Preface
Stone tools and human hands

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Archaeology is, ultimately, the science of human hands. Everything we ever study — as archaeologists, social scientists or vocational amateurs — belongs to the diversity of ideas, actions and objects created by the human mind and brought into reality by the human hand.

This analytical catalogue of flaked stone artefacts intentionally (and emphatically) features hands. Academic publications in archaeology usually ban the presence of hands in the illustrations of archaeological finds, just as they commonly ban the use of the word "people" in the norms of scientific writing. Such nouns are deemed unprofessional, amateurish, biased, subjective, as if the erasing of people and hands would facilitate, by itself alone, the accomplishment of that quimera of impersonal scientific behavior archaeologists have chased for the past one hundred years. After two decades in academia, I have learnt that such self-censoring discipline eventually makes us forget that what we actually work with is people and the products of their hands. By constantly removing the human hand from the academic depiction of archaeological artefacts, we willingly deprave those objects from most of their meaning, and, simultaneously, we willingly cut off our bridges towards the opportunity to ever comprehend the origin, functionality, taxonomy, and behavior of cultural objects.

The main purpose of this open-access catalogue is to convince readers of the human origin of the Pleistocene, older-than-Clovis lithic artefacts from this assemblage excavated at Chiquihuite Cave, Zacatecas, Mexico. After the publication of the first major paper about the finds in *Nature* (Ardelean et al., 2020)[2], I noticed that the widespread skepticism focused specifically on the supposed natural, "geofactual" origin of the objects (Chatters et al., 2022). The critics claimed the photographs included in the article were insufficient, too small or of unsatisfactory quality, hence unable to provide sufficient arguments in favor of the artificiality of the stone tools. Another line of critique focused on the raw material the tools were made of, claiming that limestones generally lacked the isotropy, granularity and other physical properties (otherwise common in cherts or obsidian), so our tools would rather be fragments naturally separated from the walls and roofs of the cave (the infamous "geofacts"). Finally, the detractors declared themselves incapable of understanding how Chiquihuite artefacts were actually used, how they were held in hand and hafted or what functions they fulfilled, as the shape of the tools did not meet the expectations of the audience usually accustomed to the spectacular Terminal Pleistocene Clovis bifaces or the standardized forms of scrapers and projectile points from even later epochs. My team and I have already addressed these issues in subsequent writings (Ardelean et al., 2022), and we explained why those critiques were unfounded; so, there is no need for redundancy. Future publications will contribute even stronger evidence.

Consequently, this exhaustive catalogue was born from the urgent and vital necessity to address five capital issues: *a)* to provide a complete list of the flaked stone artefacts that were

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considered of secure human origin after performing another detailed round of revisions and re-assessments of the entire assemblage, which led to the conformation of the definitive Chiquihuite collection that today includes "only" 1139 specimens; *b)* to offer the reader a detailed morphological, metric, contextual, and technological description and analysis of each artefact, instead of limiting ourselves to the extremely reduced amount of text and figures available in the high-status academic journals — limitations that would always and inevitably leave too many questions unanswered; *c)* to provide an abundance of larger-format and better resolution photographs of every item in our lithic collection, from different angles and in different positions, in order to enhance all the attributes of the artefact, especially those related to human authorship. For the digital version of the publication — as opposed to the evident limitations of printed books — readers can zoom in and out the photographs in order to better appreciate the details; *d)* to show, in full color, the texture, nuances, grain and behaviors of the flaked recrystallized limestones, convincing the viewer that our raw material is not inferior in quality and performance when compared to either chert, jasper, chalcedony, agate or obsidian.

Finally, the most important of them all: *e)* to show the world how the Chiquihuite stone artefacts look like when held in a human hand. The official, neutral, impersonal three-sided imagery with monochrome background and mute scale that we normally employ in academic publications always loses the human dimension and blindfolds us when trying to comprehend the artificial nature and the socio-cultural "skin" of the objects. Only the combination between stone and hand can really give the artefact back its human dimension, and ease its perception as a component of human life. Another crucial argument in favor of showing our hands in the photography of archaeological lithics is because it allows one to present artefacts in positions and angles that would be harder to achieve with the traditional perpendicular shots; it helps us play with lights and shadows, enhancing features that may otherwise remain unnoticed. Due to my not-so-performant technical capabilities and the lack of appropriate lenses, though, many lateral views of artefacts resulted in unsatisfactory and blurry products, sometimes to the extent that they were removed from the final "triplet" illustrations. A human hand plays a crucial role in correcting this handicap, by properly holding items in front of the camera, and showing the thinness of the tool and the use-wear traces marked on edges under the appropriate lighting. The multiple photographs of gloved hands rotating artefacts in various positions constitute the closest experience to actually having them laid in front of the reader. For reasons like these, I decided to invade this catalogue with the blues and greens of the nitrile gloves. This type of tools must always be handled with gloves, even if for a few seconds. Otherwise, because of the special texture of fine-grained limestones, the artefacts would absorb moisture from our skin, acquiring residues and developing lasting dark stains on their surface.

With this catalogue, specialists and public alike can form their own opinions about the artificial nature of the Chiquihuite flaked stone assemblage, about its cultural affiliations and possible trans-continental connections. Chiquihuite Cave is only one point in the increasingly complex and diverse horizon of cultures that expanded across the entire Western Hemisphere more than 25 000 years ago, originating deep into the Last Glacial Maximum (LGM) and before. The tools and weapons made of the high quality, highly practical and easily available fine-grained limestones are a particular and peculiar manifestation of practices and behaviors shared by groups of "early Americans" living simultaneously at distant locations across the continent. The only way to advance in their knowledge and to understand their connections is by making the creations of their hands accessible to everyone.

First Foreword

Chiquihuite Cave and the early settlement of the Americas

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The study of the early settlement of the Americas is a subject of unquestionable interest. Therefore, it is not surprising that this question generates a heated and secular discussion with controversy among researchers. This contributes to making this debate more attractive, but with the risk of falling into dogmatic positions that obstruct the knowledge and resolution of this subject (Fiedel, 2017).

From our point of view, the best way to advance in the knowledge of the first settlement of the Americas is to approach the problem without apriorism, without turning a certain paradigm — whatever that may be — into dogma. We think that when analyzing the first occupations of a continent, we must be careful not to confuse the evidence that testifies to the emergence of the initial settlement with the remains that can be expected from a more advanced phase of settlement, corresponding to the socialization of a particular techno-culture. The earliest evidence probably does not show a standardized technological pattern (Boëda et al., 2021), as to be expected when a particular technology is more widely spread over the territory and it has already been socialized.

The reluctance of some researchers to recognize a clearly pre-Clovis settlement on the America continent reminds us of the debate on the early settlement of Europe during the 1980s and the early 1990s (Carbonell et al., 1996; Carbonell and Rodríguez, 2006). In this debate — in which we actively participated (Carbonell et al., 1995, 2008; Carbonell and Rodríguez, 2006) — evidence prior to the Acheulean (before 500,000 years ago) was systematically questioned, with arguments such as the absence of reliable dating, questionable stratigraphic contexts, objects of dubious anthropogenic origin... History repeats itself, and underlying this debate was the historicist confusion between emergence and socialization in the framework of the first human occupations of the continents; the confusion between a poorly standardized technology and a fully standardized and systematized (socialized) technology that denotes a more systematic and extensive occupation of a territory (Carbonell et al., 2007).

In our view, in order to shed light on the earliest occupations of a continent, it is necessary to evaluate the available evidence as objectively as possible. Primarily, evidence such as lithic objects that may have been knapped by humans, given that the lithic record is usually more abundant and better preserved than other types of evidence, such as biological evidence.

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We approach the question of the first settlement of America from our experience in the analysis of the lithic industry of the European continent, including the oldest evidence dated to the end of the Early Pleistocene and the most numerous and technologically much more complex and systematized evidence from the Middle Pleistocene and Late Pleistocene. We also rely on our experience in the study of lithic materials knapped from rocks of lower quality than flint, such as limestone, sandstone, basalt, and quartz: raw materials that we know well, because they were used in some of the oldest sites in Europe. Rocks in which it is sometimes difficult to identify characteristic features of human activity, especially for researchers used to studying pieces manufactured on flint or other rocks of similar good quality.

We present our perspective on the lithic materials recovered from the Chiquihuite Cave site (Zacatecas, Mexico) as researchers who have not been directly involved in the debate on the early settlement in the Americas. Therefore, ours is an external, aseptic perspective. From this perspective, the review of the images of the lithic materials recovered at the Chiquihuite site leads us to a conclusion: there are objects in this assemblage that were undoubtedly knapped by humans. These artefacts are mainly small flakes, blades, and some cores. Among the cores, artefact #8 (1541-12309) (level SC-B) stands out. Its sagittal edge clearly delimits two faces that have been exploited to produce small flakes. The edge has a sinuous delineation characteristic of this type of centripetal bifacial exploitation.

In this assemblage, we also observed numerous flakes with non-cortical butts that have clear impact points. These flakes have non-cortical dorsal faces with ridges that delimit scars of previous removals. We can cite several examples, such as artifacts #236 (1979-12734), #270 (1506-12553), #477 (1728-12892), #489 (1836-12905), #642 (2208-16684), #749 (4067-17195), #768 (2476-16890), #838 (4105-17132), and #900 (4127-17133). We also clearly identified blades, with the characteristic longitudinal ridge on the dorsal faces and concave ventral faces, e.g., #490 (1836-12907) and #809 (3994-17127).

On the other hand, although less frequent, we have also observed some retouched pieces, such as artefacts #371 (1624-13103), #396 (1423-13056), #456 (1115-13011), #482 (273-10601), and #493 (1694-13291). In some cases, the retouching is continuous and systematic, contributing to confer a certain morphology to the artefact. This is what happens on piece #547 (370-9734), with a pointed morphology, and #977 (4416-17446) that is an end scraper. We have also identified objects with a very distinctive fracture, such as #909 (2379-17241), which is the distal end of a point.

All these pieces are ascribed to the component SC-B, with dates ranging from 16,605-15,615 calibrated years before present (calBP) until 13,705-12,200 calBP. Even more interesting is the finding of objects with clear signs of anthropic knapping in the component SC-C, dated as old as 33,150-31,405 calBP. In this stratigraphic unit, we also found flakes with dorsal faces and non-cortical platforms. On the dorsal faces of some pieces, we observe scars of previous removals, for example on #1038 (586-11809), #1041 (492-11132), #1067 (648-12273) and #1098 (2185-17218). Also, in these levels, we note some objects with retouch, such as #1132 (4140-17430) with continuous lateral retouch, or #1069 (570-10056) which presents alternating bifacial retouch on a laminar product.

Therefore, all the features that define a lithic *chaîne operatoire* are present in this assemblage. From our point of view, based on our experience of more than 30 years of analysis of lithic materials of diverse chronologies, diverse raw materials and diverse geological

contexts, artefacts knapped by humans have been recovered at Chiquihuite Cave. It is obvious that these lithic materials do not fit the techno-cultural pattern typical of later groups, such as Clovis. We are talking about a less complex, less systematized knapping, which is indicative of an earlier occupation, reflecting the emergence of the earliest human settlement in the Americas.

As we said at the beginning, we must move towards a new conception of the early American archaeological record, moving away from apriorism and preconceived ideas about what the objects knapped by early Americans should be like. We must move away from dogmatic subjectivism, which shuns the recognition of evidence that does not fit what some expect to find based on an old and decadent paradigm.

Acknowledgments

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Second Foreword

Ecofact or Artifact: documenting anthropogenic processes

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Here, we address four basic issues: 1) the value of a catalog; 2) raw material selection and technology as cultural 'choices'; 3) the need for systematic studies of natural process that may produce flaked stone; 4) a call for critics to present their evidence/data.

1) With modern technology, it is now possible to make widely available large amounts of digital data, such as the corpus contained in this catalog[3]. Ardelean has elected to undertake this massive effort because of the restrictive nature of standard publications and the need for colleagues to be informed so they can make educated critiques. Even with the option of "Supplementary information" offered by some journals, none would agree to hosting such a massive amount of data (14+ gigabytes). Yet, to adequately make his case, he felt he needed to present multiple images of a large number of pieces (artifacts) along with his reasonings. He chose to use multiple photographs of each piece. An alternative could have been 3D scans, but the one relevant example we could locate (Prentiss et al., 2015) was less than convincing for this type of item. We are aware, though, that an open-access online catalogue of representative 3D scans is already in preparation for Chiquihuite. Meanwhile, the present catalog focuses on technological attributes demonstrating why they were the products of human rather than natural actions. This catalog is not intended to be the only evidence, as other studies are being undertaken (traceology and residue analysis) that may support his interpretations. Combined with his detailed contexts, dating and stone identifications, we find his arguments compelling.
2) There is a general premise amongst many archaeologists that flaked stone technology is an essential component of all nonmetal-using societies and its presence has become a litmus test for interpreting evidence of human activities. Yet, there are sites that have been interpreted as resulting from human activities that do not have directly associated stone artifacts (Bourgeon et al., 2017; Holen and Holen, 2013: 429-444; Bennet et al., 2021). In addition, the development of sophisticated analytical techniques, such as genetics

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[3] As clarified above for the spellings "artefact/artifact", the words *catalog* and *catalogue* are both acceptable versions in English language. The first one is more common in American English, while the later is more accepted for other parts of the globe. Here, we allow both spellings, respecting the choice made by the authors of the manuscript. This is part of our cultural diversity.

(Mulligan and Kitchen, 2013) and soil chemistry, to determine the presence of humans is being used to suggest human locations lacking identifiable artifacts (Tamm et al., 2007). This has led to the proposal of a Beringian 'standstill' but has been questioned for the total lack of archaeological evidence to support it (Graf and Buvit, 2017). Furthermore, there tends to be a concept that technology evolves in complexity through time and that people seek to constantly improve functionality and efficiency, especially related to environmental 'adaptation' and tool stone selection. Both of these assumptions are readily refuted by archaeological, historical and ethnographic evidence. The idea that people would seek out and use high quality flakable stone, when available — rather than use 'inferior' materials — is a common assumption. Yet, there are archaeological examples that show a preference for 'inferior' materials, even when higher qualities are readily available (Prentiss et al. 2015). In Brazil, besides Pedra Furada and Santa Elina (Vialou et al., 2017) — which are overly controversial by the same reasoning applied to Chiquihuite (i.e., ages too old to be true) — we know of at least two rather uncontroversial cases of Holocene sites where raw material choice is far from "adequate": the Lagoa Santa sites (Araujo et al., 2012; Moreno de Sousa and Araujo, 2018), where small-sized quartz crystals were chosen over a wide variety of "better suited" raw-materials, such as flint and fine grained quartzite; and Consteca rockshelter, not dated yet, presenting flint on the upper layers, but only bad quality quartzite and even limestone within the lower layers. It is important to note that the Lagoa Santa lithic industry is so simple and inconspicuous that if it did not appear inside rockshelters together with thick ash deposits, human burials, fauna and so on, it would pass totally unnoticed, as just small quartz crystal pieces scattered across the landscape.

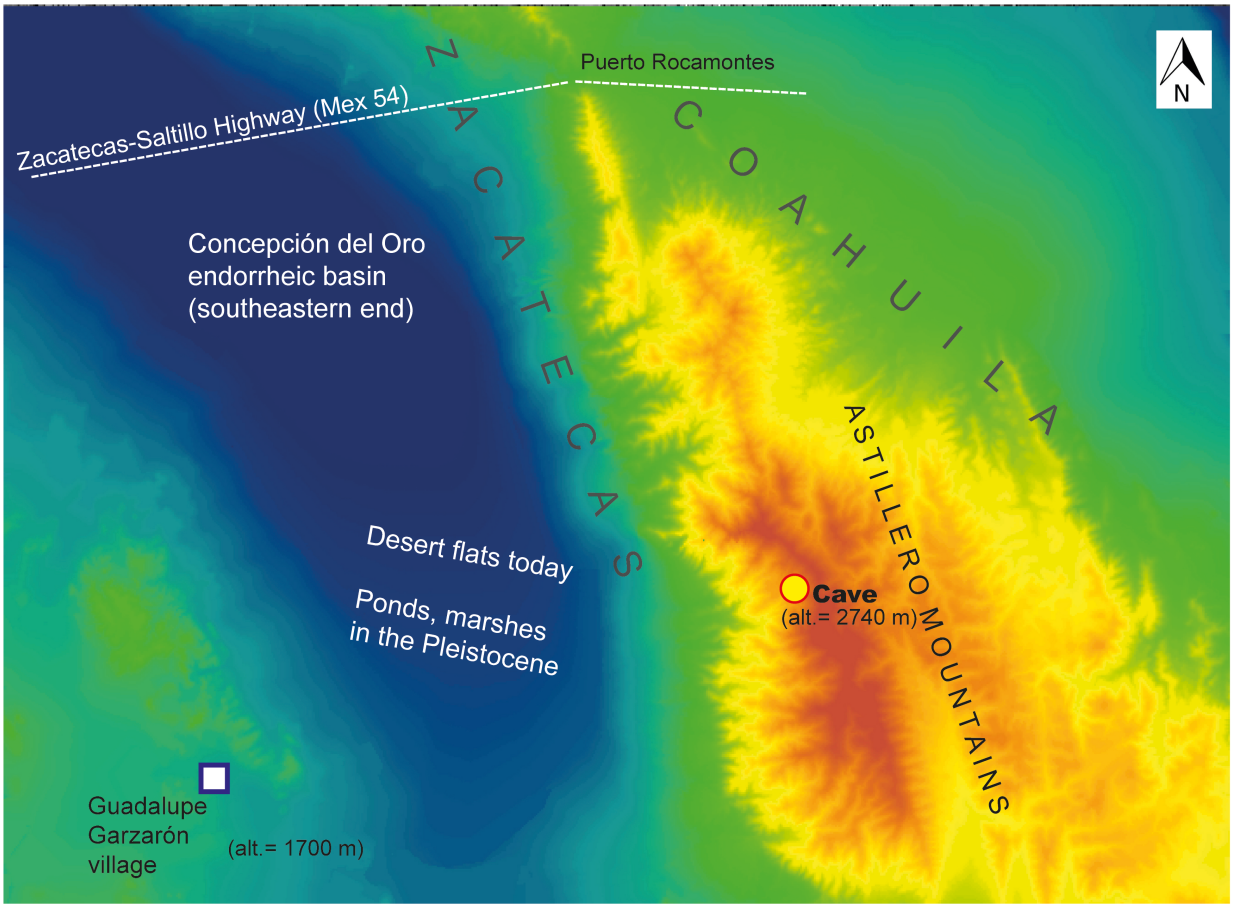
3) Critics of older-than Clovis claims frequently suggest that the stone or bone items may be of natural origin: a valid concern. However, seldom do they reference or present data to support their assertions. How does one distinguish artificial from natural? This is an age-old issue: eolith vs. artifact (eg. Hazzledine, 1914; Peacock, 1991; Barnes, 1939; Clark, 1958, Lubinski et al., 2014; Parenti et al., 2018). However, these studies mainly focus on archaeological concerns rather than the documentation of natural fracturing in clearly non-archaeological contexts; yet, there are a few that are relevant to specific archaeological contexts and raw material types (Patterson, 1983; Tune et al., 2018). "While it is important to establish the potential for taphonomic influences at all sites, it is not sufficient to simply demonstrate the existence of past geomorphic processes that might have altered cobbles (Patterson, 1983). A combination of contextual and artifact criteria must be used when testing an assemblage (Chlachula and Le Blanc, 1996). Once the potential for taphonomic alteration has been established, the assemblage must be tested for evidence of these processes. This second step is often ignored during geoarchaeological critiques of controversial sites (e.g., Haynes, 1973)" (Gillespie et al., 2014).
4) There has been some recent well documented research related to bone breakage (Holen and Holen, 2004), but these tend to be focused on human agencies rather than natural (for an exception, see Haynes et al., 2020). Where are the controlled, repeated experiments or the well documented studies of non-archaeological contexts?

With the detailed information and multiple images, this catalog makes it possible for critics (and proponents) to point out specific features on the pieces that they infer are of either natural or artifactual origin, which should include their reasoning and be referenced. It is not credible nor acceptable to just proclaim they are natural.

Supporting materials

This section includes a series of photographs, maps and other visuals meant to offer support and auxiliary information to help readers understand the geographical, stratigraphic and geo-chronological contexts in which the artefacts depicted in this catalog have been discovered.

S.M. *Figure 1*: Geographical positions of: (a) Mexico in the world; (b) Chiquihuite Cave in Mexico, shown (c) in relation to state borders, and (d) in the context of the regional orography. (Open-access base maps from www.d-maps.com). Topographic model (d) by Juan Ignacio Macías-Quintero, based on open-access data from Mexico's National Institute of Statistics and Geography (INEGI). Figure composition by C.F. Ardelean.

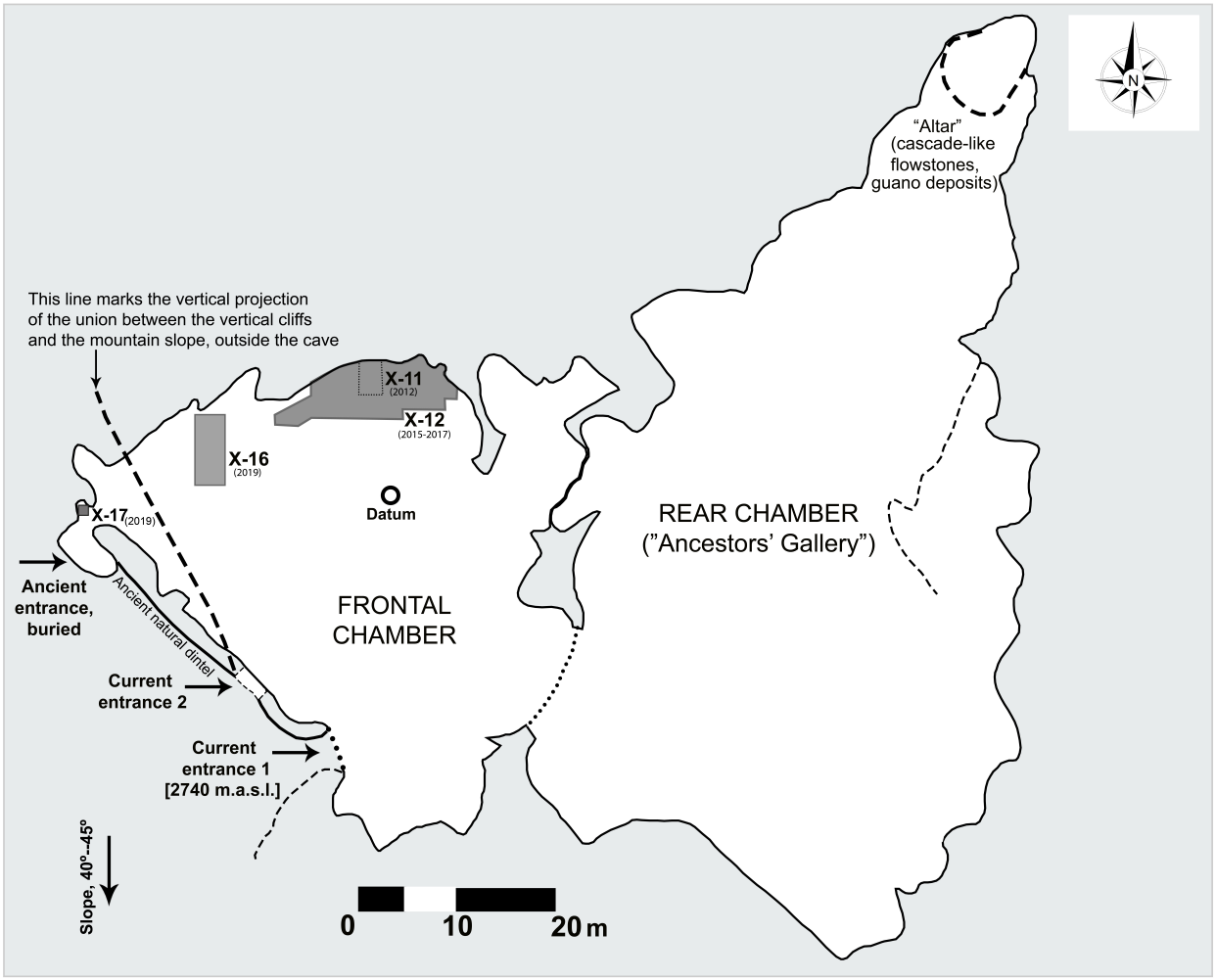


S.M. *Figure 2*: Digital elevation model (DEM) showing the immediate context of the site. Model and figure elaborated by C.F. Ardelean, using open-access GIS software and open-access data from INEGI.

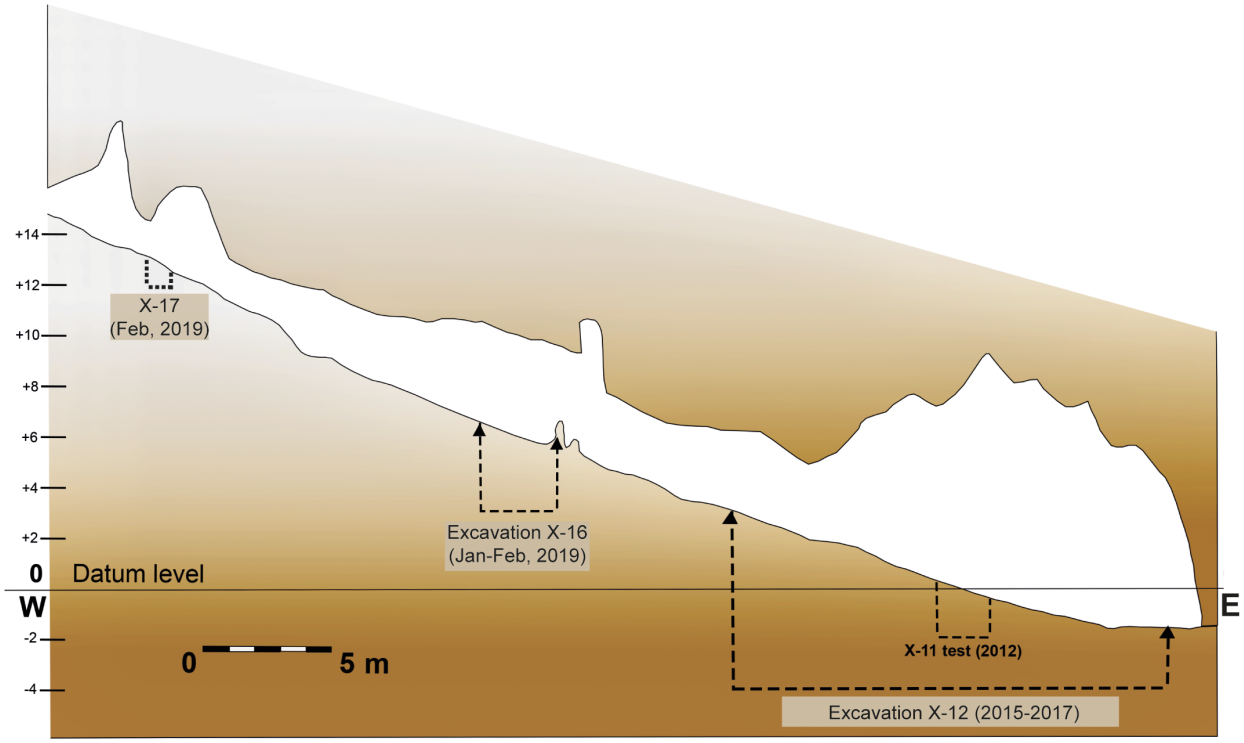
S.M. *Figure 3*: The central section of the Astillero Mountains in northern Zacatecas (with Chiquihuitillo Peak, altitude 3200 m a.s.l., visible at centre-right), as seen from the southwest, when entering the endorheic basin from Sierra Borrada in the south. The arrow indicates the location of Chiquihuite Cave, at 2740 m a.s.l. Photo by C.F. Ardelean (December 2014).

S.M. *Figure 4* (above): General view of the main chamber of Chiquihuite Cave, as seen from the eastern wall when looking towards the “double-eyed” entrance, at around 3 o’clock in the afternoon, when natural light briefly invades the cavern. Then-student Zamara Navarro sits at the centre, while exploring sediments. Photo by C.F. Ardelean (January, 2017).

S.M. *Figure 5* (below): Panoramic view of the excavation areas at Chiquihuite. In foreground, larger excavation X-12 during the re-sampling for eDNA. The lights in the background, at the centre, indicate location of excavation X-16. Photo by Mads Thomsen (February, 2019).

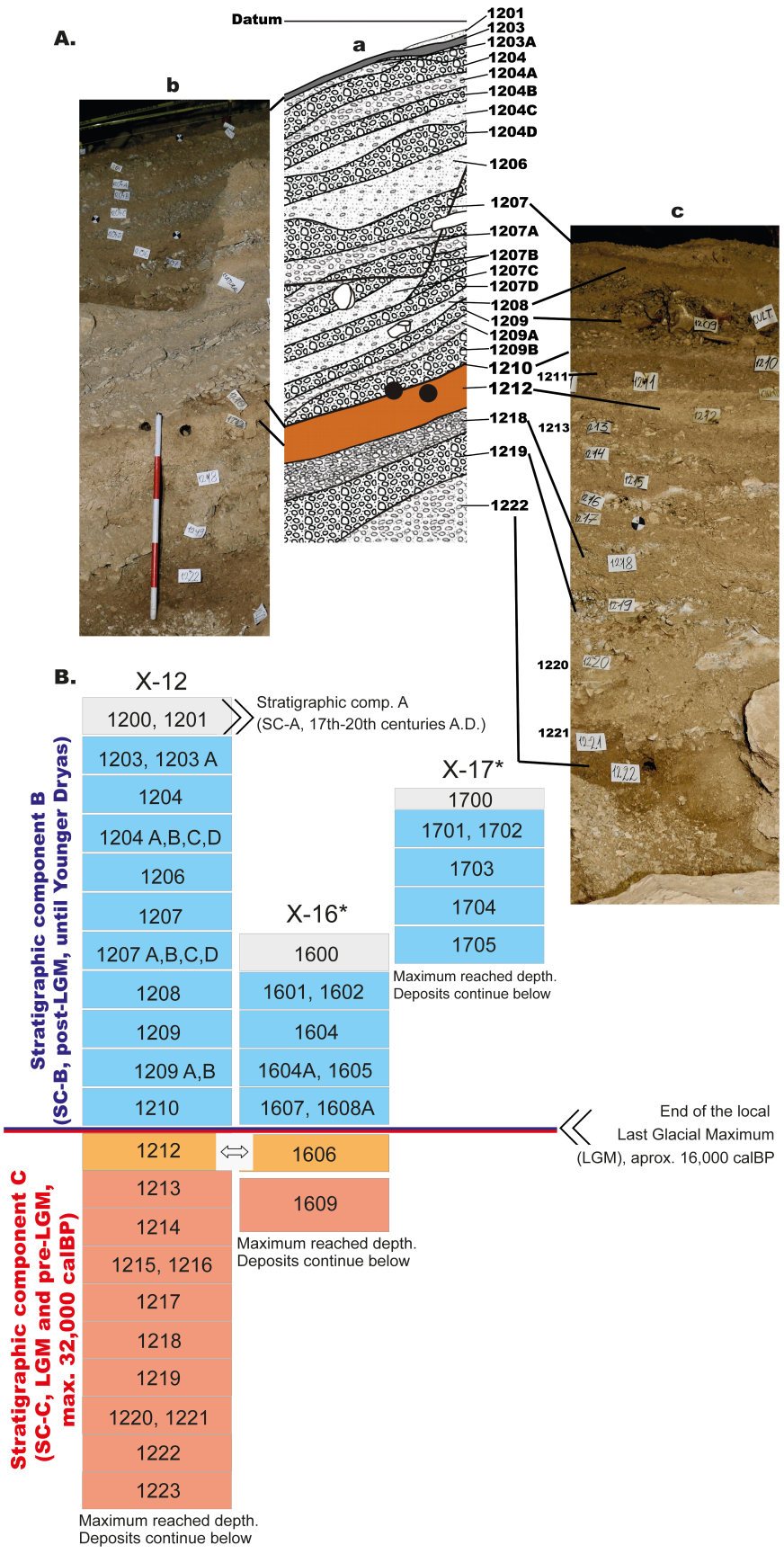


S.M. *Figure 6*: General planimetry of Chiquihuite Cave's principal chambers, showing the location of the three excavations the artefacts described in this catalogue were recovered from. On-site mapping conducted by Juan I. Macías-Quintero. Figure made by C.F. Ardelean. Version modified after Ardelean et al*.,* 2020 (p. 88, fig. 1a).



S.M. *Figure 7*: East-West cross-section "cutting" through the northern sector of Chiquihuite Cave's frontal chamber, along the southern profile of the X-12 trench, showing the position of all excavation units at the site. On-site mapping by Juan I. Macías-Quintero and team. Figure elaborated by C.F. Ardelean. Modified from Ardelean et al., 2020, Extended Data Fig.1h.

S.M. *Figure 8* (next page): Geo-chronological diagrams showing the relative relationship between stratigraphic units and inside stratigraphic components. **A.** Stratigraphic drawing (a) and photographs (b, c) showing the depositional sequence of strata inside excavation unit X-12, excavated in 2015, 2016, 2017, 2019, and published in *Nature* (Ardelean et al., 2020). **B.** Simplified diagram showing the relevant strata (also known as layers or stratigraphic units) in excavations X-12, X-16 and X-17, and how they relate to stratigraphic componentes B (SC-B, in blue; younger than the Last Glacial Maximum, LGM), and C (SC-C, in red; formed during and before the LGM). **(*)** Excavations X-16 and 17 have not yet been properly published at the moment of submission of this manuscript. However, preliminary data shows that stratum 1606 (from X-16) is the same carbonate mud-rich layer as 1212, marking the ending event of the LGM. For a detailed discussion of the geo-chronology in excavation X-12, see Ardelean et al., 2020 and Becerra-Valdivia and Higham, 2020.


A.
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B.
X-12
1200, 1201
1203, 1203 A
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1204 A,B,C,D
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1207 A,B,C,D
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1209 A,B
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1220, 1221
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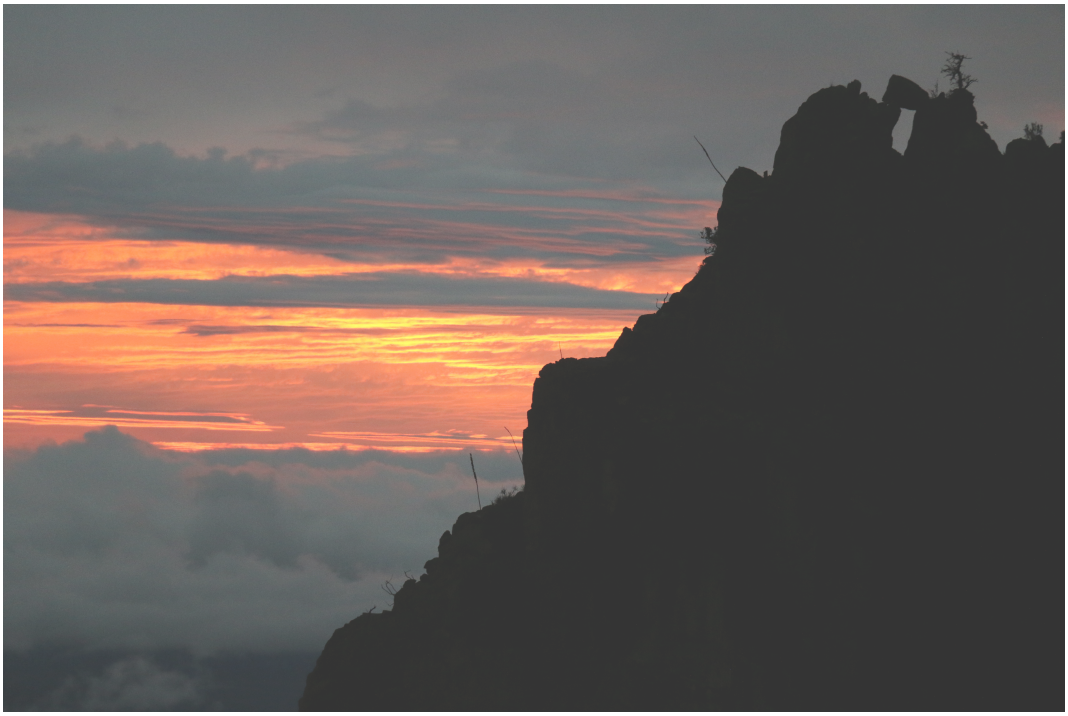
1223
Maximum reached depth.
Deposits continue below
Stratigraphic comp. A
(SC-A, 17th-20th centuries A.D.)
Stratigraphic component B
(SC-B, post-LGM, until Younger Dryas)
X-16*
1600
1601, 1602
1604
1604A, 1605
1607, 1608A
1606
1609
Maximum reached depth.
Deposits continue below
X-17*
1700
1701, 1702
1703
1704
1705
Maximum reached depth.
Deposits continue below
End of the local
Last Glacial Maximum
(LGM), aprox. 16,000 calBP
Stratigraphic component C
(SC-C, LGM and pre-LGM,
max. 32,000 calBP)



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