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More than storage: A functional analysis of the lithic industry associated with the C008 cave complex at Bentayga, Gran Canaria (Canary Islands, Spain)☆

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ABSTRACT

Although volcanic rocks are commonly found in many assemblages, functional or use-wear studies focusing on these materials are still relatively limited. This study presents a case from the Canary Islands, an archipelago of volcanic origin characterized by the presence of rocks such as basalt and obsidian, and the absence of metal resources. We report the results of functional analyses conducted on stone tools recovered from a site within the Bentayga archaeological complex, dated to the 10th–13th centuries CE. Whitin this big site, a caves complex (C008) initially used as a granary and later repurposed as a burial space, offers exceptional preservation conditions, including desiccated plant remains and soft animal tissues. Our analyses reveal that the stone tools were employed in processing plant materials, working leather, and modifying the cave structure. Notably, a basalt implement bearing use-wear traces consistent with cereal harvesting represents the earliest direct evidence for this activity in the archaeological record of the Canary Islands. The findings suggest that stone tools were actively used during both phases of the site's occupation: first for agricultural and construction tasks during its use as a granary, and subsequently for preparing the space and remains during its reuse as a burial site.

1. Introduction

Stone tools provide direct evidence of numerous productive activities carried out by past societies, particularly those related to plant processing such as harvesting implements and grinding stones. Morpho-technical and functional analyses have yielded significant insights into strategies of plant use and processing across diverse chronological and geographical contexts (Anderson, 1992, 1994; Unger-Hamilton, 1992; Ibáñez et al., 2008; Maeda et al., 2016; Snir et al., 2015; Groman-Yaroslavski et al., 2016; Pichon, 2017; Jover Maestre et al. 2019; Ibáñez et al., 2021; Mazzucco et al., 2020, Mazzucco et al., 2022). These studies have been further enriched by archaeological research on plant consumption, particularly in cases where preservation conditions allowed for the recovery of botanical remains (Sigaut, 1978; Testart et al., 1982; Harlan, 1995; Christakis, 1999; Hillman, 2000; Van der Veen, 2007; Smith, 2014; Peña-Chocarro et al., 2015; Arranz-Otaegui et al., 2016). Despite the frequent presence of lithic tools associated with plant processing in archaeological contexts, functional studies on volcanic stone tools remain relatively scarce (Huidobro, 2018; Bello-Alonso et al., 2020). This research gap limits our understanding of plant exploitation strategies in regions where volcanic rocks constitute a major component of lithic assemblages (Rodríguez-Rodríguez et al., 2022).

Storage strategies, attested at the earliest Neolithic sites in the Near East, progressively diversified and became increasingly specialised, adapting to varied environmental conditions and the specific characteristics of the goods being preserved (Kuijt and Finlayson, 2009). One of the most remarkable and effective developments was the creation of clusters of silos, either carved into the bedrock or built within larger architectural complexes with prominent examples found across the

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Maghreb and reaching their westernmost expression in the Canary Islands (Delaigue et al., 2006, 2011; Henríquez-Valido et al., 2019; Meunié, 1951; Peña-Chocarro et al., 2015). On Gran Canaria, these granaries consist of a set of silos excavated in the volcanic tuff, organised around chambers and galleries. They are often located in places that are difficult to access and/or easily defensible, such as cliffs. The stable, arid micro–environment of these granaries fosters exceptional preservation, allowing desiccated seeds and fruits, together with the insects that once infested them, to survive *in situ* (Morales et al., 2014; Henríquez-Valido, 2022). While crop management and storage logistics have been intensively researched (Henríquez-Valido et al., 2019, 2020; Onrubia Pintado, 2003; Morales et al., 2014), other categories of material culture, particularly stone tools in obsidian and other volcanic rocks, but also timber, wooden and plant fibre artifacts, ceramics and leather containers have received limited attention (Naranjo–Mayor and Rodríguez–Rodríguez, 2015; Vidal-Matutano et al., 2020, 2021).

This article aims to reveal the potential of morpho-technical and functional analysis of knapped stone tools from these granaries for reconstructing past activities. We examine the lithic assemblage from the recently excavated C008 cave complex on the southern face of the Roque Bentayga (Tejeda, Gran Canaria). Preliminary results confirm the complex's role for plant storage and reveal diverse, well-preserved archaeological remains, including organics such as desiccated leather fragments, cereal stems, rush mats and seeds. Archaeological fieldwork and radiocarbon dates also indicate that the granary was later transformed into a collective burial. The superimposed depositional episodes, together with human-induced taphonomic processes, produced a complex palimpsest. The taphonomic alterations identified at the site are exclusively anthropogenic in nature and include the reuse of storage chambers and cleaning practices during the indigenous period, as well as the modifications associated with burial practices. Also, we have documented subsequent visits to the cave complex, and documented episodes of looting. These actions account for the observed displacement and redistribution of artefacts within certain cavities. Even so, many chambers remained sealed or well preserved, with no evidence of bioturbation. Our aims are: (1) to determine the function of the lithic tools and their relationship to morphology and raw material; (2) to establish spatial and diachronic correlations with activities that occurred in the granary over time; (3) to refine knowledge of harvesting and storage techniques for ensiled plant products.

1.1. Geographical and cultural setting

The Canary Islands comprise a volcanic archipelago ca. 100 km off the north–west African coast. Archaeogenomic and radiocarbon evidence places first settlement around the turn of the Common Era by Amazigh (Berber) populations from the Maghreb (Serrano et al., 2023; Santana et al., 2024, Santana et al., 2025). Rapid colonisation was followed by the loss of regular maritime contact, fostering island–specific cultures that nevertheless retained a shared genetic and linguistic substratum, becoming the Indigenous populations of the archipelago (Santana et al., 2024, 2025). The fifteenth–century Castilian conquest precipitated a swift demise of Indigenous cultural traditions (Morales Padrón, 1974; Lobo Cabrera, 2015). In Gran Canaria, archaeological and ethnohistorical records provide evidence that subsistence combined farming of Mediterranean cereals and pulses with animal husbandry (goats, sheep, pigs), wild–resource gathering and the exploitation of rich marine biota (Rodríguez-Santana, 1994; Castellano-Alonso et al., 2018; Morales et al., 2023).

During the pre-European period, each island displayed distinctive lifeways, reflected in the variability of its material culture. The absence of metals in the archipelago placed lithic production strategies at the center of tool manufacture. Like the rest of the archipelago, Gran Canaria is igneous in origin. Its magmas exhibit a predominantly alkaline affinity, spanning a broad compositional spectrum from ultrabasic rocks such as basanites and nephelinites to more differentiated types, including trachytes and rhyolites. Basalts are common, as well as intermediate rocks such as trachybasalts and phonolites. In exceptional cases, these geological formations contain exploitable quantities of volcanic glass/obsidian (Rodríguez-Rodríguez et al., 2022). The characterisation of the obsidian tools indicates the exploitation of several sources, with geochemical signatures primarily falling within trachytic and phonolitic compositional ranges (Rodríguez-Rodríguez et al., 2005).

Obsidian was typically knapped using the bipolar technique, placing the cores on an anvil and striking them with a hard hammer, thereby producing blanks with opposed negatives and limited standardisation of form (Rodríguez-Rodríguez and Hernández Gómez, 2006). Other volcanic rocks were subjected to *façonnage* and *débitage* strategies according to the desired tool type, employing direct hard percussion, soft percussion with wooden mallets, and even indirect percussion using specific lithic tools "picks" as intermediaries (Rodríguez-Rodríguez and Francisco Ortega, 2012; Rodríguez-Rodríguez et al., 2022). Grinding tools, such as rotary querns and mortars, were also fashioned with volcanic tuff and vesicular basalt, primarily for cereal processing (Lacave-Hernández et al., 2024). To date, few traceological studies have been carried out on the island (Naranjo-Mayor and Rodríguez-Rodríguez, 2015). The present one aims to improve this research topic with a new archaeological analysis and more experimental data adapted to local resources.

1.2. Archaeological context: The C008 caves complex

The C008 forms part of a big archaeological site in the Roque Bentayga, a 1,414 m-high volcanic plug that rises abruptly from the floor of the Caldera de Tejeda (Carracedo and Troll, 2016).

Roque Bentayga was an important settlement for the Amazigh population of Gran Canaria. By the mid-1st millennium CE, settlers had occupied this massif. Radiocarbon dates indicate prolonged occupation between the 5th and 15th centuries cal CE (Santana et al., 2024). The site comprises more than a hundred excavated and natural caves used for dwelling, storage, livestock and collective burials, and sheltered by stone parapets. Rock-cut silos, Libyco-Berber petroglyphs and defensive walls testify to intensive, long-term occupation and ritual activity that continued up to the Castilian conquest. Today, Roque Bentayga and its surrounding cultural landscape form part of the UNESCO World Heritage Cultural Landscape of Risco Caído and the Sacred Mountains of Gran Canaria.

Situated 1,100 m asl at the southern escarpment of Roque Bentayga, C008 comprises multiple artificial cavities excavated into pyroclastic tuff (Fig. 1). Three silos open to the cliff face (Complex 1). One of them gives access to an inner cluster (Complex 2), organised around Chamber B, with four subsidiary silos (C–F) (Fig. 2). As a typical Indigenous-period granary, the complex was carved directly into the bedrock and as documented in similar sites, the silos were periodically cleaned to prevent pests (Morales et al., 2014; Henríquez-Valido et al., 2020; Henríquez-Valido, 2022). During the 2024 excavation of C008, it was possible to distinguish several stratigraphic units (UE in Spanish), that took into account the spatial differentiation of the silos and the various depositional events. This made it possible to identify the level of preparation of the granary, the storage levels, and the subsequent use of an area of the central chamber (B) for multiple burials (Figs. 2 and 13). The surface layer showed evidence of post-depositional disturbance due to looting and visits by people and animals after the site was abandoned. The *in situ* units are shallow deposits that yielded a diverse range of finds, including desiccated seeds, cereal ears, timber, fragments of rush mats and leather, alongside pottery and chipped stones. All those evidences confirm both the primary use of the complex as a granary and its subsequent reuse as a funerary space. Chronological interpretations rely primarily on short-lived samples such as seeds or human remains, which have provided AMS radiocarbon dates placing the use of the complex between the 10th and 13th centuries cal CE (Table 1).

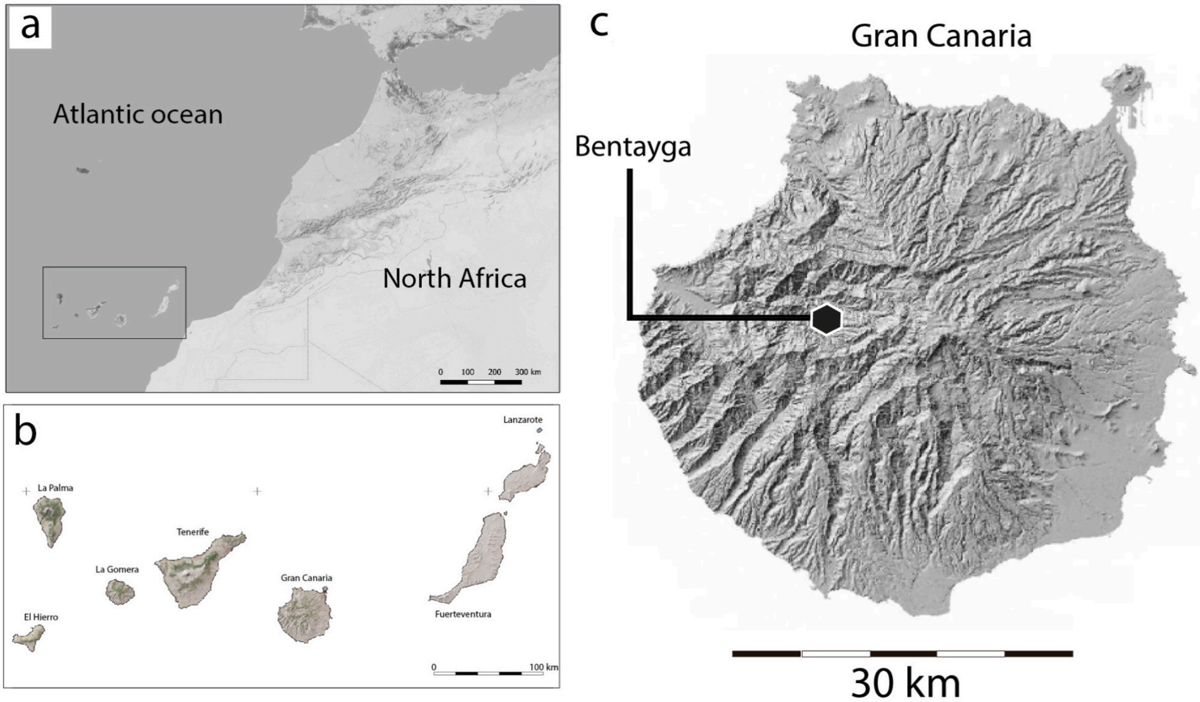

Fig. 1. a) Map of the Canary Archipelago showing its position off the north-west African coast. b) Detail indicating the location of Gran Canaria. c) Position of the Bentayga caves complex, where site C008 is situated.

2. Material and methods

2.1. Morphotechnical and functional analysis of the lithic assemblages

A total of 218 lithic pieces were recorded at the site: 212 inside the different cavities and six from the exterior area adjacent to the entrance (n = 6). The indoor pieces are distributed across chambers B (n = 154), C (n = 20), D (n = 17), and E (n = 21).

Morpho-technical analysis followed protocols previously adapted and developed for volcanic rocks in the Canary Islands (Tixier et al., 1980; Carbonell et al., 1983; Galván Santos et al., 1987; Rodríguez-Rodríguez, 1993; Rodríguez-Rodríguez and Francisco Ortega, 2012). Technological and typological features were recorded, and the raw-material type was identified macroscopically. In this study, volcanic rocks blanks measuring < 3 cm and volcanic glass fragments < 1 cm were classed as knapping debris.

Functional analysis aimed to detect use-wear traces with both low- and high-power microscopy (Odell, 1981; Keeley, 1980; Lemorini et al., 2014; Van Gijn, 2014). Only artefacts with potential analytical value were considered for traceological examination; fragments, debris, and cores were discarded from the outset. During the selection process, we considered both the edge outline and angle to identify pieces suitable for analysis, as well as their state of preservation. All pieces were examined visually to discard those that showed significant post-depositional alterations. The descriptive protocol of use-wear traces has been detailed elsewhere (Brito-Abrante and Rodríguez-Rodríguez, 2024). Use-wear attributes (scarring, rounding, abrasion, striation and polish) were characterised according to established criteria (Mansur-Franchomme, 1986; Hurcombe, 1992; Rodríguez-Rodríguez, 1998; Kononenko, 2011; Clemente-Conte et al., 2015; Astruc, 2022). For interpretation, we rely on experimental programs specifically adapted to volcanic raw materials, including non-woody plant processing and cereal harvesting (Brito-Abrante and Rodríguez-Rodríguez, 2024), as well as mineral-working activities (Lacave Hernández et al., 2024). A selection of experimental photographs illustrating these use-wear patterns is provided in the article (see Supplementary Fig. S1, S2).

Out of the total 218 lithic artefacts from the site, 46 were initially classified as potential tools. The traceological examination focused mainly on the central Chamber B, as this context yielded the highest concentration of well-preserved diagnostic artefacts. These pieces showed no apparent post-depositional alterations on first inspection, and their state of conservation made them particularly suitable for functional analysis. The remaining artefacts were excluded due to unsuitable edges outline or angle, alteration traces, or because they were clearly knapping debris, even when larger than 3 cm (grained volcanic rocks) or 1 cm (obsidian). From this corpus the use-wear study included seven obsidian flakes, 26 volcanic rock flakes and the entire *façonnage* corpus (13 pieces).

2.2. Optical equipment and laboratory protocols

Artifacts were cleaned using an EMAG Emmi-H30 ultrasonic tank filled with demineralised water. Each artefact was treated individually and placed inside a sealed plastic bag, which was then submerged in the ultrasonic tank to avoid direct contact with the ultrasonic bath. Cleaning was conducted in two sequential phases. In the first phase, the individual bags with each piece contained demineralised water with a neutral detergent (approximately 1–2% v/v) and were subjected to ultrasonic treatment for approximately 20 min in order to loosen adhering sediment. In the second phase, each artefact was again placed individually in a sealed bag containing demineralised water with neutral detergent (same concentration) and acetone (C_3H_6O) diluted to approximately 10% v/v. This treatment lasted an additional 20–25 min, until visible sediment and surface concretions were removed. Tools were examined using three microscopes: (**i**) a Nikon SMZ1000 stereomicroscope (8 × –80 ×) for low-magnification observation of macro-traces and the general distribution of edge damage; (**ii**) a Nikon Labophot-2 metallographic microscope operating at high magnification (100 × –400 ×) with incident brightfield light for detailed observation of micro-traces; and (**iii**) a Nikon Eclipse MA100 inverted metallographic microscope, also used at high magnification (100 × –400 ×) with transmitted brightfield light. The latter is used for pieces with big dimensions, such

Fig. 2. C008, Bentayga. a) Frontal view of Complex 1, displaying the three cavities/silos with exterior access; the arrow marks the entrance to Complex 2. b) View of Complex 2, with its central chamber (B) and its four additional cavities (C, D, E, F).

as picks or scrapers. Images were captured with a Nikon DS-Fi2 camera at multiple focal planes, manually controlled via NIS-Elements v. 4.30. The photographs were focus-stacked with Helicon Focus 6, after which scales were added in Photoshop CS4 and Adobe Illustrator.

3. Results

3.1. Morphotechnical analysis of the tools

Supports on volcanic rocks are mainly flakes (63), of which 11 retouched. The *façonnage* items were picks (including its rejuvenation tips) and scrapers (13). Other categories were debris, irregular fragments, two dykes and one core. Only 12 obsidian flakes were classified as full *débitage*. (Table 2). When mechanical and chemical post-depositional alterations were observed, they were carefully recorded in order to avoid them in use-were analysis.

The flake assemblage made from volcanic rocks comprises basalt (n = 18), phonolite (n = 17) and trachyte (n = 28). The recovered assemblage allows the reconstruction of blank-configuration strategies. Among these supports, full-*débitage* flakes predominate; these derive mainly from volumetric cores with a single semi-circled striking platform that produces unifacial blanks. The only core documented follows the same concept. Centripetal and orthogonal exploitation flakes are less numerous and were originated from discoidal cores (Fig. 3). Knapping debris and irregular fragments are present, indicating that initial reduction and shaping took place occasionally *in-situ*. Some pieces show thermal alterations in the form of pitting, reddening, and, in some cases, cracking on the surface (n = 20). Cortical remains indicate that most blanks derive from slightly rolled blocks or were extracted directly from *in-situ* lava flows, suggesting that raw materials were procured in areas close to the site. The analysed flakes range from 3 to 14 cm in length and from 1 to 12 cm in width, with a combined weight of 6.627 g.

By contrast, most obsidian flakes correspond to the phonolitic variety of black obsidian (n = 9), whose sources are currently unknown, although this raw material is more abundant in sites in southern Gran Canaria. Trachytic obsidian is also present (n = 3), sourced from the well-documented Hogarzales–El Cedro mining complex, located c. 17 km in a straight line from Roque Bentayga (Buxeda i Garrigós et al., 2005). Bipolar flakes predominate, reflecting the island's most common reduction strategy (Fig. 4). As noted, the small size of natural obsidian nodules privileges this technique, as it maximises the production of potentially sharp blanks despite their non-standardised morphology (Rodríguez-Rodríguez et al., 2022). Similarly, obsidian debris suggests

Table 2
Knapped lithic tools from the caves complex Bentayga. The table lists: raw material (VR = volcanic rocks; VG = volcanic glass), blank type, total number of pieces, number of retouched pieces and number of thermally altered pieces in each category.

Raw material	Blank type	No.	Retouch	Thermal Alterations
VR	Unidirectional exploitation flakes	34	6	3
	Centripetal exploitation flakes	6	2	4
	Bidirectional exploitation flakes	1	0	1
	Orthogonal exploitation flakes	6	0	2
	Unidentifiable exploitation flakes	13	3	2
	Cortical flakes	3	0	0
	Fragments	20	0	7
	Columnar dykes	2	0	1
	Cores	1	0	0
	Picks and tip rejuvenations	8	0	0
	Unifacial scrapers	3	2	0
	Bifacial scrapers	2	2	0
	Knapping debris	76	0	0
VG	Unidirectional exploitation flakes	4	0	0
	Bipolar exploitation flakes	7	0	0
	Orthogonal exploitation flakes	1	0	0
	Knapping debris	31	0	0

Table 1
Radiocarbon dating's of the site of C008 cave complex at Bentayga. The sample labelled Wall* corresponds to a barley seed embedded within the plaster coating of the silo wall.

Strat. unit	Silo	Material	Species	Quantity	LabID	CRA	Error	Calibrated (68%)		Calibtrated (95%)		Method
Wall*	E	Seed	*Hordeum vulgare*	Singular	GRM37037	1015	26	994	1032	990	1149	AMS
2	D	Human bone	*Homo sapiens*	Singular	SUERC128889	841	24	1176	1256	1166	1262	AMS
1	B	Human bone	*Homo sapiens*	Singular	SUERC128888	759	23	12,033	1280	1226	1284	AMS
1	B	Seed rachis	*Hordeum vulgare*	Singular	GRM37038	749	22	1264	1282	1228	1288	AMS
2	D	Human bone	*Homo sapiens*	Singular	SUERC128890	743	24	1264	1284	1228	1294	AMS

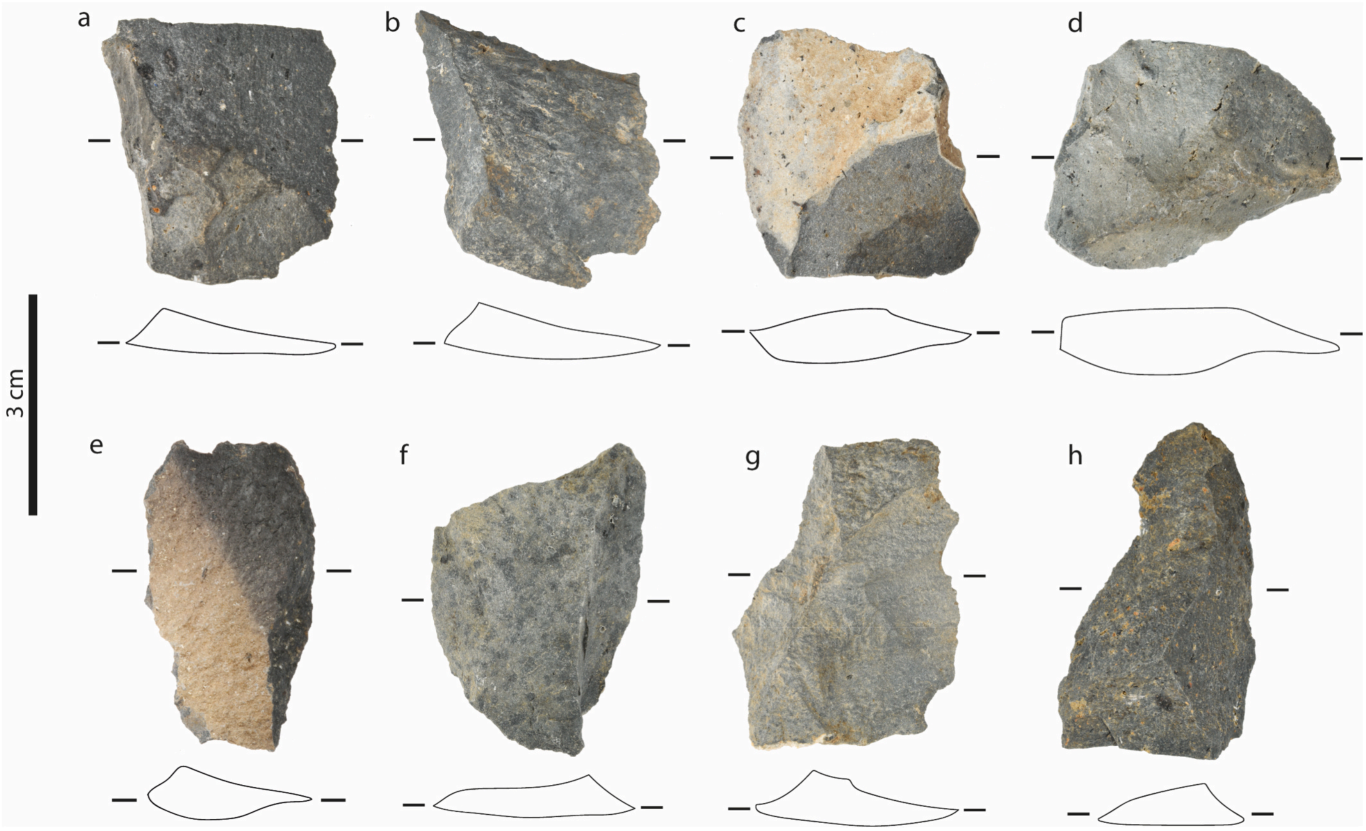

Fig. 3. Volcanic rock flakes from C008, Bentayga. a) Unidirectional phonolite flake; b) Orthogonal phonolite flake; c) Semi-cortical basalt flake; d) Orthogonal trachyte flake; e) Semi-cortical phonolite flake; f) Unidirectional basalt flake; g) Centripetal basalt flake; h) Unidirectional phonolite flake.

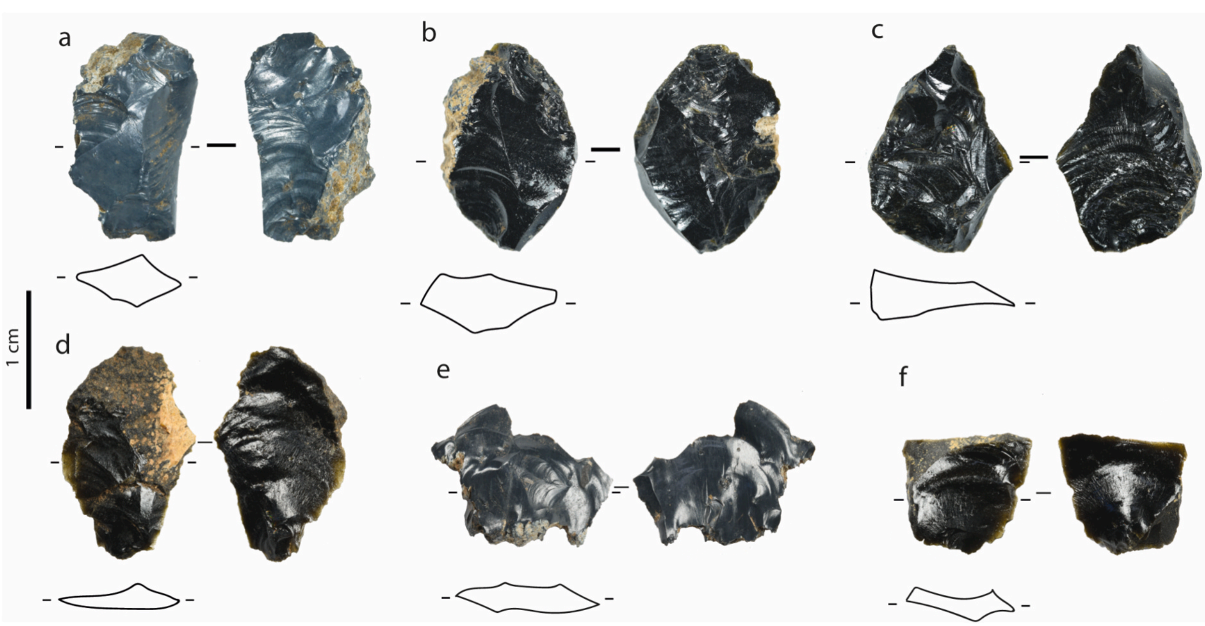

Fig. 4. Obsidian flakes from C008, Bentayga. a) Bipolar flake of trachytic obsidian; b–c) bipolar flakes of phonolitic obsidian; d) unidirectional flake of trachytic obsidian; e–f) unidirectional flakes of phonolitic obsidian.

that knapping of volcanic glass occasionally occurs at the site.

Pieces knapped by *façonnage* are highly significant. Four correspond to picks, a tool type that is unique from Gran Canaria and is especially common at sites associated with mining and quarrying, though it is also recorded, albeit less frequently, in domestic and storage contexts (Rodríguez-Rodríguez et al., 2022). Three morphological variants were identified. Type 1 and Type 2 picks exhibit two active apices separated by a central ridge, whereas Type 3 picks possess a single active apex (Rodríguez-Rodríguez and Francisco Ortega, 2012). These implements are large, measuring 12–33 cm in length and 15–22 cm in width, and together they weigh 12.570 g. Four rejuvenated apices were also recovered, indicating a maintenance strategy that reinforces the probability of their use *in situ* (Rodríguez-Rodríguez and Francisco Ortega, 2012; Naranjo-Mayor and Rodríguez-Rodríguez, 2015). A second *façonnage* group comprises five scrapers knapped from blocks or unrecognisable blanks. These supports carry one or more active edges fashioned by unifacial or bifacial removals. The multiple negative sequences, sometimes arranged in a stepped formation, create an abrupt, sometimes curved profile. As the picks, these pieces are sizeable, ranging from 13 to 18 cm in length and 7 to 14 cm in width, with a combined weight of 3.622 g.

3.2. Functional-analysis results

Use-wear analysis revealed signs of use in a single obsidian tool of the seven analysed flakes. For other volcanic rocks, use-wears were recorded in 22 of the 39 analysed items (Table 3). Detailed dimensional data for the lithic artefacts showing diagnostic use-wear traces are provided in Supplementary Material 3. The wear patterns show different tasks associated to the processing of animal, vegetable and mineral materials, indicating that these tools fulfilled multiple functions across diverse productive contexts. In several cases the worked material could not be identified precisely; diagnoses therefore relied on the hardness of the worked material (soft, hard, or indeterminate), although in every instance the motion employed was determined.

Only one of the obsidian flakes analysed shows wear related to butchery activities. This tool shows continuous abrasion on the edge, although some oblique scars can also be observed, consistent with longitudinal movements (Fig. 5, a). Fine, isolated, shallow and discontinuous striations are also observed, very limited to the abraded active edge. In most cases, they are oriented longitudinally, although some are oblique, which is a common orientation in these meat-cutting practices (Fig. 5, b). The abrasion on the edge is continuous, suggesting intermittent contact with harder components during use, probably bone. This combination of attributes is consistent with the processing of soft animal material. Three flakes—two made of basalt and one of trachyte—were associated with the processing of dry hide using both longitudinal and transverse motions (Fig. 6a, b). The edge is moderately rounded, being marginal in location and continuous in distribution. Generalised abrasion was recorded on both the edge and the surface, along with the presence of micropits. Striations of both rough-bottomed and sleek types were identified, ranging from shallow to deep, with parallel and transverse orientation, and appearing in both isolated and grouped dispositions. These occur over polished surfaces of medium development, primarily located on the upper parts or ridges. The polish exhibits a smooth to rough texture and a bumpy morphology (Fig. 6c, d).

One phonolite flake and one basalt flake presented use-wear traces associated with the processing of non-woody plant materials, possibly rushes, which were recorded in the burial area. The edge exhibits medium-intensity rounding, with shallow striations of both rough-bottomed and sleek types, oriented parallel and transverse to the edge. A polish of medium development is present along the edge, showing a smooth texture and slightly undulating morphology. The artefact with two active edges was used for two distinct activities on the same non-woody plant: one edge for longitudinal cutting (Fig. 7a), and the other for transverse scraping motions (Fig. 7b).

Furthermore, a single basalt retouched flake presented use-wear traces consistent with cereal harvesting activities (Fig. 8). At low magnification, the active edge exhibits bifacial and alternating edge scarring, with a discontinuous distribution. Scar morphologies are predominantly crescent-shaped, although semicircular scars with feather terminations are also present (Fig. 8 b). Edge rounding is bifacial and continuous along the entire cutting edge, indicating prolonged contact with a relatively vegetal material (Fig. 8 a). Under higher magnification, abrasion is documented on the surface, displaying a discontinuous distribution. Striations are very abundant and bifacial, with a continuous distribution and a dominant orientation parallel to the edge (Fig. 8 c, d). The most frequent striation types include smooth-edged striations with a bright bottom and irregular-edged striations with a darker bottom, together with occasional intermittent striations. An extensive polish development affects both the edge and adjacent surface areas of the not retouched face, whereas it is less intense in the opposite retouched one, indicating a rejuvenation action to continue with harvesting task (Fig. 8 c, d, f). This polish shows a very smooth texture and a morphology ranging from smooth to slightly bumpy. In addition, on several phenocrystal boundaries, smooth polished surfaces and fine striations are visible (Fig. 8 e).

Additionally, in other three volcanic rock flakes, it was only possible to determine the relative hardness of the worked materials and the directionality of motion. In these cases, the motion was determined based on the location, distribution, morphology, and termination of the scars. Microscopic analysis further confirmed whether the action was longitudinal or transverse. The distinction between soft and hard material was assessed through the characteristics of the scars, as well as the presence or absence of edge rounding, the distribution of striations, and the development of polish. Accordingly, one phonolite flake was used for transverse motions on hard material; one basalt flake for longitudinal cutting actions on soft material; and one trachyte flake showed complex use on an indeterminate material.

Most of the *façonnage* tools analysed exhibited use-wear consistent with activities potentially related to mineral working. In many cases, traces were present both on the apices and along the ridges of the picks (Fig. 9a; Fig. 10). The degree of development varied: some pieces show very pronounced rounding and abrasion (Fig. 9a), whereas others preserve only small step-terminated fractures with slight rounding at the base (Fig. 9b). They reflect continued rejuvenations tasks to maintain

Table 3
Functional interpretation of the lithic set from C008, Bentayga. The symbol (*) indicates a single artefact bearing two or more edges/sides used on the same contact material but with different movements.

Worked material	Movement	Raw material				
		Obsidian	Basalt	Trachyte	Phonolite	TOTAL
Butchery	Longitudinal	1				1
Hide	Longitudinal		1	1		
	Transversal		1			3
Non-woody plants	Longitudinal		1		1*	
	Transversal				1*	2
Cereals	Longitudinal		1			1
Mineral	Percussion			8*		
	Transversal complex		2*	8*	3*	13
Hard material	Transversal				1	
	Complex			1		2
Soft material	Longitudinal		1			1
TOTAL						23

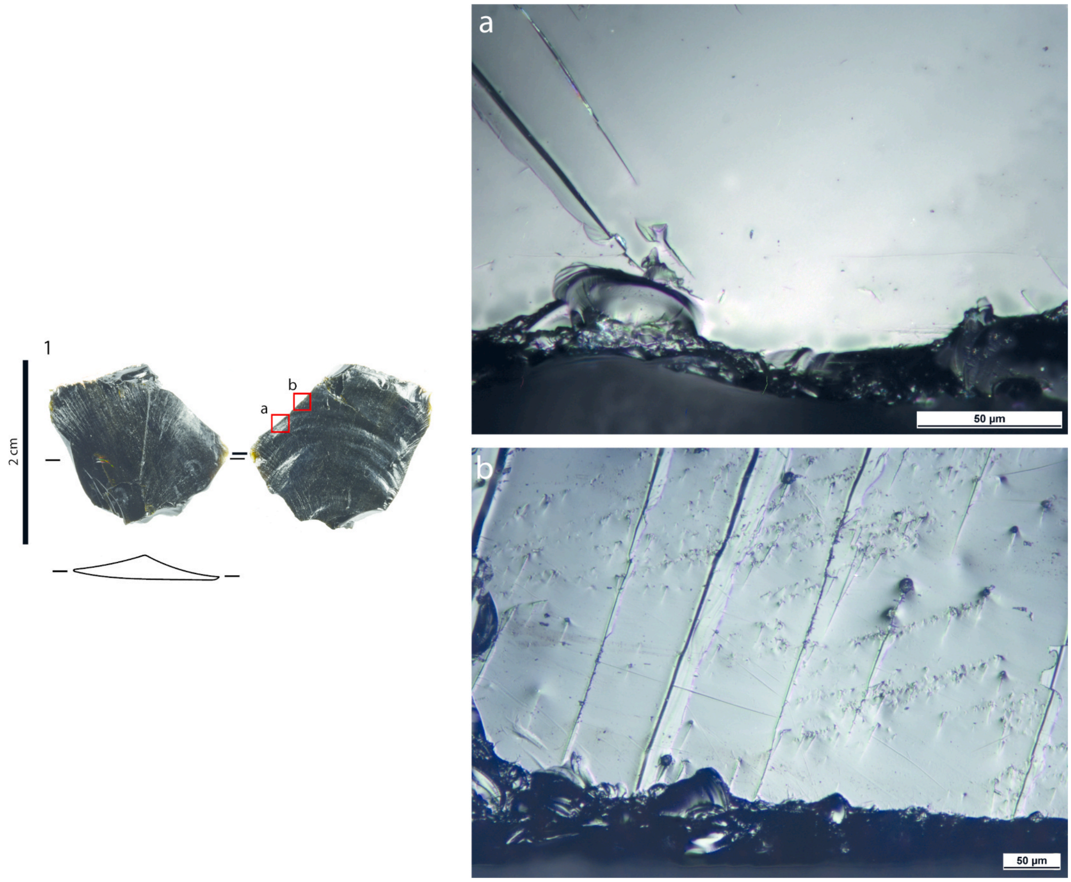

Fig. 5. Use-wear traces associated with butchery. 1) Phonolitic obsidian flake showing wear on one lateral edge; a: Scarring, very shallow, parallel, sleeks striations with neither rounding or polish (400 ×); b: Continuous abrasion along the edge, very shallow and fine, parallel and oblique, sleeks striations without polish or rounding (200 ×).

functionality. Characteristic traces observed on the picks include discontinuously distributed scars on the apices, with irregular or trapezoidal morphology and step or hinge termination. Picks with completely rounded edges and pronounced abrasion were also documented, consistent with continuous percussive action against hard mineral materials (Fig. 9a; Fig. 10a). In addition, in several cases, volcanic tuff residues were recorded with the naked eye in active apices. These recurring patterns, combining rounding, abrasion, and step terminations suggest intensive and repetitive contact with a hard, abrasive material, most plausibly volcanic tuff, and align with previous experimental and archaeological results (Lacave Hernández et al., 2024). Scrapers display wear comparable to that documented along the ridges of the picks, though restricted to edges and straight portions. The observed use-wear includes moderate edge rounding, continuous abrasion, and rough-bottomed striations with transverse orientation, as well as on the phenocrystal, all consistent with scraping activities on mineral matter (Fig. 11.a–d). In some specimens, polish with a smooth texture and flat morphology was also recorded (Fig. 11.b-c).

4. Discussion

Functional analysis of the stone tools recovered from the C008 at Roque Bentayga reveals considerable variability in contact materials, pointing to a wide spectrum of associated activities. The assemblage exhibits marked compositional and textural diversity in the volcanic raw materials employed. This variability reflects the complex local geology, characterised by lava flows, several layers of unsoldered ignimbrites, extensive deposits of heterogeneous lithology, and multiple intrusions in the form of plugs and domes of differentiated composition. Such geological conditions mainly yield volcanic rocks, the dominant raw material in this study. Previous work has noted that use-wear observation on volcanic rocks is challenging owing to their heterogeneous surfaces, consisting of an amorphous matrix and phenocrysts of varying size (Richards, 1988; Asryan et al., 2014; Clemente-Conte et al., 2015; Álvarez-Fernández et al., 2025). In the C008, these difficulties were partially offset by the excellent preservation of the artefacts. The site's overall state of preservation, favoured by the Canary Islands dry subtropical climate and the micro-environments within rock-cut cavities, has also allowed the survival of perishable organic remains that enrich functional interpretations (Vidal-Matutano et al., 2021; Henríquez-Valido, 2022; Morales et al., 2023).

A small obsidian assemblage was likewise documented at the site. Volcanic glass is not abundant on the island and it is difficult to obtain big quantities or large tools (Rodríguez-Rodríguez et al., 2022). Owing to its smooth, homogeneous surface, obsidian tends to display more conspicuous use-wear traces than other volcanic rocks (Hurcombe, 1992; Rodríguez-Rodríguez, 1998; Kononenko, 2011; Astruc, 2022; Brito-Abrante and Rodríguez-Rodríguez, 2024; Pichon et al., 2025). Nevertheless, only one piece showed clear signs of having been used on soft materials, which is consistent with patterns observed at other sites (Naranjo-Mayor and Rodríguez-Rodríguez, 2015). The edge sharpness suits well with this kind of contact material.

Regarding artefact typology, it is noteworthy that every large, knapped implement, such as picks and scrapers, shows evidence of use. Although we don't know if all of them were employed *in situ*, these shed light on the activities undertaken around Roque Bentayga, aimed to the modification of the thick volcanic-tuff deposits. Tuff generates highly developed wear traces as scarring, rounding, abrasion, striations and

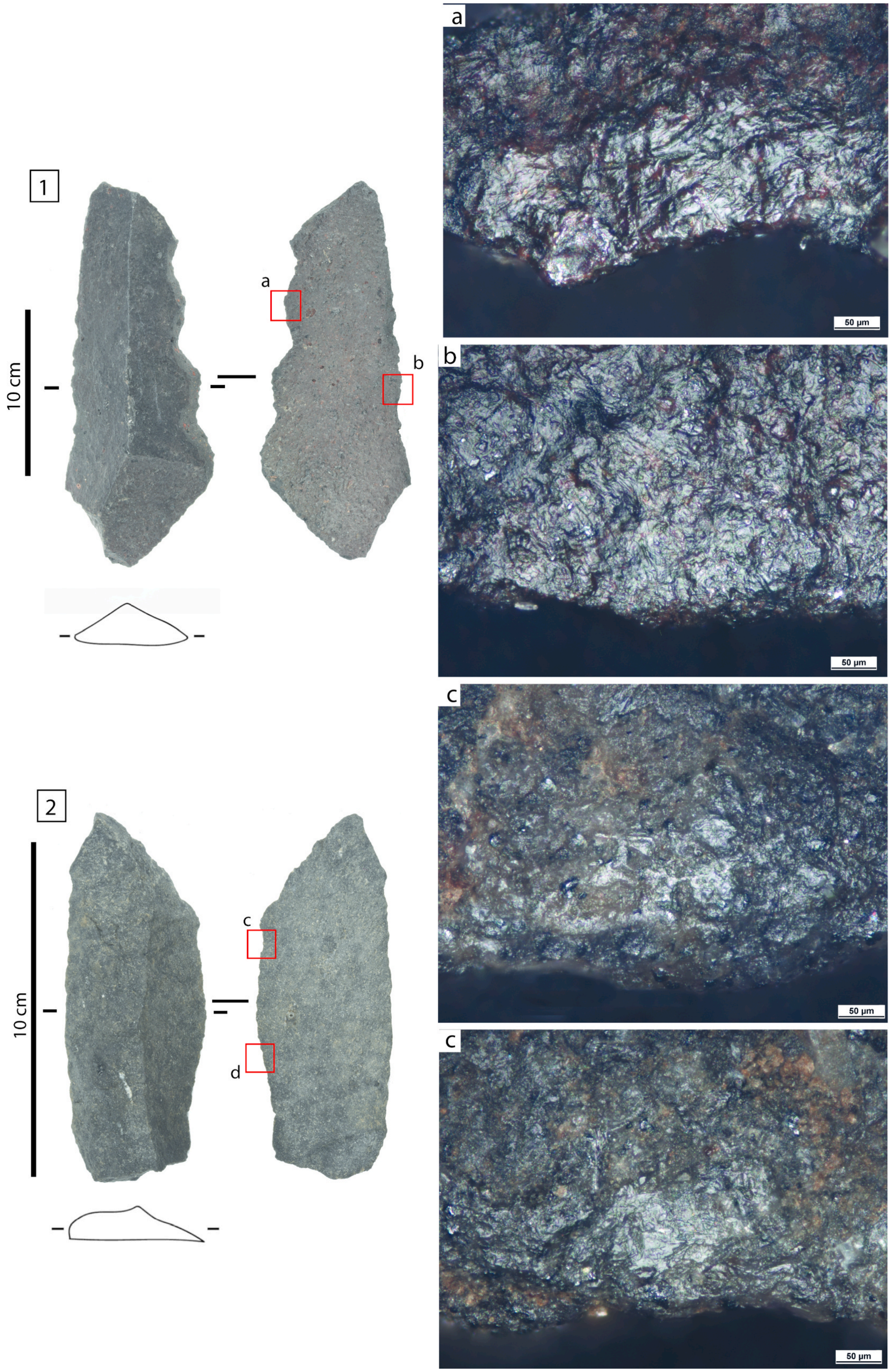

Fig. 6. Use-wear traces linked to hide working. 1) Retouched basalt flake with wear on both lateral edges, indicative of complex working; a: Parallel and oblique, rough-bottomed striations, both shallow and deep, over a rough/bumpy polish (200 ×); b: Continuous surface abrasion; predominantly transverse, deep, rough-bottomed striations; rough/bumpy polish (200 ×). 2) Basalt flake with use-wear on one edge attributable to scraping; c: Moderately developed edge rounding, continuous abrasion on edge and surface, and rough/bumpy polish on both (200 ×); d: Edge and surface abrasion; parallel and transverse, rough-bottomed striations; moderately developed polish of same characteristics (200 ×).

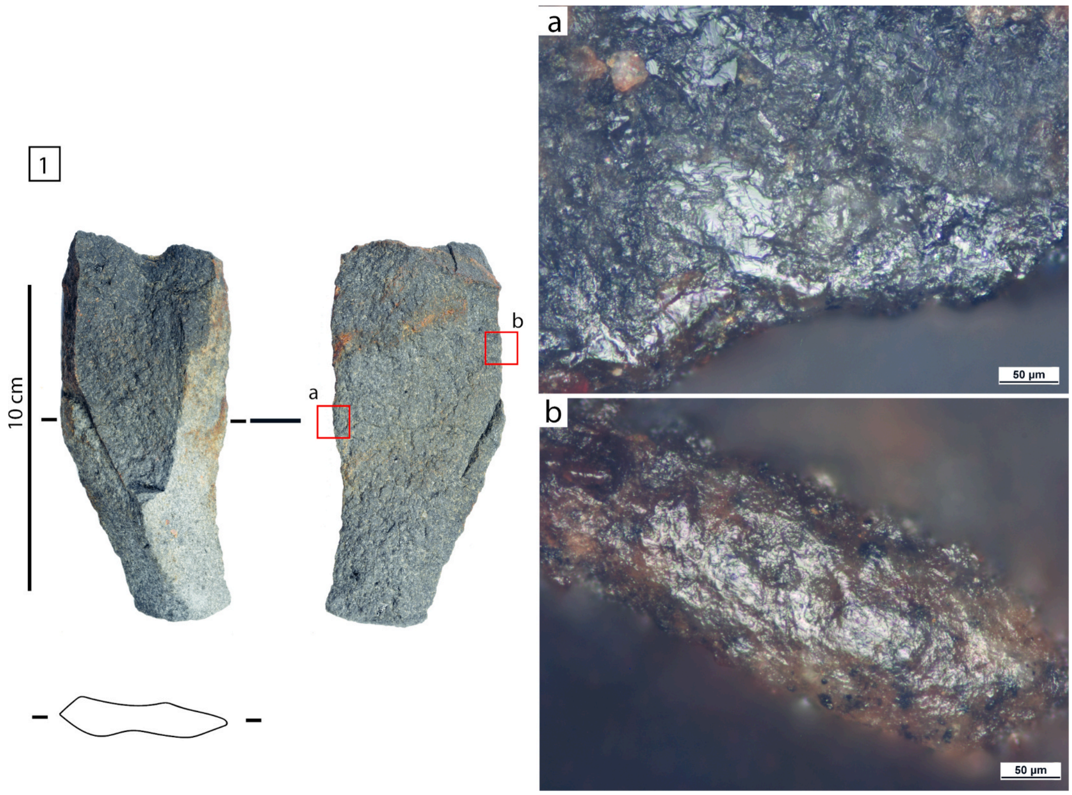

Fig. 7. Use-wear traces related to non-woody plant processing. 1) Basalt flake showing wear on both lateral edges from scraping and cutting non-woody vegetal material (probably rushes). a: Parallel and transverse, shallow, rough-bottomed striations with discontinuous, bumpy polish (200 ×); b: Slight edge rounding, discontinuous abrasion, transverse rough-bottomed striations—both shallow and deep—with discontinuous, bumpy polish (200 ×).

even polish, and the distribution of these traces on apices and edges lets reconstruction of the technical gestures involved, corroborated by experimental programmes (Lacave-Hernández et al., 2024).

The apices of the picks record percussive tasks aimed at pecking tuff walls to excavate cavities, while some crests also carry transverse-scraping wear, linked to later wall regularisation. Large scrapers likewise display traces of such transverse task. It is striking that, whereas picks are plentiful in rotary querns quarries and mine contexts, scrapers are rarely associated with those production workshops; yet both tool types occur together in silos and domestic contexts. This pattern may reflect the greater care required when preparing cavities for storage or habitation, whose walls tend to be extremely regular and homogeneous (Rodríguez-Rodríguez et al., 2022). The use-wear observed on the picks indicates intensive activity on mineral materials, to the extent that some tips became completely worn out and unusable. In certain cases, however, the working edge was rejuvenated and reused. A notable example of this is the presence of four pick tips recovered from the site, all displaying similar wear patterns associated with this specific task. Scraper edges likewise attest to heavy use: not only the wear traces are strongly developed, but many pieces exhibit multiple resharpening sequences that produce abrupt, step-like retouch and even concave-curved profiles—a combination previously noted at the granary of El Cenobio de Valerón (Naranjo-Mayor and Rodríguez-Rodríguez, 2015). Taking together, these results highlight how morphology and raw material properties intersected to condition tool function: robust morphologies such as picks and scrapers, combined with volcanic rocks, were best suited to perform the demanding tasks of pecking and regularising tuff walls. This strong link between morphology, raw material and activity fulfils one of the primaries aims of this study.

Turning to the analysed flake assemblage of volcanic rocks ($n = 63$), 9 display diagnostic use-wear (ca. 14%). Of these, 2 are large flakes (>10 cm), 4 are medium-sized (5–10 cm), and 3 are small (<5 cm). Most are full-*débitage* flakes, mainly unidirectional. The former two large flakes were retouched, echoing other island sites where large flakes, usually cortical, were preferentially retouched (Rodríguez-Rodríguez et al., 2022). However, in C008, medium-sized centripetal and unidirectional flakes also show retouch, indicating that blocks of intermediate size were likewise selected for tool manufacture. What is particularly remarkable is that, in contrast to other sites, none of these tools is cortical; they all derive from plein *débitage*. This distinctive technological choice suggests a direct link between blank morphology, raw material properties, and functional requirements.

4.1. Functional inference from use-wear: Plant processing and funerary craftwork

Another relevant issue concerns the relationship between use-wear on the lithic toolkit and the successive occupation episodes of the caves. The wear traces observed on the flakes reflect both craft activities (Fig. 7a, b) and crop-harvesting tasks (Fig. 8). These results reflect the possible activities that may have taken place in the archaeological site. Significantly, the retouched basalt flake exhibiting wear linked to cereal harvesting has been identified for the first time, providing the earliest direct evidence of harvesting with such implements in the Canary Islands (Fig. 8).

Previous archaeobotanical studies had inferred harvesting practices. European narrative sources state that the Indigenous population harvested only the ear of the cereal (Morales, 2010), possibly by hand, and leaving the remainder of the plant in the field. In accordance with this account, cereal remains inside granaries largely comprise ear fragments and, in some occasions, complete articulated ears, corroborating that practice (Morales et al., 2014). This strategy keeps the grain enclosed within the ear, protecting it against pests and moisture and easing storage; it also prevents accidental harvesting of weeds and reduces the labour needed for cleaning (Morales, 2010). In order to separate the ear from the rest of the plant, it has been proposed that only the hand was

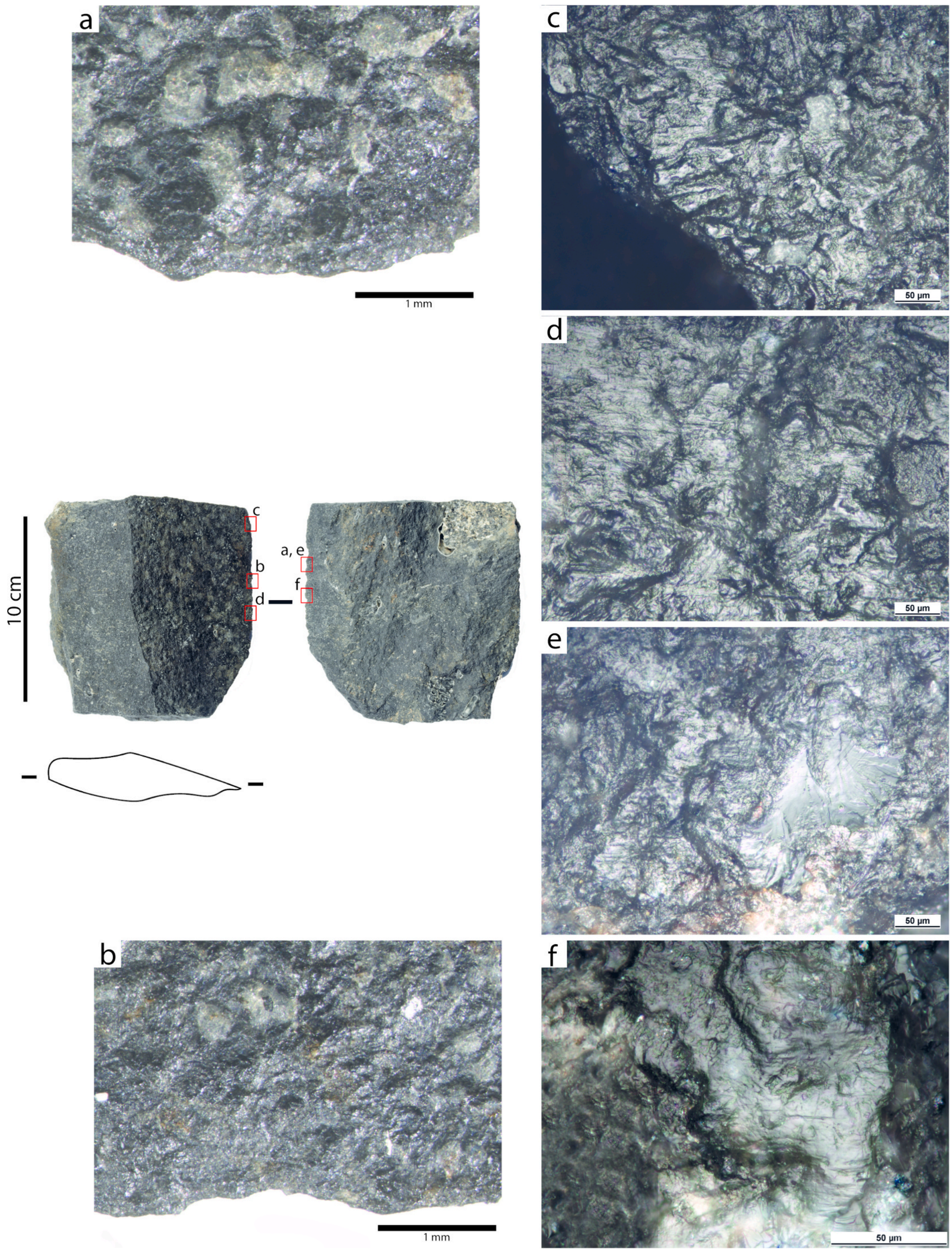

Fig. 8. Retouched basalt flake with use-wear associated with cereal harvesting. a-b: Scarring discontinuous along the edge with rounding in the upper part of the surface and the limit of the scars (10 ×); c-d: Very shallow, parallel, sleeks striations over very smooth and continuous polish on the surface and edge (200 ×); e: Very shallow, parallel, sleek striations on the phenocrystal and on the surface with continuous polish with very smooth texture and morphology (200 ×); f: Very shallow, parallel, sleeks striations across the entire continuous polish, exhibiting a very smooth texture and bumpy morphology (400 ×).

used, without cutting tools, as still observed among certain Bedouin communities in Jordan (Simms and Russell, 1997). However, preliminary examination of the ear fragments found in the granaries reveals cut marks at their base, although it remains uncertain whether these were produced by a cutting edge or by manual twisting (Morales et al., 2014).

The recovery on settlement sites of Gran Canaria of seeds belonging to ruderal plants (species that thrive in arable fields and may be unintentionally gathered with cereals), implies that other harvesting methods were also employed (Morales, 2010). One hypothesis is that the entire plant (ear, stem and root) was uprooted, a practice documented ethnographically in the Canaries, particularly in arid zones where dry soils facilitate uprooting yet do not prevent the accidental collection of ruderal species. Further support for a low-cut or uprooting strategy comes from the presence of weed remains inside silos, suggesting that stems were removed at a lower point than would be expected if only the ears had been taken (Henríquez-Valido, 2022). It is important to mention in this case that skeletal markers of physical activity in contemporaneous Indigenous bone remains suggest that female carried out this work: their bones show more robust muscle attachment sites

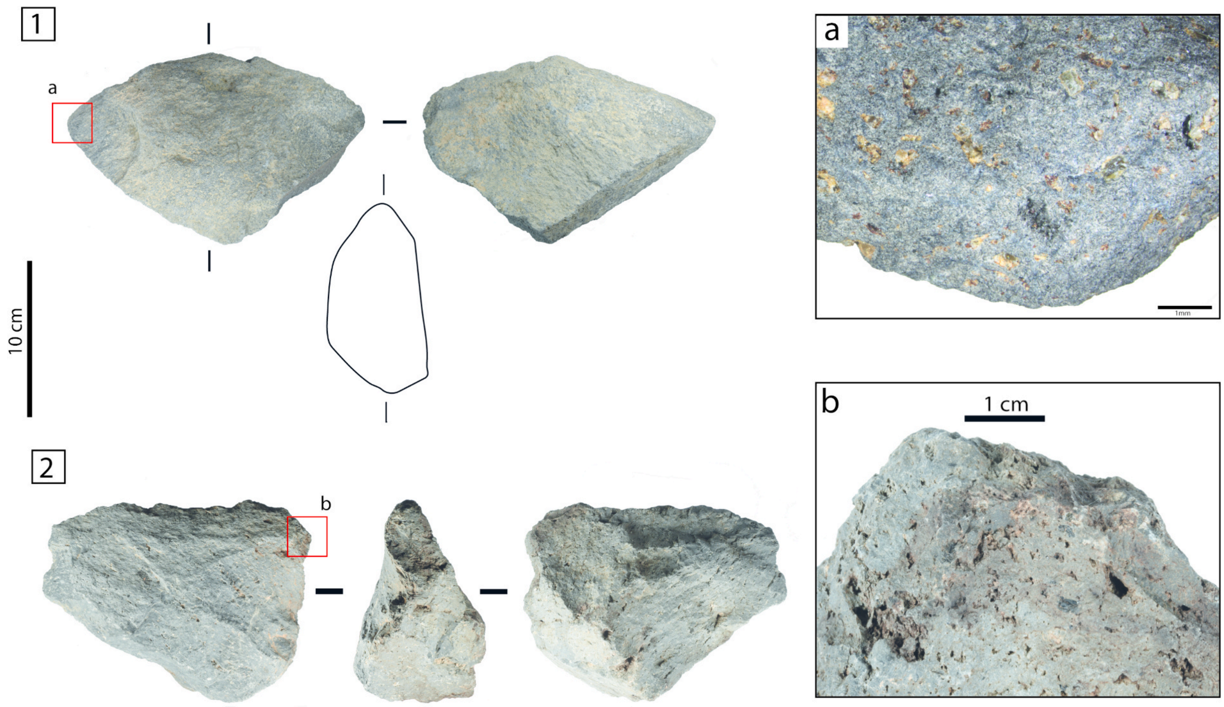

Fig. 9. Use-wear on pick apices associated with mineral working. 1) Type-1 trachyte pick showing wear on both apices. a: Highly developed rounding on the apex and tuff residues visible (0.8 ×). 2) Type-2 trachyte pick with wear on one apex, the other entirely removed by an accident during rejuvenation. b: Apex exhibits step-terminated scar on the right site with slight rounding on the left; tuff residues also present.

Fig. 10. 1) Use-wear on the apex of a Type-3 trachyte pick linked to mineral working. a: Step and feather scars, rounding on edges and arises, accompanied by abrasion and micropits.

linked to forearm and hand flexion and pronation–supination movements, which may also be related to harvesting strategies using stone tools, in addition to artisanal work (Santana et al., 2015).

The discovery of a basalt tool with cereal cutting traces implies the existence of additional harvesting and processing methods not previously documented in Gran Canaria. One hypothesis is that the tool was used as a sickle for harvesting cereal crops in the fields. It may have subsequently been brought to the granary for storage or further processing. However, the granary is situated on a cliff, where the soil is not suitable for cereal cultivation. This suggests that the fields were likely located on the valley floor below. If this is the case, the tool would have been transported a considerable distance up to the cave. Alternatively, the tool was used in the cave to process cereal plants harvested through uprooting. It is possible that a post-harvest cut with the stone tool was performed to detach the ears or to reuse the straw as building material. Indeed, abundant fragments of barley ears, straw, and cereal roots bearing cut marks have been recorded at the site. In Silo E, much of the original floor was preserved, revealing a layer composed of bundles of uprooted plants lacking ears and showing clean cut marks (Fig. 12a, b). The harvesting tool was recovered from Silo C, which suggests that such processing activities may have been carried out within the interior of these silos. As proposed for El Cenobio de Valerón, where mill stones and mortars are abundant, cave granaries may have operated not only as storage facilities but also as venues for processing harvested plants, both for preservation and for preparation before consumption (Naranjo-Mayor and Rodríguez-Rodríguez, 2015; Henríquez Valido, 2022).

Many of these remains can therefore be related to the broad use of the space as a granary—*sensu lato*—activities covering everything from shaping and restoring the cavity by working on the tuff walls to harvesting and processing the crops. Additional evidence points to practices not directly linked to agriculture, such as the obsidian tool bearing butchery traces, which suggests the processing of fresh meat. Within the granary, faunal remains bearing butchery marks further corroborate meat consumption and are consistent with the observed use-wear traces.

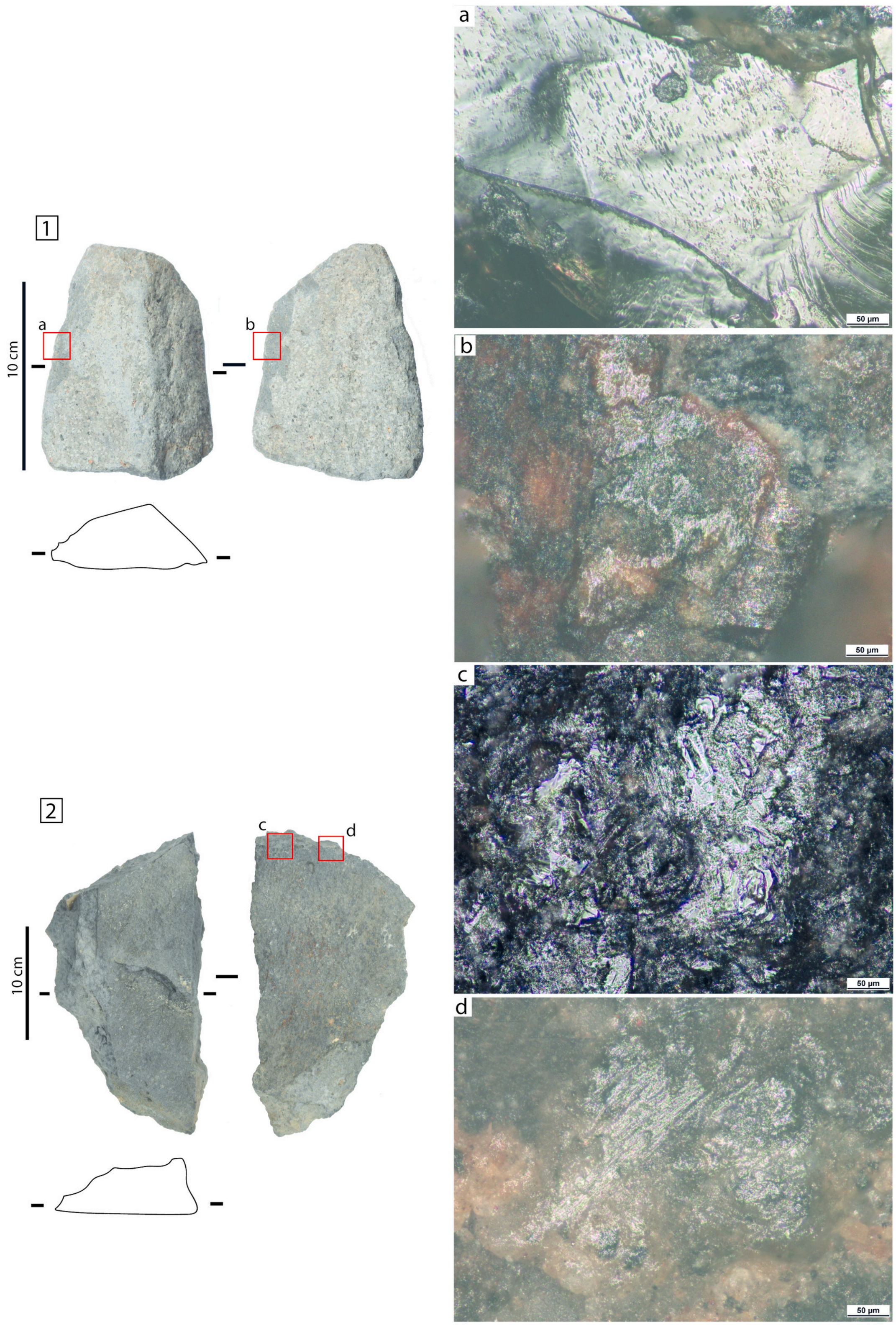

Fig. 11. 1) Scraper on a trachyte block showing wear on two opposed edges, indicating varied motions on mineral material. a: Rough-bottomed, transverse and oblique striations one the phenocrystals completely modified by the polish, continuous on the surface of the crystals, with smooth texture and flat morphology (200 ×); b: Rough-bottomed, transverse striations across the edge with continuous abrasion (200 ×). 2) Basalt scraper on an undetermined support with a single active edge showing wear from scraping minerals. c: Rough-bottomed striations on the amorphous matrix with a polish smooth and flat in the upper part of the surface (200 ×); d: Sleeks and rough-bottomed striations, transverse and oblique, on a smooth, flat polished surface with micropits (200 ×).

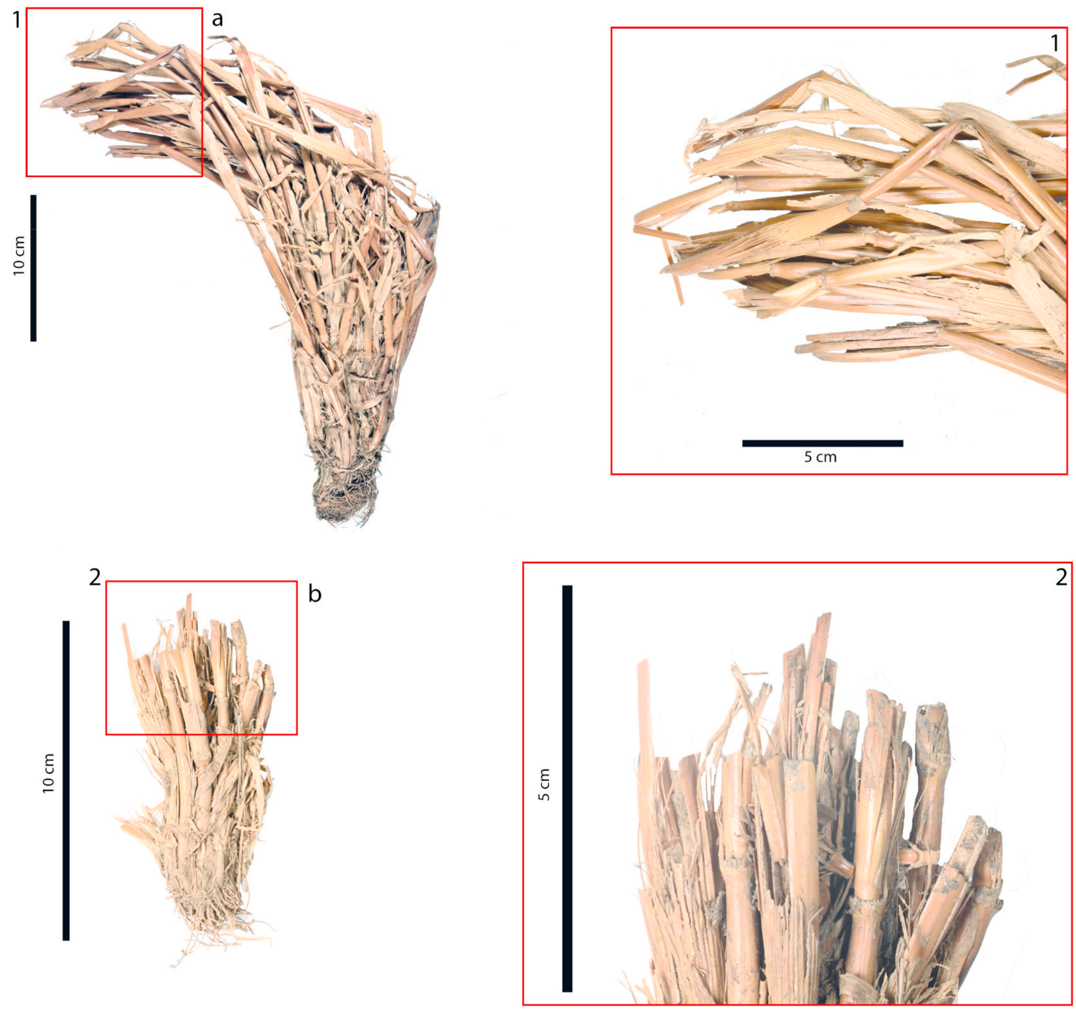

Fig. 12. Remains of cereal stems from Complex 2, in C008, Bentayga, with detail of the upper part. a) Cereal stem uprooted; 1) Close-up of the upper part showing clean cut marks. b) Cereal stem uprooted; 2) Close-up of the upper part with evidence of a clean cut.

Whether this represents casual consumption by a visitor to the store or the preparation of meat for drying in a location with favourable conditions remains uncertain.

The site also reveals a second occupational phase as a collective burial. Within this phase, two basalt flakes and one trachyte flake display wear associated with working dry hide, cutting and transverse motions, alongside other lithic implements. Findings from this phase likewise indicate craft activities such as cutting and scraping rush, represented on further volcanic rock flakes. These lithic tools were found in association with the three adult and perinatal individuals, as well as fragments of rush mats. The wear traces consistent with fibre and hide-working suggest that they were directly involved in shrouding activities carried out within the chamber. Alternative explanations, such as their deriving from the renewal of the space (fill and floor preparation for the funerary deposit) or from the storage of tools previously used elsewhere, cannot be entirely excluded. However, the spatial arrangement of the instruments and their close association with the rush mats (Figs. 13, 14) strongly support their interpretation as implements used in the preparation of funerary bundles. Archaeothanatological analysis and the preservation of perishable remains further confirm that the individuals buried in cave C008 were wrapped in shrouds made with vegetal fiber and animal soft tissues. This funerary practice is characteristic of the Indigenous Gran Canarian society (Delgado-Darias et al., 2017). On going archaeoentomological studies must clarify the interval between death and shrouding and the period before final deposition, but preliminary results suggests that these steps were completed within few days (Henríquez-Valido et al., 2025). Thus, it is plausible that these tools were used to manufacture shrouds made of plant fiber for wrapping the human corpses buried within the cavity. In this case, shrouding procedures such as adjustment of hides and rush textiles may have been finished at the burial location itself. This is a preliminary hypothesis, and we cannot rule out that the lithic tools recorded in the funerary deposit might form part of the grave goods, as suggested elsewhere on the island (Alberto-Barroso et al., 2019, Alberto-Barroso et al., 2020). The burial practices of Gran Canaria, however, are not characterised by abundant objects unrelated to the shroud or grave goods. It is therefore noteworthy that the artefacts associated with the C008 burials were probably used in tasks required to process the raw materials of the funerary bundles: rush and hide.

The distinction between these two phases: first as storage place (Phase 1) and later as a burial use (Phase 2) can be established on both morphological, spatial, and chronological evidences.

Phase 1. Use of the cave as a granary. This phase is dated from the 10th-11th to the 12th-13th century cal CE. The earliest dating was obtained from a seed recorded in the plaster covering the western wall of the silo. This date probably indicates the time when the cave was excavated and built to store plant products. Stone tools working mineral materials were probably used during this phase. The overall layout of the cave complex, with its multiple rock-cut silos arranged around a central chamber, corresponds to the well-documented typology of Indigenous-period granaries on Gran Canaria, a form specifically designed for crop storage (Henríquez Valido, 2022). Archaeobotanical

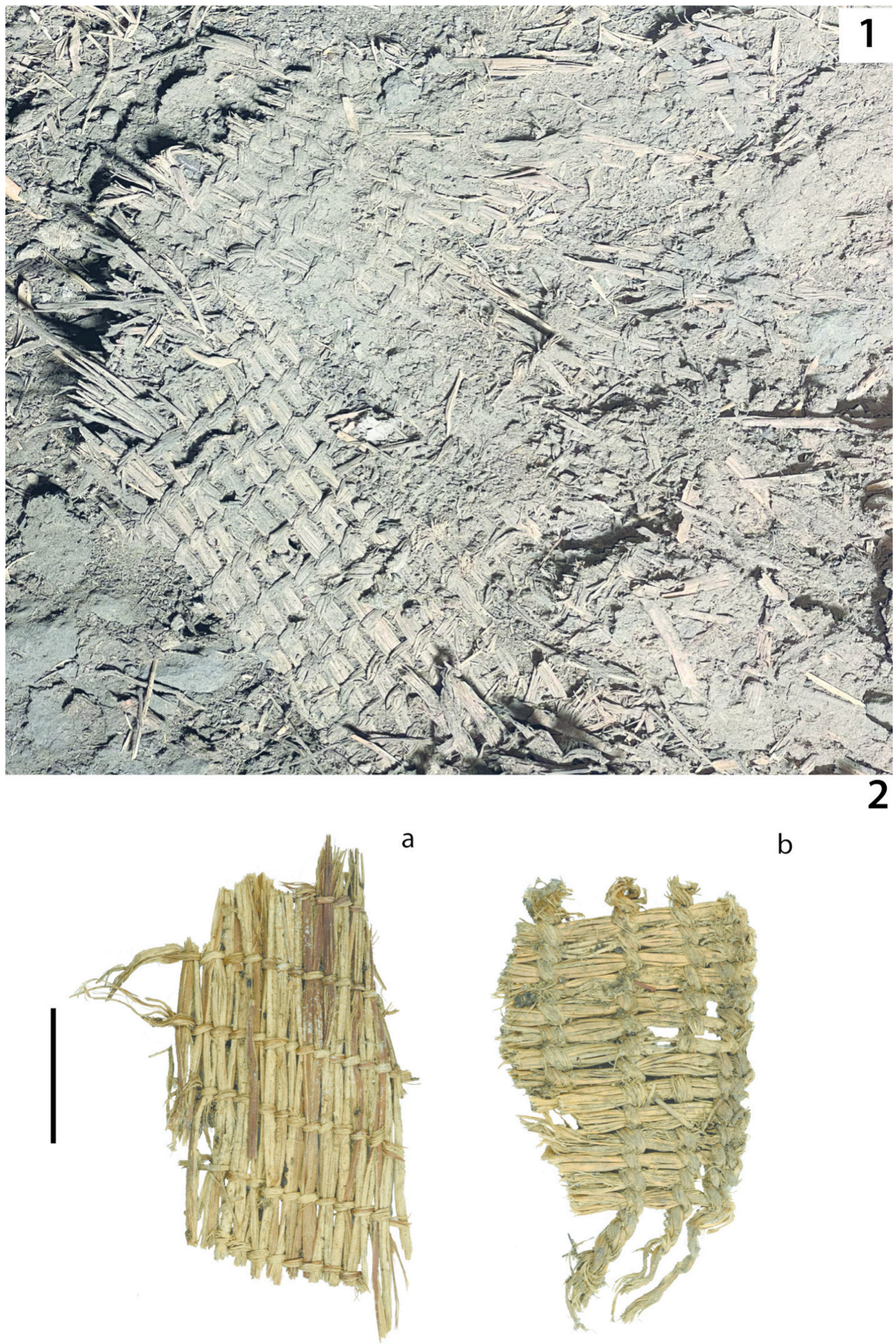

Fig. 13. Organic artefacts from the Complex 2, in C008, Bentayga. 1) *In situ* rush mat in type 1 fabric (*Juncus* sp.) from chamber D of the complex; 2) Detail of two fragments of type 2 fabric from chamber B (*Juncus* sp.); b has a type 1 warp finish off.

remains such as seeds, straw, and cut cereal stems recorded during excavations in the lateral chambers further support this interpretation.

Phase 2. Use of the cave as a burial. This phase is dated to the12th–13th centuries cal CE, when the individuals were buried. Both the human remains, and a barley fragment recorded in UE 1 were radiocarbon dated to the 12th–13th centuries cal CE (see table 1). The close overlap of these latter dates indicates that the funerary use was established rapidly after storage activities were finished, without extensive cleaning or reconditioning of the cave floor. The funerary area is limited to the central chamber (B). It contained several adult and perinatal individuals, along with rush mat fragments and lithic implements bearing fibre- and hide-working traces.

Here we propose that the deposition of the deceased took place once the central chamber was no longer used to store food. When the cave was later reused as a collective burial, remains from phase 1 were likely displaced towards peripheral chambers (e.g., chamber C), while tools employed during phase 2 remained in association with the deceased. This spatial segregation, in addition to the use-wear in the stone tools, strongly suggests a transformation of the complex: from its initial role as a granary to its later reuse as a collective burial. Although post-depositional disturbances or displacements cannot be completely ruled out, the evidence clearly preserves the imprint of both phases, allowing their distinction.

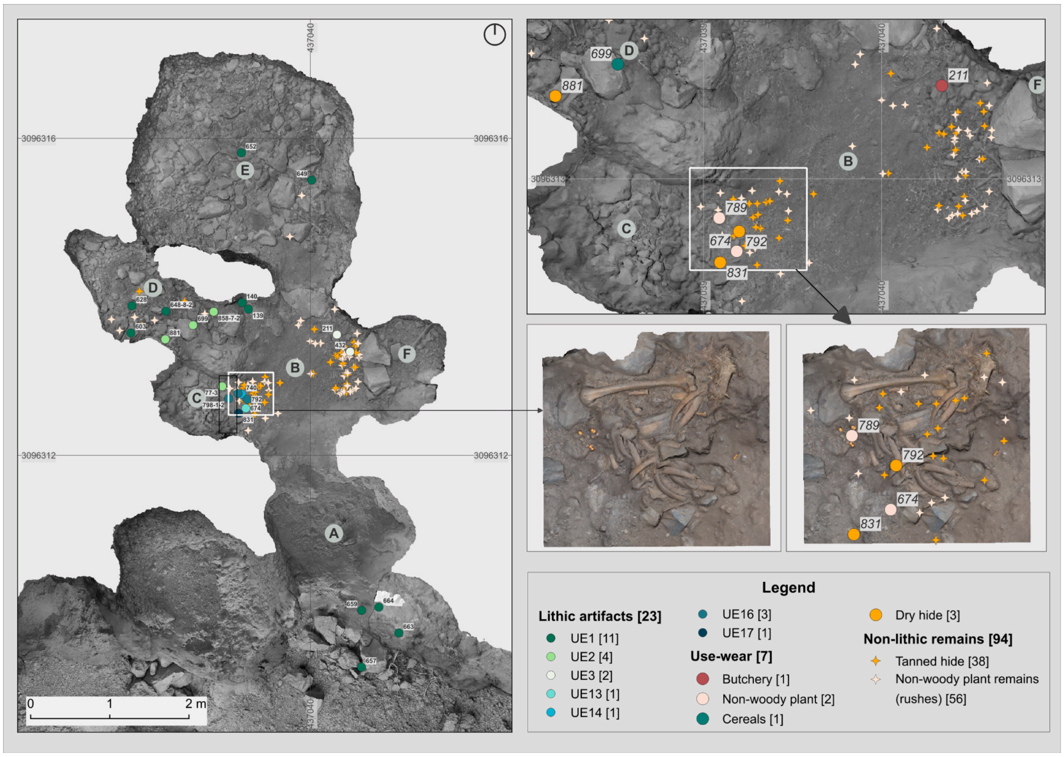

Fig. 14. Detail of Complex 2 inside C008 at Bentayga. The image situates the funerary deposit in chamber B, reached via chamber A, where volcanic-stone tools bearing use-wear from hide and rush-working were recovered in direct association with the bone remains.

5. Conclusion

The functional analysis of the lithic tools from complex C008 at Bentayga offers fresh insights into storage spaces and, in this case, certain funerary deposits. This study was possible owing to the excellent preservation of the artefacts, despite the well-known difficulties of observing use-wear on volcanic rocks in comparison with materials such as flint (Clemente-Conte, 1997; Asryan et al., 2014; Álvarez-Fernández et al., 2025). Although reflected-light microscopy has been effective in this case, the potential of complementary techniques such as SEM has recently been highlighted for volcanic rocks (Asryan and Rots, 2024), as it enables high-resolution documentation of use-wear as well as the identification of residues. This perspective underlines the importance of continuing to refine methodological approaches for future studies in this kind of raw material.

The results highlight the central role that lithic tools played in both the shaping of the granary and the diverse activities performed there. During the site's first phase as a storage facility, the most notable finding is a basalt implement bearing cereal-harvesting traces, the first direct evidence of such a practice in the pre-European archaeology of Gran Canaria. This find enriches ongoing debates on harvesting modalities and subsequent crop-processing techniques, not only for the Canary Islands but for northwestern Africa as a whole. In addition, it documents a previously unreported post-harvest processing technique. While further study is required to validate these observations, this finding opens new avenues for exploring ancient harvesting strategies and for identifying comparable lithic tools and use-patterns at other sites and periods.

Finds associated with working dry hide and rush, linked to the site's final use as a collective burial, pose an intriguing question: did these tools constitute grave goods, or were they employed to adjust the hide-and-rush shrouds? Although this issue remains open, the functional analysis of the lithic assemblage has clearly advanced our understanding of activities associated with both occupational phases. More importantly, it opens broader perspectives on cultural practices and belief systems within Indigenous Gran Canarian society.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to improve the English of the manuscript, as the authors of this article are not native speakers. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

CRediT authorship contribution statement

Idaira Brito-Abrante: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Jonathan Santana:** Writing – review & editing, Visualization, Resources, Project administration, Funding acquisition. **Jacob Morales:** Writing – review & editing, Visualization, Resources, Project administration, Funding acquisition. **Miguel del Pino Curbelo:** Writing – review & editing, Visualization, Resources, Project administration. **Candela Martínez-Barrio:** Writing – review & editing, Visualization, Project administration. **Julie Campagne:** Writing – review & editing, Visualization. **Sandra Cancel:** Writing – review & editing, Visualization, Project administration. **Amelia Rodríguez-Rodríguez:** Writing – original draft, Visualization, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jasrep.2026.105668.

Data availability

Data will be made available on request.

References

Alberto-Barroso, V., Delgado-Darias, T., Moreno-Benítez, M., Velasco-Vázquez, J., 2019. La dimensión temporal y el fenómeno funerario entre los antiguos canarios. Zephyrus 84, 139–160. https://doi.org/10.14201/zephyrus201984139160.

Alberto-Barroso, V., Velasco-Vázquez, J., Delgado-Darias, T., Moreno-Benítez, M.A., 2020. Los antiguos canarios ante la muerte. Tradición vs. ruptura. In: Afonso-Carrillo, J. (Ed.), Gran Canaria: las huellas del tiempo. Actas XV Semana Científica Telesforo Bravo. Instituto de Estudios Hispánicos de Canarias. Puerto de la, Cruz, pp. 13–40.

Álvarez-Fernández, A., Márquez, B., García-González, R., Arsuaga, J.L., Pérez-González, A., Baquedano, E., 2025. Experimental use-wear on non-flint tools: Unraveling butchering processes at the Cueva Des-Cubierta site (Pinilla del Valle, Spain). J. Archaeol. Sci. Rep. 62, 105056. https://doi.org/10.1016/j.jasrep.2025.105056.

Anderson, P.C., 1992. Experimental Cultivation, Harvest and Threshing of Wild Cereals. Their Relevance for Interpreting the Use of Epipalaeolithic and Neolithic Artifacts. In: Anderson, P.C. (Ed.), Prehistory of Agriculture. Institute of Archaeology. University of California, Los Angeles, pp. 118–144.

Anderson, P.C., 1994. Insight into plant harvesting and other activities at Hatoula, as revealed by microscopic functional analysis of selected chipped stone tools. Le Gisement de Hatoula en Judée occidentale, Israël : rapport de fouilles 1980-1988. In: Lechevallier, M., Ronen, A. (Eds.), Mémoires et travaux du. Centre de recherche français de Jérusalem: Association Paléorient, Paris, pp. 277–293.

Arranz-Otaegui, A., Colledge, S., Zapata, L., Teira-Mayolini, L.C., Ibáñez, J.J., 2016. Regional diversity on the timing for the initial appearance of cereal cultivation and domestication in southwest Asia. Proc. Natl. Acad. Sci. U.S.A. 113 (49), 14001–14006. https://doi.org/10.1073/pnas.1612797113.

Asryan, L., Ollé, A., Moloney, N., 2014. Reality and confusion in the recognition of post-depositional alteration and use-wear: an experimental approach on basalt tools. J. Lithic Stud. 1, 9–32. https://doi.org/10.2218/jls.v1i1.815.

Asryan, L., Rots, V., 2024. Exploring basalt: a methodological framework for analysing wear traces on basalt tools. J. Archaeol. Method Theory 31, 1954–1983. https://doi.org/10.1007/s10816-024-09663-8.

Astruc, L., 2022. Use-wear analysis of lithic tools: technical processes and cultural developments in Anatolia. In: Baysal, A. (Ed.), The Lithics from Anatolia and beyond. Archeopress, Oxford,, pp. 50–57.

Bello-Alonso, P., Rios-Garaizar, J., Panera, J., Martín Perea, D.M., Rubio-Jara, S., Pérez-González, A., Rojas Mendoza, R., Domínguez-Rodrigo, M., Baquedano, E., Santonja, M., 2020. Experimental approaches to the development of use-wear traces on volcanic rocks: Basalts. Archaeol. Anthropol. Sci. 12, 1–26. https://doi.org/10.1007/s12520-020-01058-6.

Brito-Abrante, I., Rodríguez-Rodríguez, A., 2024. Use-wear analysis of obsidian and other volcanic rocks: an experimental approach to working plant resources. J. Archaeol. Method Theory 31, 1873–1916. https://doi.org/10.1007/s10816-024-09659-4.

Buxeda i Garrigós, J., Kilikoglou, V., Martín-Rodríguez, E., Rodríguez-Rodríguez, A., Madrid-Fernández, M., 2005. Preliminary results on obsidians from Gran Canaria. Geoarch. Bioarch. Stud. 5, 49–51.

Carbonell, E., Mora, R., Guilbaud, M., 1983. Utilización de la lógica analítica para el estudio de tecno-complejos a cantos tallados. GIPES Moviment Lògica Històrica, Barcelona.

Carracedo, J.C., Troll, V.R., 2016. The Geology of the Canary Islands. Elsevier. https://doi.org/10.1016/C2015-0-04268-X.

Castellano-Alonso, P., Moreno, M., Rodríguez-Rodríguez, A., Sáenz, J.I., Onrubia, J., 2018. Gestión de la ganadería y patrones de consumo de una comunidad indígena expuesta al fenómeno colonial: El caso de la Estructura 12 de la Cueva Pintada (Gran Canaria, España). Archaeofauna 27, 37–56. https://doi.org/10.15366/archaeofauna2018.27.003.

Christakis, K.S., 1999. Pithoi and food storage in Neopalatial Crete: a domestic perspective. World Archaeol. 31 (1), 1–20.

Clemente-Conte, I., 1997. Los instrumentos líticos de Túnel VII: una aproximación etnoarqueológica. Universidad Autónoma de Barcelona, Consejo Superior de Investigaciones Científicas (España).

Clemente-Conte, I., Lazuén Fernández, T., Astruc, L., Rodríguez-Rodríguez, A., 2015. Use-wear analysis of nonflint lithic raw materials: the cases of quartz/quartzite and obsidian. In: Marreiros, J., Gibaja, J.F., Ferreira Bicho, N. (Eds.), Use-Wear and Residue Analysis in Archaeology. Springer. https://doi.org/10.1007/978-3-319-08257-8_5.

Delaigue, M.C., Bokbot, Y., Onrubia Pintado, J., Amarir, A., 2006. Etnoarqueología de los graneros fortificados magrebíes: el agadir de Id Aysa (Amtudi, Marruecos). In: Briz i Godino, I., Vila i Mitjà, A. (Eds.), Etnoarqueología de la Prehistoria: más allá de la analogía, 6th ed. Institució Milà i Fontanals. Consejo Superior de Investigaciones Científicas, Barcelona, pp. 161–172.

Delaigue, M.C., Onrubia Pintado, J., Bokbot, Y., Amarir, A., 2011. Une technique d'engrangement, un symbole perché. Le grenier fortifié Nord-africain. Tech Cult. 57 (2), 182–201. https://doi.org/10.4000/tc.5875.

Delgado-Darias, T., Alberto-Barroso, V., Velasco-Vázquez, J., Santana, J., 2017. La construcción del modelo cultural. El significado de los fardos funerarios y la conformación de identidad a partir de la momia. XXII Coloquio de Historia Canario-Americana 1–15.

Galván Santos, B., Rodríguez-Rodríguez, A., Francisco, M.I., 1987. Propuesta metodológica para el estudio de las industrias líticas talladas de las islas Canarias. Tabona 6, 9–90.

Groman-Yaroslavski, I., Weiss, E., Nadel, D., 2016. Composite sickles and cereal harvesting methods at 23,000-years-old Ohalo II Israel. PLoS ONE 11 (11), e0167151. https://doi.org/10.1371/journal.pone.0167151.

Harlan, J.R., 1995. The Living Fields: Our Agricultural Heritage. Cambridge University Press, Cambridge.

Henríquez-Valido, P., Morales, J., Vidal-Matutano, P., Moreno-Benítez, M., Marchante-Ortega, Á., Rodríguez-Rodríguez, A., Huchet, J.B., 2020. Archaeoentomological indicators of long-term food plant storage at the Prehispanic granary of La Fortaleza (Gran Canaria, Spain). J. Archaeol. Sci. 120, 105179. https://doi.org/10.1016/j.jas.2020.105179.

Henríquez-Valido, P., 2022. Estudio carpológico y arqueoentomológico de los graneros colectivos de Gran Canaria (siglos V-XV de nuestra era). Aportaciones al estudio del almacenamiento de alimentos. PhD thesis. Universidad de Las Palmas de Gran Canaria, Spain.

Henríquez-Valido, P., Morales, J., Vidal-Matutano, P., Santana-Cabrera, J., Rodríguez-Rodríguez, A., 2019. Arqueoentomología y arqueobotánica de los espacios de almacenamiento a largo plazo: el granero de Risco Pintado, Temisas (Gran Canaria). Trab. Prehist. 76, 120–137. https://doi.org/10.3989/tp.2019.12229.

Henríquez-Valido, P., Santana, J., Morquecho-Izquier, A., Rodríguez-Rodríguez, A., Huchet, J.B., 2025. Insects in the far West: Burial practices on El Hierro Island (Canary Islands, Spain; ca. 6th-11th centuries) reconstructed via funerary archaeoentomology. J. Archaeol. Sci. 173, 106120. https://doi.org/10.1016/j.jas.2024.106120.

Hillman, G.C., 2000. Plant Food Economy at Abu Hureyra. In: Moore, A.M.T., Hillman, G.C., Legge, A.J. (Eds.), Village on the Euphrates: From Foraging to Farming. Oxford University Press, London, pp. 372–392.

Huidobro, C., 2018. L'équipement lithique des chasseurs-cueilleurs maritimes de Patagonie australe pendant l'Holocène moyen. Fabrication et utilisation des armes et des outils. PhD thesis. Université Paris I Panthéon Sorbonne, France.

Hurcombe, L., 1992. Use wear analysis and obsidian: Theory, experiments and results. University of Sheffield, Sheffield.

Ibáñez, J.J., Clemente Conte, I., Gassin, B., Gibaja, J.F., Gonzáles Urquijo, J.E., Márquez, B., Philibert, S., Rodríguez Rodríguez, A., 2008. Harvesting technology during the Neolithic in south-west Europe. In: Long, L., Skakun, N. (Eds.), Prehistoric Technology' 40 Years Later: Functional Studies and the Russian Legacy. BAR International Series, S1783. Oxford, pp. 183–196.

Ibáñez, J.J., Anderson, P.C., Arranz-Otaegui, A., González-Urquijo, J.E., Jörgensen-Lindahl, A., Mazzucco, N., Pichon, F., Richter, T., 2021. Sickle gloss texture analysis elucidates long-term change in plant harvesting during the transition to agriculture. J. Archaeol. Sci. 136, 105502. https://doi.org/10.1016/j.jas.2021.105502.

Jover Maestre, F.J., Rodríguez-Rodríguez, A., Torregrosa Giménez, P., 2019. Dientes de hoz, hoces y Edad del Bronce: la contribución de un programa experimental de siega. Complutum 30 (1), 131–154. https://doi.org/10.5209/CMPL.64511.

Keeley, L.H., 1980. Experimental determination of stone tool uses: A microwear analysis. University of Chicago Press, Chicago.

Kononenko, N., 2011. Experimental and archaeological studies of use-wear and residues on obsidian artefacts from Papua New Guinea. Technical Reports of the Australian Museum 21, 1–244. https://doi.org/10.3853/j.1835-4211.21.2011.1559.

Kuijt, I., Finlayson, B., 2009. Evidence for food storage and predomestication granaries 11,000 years ago in the Jordan Valley. Proc. Natl. Acad. Sci. U.S.A. 106, 10966–10970. https://doi.org/10.1073/pnas.081276410.

Lacave-Hernández, A., Rodríguez-Rodríguez, A., Naranjo-Mayor, Y., Marrero Salas, E., 2024. Islands without iron. Strategies for manufacturing prehistoric rotary querns without metal tools in the Canary Islands: Working hypotheses and experimentation. J. Archaeol. Method Theory 31, 414–447. https://doi.org/10.1007/s10816-023-09609-6.

Lemorini, C., Thomas, W.P., David, R.B., Alyssa, N.C., Peter, W.D., Laura, C.B., Fritz, H., James, S.O., Frank, W.M., Margaret, J.S., 2014. Old stones' song: usewear experiments and analysis of the Oldowan quartz and quartzite assemblage from Kanjera South (Kenya). J. Hum. Evol. 72, 10–25. https://doi.org/10.1016/j.jhevol.2014.03.002.

Lobo Cabrera, M., 2015. Las Palmas: una ciudad de negocios en el siglo XVI. In: Iglesias Rodríguez, J.J., Pérez García, R.M., Fernández Chaves, M.F. (Eds.), Comercio y cultura en la Edad Moderna. Comunicaciones de la XIII Reunión Científica de la Fundación Española de Historia Moderna. Fundación Española de Historia Moderna, Madrid, pp. 599–611. https://doi.org/10.20350/digitalCSIC/12331.

Maeda, O., Lucas, L., Silva, F., Tanno, K., Fuller, D.Q., 2016. Narrowing the harvest: increasing sickle investment and the rise of domesticated cereal agriculture in the Fertile Crescent. Quat. Sci. Rev. 145, 226–237. https://doi.org/10.1016/j.quascirev.2016.05.032.

Mansur-Franchomme, M.E., 1986. Microscopie du matériel lithique préhistorique. Centre National de la Recherche Scientifique, Paris.

Mazzucco, N., Ibáñez, J.J., Capuzzo, G., Gassin, B., Mineo, M., Gibaja, J.F., 2020. Migration, adaptation, innovation: the spread of Neolithic harvesting technologies in the Mediterranean. PLoS ONE 15, e0235874. https://doi.org/10.1371/journal.pone.0235874.

Mazzucco, N., Mineo, M., Arobba, D., Caramiello, R., Caruso Fermé, L., Gassin, B., et al., 2022. Multiproxy study of 7500-year-old wooden sickles from the Lakeshore Village of La Marmotta. Italy. Sci. Rep. 12, 14976. https://doi.org/10.1038/s41598-022-18597-8.

Meunié, J., 1951. Greniers Citadelles au Maroc. Publications de ÍInstitut des Hautes Études Marocaines, París.

Morales, J., 2010. El uso de las plantas en la Prehistoria de Gran Canaria: Alimentación, agricultura y ecología. Las Palmas de Gran Canaria: Museo y Parque Arqueológico Cueva Pintada. Cabildo Insular de Gran Canaria, Las Palmas de Gran Canaria.

Morales, J., Rodríguez-Rodríguez, A., González-Marrero, M.C., Martín-Rodríguez, E., Henríquez-Valido, P., del-Pino-Curbelo, M., 2014. The archaeobotany of long-term crop storage in northwest African communal granaries: a case study from pre-Hispanic Gran Canaria (cal. AD 1000-1500). Veg. Hist. Archaeobot. 23 (6), 789–804. https://doi.org/10.1007/s00334-014-0444-4.

Morales, J., Speciale, C., Rodríguez-Rodríguez, A., Henríquez-Valido, P., Marrero-Salas, E., Hernández-Marrero, J.C., López, R., Delgado-Darias, T., Hagenbland, J., Fregel, R., Santana, J., 2023. Agriculture and crop dispersal in the western periphery of the Old World: the Amazigh/Berber settling of the Canary Islands (ca. 2nd–15th centuries CE). Veg. Hist. Archaeobot. https://doi.org/10.1007/s00334-023-00920-6.

Morales Padrón, F. 1974. Ordenanzas del Concejo de Gran Canaria: (1531). Cabildo Insular de Gran Canaria, Las Palmas de Gran Canaria.

Naranjo-Mayor, Y., Rodríguez-Rodríguez, A., 2015. Artefactos e instrumentos de piedra en un espacio de almacenamiento colectivo. El caso de El Cenobio de Valerón (Gran Canaria, España). Munibe Antropologia-Arkeologia 66, 291–308.

Odell, G.H., 1981. The mechanics of use-breakage of stone tools: some testable hypotheses. J. Field Archaeol. 8, 197–209.

Onrubia Pintado, J., 2003. La isla de los Guanartemes: territorio, sociedad y poder en la Gran Canaria indígena (siglos XIV-XV). Cabildo Insular De Gran Canaria, Las Palmas de Gran Canaria.

Peña-Chocarro, L., Pérez-Jordà, G., Morales, J., Zapata, L., 2015. Storage in traditional farming communities of the Western Mediterranean: ethnographic, historical and archaeological data. Environ. Archaeol. 20 (4), 1–11. https://doi.org/10.1179/1749631415Y.0000000004.

Pichon, F., 2017. Exploitation of the cereals during the Pre-pottery Neolithic of Dja'de-el-Mughara: preliminary results of the functional study of the glossy blades. Quat. Int. 427, 138–151. https://doi.org/10.1016/j.quaint.2016.01.064.

Pichon, F., Ibáñez Estévez, J.J., Astruc, L., Gassin, B., Rodríguez-Rodríguez, A., Lugliè, C., 2025. Shining light on dark matter: advancing functional analysis of obsidian tools with confocal scanning microscopy. J. Archaeol. Method Theory 32. https://doi.org/10.1007/s10816-025-09700-0.

Richards, T.H., 1988. Microwear Patterns on Experimental Basalt Tools. BAR International Series S460. Archaeopress, Oxford.

Rodríguez-Rodríguez, A., 1993. La industria lítica de la Isla de La Palma. "Cuevas de San Juan": un modelo de referencia. PhD thesis. Universidad de La Laguna, Spain.

Rodríguez-Rodríguez, A., 1998. Traceología de las obsidianas canarias, Resultados experimentales. El Museo Canario 53, 21–58.

Rodríguez-Rodríguez, A., Francisco Ortega, I., 2012. Estudio de los picos tallados de la época preeuropea de Gran Canaria. Un ejemplo de especialización en el trabajo a partir de las evidencias recuperadas en la cantera de molinos de Montaña Quemada. Complutum 23 (1), 77–97. https://doi.org/10.5209/rev_CMPL.2012.v23.n1.39532.

Rodríguez-Rodríguez, A., Martín Rodríguez, E., Mangas Viñuela, J., Melián Aguiar, J., 2005. La Gestión De Los Recursos Obsidiánicos En El Centro De Producción De La Montaña De Hogarzales. El Ejemplo De La Mina 38. Tabona 14. 213 – 238.

Lágrimas Negras". L'exploitation de l'obsidienne aux îles Canaries: de la simplicité des systèmes de taille à la spécialisation artisanale. In: Astruc, L., Bon, F., Léa, V., Milcent, P-Y., Philibert, S. (Eds.), Normes techniques et pratiques sociales: De la simplicité des outillages pré et protohistoriques. XXVI Rencontres Internationales d'Archéologie et d'Historie d'Antibes.

Rodríguez-Rodríguez, A., Francisco Ortega, I., Naranjo Mayor, Y., 2022. El regalo de los volcanes. El trabajo de la piedra de la población de Gran Canaria. Cabildo de Gran Canaria, Las Palmas de Gran Canaria.

Rodríguez-Santana, C.G., 1994. Las ictiofaunas arqueológicas del Archipiélago Canario: Una aproximación a la pesca prehistórica. PhD thesis. Universidad de La Laguna, Spain.

Santana, J., Velasco-Vázquez, J., Rodríguez-Rodríguez, A., 2015. Entheseal changes and sexual division of labor in a North-african population: the case of the pre-hispanic period of the Gran Canaria Island (11th–15th c. CE). J. Comp. Human Biol. 66, 118–138. https://doi.org/10.1016/j.jchb.2014.10.005.

Santana, J., del Pino, M., Morales, J., Fregel, R., Hagenblad, J., Morquecho, A., et al., 2024. The chronology of the human colonization of the Canary Islands. Proc. Natl. Acad. Sci. U.S.A. 121 (28), e2302924121. https://doi.org/10.1073/pnas.2302924121.

Santana, J., del Pino Curbelo, M., Iriarte, E., Morales, J., Caro, J.L., Fregel, R., Hagenblad, J., García González, R., Rodríguez Rodríguez, A., 2025. Climate, biogeography, and human resilience in the demographic history of the Canary Islands during the Amazigh period. Sci. Rep. 15, 19485. https://doi.org/10.1038/s41598-025-04302-y.

Serrano, J., Ordóñez, C.A., Santana, J., Sánchez-Cañadillas, E., Arnay, M., Rodríguez-Rodríguez, A., Fregel, R., et al., 2023. The genomic history of the indigenous people of the Canary Islands. Nat. Commun. 14 (1), 4641. https://doi.org/10.1038/s41467-023-40198-w.

Sigaut, F., 1978. Identification des techniques de récolte des graines alimentaires. J. Agric. Trop. Bot. Appl. 25 (3), 145–161.

Simms, S.R., Russell, K.W., 1997. Bedouin hand harvesting of wheat and barley: Implications for early cultivation in Southwester Asia. Curr. Anthropol. 38 (4), 696–702. https://doi.org/10.1086/204658.

Smith, M.L., 2014. The archaeology of urban landscapes. Ann. Rev. Anthropol. 43, 307–323. https://doi.org/10.1146/annurev-anthro-102313-025839.

Snir, A., Nadel, D., Groman-Yaroslavski, I., Melamed, Y., Sternberg, M., Bar-Yosef, O., et al., 2015. The origin of cultivation and proto-weeds, long before Neolithic farming. PLoS ONE 10 (7), e0131422. https://doi.org/10.1371/journal.pone.0131422.

Testart, A., Forbis, R.G., Hayden, B., Ingold, T., Perlman, S.M., Pokotylo, D.L., Rowley-Conwy, P., Stuart, D.E., 1982. The significance of food storage among hunter-gatherers: residence patterns, population densities, and social inequalities. Curr. Anthropol. 23 (5), 523–537.

Tixier, J., Inizan, M.L., Roche, H., 1980. Préhistoire de la pierre taillée, 1: Terminologie et technologie. C.R.E.P, Valbonne.

Unger-Hamilton, R., 1992. Experiments in harvesting wild cereals and other plants. In: Anderson, P.C. (Ed.), Préhistoire De L'agriculture: Nouvelles Approches Expérimentales et Ethnographiques. CNRS Editions, Paris, pp. 211–224.

Van der Veen, M., 2007. Formation processes of desiccated and carbonized plant remains the identification of routine practice. J. Archaeol. Sci. 34 (6), 968–990. https://doi.org/10.1016/j.jas.2006.09.007.

Van Gijn, A., 2014. Science and interpretation in microwear studies. J. Archaeol. Sci. 48, 166–169. https://doi.org/10.1016/j.jas.2013.10.024.

Vidal-Matutano, P., Morales, J., Henríquez-Valido, P., Marchante Ortega, A., Moreno Benítez, M.A., Rodríguez-Rodríguez, A., 2020. El uso de la madera en espacios de almacenamiento colectivos: Análisis xilológico y antracológico de los silos prehispánicos (ca. 500–1500 d.C.) de La Fortaleza (Santa Lucía de Tirajana, Gran Canaria). Vegueta 20, 469–489.

Vidal-Matutano, P., Rodríguez-Rodríguez, A., González-Marrero, M.C., Morales, J., Henríquez-Valido, P., Moreno-Benítez, M.A., 2021. Woodworking in the cliffs? Xylological and morpho-technological analyses of wood remains in the Prehispanic granaries of Gran Canaria (Canary Islands, Spain). Quat. Int. 593, 407–423. https://doi.org/10.1016/j.quaint.2020.09.055.