Ogallala Formation are exposed as gravel deposits on top of the Dockum Group, 3–5 km from the homestead.

Figure 7. A 3D model of the Maxey Rock House.

6.2. Maxey Rock House

The Maxey Rock House occupied a space of 13 m north to south and 8.12 m east to west, with a covered front porch facing north and a covered back porch facing south. The house was expanded two separate times before it was rocked in 1938. The rocking used a technique known as puzzle rubble [40], in which undressed stones are embedded vertically within cement mortar (Figure 7).

A total of 574 images from an UAV and 911 images from a Nikon DSLR camera were used to create a photogrammetry 3D model of the rock wall exterior of the house. A total of 1,650 individual rocks were mapped across the house, representing 24 types. Most of the rocks were procured from the Ogallala Formation, followed by the Triassic-age Dockum Group, and then the Walnut and Antlers formations of the Cretaceous-age Fredericksburg Group. Macy silcrete from the Ogallala Formation was used most commonly in rocking the exterior wall (Figure 8, Table 2).

Figure 8. Source of rocks used along the east wall of the Maxey Rock House.

Table 2. Sources of the rocks used in the Maxey Rock House.

Source	Rock Type	Count	Area m^2 (Sum)
Antlers Formation	gravel conglomerate	36	0.95
	cobble	31	0.04
	sandstone	1	0.04
Dockum Group	sandstone	362	23.04
	iron concretion	8	0.03
	petrified wood	1	0.04
Ogallala Formation	basalt	2	0.01
	caliche caprock	2	0.11
	chalcedony	1	0.00
	gravel conglomerate	1	0.01
	Macy Silcrete	881	40.41
	petrified wood	1	0.00
	Potter Member quartzite	6	0.03
	purple quartzite	1	0.00
	quartzite cobble	5	0.00
Walnut Formation	fossils	12	0.01
	sandstone	275	23.01
nonlocal source	chert	1	0.02
	granite	5	0.03
	gypsum	3	0.10
	manufactured glass	4	0.06
	petrified wood	11	0.12
Total		1650	88.07

Based on the total area of the rocked house, Macy silcrete was used across 34.5% of the house, followed by sandstone from the Dockum Group (19.86%), and then sandstone from the Walnut Formation (9.8%). Maxey made five decorative mosaic panels of smaller rocks around the house, using petrified wood, chalcedony, and manufactured glass from unknown sources, as well as gravels and fossils from the Ogallala, Antlers, and Walnut formations (Figure 9). The panels ranged in size from 0.28 m^2 to 0.065 m^2. Three archways on the front porch were created using vertically aligned rock, mainly Macy silcrete (92%), with some Walnut Formation sandstone (8%).

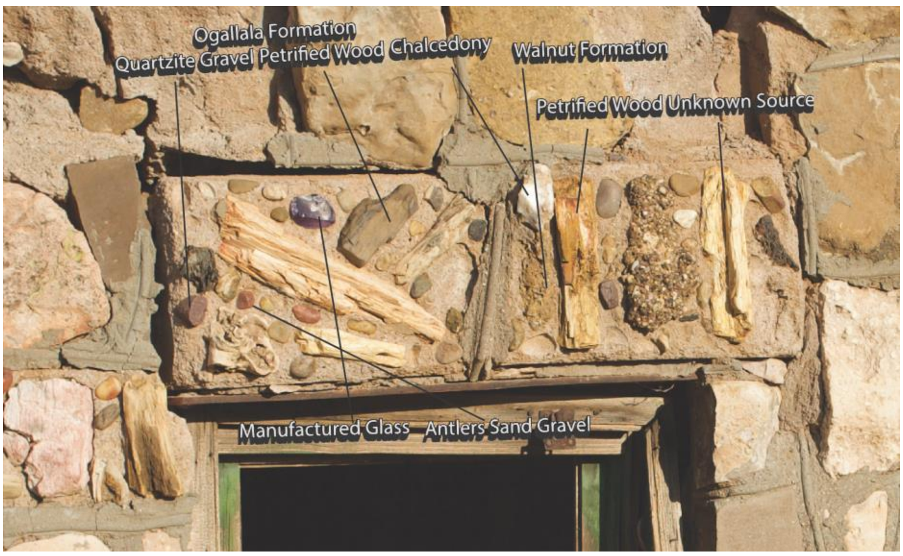

Figure 9. Source of the rocks used in a mosaic above a window sill along the east wall of the Maxey Rock House.

The Macy silcrete outcrop located at the headwaters of Spring Creek is 1.8 km to the south and the closest source of rock to the Rock House (Figure 10). This silcrete occurs as large, flat slabs (blade shapes [41]), making it easy to collect and use. Triassic rock outcrops are located ~5 km to the southwest near the South Fork River. Large, blade-shaped sandstone pieces also are available in this area. In comparison, the Cretaceous rocks and fossils are located the farthest from the house at a distance of over 7 km, closer to the original homestead location. At this outermost place, the Walnut Formation sandstone and fossiliferous sandstone are the largest and flattest in dimension with a blade shape, making them the most suitable for rock wall construction.

Figure 10. Outcrop of Macy silcrete rock at the head of Spring Creek.

7. Discussion

Building upon the cultural aspects of geoheritage is important for documenting and understanding the heritage of both the past and the present. By understanding how people have interacted with past landscape geodiversity, it then becomes possible to develop new geoheritage connections today that lead to greater geoheritage awareness and conservation. Geoheritage represents the natural systems and the social construction of interrelated cultural values [42].

Scholars are beginning to expand geoheritage even further to examine the interrelationship between geodiversity and indigenous peoples as part of cultural landscapes. For example, Gravis et al. [43] demonstrated the importance of geoheritage to the Maori people. It is a connection to the landscape related to landforms and rock features.

The use of archaeology to examine aspects of prehistoric geoheritage is an under-utilized but vital area of research [44]. Past peoples' connections to the landscape are uncovered through archaeology. Cruz et al. [45] have linked the use of obsidian to understanding the importance of prehistoric cultures in Mexico. Valdez [46] has investigated how geoheritage knowledge uncovered from archaeological research can be transmitted to people today. Geoheritage is a reflection of a people's identity; the transformations that humans have imposed on the natural environment are a mirror of their ways of life, their values, and their needs [46].

Geoheritage work is improved by including past perspectives for two reasons. Geological interpretations are aided by including people in the story and help to develop geoheritage as a research discipline. As Macadam [47] points out, making people part of geological interpretations helps to explain geological principles to people in a more comprehendible fashion. Results from historic and prehistoric research can be added to interpretations. Conducting inventories and instituting geoconservation measures to protect the geodiversity of the landscape is a vital part of the discipline. Geoheritage as research, however, is critically important to the discipline by bringing forth new insights into how society impacts and is impacted by geodiversity in both the past and present [48,49].

Geoheritage research has delineated the impact of the Southern High Plains' eastern escarpment landscape geodiversity on homesteaders in the region in the early 20th century. The eastern escarpment region contains a highly diverse series of geological resources, including the exposed Triassic-age Dockum Group, the Cretaceous-age Trinity and Fredericksburg Groups, and the Miocene–Pliocene-age Ogallala Formation. This research has found that J.F. Maxey, described as a rock collector by his descendants, created a rock collection (~1902–1907) of curated items that represents the geodiversity of the eastern escarpment region.

Maxey focused on collecting well-rounded and polished quartzite pebbles from the Antler and basal sections of the Ogallala Formation, as well as Cretaceous-age marine fossils from the Walnut Formation. He also collected a diversity of rocks representing the range of geological sources available along the eastern escarpment. Later, Maxey used stones collected from a distance of 1.8 to 7 km from the surrounding landscape to rock the exterior of his house using a puzzle rubble style of masonry. Macy silcrete was favored in the construction, with a source located nearest to the house, and composed of large blade-shaped slabs [41] suitable for constructing a rock wall. Rocks from the Dockum Group and Walnut Formation, although located a greater distance away, comprised a high percentage of the rock used in the house. These sandstone rocks were also blade-shaped. Maxey used smaller pieces to further decorate the house and created five distinctive mosaics comprising a variety of rocks from the eastern escarpment region. Less than 2% of the rock used was not locally procured along the eastern escarpment. Pieces of manufactured glass, petrified wood, and granite were likely collected elsewhere.

The Maxey Rock House is an example of the puzzle rubble style of houses constructed throughout Texas in the late 19th and early 20th centuries [40,50,51]. The first rock house in the eastern escarpment region was built by Hank Smith in 1878 in Blanco Canyon. Smith's Rock House became a local landmark for travelers and homesteaders moving into northwest Texas. In the 1930s, puzzle rubble masonry became popular due to the economic depression and the difficulty in obtaining resources [50,51]. In particular, the use of petrified wood from the Late Cretaceous Glen Rose Formation that outcrops throughout north-central Texas and the Big Bend area of southwest Texas was a popular source of decorative rock added to houses during this time period [50,51]. The pieces of petrified wood on the Maxey Rock House may be from the Glen Rose Formation. Future work can further delineate the geoheritage significance of how puzzle rubble style masonry and, in particular, the use of petrified wood was used in homes in the 1930s across Texas.

The findings of this study underscore the importance of collaborating with private landowners. In Texas, over 93% of the land is privately owned [52]. While it is crucial to document geodiversity and its importance to geoheritage on public lands, this work will become much more comprehensive when private landowners are included, especially in places with limited public lands such as Texas.

The use of photogrammetry to digitally document the rocks used in constructing the exterior wall of Maxey's house is a significant tool for geoheritage, particularly when working on private land without public access. The resulting 3D model of the Maxey Rock House (supplementary material: https://skfb.ly/oDrUq) can be shared online and viewed in augmented reality or virtual reality so that the public can access this aspect of geoheritage. It is essential to identify and disseminate the geoheritage of remote areas, particularly pertinent to vernacular architecture in rural contexts. Most heritage is viewed digitally [53]; therefore, providing a digital space for geoheritage public access through tools such as photogrammetry is important [54–56].

8. Conclusions

The results of geoheritage research can reveal the interrelationship between landscape geodiversity and the people of the past. Building stones, as an example of geoheritage research, serve as a guide or indicator of a landscape's geodiversity and represent an ex situ geoarchive. Identifying the source locations of building stones provides insights into the geodiversity of a landscape, builders' selection choices (use and intensity), and builders' architectural designs.

This study examined a rock collection (~1902–1907) and a rock-walled house (1938) constructed by J.F. Maxey along the Southern High Plains escarpment near Post, Texas. The eastern escarpment contains rock exposures from the Triassic-age Dockum Group, the Cretaceous-age Trinity and Fredericksburg groups, and the Miocene–Pliocene-age Ogallala Formation. The rock collection and rock-walled house represent the geodiversity of the eastern escarpment region. The location and size of rocks available influenced the frequency and types of rocks used in constructing the rocked house. Maxey also selected smaller rocks with more aesthetic appeal to decorate his house and curated them as part of his rock collection.

Digital documentation of the Maxey Rock House using photogrammetry to create a 3D model is important not only for research but for making information available to the public. In regions such as Texas, where most of the land is privately owned, accessing geoheritage is difficult. Through the 3D digital documentation of geoheritage, however, it becomes possible not only to delineate the geoheritage in collaboration with private landowners, but to share the findings via digital 3D models with the public.

Supplementary Materials: The 3D model of the Maxey Rock House is viewable on SketchFab at https://skfb.ly/oDrUq.

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References

1. Brocx, M.; Semeniuk, V. Building Stones Can Be of Geoheritage Significance. *Geoheritage* **2017**, *11*, 133–149. [CrossRef]
2. De Wever, P.; Baudin, F.; Pereira, D.; Cornée, A.; Egoroff, G.; Page, K. The Importance of Geosites and Heritage Stones in Cities—A Review. *Geoheritage* **2016**, *9*, 561–575. [CrossRef]
3. Pacheco, M.; Cachão, M. Urban Geology of Lisbon: The Importance of the National Palace of Ajuda (Lisbon, Portugal). *Geoheritage* **2021**, *13*, 84. [CrossRef]

4. Polck, M.A.d.R.; de Medeiros, M.A.M.; de Araújo-Júnior, H.I. Geodiversity in Urban Cultural Spaces of Rio de Janeiro City: Revealing the Geoscientific Knowledge with Emphasis on the Fossil Content. *Geoheritage* **2020**, *12*, 7–24. [CrossRef]
5. Corbí, H.; Martínez-Martínez, J.; Martin-Rojas, I. Linking Geological and Architectural Heritage in a Singular Geosite: Nueva Tabarca Island (SE Spain). *Geoheritage* **2018**, *11*, 703–716. [CrossRef]
6. Richards, S.J.; Newsome, D.; Simpson, G. Architectural Geoheritage, Engaging the Observer and the Geotourism Potential of the Lighthouse Hotel Rock Wall, Bunbury, Western Australia. *Geoheritage* **2020**, *12*, 75. [CrossRef]
7. Wolniewicz, P. Classification and Quantification of Urban Geodiversity and Its Intersection with Cultural Heritage. *Geoheritage* **2022**, *14*, 63. [CrossRef]
8. da Silva, C.M. Geodiversity and Sense of Place: Local Identity Geological Elements in Portuguese Municipal Heraldry. *Geoheritage* **2019**, *11*, 949–960. [CrossRef]
9. Kubalíková, L.; Zapletalová, D. Geo-Cultural Aspects of Building Stone Extracted Within Brno City (Czech Republic): A Bridge Between Natural and Cultural Heritage. *Geoheritage* **2021**, *13*, 78. [CrossRef]
10. Prosser, C.D. Communities, Quarries and Geoheritage—Making the Connections. *Geoheritage* **2019**, *11*, 1277–1289. [CrossRef]
11. Baucon, A.; Piazza, M.; Cabella, R.; Bonci, M.C.; Capponi, L.; de Carvalho, C.N.; Briguglio, A. Buildings that 'Speak': Ichnological Geoheritage in 1930s Buildings in Piazza della Vittoria (Genova, Italy). *Geoheritage* **2020**, *12*, 70. [CrossRef]
12. Careddu, N.; Cuccuru, S.; Grillo, S.M. Sardinian granitoids: 4000 years of geoheritage and dimension stones. *Resour. Policy* **2021**, *74*, 102339. [CrossRef]
13. Lezzerini, M.; Pagnotta, S.; Legnaioli, S.; Palleschi, V. Walking in the Streets of Pisa to Discover the Stones Used in the Middle Ages. *Geoheritage* **2019**, *11*, 1631–1641. [CrossRef]
14. Pijet-Migoń, E.; Migoń, P. Geoheritage and Cultural Heritage—A Review of Recurrent and Interlinked Themes. *Geosciences* **2022**, *12*, 98. [CrossRef]
15. Fratini, F.; Rescic, S.; Arrighetti, A.; Cantisani, E.; Pecchioni, E. Pietra Alberese: From Traditional Building Material of the Tuscan Countryside to the Present Use (Tuscany, Italy). *Geoheritage* **2022**, *14*, 51. [CrossRef]
16. National Academies of Sciences, Engineering, and Medicine. *America's Geoheritage II: Identifying, Developing, and Preserving America's Natural Legacy: Proceedings of a Workshop*; The National Academies Press: Washington, DC, USA, 2021.
17. Cook, T.; Abbott, L. Geoheritage: Preserving Earth's Legacy. EARTH. Available online: https://www.earthmagazine.org/article/geoheritage-preserving-earths-legacy (accessed on 15 February 2023).
18. Stanley, M. Geodiversity. *Earth Herit.* **2000**, *14*, 15–18.
19. Sabin, T.J.; Holliday, V.T. Playas and lunettes on the Southern High Plains: Morphometric and spatial relationships. *An. Assoc. Ameri. Geog.* **1995**, *85*, 286–305. [CrossRef]
20. Holliday, V.T. *Stratigraphy and Paleoenvironments of Late Quaternary Valley Fills on the Southern High Plains (Memoir/Geological Society of America, 186)*; Geological Society of America: Boulder, CO, USA, 1995; p. 142.
21. Johnson, E. Landscapes and Peoples of the Llano Estacado. In *Archaeological Landscapes on the High Plains*; Scheiber, L.L., Clark, B.J., Eds.; University Press of Colorado: Boulder, CO, USA, 2008; pp. 115–156.
22. Lehman, T.; Chatterjee, S. Depositional Setting and Vertebrate Biostratigraphy of the Triassic Dockum Group of Texas. *J. E. Sys. Sci.* **2005**, *114*, 325–351. [CrossRef]
23. Gustavson, T.C.; Baumgardner, R.W., Jr.; Caran, S.C.; Holliday, V.T.; Mehnert, H.H.; O'Neill, J.M. Quaternary geology of the southern Great Plains and an adjacent segment of the Rolling Plains. In *Quaternary Nonglacial Geology: Conterminous U.S. Centennial Volume K-2*; Morrison, R.B., Ed.; Geological Society of America: Boulder, CO, USA, 1991; pp. 477–501.
24. Reeves, C.C., Jr.; Reeves, J.A. *The Ogallala Aquifer of the Southern High Plains: Volume 1 Geology*; Estacado Books: Lubbock, TX, USA, 1996.
25. Ferring, C.R. Archaeological Geology of the Southern Plains. In *Archaeological Geology of North America*; Lasca, N.P., Donahue, J., Eds.; Geological Society of America: Boulder, CO, USA, 1990; pp. 253–266.
26. Cruse, J.B. *Battles of the Red River War: Archeological Perspectives on the Indian Campaign of 1874*; Texas A&M University Press: College Station, TX, USA, 2008.
27. Gard, W. *The Great Buffalo Hunt*; Alfred A. Knopf: New York, NY, USA, 1959.
28. Hill, F.P.; Jacobs, P.H. *Grassroots Upside Down: A History of Lynn County, Texas*; Nortex Press: Austin, TX, USA, 1986.
29. Ward, D. A Heritage Perspective on the Historic U-Lazy-S Ranch—A Case Study in Heritage Construction. Master's Thesis, Texas Tech University, Lubbock, TX, USA, 2016.
30. White, O.M.; Graves, D.; Mason, J.J.F. *Maxey Oral History Interview*; Ward, D.C., Cunningham, D., Eds.; Museum of Texas Tech University: Lubbock, TX, USA, 2014.
31. Garrold, S. A Comparative Study of the Role of Firearms in American Western Heritage through Their Use on the Historic U-Lazy-S Ranch, Western Texas. Master's Thesis, Texas Tech University, Lubbock, TX, USA, 2020.
32. Martz, J. Lithostratigraphy, chemostratigraphy, and vertebrate biostratigraphy of the Dockum Group (Upper Triassic), of southern Garza County, West Texas. Doctoral Dissertation, Texas Tech University, Lubbock, TX, USA, 2008.
33. Fallin, J.A.T. *Hydrogeology of the Lower Cretaceous Strata Under the Southern High Plains of Texas and New Mexico*; Texas Water Development Board: Austin, TX, USA, 1989.
34. Brand, J.P. *Cretaceous of Llano Estacado of Texas*; Bureauof Economic Geology, University of Texas: Austin, TX, USA, 1953; Volume 20.

35. Gustavson, T.C.; Winkler, D.A. Depositional facies of the Miocene-Pliocene Ogallala Formation, Northwestern Texas and Eastern New Mexico. In *Geologic Framework and Regional Hydrology: Upper Cenozoic Blackwater Draw and Ogallala Formations, Great Plains*; Gustavson, T.C., Ed.; University of Texas Bureau of Economic Geology: Austin, TX, USA, 1990; pp. 3–22.
36. Hurst, S.; Johnson, E.; McCoy, Z.M.; Cunningham, D. The lithology of Ogallala gravels and hunter-gatherer procurement strategies along the Southern High Plains eastern escarpment of Texas, USA. *Geoarchaeology* **2010**, *25*, 96–121. [CrossRef]
37. Hurst, S.; Johnson, E.; Cunningham, D. A behavioral landscape perspective on silcrete use in hunter-gatherer lithic technologies along the Southern High Plains Eastern Escarpment of Northwestern Texas (USA). *J. Archaeol. Sci. Rep* **2017**, *15*, 528–538. [CrossRef]
38. McCoy, Z. The Distribution and Origin of Silcrete in the Ogallala Formation, Garza County, Texas. Master's Thesis, Texas Tech University, Lubbock, TX, USA, 2011.
39. Eifler, G.K.; Frye, J.C.; Leonard, A.B. *Geologic Atlas of Texas, Lubbock Sheet*; Geologic Atlas of Texas, map scale 1:250,000; The University of Texas at Austin, Bureau of Economic Geology: Austin, TX, USA, 1967.
40. Sasser, E.S. *Dugout to Deco: Building in West Texas 1880–1993*; Texas Tech University Press: Lubbock, TX, USA, 1993.
41. Zingg, T. Beitrag zur schotteranlyse. *Mineral. Und Petrol. Mitterwald* **1935**, *15*, 39–140.
42. Reynard, E.; Giusti, C. The Landscape and the Cultural Value of Geoheritage. In *Geoheritage: Assessment, Protection, and Management*; Reynard, E., Brilha, J., Eds.; Elsevier Science Publishing Co.: Amsterdam, The Netherlands, 2018; pp. 147–166. [CrossRef]
43. Gravis, I.; Németh, K.; Procter, J.N. The Role of Cultural and Indigenous Values in Geosite Evaluations on a Quaternary Monogenetic Volcanic Landscape at Ihumātao, Auckland Volcanic Field, New Zealand. *Geoheritage* **2016**, *9*, 373–393. [CrossRef]
44. Gray, M. *Geodiversity Valuing and Conserving Abiotic Nature*; John Wiley & Sons, Ltd: West Sussex, UK, 2013.
45. Cruz-Pérez, M.A.; Canet, C.; Pastrana, A.; Domínguez-Peláez, S.; Morelos-Rodríguez, L.; Carcavilla, L.; Salgado-Martínez, E.; Krieger, P.; García-Alonso, E.J.; Martínez-Serrano, R.G.; et al. Green and Golden Obsidian of "Cerro de Las Navajas", Hidalgo (Mexico): Geoarchaeological Heritage That Deserves International Recognition. *Geoheritage* **2021**, *13*, 92. [CrossRef]
46. Valdez, F. Geoheritage: Obtaining, Explaining and Transmitting Archaeological Knowledge. *Int. J. Geoheritage Park.* **2018**, *6*, 86–102. [CrossRef]
47. Macadam, J. Geoheritage: Setting the Message Across. What Message and Whom. In *Geoheritage: Assessment, Protection, and Management*; Reynard, E., Brilha, J., Eds.; Elsevier: Amsterdam, Denmark, 2018; pp. 267–288. [CrossRef]
48. Rassios, A.E.; Grieco, G. Is geoheritage a "cutting-edge" science? Promotion of an extension to the definition of geoheritage with emphasis as a significant discipline in geosciences with cultural and societal relevance. In *Plate Tectonics, Ophiolites, and Societal Significance of Geology: A Celebration of the Career of Eldridge Moores*; Wakabayashi, J., Dilek, Y., Eds.; The Geological Society of America Special Paper 552: Boulder, CO, USA, 2021; pp. 37–53. [CrossRef]
49. Henriques, M.H.; dos Reis, R.P.; Brilha, J.; Mota, T. Geoconservation as an Emerging Geoscience. *Geoheritage* **2011**, *3*, 117–128. [CrossRef]
50. Baker, T.L.; Chaplo, P.V. *A Guide to the Historic Architecture of Glen Rose, Texas: Bypassed, Forgotten, and Preserved*; Texas A&M University Press: College Station, TX, USA, 2022.
51. Garrett, C.G. *Stone-Tree Houses of Texas*; Rock Stone Press: Spicewood, TX, USA, 2012.
52. Wildlife, T.P.A. Private Landowners and Listed Species. Available online: https://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/landowner-tools.phtml (accessed on 12 December 2022).
53. Garduño Freeman, C.; González Zarandona, J.A. Digital spectres: The Notre-Dame effect. *Int. J. Herit. Stud.* **2021**, *27*, 1264–1277. [CrossRef]
54. González-Delgado, J.Á.; Martínez-Graña, A.; Holgado, M.; Gonzalo, J.C.; Legoinha, P. Augmented Reality as a Tool for Promoting the Tourist Value of the Geological Heritage Around Natural Filming Locations: A Case Study in "Sad Hill" (The Good, the Bad and the Ugly Movie, Burgos, Spain). *Geoheritage* **2020**, *12*, 34. [CrossRef]
55. Martínez-Graña, A.; González-Delgado, J.Á.; Ramos, C.; Gonzalo, J.C. Augmented Reality and Valorizing the Mesozoic Geological Heritage (Burgos, Spain). *Sustainability* **2018**, *10*, 4616. [CrossRef]
56. Sang, X.; Leng, X.; Ran, X.; Li, X.; Xue, L. A Virtual 3D Geological Library Based on UAV and SFM: Application for Promoting Teaching and Research on Geological Specimen and Heritage Online. *Geoheritage* **2022**, *14*, 34. [CrossRef]