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KONSO-GARDULA RESEARCH PROJECT

Volume 2
Archaeological Collections:
Background and the Early Acheulean Assemblages

Edited by
Yonas Beyene, Berhane Asfaw, Katsuhiro Sano, and Gen Suwa

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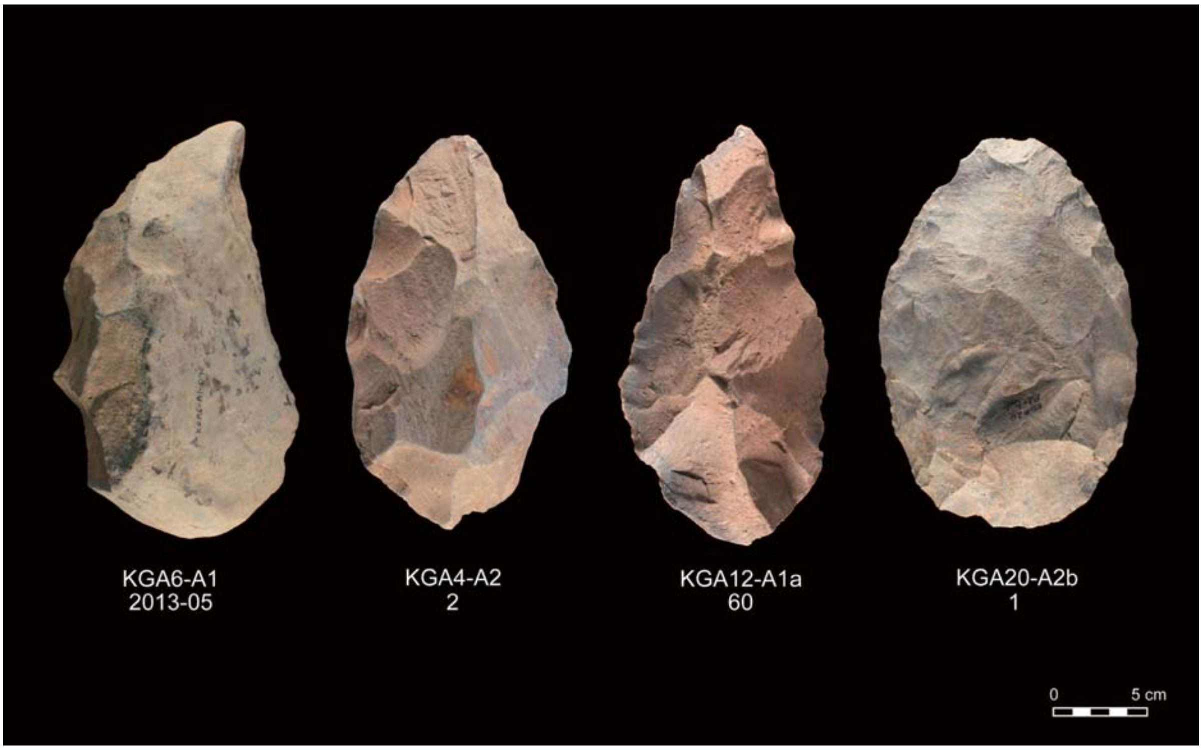

Edited by

Yonas Beyene,* Berhane Asfaw, Katsuhiro Sano, *** and Gen Suwa*****

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CONTENTS

Acknowledgements

The archaeological materials described in this volume are predominantly based on results of field research undertaken by the Konso-Gardula Paleoanthropological Research Project (KGA Project), co-directed by Gen Suwa and Yonas Beyene, under permission of the government of Ethiopia. We thank the Authority for Research and Conservation of Cultural Heritage (A.R.C.C.H. formerly the C.R.C.C.H.) of the Ministry of Culture and Tourism of Ethiopia for the continued support to the project over the years. All materials are currently stored in the laboratory facilities of the A.R.C.C.H., Addis Ababa. Berhane Asfaw intiated the Paleoanthropological Inventory of Ethiopia, which led to the 1991 discovery of the fossiliferous and artifact containing deposits of the Konso area.

We thank the Ethiopian government and its many individuals involved in supporting and promoting paleoanthropological research in Ethiopia, and in particular enabling the field and laboratory research of the KGA project. We thank the Southern Nations, Nationalities, and People's Regional State (S.N.N.P.R.S.), the Culture and Tourism Bureau of the S.N.N.P.R.S., and the Konso administrative district for their support and facilitation to the research.

Aside from the three senior project members mentioned above, the following individuals participated as scientific staff in the KGA field research between 1993 and 2003, and are gratefully acknowledged: Shigehiro Katoh, Shinji Nagaoka, Giday WoldeGabriel, Mohammed Umer Mohammed, Stanely Ambrose, Shinji Fujimoto, Hideo Nakaya, Yohannes Haile-Selassie, Awoke Amzaye, Reiko Kono, Kazuhiro Uzawa, Yohannes Zeleke and G. P. Grigoriev. Field participation and support was also provided by Alemu Admassu, Tadewos Assebewerk, Tafessa Gebreegzabiher, Solomon Teshome, Gezahenge Petros, Getachew Foule, Kebede Geleta, Asamerew Dessie, Tsehay Eshete, Sampson Yoseph, Solomon Eshete from Addis Ababa and Bedru Ahemed, Metasebia Bekele, Yohannes Hadeya, Mulugeta Belay from Awassa. We are particularly grateful to the local field assistance provided to us at Konso from Dinote Kusia, Kusia Shekaido, Kampiro Kayrante although many more individuals helped us especially in the excavations. Kazuhiro Uzawa and Yohannes Zeleke also assisted in the laboratory curatorial work.

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CHAPTER 1

Introduction

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1.1 OVERVIEW

The Konso-Gardula (KGA) paleoanthropological research area was first discovered in fall 1991 by the field project led by one of us (B.A.), the Paleoanthropological Inventory of Ethiopia (Asfaw et al., 1992). The Inventory project led to the unexpected realization that sediments exposed in the Karat (or Konso) town area were rich in Early Pleistocene artifacts and vertebrate fossils. A brief summary of the events at Konso-Gardula that led to its discovery is presented below. The research area was named after the two administrative zones Konso and Gardula (now the Dirashie administrative district) where the sediments crop out. Thereafter, administrative boundaries changed so that the entire research area lies within the Konso district. Therefore, for brevity, we alternatively call the research area and the project the Konso paleoanthropological research area or project.

The KGA research area is located at the southern extremity of the Ganjuli Graben, south of Lake Chamo, approximately 180 km northeast of the fossiliferous Plio-Pleistocene deposits of the northern Turkana Basin (see Chapter 2 Fig. 2.1). The Ganjuli Graben occupies the southwestern extremity of the Main Ethiopian Rift and is offset to the east from the Stephanie Rift, the latter a northern extension of the Kenyan Gregory Rift. The Early Pleistocene sediments of the Konso Formation occur between 1,100 and 1,500 meters altitude in the headwaters of the Gato/Iyanda drainage system, a tributary of the Segen River. This region is separated from the Stephanie Rift and the Turkana Basin by the Konso mountainous terrain of approximately 1,600 to 2,100 m altitude.

The Paleoanthropological Inventory of Ethiopia established the occurrence of ~1.4 Ma *Homo erectus* fossils and early Acheulean artifacts at Konso (Asfaw et al., 1992). Field research and laboratory analysis thereafter established that the formation spans the time period ~1.95 to ~0.8 Ma (Katoh et al., 2000; Nagaoka et al., 2005; WoldeGabriel et al., 2005; Beyene et al., 2013). Abundant lithic assemblages and vertebrate fossils have been recovered (Beyene et al., 1996, 1997, 2013; Suwa et al., 1997, 2003), including fossil remains of *Australopithecus boisei* (1.43~1.44 Ma) and *Homo erectus* (~1.45 to ~1.25 Ma) (Suwa et al., 2007). However, only brief descriptions of the Konso archaeology have so far been reported (Beyene et al., 1996, 1997, 2013; Echassoux, 2012).

In this volume we systematically present the archaeological materials that formed the basis of the Beyene et al. (2013) comparative analysis of the ~1.75 to ~0.85 Ma Acheulean lithic assemblages. These time-successive assemblages were collected at locations where concentrations of lithic artifacts were found, many of them characterized by large cutting tools (LCTs) and picks. The stratigraphic horizons of origins of these assemblages were determined by excavations and/or examination of local sections. The LCT and related assemblages thus available are crucial in understanding the characteristics and range of lithic technologies that occurred in the ~1.75 to ~0.85 Ma time interval.

In Chapter 2, we overview the archaeological field research undertaken from 1993 through 2010. We then summarize the collection and documentation methodologies and present the chronostratigraphic background.

In Chapter 3, we present a site by site analysis of the LCT and pick assemblages that we collected. We do this by a combination of 1) a systematic presentation based on a comprehensive attribute logging system, and 2) individual descriptions of selected tools that show lithic technology representative of the assemblage and/or are particularly worthy of mention.

In Chapter 4, we provide more comprehensive inter-assemblage comparisons and discuss some of the insights that we gained from the early Acheulean at Konso.

1.2 A BRIEF HISTORY OF DISCOVERY

The field survey project the Paleoanthropological Inventory of Ethiopia was conceived and initiated by Berhane Asfaw in 1988 and continued through 1991. The project background and aims are outlined in Asfaw et al. (1990) and WoldeGabriel et al. (1992). Briefly, it aimed to document paleoanthropological resources outside established research areas.

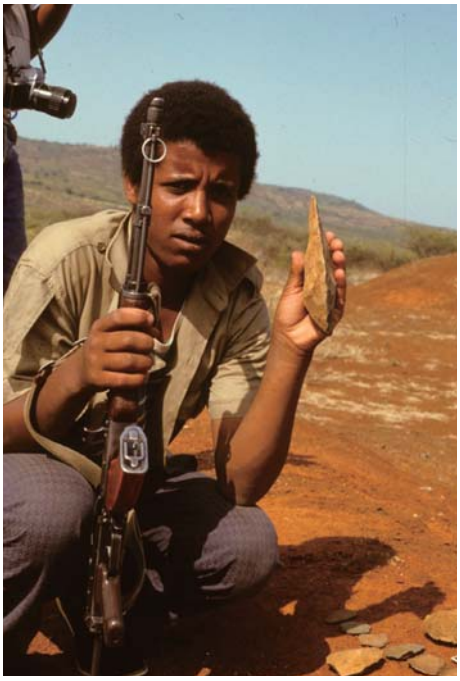

Fig1.1. The KGA1 locality, where limited surface scatters that included well-made handaxes were found (September 29, 1991, soldier Kalayu holding a handaxe).

The methods used were to identify target areas by satellite and air photographic imagery in little known and/or paleoanthropologically unexplored areas, and to undertake foot transect surveys to sample the area for initial understandings. From its initiation in December 1988 to November 1991, 127 days of Inventory survey field work were undertaken. Aside from Berhane Asfaw, leader of the project, Gen Suwa and Yonas Beyene, two senior authors of this volume, were invited to participate. Others that participated in the Inventory project include Tim White, Giday WoldeGabriel, Sileshi Semaw, Yohannes Haile-Selassie, and other Ethiopian professionals who later developed into established scientists.

In 1991, a three week Inventory field work was planned for a part of the southern Ethiopian Main Rift, an area extending from around Lake Chamo south to the Konso area. This field work was conducted from September 25 to October 15, 1991, by B. Asfaw, Y. Beyene, T. White, G. Suwa, and Y. Haile-Selassie, joined by Tesfaye Yemane of the Geological Survey of Ethiopia. Four government soldiers (EPRDF) from Arba Minch accompanied us for this field work. In this survey, we first focused on volcaniclastic sedimentary target areas at the northern and southern parts of the planned survey areas near Lake Chamo and around Konso town. Although some, perhaps Miocene, wood fossils were recorded southeast of Konso town, the fossil-rich Konso Formation deposits were not encountered until about a week into the survey.

Locality KGA1 was established as an artifact-bearing site based on rare surface occurrences of well-made handaxes (Fig. 1.1). At that time, because of their seemingly advanced lithic technology, these were thought to belong to the middle or late Middle Pleistocene. Today, we consider these to probably derive from the upperrmost Konso Formation, possibly ~0.8 Ma, broadly coeval in time to the KGA18 and KGA20 sediments and artifacts. Locality KGA2 where few fossils were found was established close to KGA1.

Fig.1.2. Locality KGA4 as encountered in October 1991. Fossils scattered along villager trail (left), Berhane Asfaw with villagers aside large mammal limb bone fossils (October 2, 1991).

The fossil and artifact rich exposures of the Konso Formation were encountered in the first week of October. On October 2, 1991, we conducted several foot survey transects that targeted low lying soft sediments hidden ~5 km away from the main highway road. We walked from the main road or navigated our field vehicles into small river sand beds and approached the target exposures. We first encountered the low-lying sediments of KGA3 where a cluster of fossils and artifacts were found. We then targeted what appeared to be a sizeable sediment exposure on the air photograph. As we walked onto the slopes of this low hill, what we now call the KGA4 locality, the unexpected sight of mammalian fossils literally scattered along the villager foot trails awaited us (Fig. 1.2). Fossil and artifact bearing exposure patches in between KGA3 and KGA4 was named KGA5. KGA6 was established one drainage south of KGA4.

On the air photo imagery other apparently similar sedimentary patches were seen, distributed 10 to 20 km northwest of Karat (Konso) town in an area over 10 km in extent. In the coming week we would transect a part of this area, leading to the discovery of the fossil and artifact rich localities of KGA7 through KGA12. These fossiliferous exposures are patchy, low-lying, and partially covered by more recent deposits. They inter-finger the more noticeable but sterile weathered volcanic or basement exposures. Because of this, they had gone unnoticed and unknown to science until our survey of October 1991.

Fig.1.3. Southwestern part of Locality KGA10 on October 8, 1991, the first day of survey at KGA10. The right lower photograph shows a partial cranium of a bovid.

On October 5, we planned to transect the southwestern part of the targeted exposures. We parked at the western margin of the Boleshe river basin that overlooks what we now call KGA7. We descended down the exposed Precambrian margin and walked into the Boleshe valley. There, as we walked downstream towards the east, thin sedimentary layers overlying the Precambrian were seen to gradually thicken. After walking ~1 km, a whitish sand layer gradually but noticeably thickened. This layer is a useful stratigraphic marker lying in between the overlying dark gray clays and the underlying orange to brown silt/sands/gravels. To our delight, fossils and artifacts were found exposed on the surface down slope of the whitish sands. Fossils were found to increase in density towards the eastern end of the exposure. One location exhibited an impressive concentration of crude handaxes and picks, later designated the archaeological site KGA7-A1.

The next day, on October 6, we planned a south to north transect from KGA7, and encountered fossil and artifact bearing sediments to the north that we named KGA8. Towards the end of this day's survey, Yonas Beyene and Tim White walked north of KGA8 to the ridge top overlooking farther north. The exposures that they viewed were later named KGA9, and also included the western part of KGA10. They verbally reported observing steep-sloped "layer cake-like sediments reminiscent of Olduvai Gorge", and that fossils were seen literally "raining" down slope.

Fig.1.4. Berhane Asfaw examining the surface scatter of fossils at Locality KGA10 southern face on October 8, 1991.

On October 8, we planned a transect through the "mesa-like" outcrop, visible on the air photo, that we would name KGA10. We walked along the eastern margin of the KGA7 and KGA8 exposures. Walking past these, the KGA10 "mesa" comes into full frontal view (Fig. 1.3). Overlooking the KGA10 exposure, unknown to science until then, we took a deep breath and then set into its southwestern part. When we reached the foot slopes of the mesa hill, our expectations were more than realized. All along the mesa slope, an impressive surface scatter of fossil and artifacts were observed (Fig. 1.4). Teeth, postcranial articular ends, horn cores, occasional partial crania, handaxes and picks were all awaiting discovery. Since the objective of the Inventory project was to document but not necessarily collect, the survey team did minimal fossil and artifact collecting.

On October 9, we surveyed exposures north of KGA10, one of which we named KGA12. From the car park, this was a foot survey 5 km in a straight line on the imagery. KGA12 was another locality incredibly rich in both fossils and artifacts. In particular, we discovered a small depression with an impressive surface concentration of handaxes prompting the nickname "handaxe valley" (Fig. 1.5).

As we were heading back to the car park close to the main highway, unexpected strong rains came. This was followed by flash flooding that almost washed away our vehicles. With the sky clear and the sun bright in the morning, we had parked our field vehicles in the dry sand river bed close

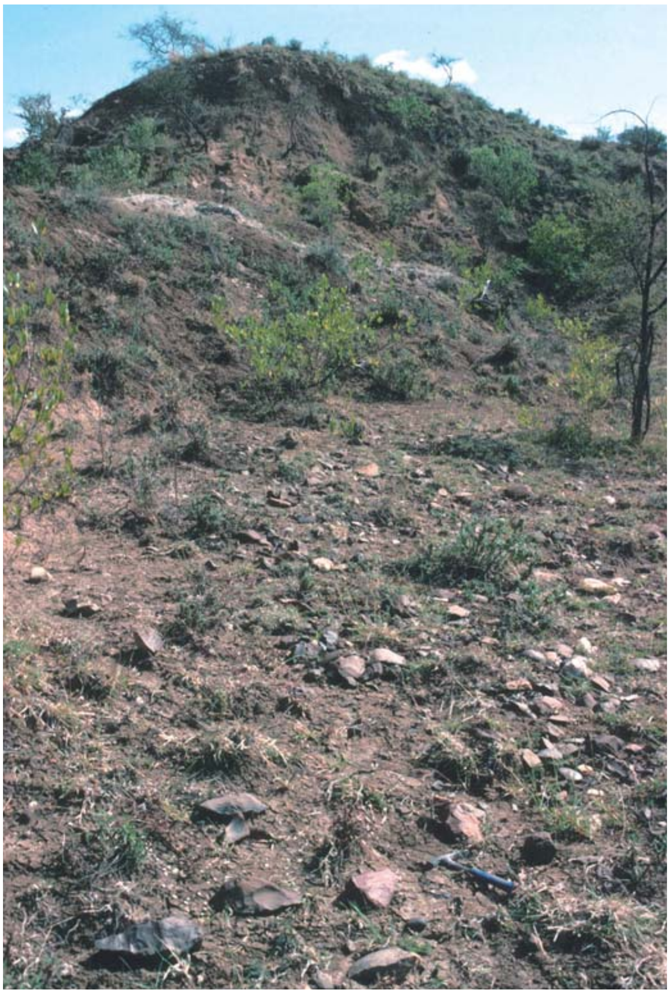

Fig.1.5. Concentration of handaxes discovered at KGA12, photograph taken on August 24, 1994.

to the highway. As we rushed back after the downpour, the waters had risen to the floorboard level. One of our field vehicles was stuck in loose sand, which we had to dig and pull out with the other vehicle. We returned to camp drenched and soaked with water, mud, and silt.

The results of this Inverntory project fieldwork at Konso was in part published in Asfaw et al. (1992) in the journal Nature. In summer 1993, Yonas Beyene and Gen Suwa initiated the Konso-Gardula paleoanthropological field research. Systematic field research initially focused on the core areas of KGA4, KGA6 and KGA 7 through KGA12, and subsequently expanded to the more peripheral areas of KGA18 through KGA21.

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CHAPTER 2

Overview of the Archaeological Research at Konso

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2.1 OVERVIEW

Archaeological assemblages occur throughout the ~1.9 Ma to ~0.85 Ma time period of the Konso Formation. The Konso paleoanthropological research area is divided into 21 collecting localities (Figs. 2.1 and 2.2). These were designated and defined to broadly coincide with accessible sedimentary outcrop patches of circa one or more kilometers in diameter. Locality boundaries are defined predominantly by ridge tops, valley floors, or uplifted basement, and occasionally by visible faults that bring into contact non-overlapping stratigraphic intervals.

Systematic surface collecting and excavations were undertaken in the field seasons of 1993 through 2000, 2002 and 2003. Follow up work were done in 2010 and 2013. Each archaeological "site" was designated by a combination of collecting locality number (in common with the paleontological work, see Suwa et al., 2014) and a site designation nomenclature comprising the alphabet "A" followed by a numerical number. This results in site designations such as KGA7-A1 and so on. These "sites" represent locations of archaeological occurrences, where we initially observed concentrations of artifacts exposed on sediment surfaces and thereafter conducted excavations and/or made systematic collections. In the latter case, we confirmed stratigraphic provenience by excavation and/or stratigraphic observation of nearby sections. In a few cases, we encountered and collected artifacts in trench excavations that were conducted for soil carbonate sampling.

The archaeological sites established as per above and their geographical locations within the KGA research area are summarized in Table 2.1 and Figs. 2.3 and 2.4.

Assemblages that apparently lack large cutting tools (LCTs) and/or picks, and possibly attributable to the Oldowan technological complex, were observed at ~1.9 Ma (KGA4 and KGA11), ~1.75 Ma (circum KYT1 and KYT2 levels at KGA6), ~1.6 Ma (KGA21), and ~1.45 Ma (KGA4-A3 site). However, the younger examples may be better considered facies of the early Acheulean, depending on the large core and flake technology representations seen in the assemblages with few or no LCTs (see also, Semaw et al., 2009 for a discussion on developed Oldowan versus Acheulean).

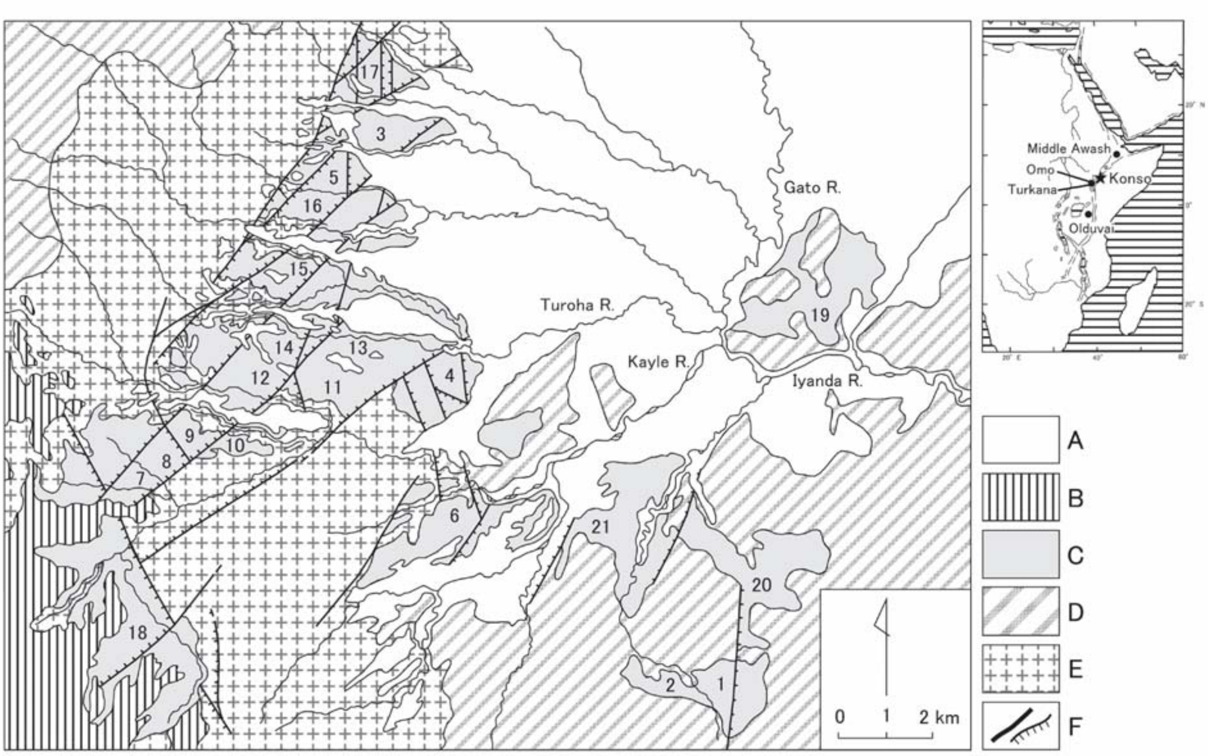

Fig. 2.1. Geologic map and localities of the Konso Formation. Numbers in the map refer to collecting localities named in sequence from KGA1 to KGA21. A, Middle Pleistocene to Holocene fluvial deposits; B, Early to Middle Pleistocene erosional surface deposits; C, Early Pleistocene Konso Formation; D, Tertiary mafic lavas; E, Precambrian crystalline basement rocks; F, faults with downthrown side shown by ticks.

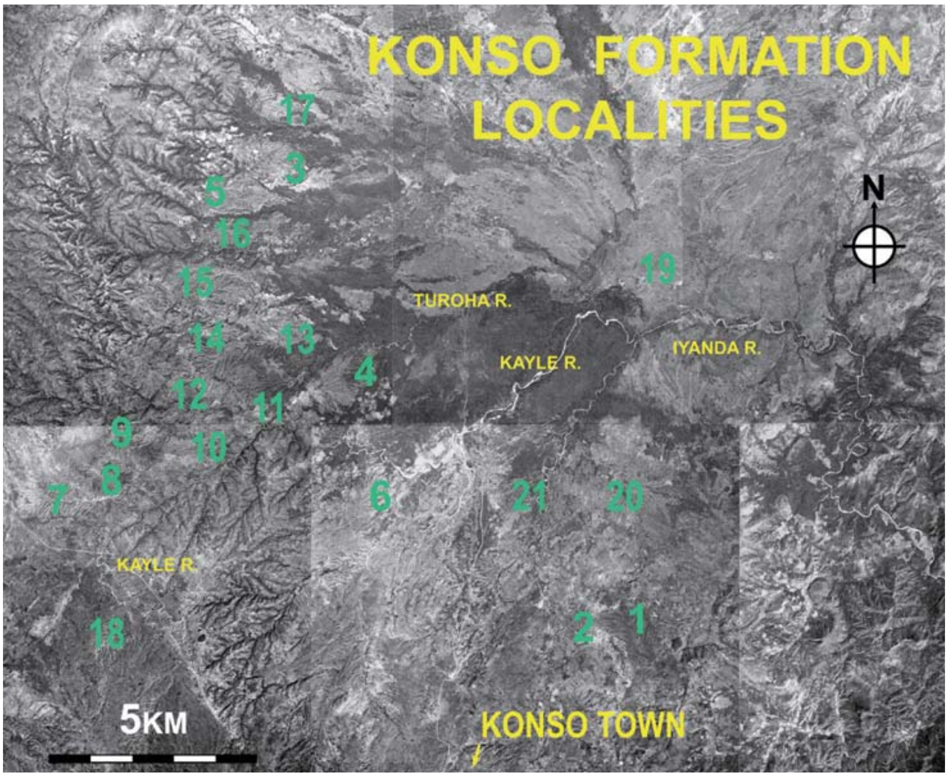

Fig. 2.2. The Konso Formation localities designated for survey and collecting. The air photograph composite is based on 1/50000-scale prints of runs taken in 1984, available at the Mapping Authority, Addis Ababa.

Table 2.1. KGA archaeological sites

Locality	Year	Investigation type	Age	Level	Characteristics (dominant tools)
KGA1-A1	1991/93/98	surface data (Inventory preoject survey area)	~0.8 Ma ?	not known	Acheulean (handaxes)
KGA4-A1	1993/95	surface data (KGA4-14 *H. erectus* site)	~1.45 Ma	TBT-	Acheulean (picks, cores)
KGA4-A2	1994/95	surface collection/excavation	~1.6 Ma	HAT+	Acheulean (LCT, picks)
KGA4-A3	1997	excavation	~1.45 Ma	A3T+ TBT-	Acheulean/Oldowan?
KGA4-A4	1998	surface data	~1.45 Ma	TBT-	Acheulean (picks, handaxes)
KGA4-TRTct	2002	carbonate isotope trench	~1.9 Ma	TRT-	Oldowan
KGA4-EE	2010	survey/selective collection	~1.45 Ma	TBT+	Acheulean (picks, cores)
KGA6-A1	1996/2002/03/13	surface collection	~1.75 Ma	~ KYT2	earliest Acheulean (picks)
	1997	excavation: Locus A	~1.75 Ma	~ KYT2	earliest Acheulean/Oldowan
	2003	excavation: Locus B, C	~1.75 Ma	KYT2+	earliest Acheulean/Oldowan
	2003	excavation: Locus D	1.76 Ma	KYT1-	Oldowan
KGA7-A1	1993	surface collection	~1.4 Ma	~BWT	Acheulean (picks)
KGA7-A2	1993	surface collection	1.3~1.4 Ma	BWT+	Acheulean (knives, cleavers)
KGA7-A3a, b, c	1998	surface collection	~1.4 Ma	~BWT	Acheulean (picks)
KGA8-A1	1995/2013	surface collection	1.3~1.4 Ma	8HGT+	Acheulean (handaxes, cleavers)
KGA8-A2	2013	surface collection	1.3~1.4 Ma	BWT+	Acheulean (handaxes)
KGA10-A1	1993/94	geological trench (KGA10-1 *H. erectus* site)	1.43~1.44 Ma	LHT- to LHT+	not diagnostic (flakes, cores)
KGA10-A2	1993/94	excavation	1.43~1.44 Ma	LHT-	not diagnostic (flakes, cores)
KGA10-A3	1993	excavation	1.43~1.44 Ma	LHT+	not diagnostic (flakes, cores)
KGA10-A4	1993	excavation (sands in upper dark clay)	~1.43 Ma	LHT++	not diagnostic (flakes, cores)
KGA10-A5	1993	excavation (sands in upper dark clay)	~1.43 Ma	LHT++	not diagnostic (flakes, cores)
KGA10-A6	1993	surface collection	1.43~1.44 Ma	LHT+	Acheulean (cores, handaxes, picks)
KGA10-A7	1994/96	excavation	1.43~1.44 Ma	LHT+	not diagnostic (flakes, cores)
KGA10-A8	1994	surface collection	1.43~1.44 Ma	LHT+	Acheulean (cores)
KGA10-A9	1994	excavation (KGA10-656 *H. erectus* site)	1.43~1.44 Ma	LHT+	not diagnostic (flakes, cores)
KGA10-A10	1994/96	excavation	1.43~1.44 Ma	LHT-	Acheulean (picks, cores)
KGA10-A11	1994	surface collection	~1.45 Ma	IVT-	Acheulean (handaxes, picks)
KGA10-A12	1995	excavation (landscape approach trench)	1.43~1.44 Ma	LHT-	few artifacts
KGA10-A13	1996	excavation (landscape approach trench)	1.43~1.44 Ma	LHT-	few artifacts
KGA10-A14	1996	excavation (landscape approach trench)	1.43~1.44 Ma	LHT-	few artifacts
KGA10-A15	1996	excavation (landscape approach trench)	1.43~1.44 Ma	LHT-	few artifacts
KGA12-A1a,b	1994	surface collection	~1.25 Ma	PST2+ HGT-	Acheulean (handaxes)
KGA12-A1c	1996	surface collection	~1.25 Ma	PST2+ HGT-	Acheulean (handaxes)
KGA18-A1a	1999/2000	surface collection	~0.85 Ma	BAT1+	Acheulean (handaxes)
KGA18-A1b	2013	surface collection	~0.85 Ma	BAT1+	Acheulean (handaxes)
KGA19 west NBT block	2000	surface data	~1.6 Ma	NBT+	Acheulean (handaxes, picks)
KGA20-A1	1998/2000	surface collection	~0.85 Ma	BAT1-	Acheulean (handaxes)
KGA20-A2	1998/2000	surface collection	~0.85 Ma	BAT1+	Acheulean (handaxes)
KGA21-BRTct	2002	carbonate isotope trench	~1.6 Ma	BRT-	Acheulean/Oldowan?

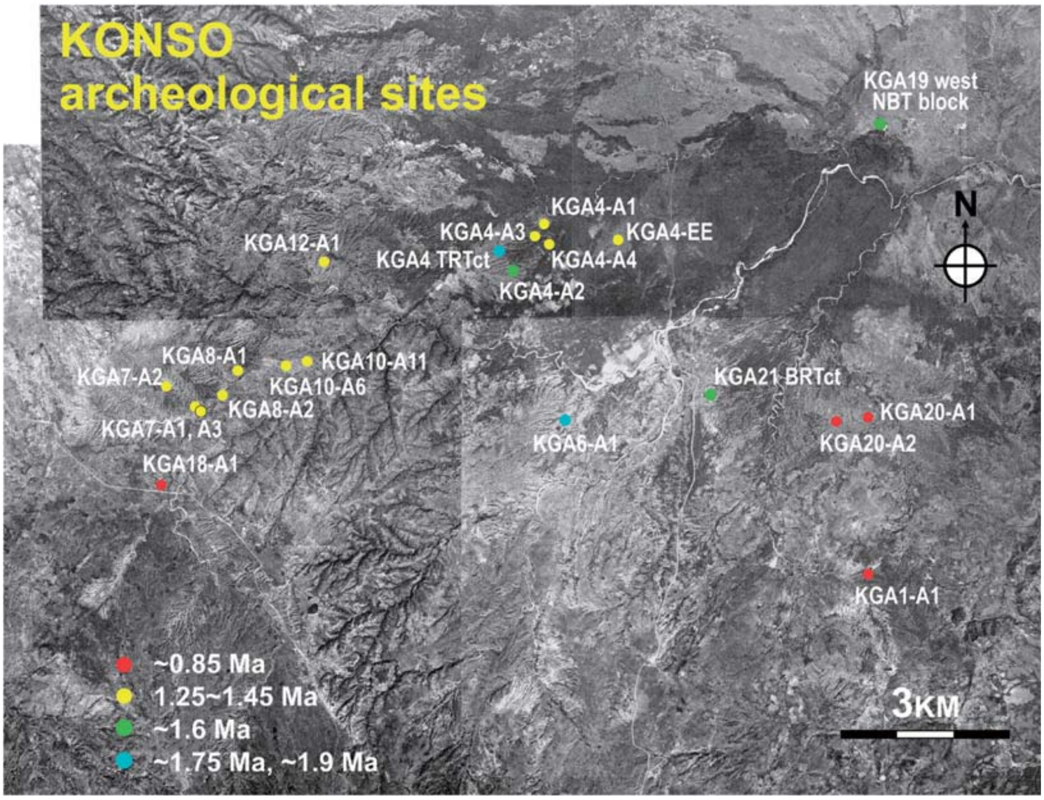

Fig. 2.3. Location of archaeological sites documented at Konso (air photographs as in Fig. 2.2).

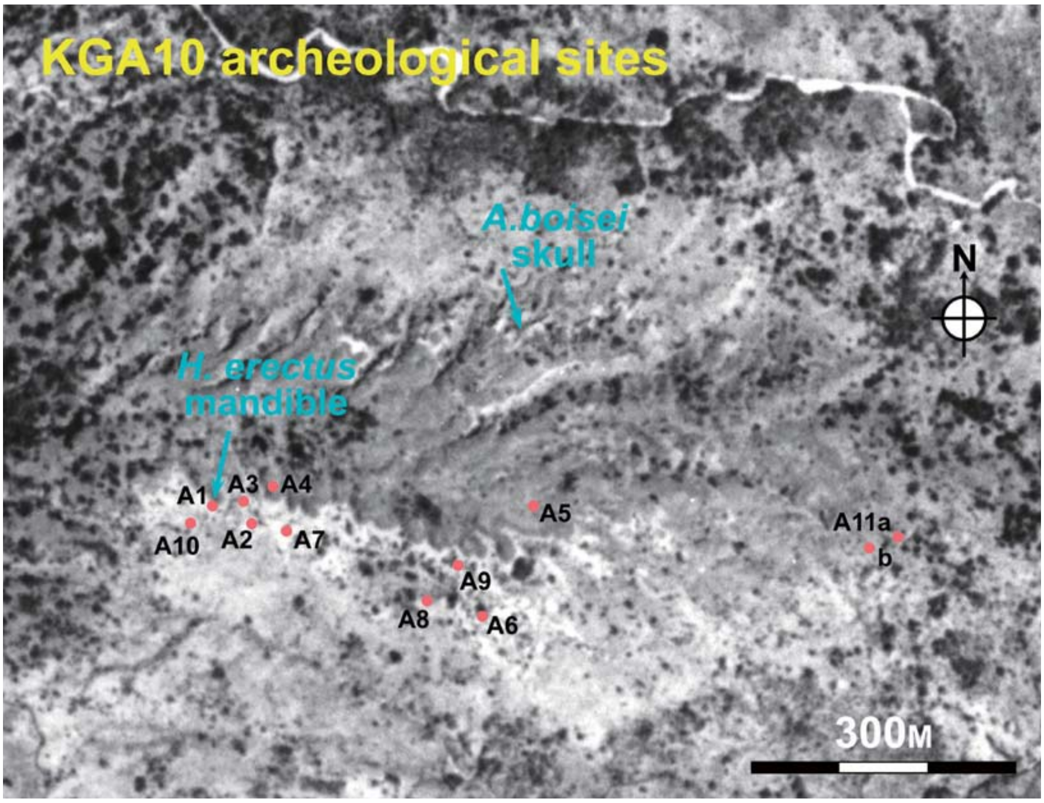

Fig. 2.4. Location details of archaeological sites at the KGA10 locality, plotted on enlarged (×10) print of 1/50000 scale air photograph.

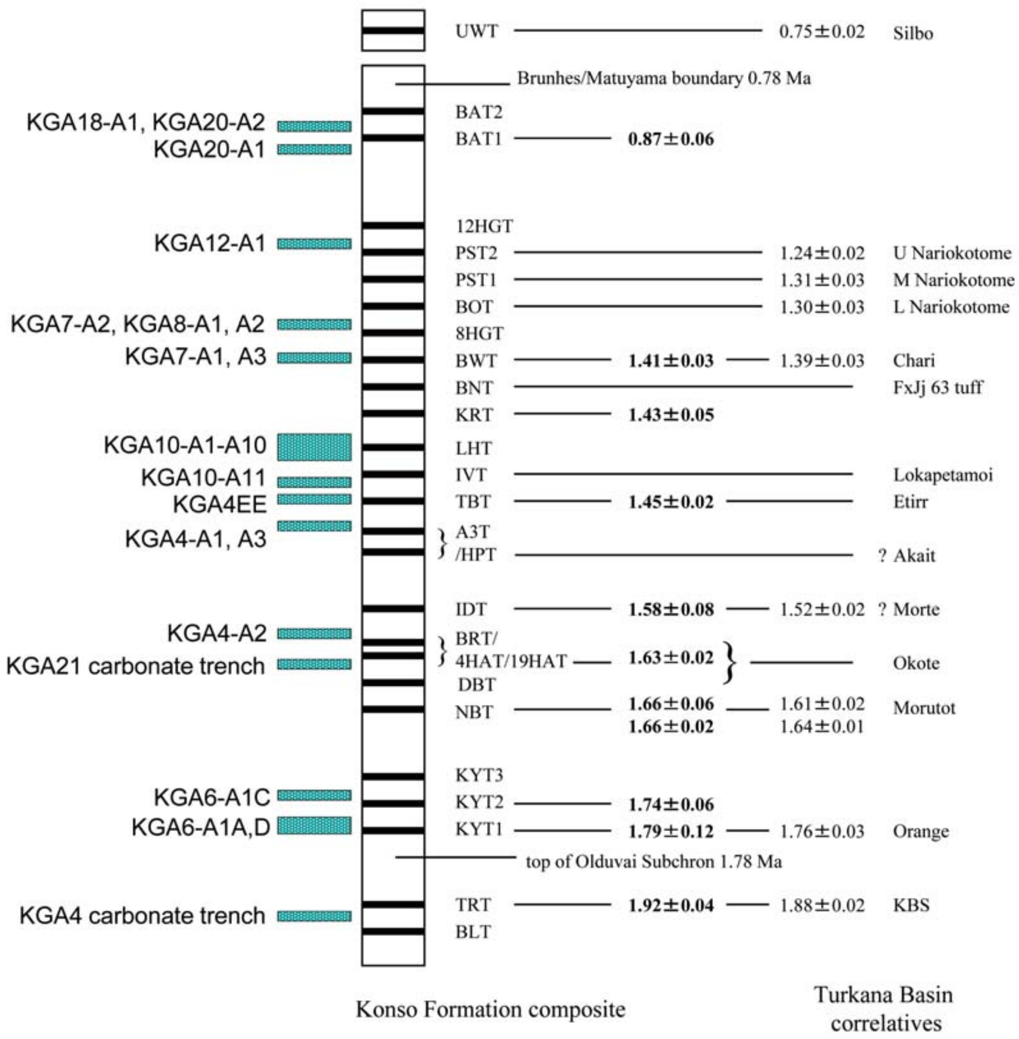

Fig. 2.5. Schematic stratigraphic column of the Konso Formation and archaeological site placements. $^{40}Ar/^{39}Ar$ dates of the Konso tuffs are indicated in million years (Ma); error margins are in SD of dated grains (Beyene et al., 2013). Green horizontal bars indicate approximate stratigraphic positions of archaeological sites.

The earliest recognized Acheulean assemblage occurs at KGA6 just above the KYT2 tuff. The KYT2 is ~6 m above the top of the Olduvai Subchron and has been radioisotopically dated to 1.74 ± 0.06 Ma (Beyene et al., 2013). This is indistinguishable in age from the earliest Acheulean of the Turkana Basin (Roche et al., 2004; Texier et al., 2006), recently considered the world's oldest with an interpolated age of 1.72 or 1.76 Ma (Lepre et al., 2011).

At Konso, a more typical early Acheulean with abundant large bifacial tools occurs at the ~1.6 Ma HAT levels of KGA4 and KGA19. Thereafter, Acheulean assemblages are commonly seen at many of the fossil- and artifact-bearing Konso localities. Well-preserved artifacts were observed at the ~1.45 Ma (KGA4, KGA10), ~1.4 Ma (KGA5, KGA7), ~1.3 to ~1.25 Ma (KGA8, KGA12), and ~0.85 Ma (KGA18, KGA20) levels.

2.2 STRATIGRAPHIC AND CHRONOLOGIC CONTEXT

The chronostratigraphic framework of the Konso Formation was first presented in Katoh et al. (2000) and Nagaoka et al. (2005), focusing on localities KGA4 and KGA6 to KGA14. Tephrostratigraphic summaries of KGA18 through KGA21 were added by Beyene et al. (2013). In the latter publication, we presented an overview of the Konso Formation stratigraphy, and a schematic summary of the chronological placements of the archaeological assemblages. In this chapter, we present in more detail the chronostratigraphic placements of the Konso Formation archaeological assemblages.

The Konso Formation represents unconsolidated sediments of predominantly lacustrine and lake-margin fluvial lithofacies that accumulated at the southern extremity of a small subsiding sedimentary basin. A lacustrine depositional environment is thought to have intermittently prevailed in the area, with the maximum paleolake expansion of up to 2 km east-west and 8 km north-south at about <~1.3 Ma to ~1.4 Ma (Nagaoka et al., 2005). The uppermost sediments of the Konso Formation at ~0.85 Ma age are exposed several kilometers farther south, suggesting that there was either additional lake expansion or a shift of the paleolake location after 1.0 Ma.

The northeastern extent of this paleolake cannot be determined from available surface exposures. However, the topography of the Ganjuli Graben and the lack of known contemporary sediments in the Lake Chamo Basin suggest that the Konso paleolake was confined to the southern extremity of the graben, rather than being part of a greater paleolake Chamo. The relative rarity of fossil fish remains in much of the Konso Formation supports this interpretation. Fossils and lithic artifacts occur mainly in the fluvial sediments of small river systems, mostly representing lake-margin floodplain and alluvial fan settings. These river systems were perhaps equivalent in development to the present day tributaries of the Gato/Iyanda Rivers.

The chronostratographic placements of the Konso archaeological assemblages range from ~1.9 to ~0.8 Ma and are schematically shown in Fig. 2.5. In Katoh et al. (2014), we presented selected stratigraphic columns of the Konso Formation for the purpose of placing the paleontological collection in chronostratigraphic context. These stratigraphic columns are also applicable to the arcaheological assemblages that occur within the same area.

2.3 SITE CONTEXT OF THE COLLECTED ASSEMBLAGES

We present below (in chronological order) the contextual information of the sites and respective assemblages that we describe in Chapters 3 and 4. Artifact assemblages from the other sites listed in Table 2.1 will be reported elsewhere.

KGA6-A1 (~1.75 Ma)
KGA4-A2 (~1.6 Ma)
KGA10-A11 (~1.45 Ma)
KGA10-A6 (~1.43 to ~1.44 Ma)
KGA7-A1 and A3 (~1.40 Ma)
KGA7-A2 (~1.40 to ~1.30 Ma)
KGA8-A1 (~1.40 to ~1.30 Ma)
KGA12-A1 (~1.25 Ma)
KGA18-A1 (~0.85 Ma)
KGA20-A1 and A2 (~0.85 Ma)

KGA6-A1

Differential GPS reading: N5º 23'55.4", E37º 25' 29.6" (Locus A)
Estimated age: ~1.75 Ma

The Acheulean assemblage at the KGA6-A1 site was first recognized in 1996 during survey when initial surface collections were done. Because of the crude Acheulean-looking artifacts and their inferred old age (considered ~1.7 Ma at that time), the location was first excavated in 1997 and additionally in 2003. The 1997 excavation (at Locus A) revealed multiple archaeological horizons but the LCT/pick-bearing horizon was not conclusively established. The 2003 excavations were undertaken in grids designated Locus B, Locus C and Locus D, immediately adjacent to the Locus A excavation.

The four excavation loci span an area of ~16 m × 6 m. Five *in situ* archaeological horizons were recognized from just below the Kayle Tuff-1 (KYT1) to about 2 m above the Kayle Tuff-2 (KYT2). Three of these horizons exhibited tool assemblage characteristics compatible with an Oldowan technological attribution. Both Locus C and a stratigraphically higher more limited occurrence at Locus A exhibited large flake-based blanks. At Locus C, a 4 m × 5 m excavation yielded *in situ* tools attributable to the Acheulean technology (n = 4), whereas another 24 were concentrated within ~1 m adjacent to the *in situ* excavation margin. The latter suggested a recently washed out lag accumulation. The remaining specimens were found farther down slope of the Locus C northern margin. The excavation plan and local stratigraphic section taken at Locus C are shown in Fig. 2.6.

A composite stratigraphic section (K6-1), taken in the general area that includes the KGA6-A1 site, is shown in Katoh et al. (2014) page 19.

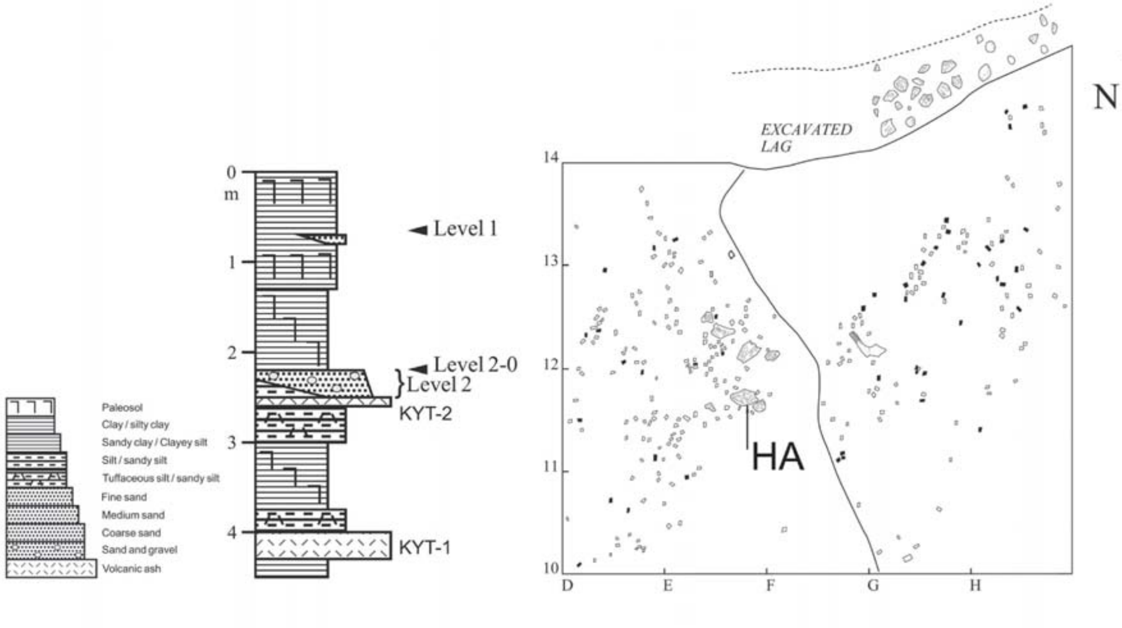

Fig. 2.6. Local stratigraphic section and excavation plan and at KGA6-A1 Locus C. Grids were designated in 1 meter intervals. Hatched symbols represent large flakes and tools; open smaller symbols represent flakes, cores, and fragments; filled symbols are osteodental fragments. The irregular line traversing the excavation represents a fault line with the western side downthrown by about 50 cm. Artifacts recovered at levels 2-0 and 2 are shown. Artifact labeled HA is the handaxe E11-13 described in Chapter 3.

KGA4-A2

Differential GPS reading: N5º 25' 19.3", E37º 24' 59.1"
Estimated age: ~1.6 Ma

The KGA4-A2 site is situated adjacent to the KGA4 paleontological "collecting area 3" which widely exposes the ~1.9 Ma strata and abundant fossils. In 1994, joint paleontological and archaeological survey at mid-southeastern part of KGA4 led to the recognition of a concentrated surface and *in-situ* occurrences of early Acheulean handaxes and picks. Close examination of the deposits revealed that these occurred close to a fault that separated the handaxe-bearing sediments from the more extensive ~1.9 Ma fossiliferous sequence. A tuff, the KGA4 Handaxe Tuff (4HAT), occurs at the fault margin in the form of a small localized lens, at a stratigraphic level ~2 m below the handaxe and fossil-bearing indurated sands. A composite stratigraphic section (K4-3) of the KGA4 area close to the KGA4-A2 site is shown in Katoh et al. (2014) page 18. The local section at the KGA4-A2 site is shown in Fig. 2.7.

Multiple attempts of radioisotopically dating this tuff failed to clarify its age, although two crystals were reported as roughly ~1.5 Ma in age (Katoh et al., 2000). With this geochronological ambiguity, we proceeded to undertake tephro- and magnetostratigraphic assessments within the Konso Formation. Tuff correlations were complicated, but through a combination of geochemical, petrographic and magnetostratigraphic analyses, our current interpretation is that the 4HAT is probably very close in depositional age to the KGA19 Handaxe Tuff (19HAT) dated to 1.63±0.02 Ma (Beyene et al., 2013: Katoh et al. in preparation). The tuffs 4HAT and 19HAT have very similar geochemical composition, and probably come from closely separated eruptions of the same volcanic source or even from the same eruptive sequence. Combining the petrographic, tephrostratigraphic, geochronologic, and magnetostratigrahic results, we consider both 4HAT and 19HAT to be broadly ~1.6 Ma in age, as outlined in more detail in Beyene et al. (2013).

In 1995, we excavated the northeastern end of the low-lying ridge at the KGA4-A2 site, where erosion exposes the fossil and artifact-bearing horizon in a tongue-like fashion. The artifact and fossil bearing horizon is a sandy layer containing small (<~5 mm) oxidized nodules, and forms a small resistant ledge (~5 meters) at the northeastern end of the low-lying predominantly silty clay ridge. *In situ* artifacts and fossils were observed partially exposed on this erosional ledge and

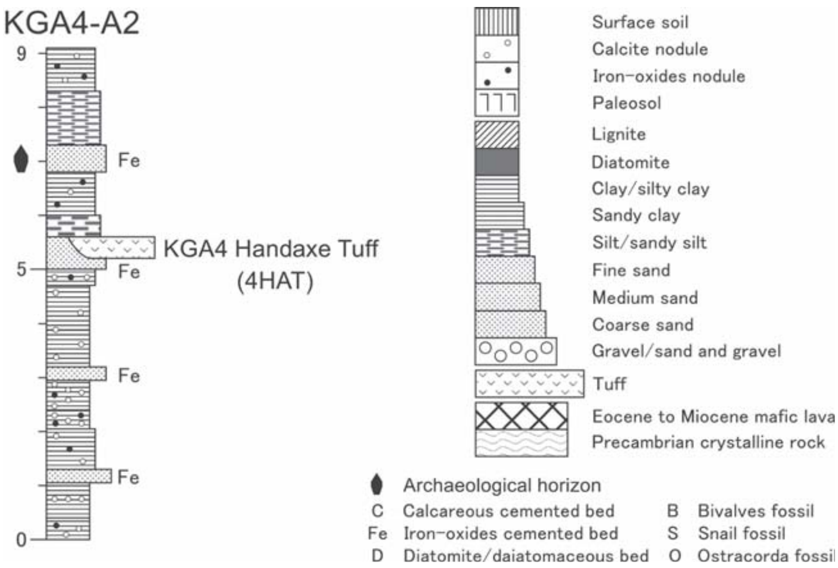

Fig. 2.7 Local stratigraphic section at KGA4-A2.

its slope, which enabled both controlled surface collection of the exposed materials and *in situ* excavation. A 100% surface collection (all tools, cores, and flakes on the lag surface) was conducted in an area totaling 5 m × 8 m, initially in 1994 and in preparing for the 1995 excavation. In 1995, an area of 2 m × 2 m was excavated. These materials were briefly reported in Beyene et al. (1997) and further details of the excavated materials will be presented elsewhere. In Chapter 3, we describe the surface collection assemblage.

KGA10-A11

Differential GPS reading: N5º 24' 27.5", E37º 23' 06.5" (A11a)
Differential GPS reading: N5º 24' 27.1", E37º 23' 05.7" (A11b)
Estimated age: ~1.45 Ma

KGA10 is paleontologically the richest locality so far recognized and has yielded the greatest number (n=14) of hominid specimens. Systematic paleontological and archaeological surveys were conducted from 1993 to 1996.

The KGA10-A11 surface collection site is located at the eastern end of the fossil-rich KGA10 exposures. A stratigraphic section (K10-1) shown in Katoh et al. (2014) page 20 depicts the general stratigraphy of the area spanning the KGA10-A11 site and the isolated and small Ivory Tuff (IVT) exposure patch.

The stratigraphically higher *Australopithecus boisei* fossil-bearing whitish-colored sands pinch out west of the KGA10-A11 location. The local section at the KGA10-A11 site exposes the lower sedimentary units dominated by dark gray/brown silty clays that unconformably overlie the Precambrian basement rock. A gravelly sand horizon is intermittently exposed showing *in situ* bone and artifacts. This horizon occurs stratigraphically ~2m below the IVT which is considered ~1.44 Ma. The widely distributed Trail Bottom Tuff (TBT) does not crop out at KGA10, and the stratigraphic relationship between the artifact bearing KGA10-A11 level and the TBT is therefore unclear.

Several locations of relatively dense cluster of surface accumulation of handaxes and picks were found in the KGA10-A11 area. In 1994, two collection areas were designated KGA10-A11a and -A11b, each in 50 m^2 (5 m × 10 m) grids, and 100% collecting was undertaken.

KGA10-A6

Differential GPS reading: N5º 24' 24.0", E37º 22' 51.1"
Estimated age: ~1.43 to ~1.44 Ma

The KGA10-A6 surface collection site is located on the southern side of the KGA10 mesa-like hill, ~300 meters east of the KGA10-A1 *Homo erectus* site and ~50 meters south of the hill margin. The KGA10 southern face area exhibits in descending stratigraphic order a predominantly dark gray upper clay sequence, a whitish partially calcified sand bed, a yellowish brown series of alternating tuffaceous silts and sands, and a lower sequence of predominantly dark gray/brown silty clays.

KGA10-A6 is located at the western margin of a small valley exposing the lower dark clays, and stands out in the form of a small (~15 m diameter) resistant sediment block. General stratigraphic sections at southern KGA10 are shown in Katoh et al. (2014) page 20 (sections K10-2 and K10-3). An impressive concentration of stone tools, mostly picks and large cores in quartz and basalt, were observed *in situ* and eroding out of the tuffaceous silty sands at a stratigraphic level less than 3 m above the Lehayte Tuff (LHT). Selective surface collecting of the LCTs/picks was undertaken in 1993 in a 22.5 m^2 area.

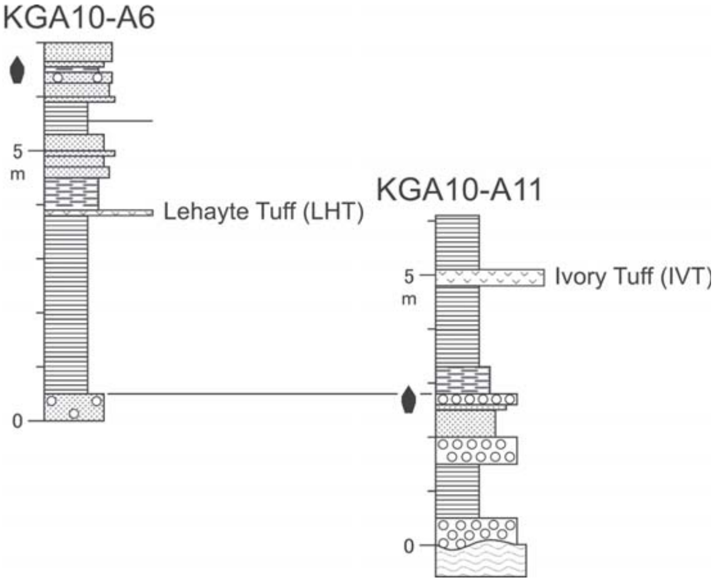

Fig. 2.8. Local stratigraphic sections at KGA10-A6 (left) and the KGA10-A11 and adjacent area (right) (symbols and legends as in Fig. 2.7).

KGA7-A1 and A3

Differential GPS reading: N5º 24' 02.0", E37º 22' 00.5" (KGA7-A1)
Differential GPS reading: N5º 23' 59.0", E37º 22' 03.7" (KGA7-A3)
Estimated age: ~1.40 Ma

Locality KGA7 includes the Boleshe River valley and the smaller drainage to the north. Sites KGA7-A1 and A3 are located close by (~100 meters), at the eastern end of the sediments exposed along the small drainage north of the Boleshe.

Site KGA7-A1 occurs along a narrow subsidiary incision that intersects the KGA7 ridge (the ridge in between the Boleshe and smaller northern drainage), ~200 meters from the eastern contact of the Konso Formation sediments with the Precambrian basement rock. During the inventory survey, striking examples of large elongated picks were found. Selective surface collecting of the picks and LCTs was undertaken in 1993.

Site KGA7-A3 was established close to the eastern end of the Konso Formation exposures at KGA7, where *in situ* and deflated artifacts and fossils were observed near the sediment/basement contact area. Three surface collection areas, KGA7-A3a to A3c, were designated within a distance of ~50 meters. Each was approximately 120 m^2 in area and 100% collecting was undertaken.

Representative stratigraphic sections (K7-1 and K7-2) of locality KGA7 are shown in Katoh et al. (2014) page 21. The KGA7-A1 and A3 sites are located northeast of geologic section K7-1. The local sections at the KGA7-A1/A3 sites and vicinity are shown in Fig. 2.9. The KGA7-A1 and A3 artifacts and fossils were observed eroding out of the whitish sandy unit, locally ~2 m thick, at the lower contact of the dark gray silty clays that dominate the upper horizons. This unit can be traced widely across much of KGA7 and KGA8, and at places contains small patches of the Bright White Tuff (BWT). In the stratigraphic sections immediate at and near KGA7-A1 and A3, the BWT is not exposed. The relationship between the main artifact-bearing unit(s) and the BWT is therefore unknown, but the collected assemblages and the BWT can be considered broadly coeval. The Karat Tuff (KRT) is exposed locally and occurs 3 to 4 m below the main artifact and fossil-bearing sandy unit.

KGA7-A2

Differential GPS reading: N5º 24'13.2", E37º 21' 44.8"

Estimated age: ~1.40 to ~1.30 Ma

The KGA7-A2 site is located ~0.7 km upstream (west) of KGA7-A1 and A3. A small number of fresh quartzite artifacts were found clustered on the slopes of the ridge, at and below a thin sandy horizon within the dark gray silt/clay sediments. Because of the otherwise sterile nature of the sediments, this sand layer is onsidered the source of the artifacts. This inference was confirmed by a geological trench dug in 2002. The sand lens occurs ~10 m above a thick sand unit correlative to

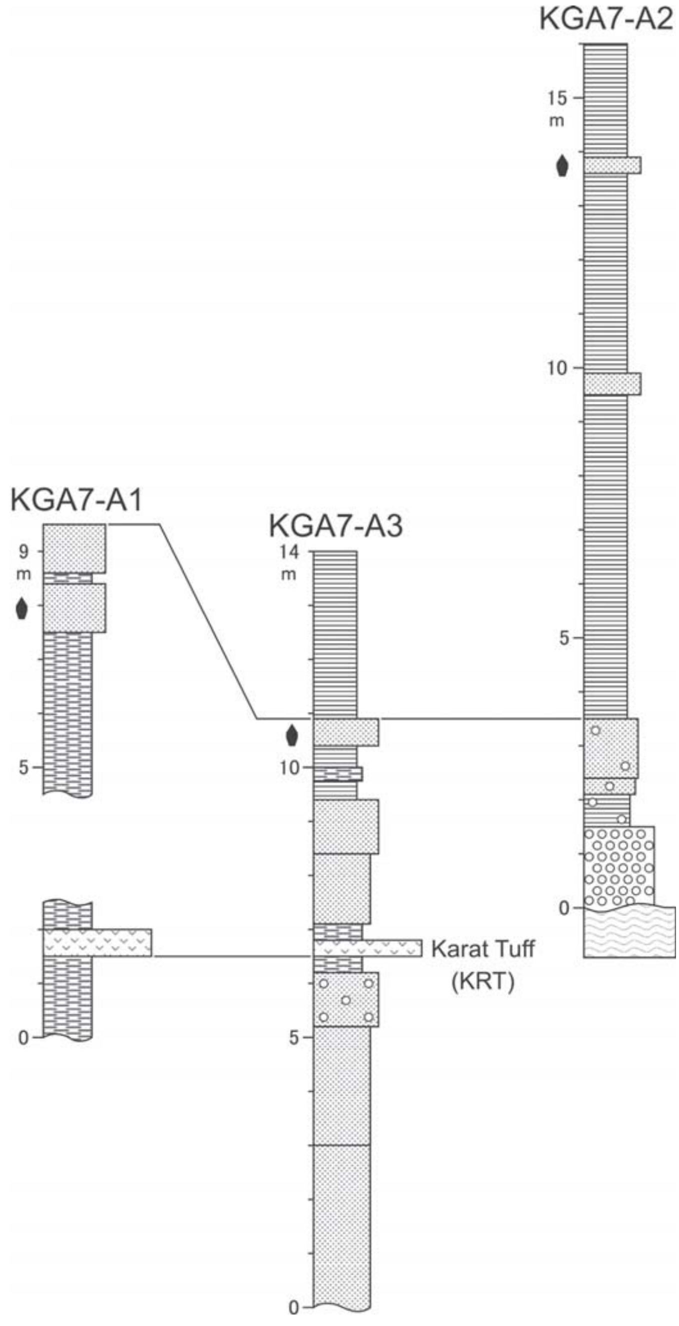

Fig. 2.9. Local stratigraphic sections at KGA7-A1 (left), A2 (right) and A3 (middle) (symbols and legends as in previous figures).

the KGA7-A1 and A3 artifact containing sands. The local stratigraphic section at the KGA7-A2 site is shown in Fig. 2.9.

At KGA7, the Boleshe Tuff (BOT) and PisoTuff-1 (PST1) overlie the BWT. West of KGA7-A2, several altered tuffs are recognized above the KGA7-A2 sand level. It is possible that these include correlatives of BOT and/or PST1, although geochemical analyses were not possible. Thus, we consider the KGA7-A2 artifact bearing sands to underlie the BOT. Controlled surface collecting was done in 1993, and all observable artifacts were collected within a small area of approximately 20 m^2.

KGA8-A1

Differential GPS reading: N5º 24' 21.8", E37º 22' 24.8"
Estimated age: ~1.40 to ~1.30 Ma

The KGA8-A1 site occurs on the northern side of the KGA8 valley, towards the eastern end of the KGA8 sediment exposures. At or close to KGA8-A1, both upper and lower KGA8 sedimentary sections are exposed (sections K8-3 and K8-4 in Katoh et al., 2014, page 21). The local section at the KGA8-A1 site is shown in Fig. 2.10, together with geologic composite section K8-4 of this area. As is the case at KGA7, the upper horizons are dominated by dark gray silty clays. This sequence is underlain by a whitish calcified sandy unit that laterally contains small lenses of the BWT. The KRT is exposed further below. Another tuff, the KGA8 Hard Gray Tuff (8HGT), occurs ~2 m above the BWT containing calcified sands, locally just west of KGA8-A1.

KGA8-A1 lies close to a small fault that juxtaposes the upper dark silty clays with the main KGA8 sedimentary sequence. The upper sequence contains the KGA8 Hard Gray Tuff (8HGT) and a superjacent buff tuffaceous sandy silt unit. The artifact bearing horizon at KGA8-A1 was confirmed by a geological trench as the first gravelly sand unit ~1 m above the buff tuffaceous sandy silt, and thus stratigraphically overlies both 8HGT and BWT. Although, no capping tuff unit occurs locally, the KGA8-A1 artifact bearing horizon is inferred to lie below the BOT level.

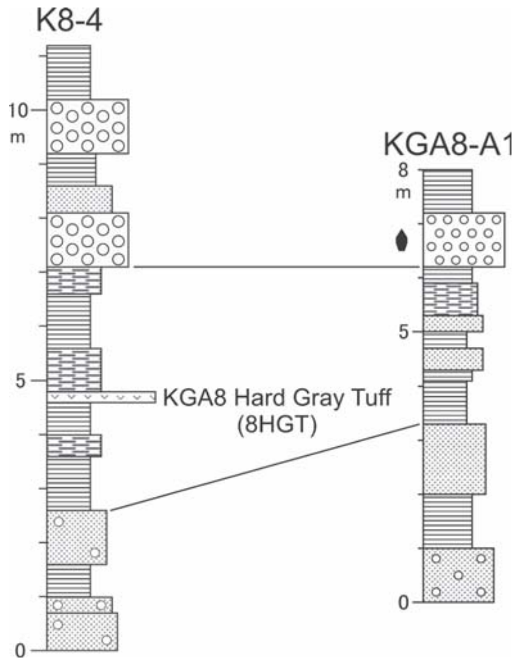

Fig. 2.10. Local stratigraphic section at KGA8-A1 (right) (symbols and legends as in previous figures).

The relative stratigraphic positions of KGA8-A1 and KGA7-A2 are identical in that the artifact-bearing horizons are considered to lie above BWT and below BOT. It is possible that the artifact assemblages of the two sites, both characterized by fresh quartzites, in fact represent (pene) contemporaneous assemblages although they are located >1 km apart.

A selective collection of LCT, picks and other large tools was undertaken in 1995, within a gridded area of 64 m^2. We revisited the area in 2013, and further undertook surface collection at the same location. In 2013, a 100% collection of not only LCTs and picks, but also flakes and cores were undertaken in a gridded area of approximately 100 m^2 (9 m × 11 m) (KGA8-A1b). A second selective collection of only the LCTs and picks were made in another gridded area of approximately 60 m^2 (7.5 m × 8 m) (KGA8-A1c) immediately downslope on the same ridge slope.

KGA12-A1

Differential GPS reading: N5º 25' 25.3", E37º 23' 11.6" (1994 collection area)
Differential GPS reading: N5º 25' 24.7", E37º 23' 11.7" (1996 collection area)
Estimated age: ~1.25 Ma

The KGA12-A1 site occurs towards the western end of the richly fossiliferous sediment exposures of KGA12. A small recess-like valley is formed above the locally resistant Bench Tuff (BNT) horizon. An impressive surface concentration of handaxes was found there during the 1991 Inventory survey. This prompted the nickname "handaxe valley".

A composite stratigraphic section near the KGA12-A1 site (K12-2) is shown in Katoh et al. (2014) page 21, and the section corresponding to the KGA12-A1 site and vicinity is shown in Fig. 2.11. The BWT is exposed at the mid-upper section, and the KGA12 Hard Gray Tuff (12HGT) occurs higher. A yellow gravelly sand unit occurs 2 to 3 m above the BWT and 2.5 m below the 12HGT. This unit is continuous for almost the entire east-west extent of the KGA12 exposures, and locally contains *in situ* fossils and handaxes. Toward the eastern end of KGA12, this sand unit lies immediately above the Piso Tuff-2 (PST2). The KGA12-A1 surface artifacts are considered to have eroded out of this yellow gravelly sand unit. *In situ* artifacts were observed in the sections flanking the KGA12-A1 valley.

The KGA12-A1 assemblage was first collected in the "handaxe valley" in 1994, a collecting area of 50 m^2 (10 m × 5 m) was designated and this was further divided into two collecting areas each 25 m^2. A 100% surface collection was done at the southern 25 m^2 area (KGA12-A1a), and a selective collection of all LCTs was taken at the northern 25 m^2 area (KGA12-A1b). Another 25 m^2 100% collection was made in 1996 in the "handaxe valley" ~20 m south of the 1994 location and designated as KGA12-A1c.

KGA18-A1

Differential GPS reading: N5º 23' 18.3", E37º 21' 42.9" (1999 collection area)
Hand held GPS reading: N5º 23' 18.9", E37º 21' 40.7" (2013 collection area)
Estimated age: ~0.85 Ma

The KGA18-A1 site occurs at outcrops adjacent to the main highway as the road ascends southward from the Kayle River crossing. A gravelly sand unit 1 to 1.5 m thick occurs in shallow local sections that can laterally be shown to lie ~4 m above the Baraisa Tuff-1 (BAT1). Artifacts (and few fossils) can be inferred to erode out of this sand unit, in otherwise sterile sediments. Low density surface scatter is usually seen, but a few locations exhibit concentrations of ~10 or so LCT artifacts. One of such concentrations was collected in 1999 and designated KGA18-A1a. The same area was revisited in 2013. Highway renovation and farming has altered the landscape to the extent that it was difficult to visually relocate the initially collected KGA18-A1 artifact site. However, in the same general vicinity, probably one small ridge west (~50 m) of KGA18-A1a, another cluster of LCTs were found and collected as KGA18-A1b. The stratigraphic section of the KGA18-A1 area is shown in Fig. 2.12.

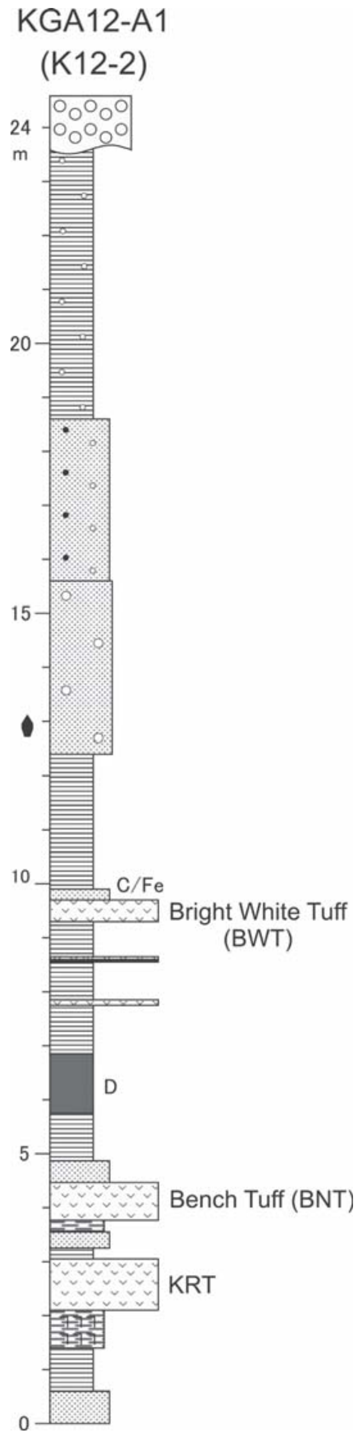

Fig. 2.11. Local stratigraphic section at KGA12-A1 (symbols and legends as in previous figures).

KGA20-A1 and A2

Differential GPS reading: N5° 23' 55.4", E37° 28' 23.5" (KGA20-A1)
Differential GPS reading: N5° 23' 54.7", E37° 28' 03.9" (KGA20-A2)
Estimated age: ~0.85 Ma

KGA20-A1 and A2 occur approximately ~0.5 km apart in the low-lying sediments of the same basin. A tuff horizon correlative of the Baraisa Tuff-1 (BAT1) intervenes between the artifact and fossil-bearing units of the two sites (KGA20-A2 being the stratigraphically higher). Another tuff, the Baraisa Tuff-2 (BAT2), overlies the KGA20-A2 horizon. Tuff BAT2 in turn occurs 2 to 6 m below the Upper White Tuff (UWT), the latter considered a correlative of the Turkana Basin Silbo Tuff (Beyene et al., 2013). Stratigraphic sections near the KGA20-A1 and A2 sites are shown in Katoh et al. (2014) page 32 (sections K20-2 and K20-3), and reproduced here as local sections (Fig. 2.12).

In 1998, selective collecting of the surface LCTs was conducted at KGA20-A1, and controlled collecting was done at KGA20-A2. At KGA20-A2 artifact concentration was not as dense as in some of the other collection sites so that 100% collection was undertaken in an extended area of 28 m × 10 m. Additional selective collecting of LCTs was done outside this area.

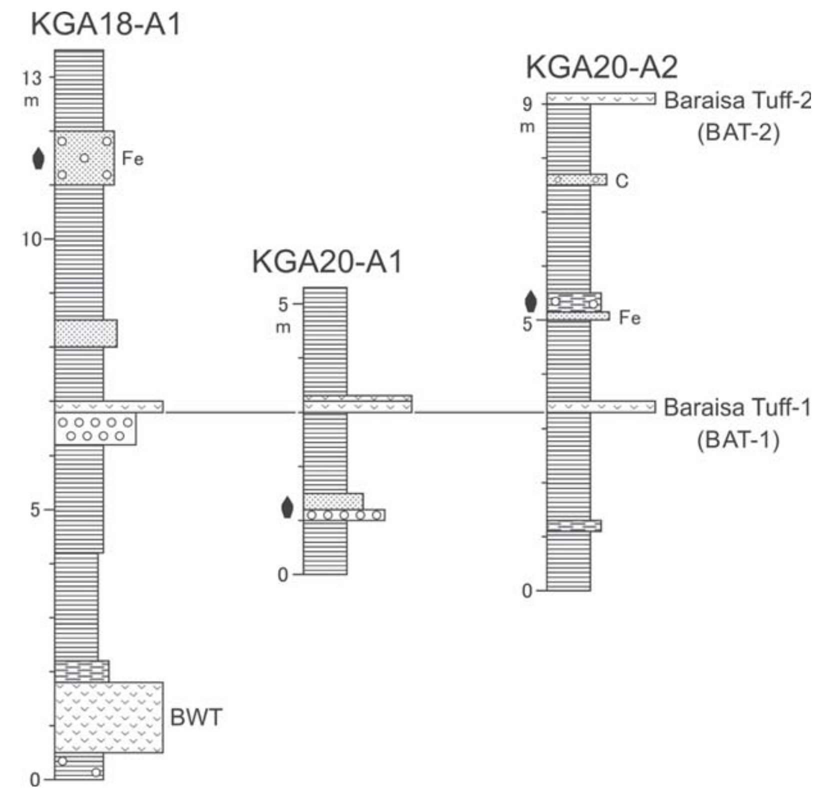

Fig. 2.12 Composite stratigraphic section of the KGA18-A1 area (left) and local sections at KGA20-A1/A2 (middle and right) (symbols and legends as in previous figures).

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CHAPTER 3

The Acheulean Assemblages of Konso: A Site by Site Analysis

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3.1 INTRODUCTION

We present below an attribute analysis of 11 artifact assemblages that we recovered from the Konso Formation. One assemblage from KGA6, comes from the stratigraphically lower ~1.75 Ma time horizon, and another from KGA4 comes from the ~1.6 Ma level. The ~1.45 to ~1.25 Ma time period is represented by seven assemblages from the artifact-rich KGA7, KGA8, KGA10, and KGA12 localities. At localities KGA18 and KGA20 assemblages were collected from the uppermost ~0.85 Ma horizons.

Representative artifacts of the Acheulean assemblages that we analyzed are figured in Plates 1–66. Brief descriptions of these artifacts are individually given after the attribute analysis presentation.

We considered an assemblage to represent the early Acheulean technological complex based on the production of large flake blanks (>10 cm and frequently exceeding ~20 cm) and modification of these large blanks and similar-sized cobbles into handaxes, cleavers, and picks (Beyene et al., 2013). Most of these large tools are categorized as some form of Large Cutting Tool (LCT, mostly hand axes and cleavers) or Heavy Duty Tool (HDT, mostly picks and core axes).

3.2 ATTRIBUTE ANALYSIS

Technological attribute analysis: methodology

The methodology adopted in the technological analysis of the present report is outlined below. It consists of a coding system developed by Y.B., the senior author of this chapter. This was done in conjunction with the late J. Desmond Clarke through collaborative work during the early to middle 1990s. The attribute coding system is based on terminology and definitions outlined in Clark and Schick (2000) and Kleindeinst (1962).

The full coding system is presented in the Appendix 1, and includes the following technological attribute categories:

- Raw Material (9 categories)
- Physical Condition (5 categories)

- Specific Tool Type (Large Cutting Tools/Heavy Duty Tools) (27 categories)
- Cortex (6 categories)
- Primary Form (Flake/Cobble/Indeterminate/Block)
- Flake Type (End struck/Side struck/Kombewa/Indeterminate)
- Unifacial/Bifacial (5 categories)
- Dimension (Length/Breadth/Thickness)
- Cross-section Shape (8 categories)
- Sinuosity (Wavy/Sinuous/Straight)
- Edge Angle
- Biface Butt Plan (8 categories)
- Invasiveness (Marginal/Semi-invasive/Invasive)
- Flake Scar Number
- Maximum Dimension of Flake Scars
- Cleaver Edge Plan (6 categories)
- Cleaver Bit Angle
- Cleaver Bit Dimension

The results of the site by site attribute analysis are summarized in Tables A2.1–A2.21 presented in the Appendix 2.

KGA6-A1 (Plates 1–8)

Overview

General presentation of artifacts

A total of 116 artifacts were collected at KGA6-A1, comprising 61 large cutting tools and heavy duty tools (hereafter LCTs/HDTs) (52.6%), 35 flakes (30.2%), 12 chunks (10.3%), four core/choppers (3.4%), one core (0.9%), and three cobbles (2.6%).

General presentation of raw materials

The most frequent rock type is local basalt (n=112, 96.6%) and quartzite, quartz, siliceous rock, and indeterminate rock are used on one piece each.

General presentation of physical conditions

Most of the artifacts are moderately weathered (n=68, 58.6%) or weathered (n=27, 23.3%). Twenty-one items (18.1%) show a fresh condition. The weathered pieces are made on basalt.

Large Cutting Tools & Heavy Duty Tools

Typology

A total of 61 LCTs/HDTs were recovered from KGA6-A1, including eight handaxes (13.1%), five cleavers (8.2%), 15 picks (24.6%), two large scrapers (3.3%), four part bifaces (6.6%), 21 modified pieces/blanks (34.4%), and six broken LCTs/HDTs (9.8%).

Raw material

All the 61 LCTs/HDTs at KGA6-A1 are made on basalt.

Physical condition

Most of the LCTs/HDTs are either moderately weathered (n=37, 60.7%) or weathered (n=11, 18.0%). Thirteen artifacts (21.3%) show a fresh condition.

Presence of cortex

Half of the LCTs/HDTs (n=26, 47.3%) exhibit no cortex. Seven artifacts (12.7%) have "small amount" (<25% of the surface) of cortex, five artifacts (9.1%) have "modest amount"(25–50% of the surface) of cortex, and 13 artifacts (23.6%) retain "much" cortex (>50% of the surface). The remaining four items (7.3%) are indeterminate owing to weathering.

Primary form

While two handaxes (3.5%) are made on cobble and two pieces (3.5%) allow no determination, the remaining LCTs/HDTs (n=53, 93.0%) are made on flake. It would be worth noting that no blocks were selected as blanks for producing LCTs/HDTs at KGA6-A1.

Flake type

Out of the 53 LCTs/HDTs made on flake, 34 pieces (64.2%) are made on an end struck flake, and 11 (20.8%) are made on a side struck flake. The remaining eight pieces (15.1%) do not allow determination of flake type due to flaking on the ventral surface. While most of the handaxes and picks are made on either an end struck flake or are indeterminate, almost half of the cleavers are made on a side struck flake, probably because of preferential form of the flakes.

Unifacial/bifacial

Most of the LCTs/HDTs are unifacially modified. A total of 35 pieces (74.5%) are unifacial and nine tools (19.1%) are just partly bifacial. Only two pieces (4.3%) are fully bifacial and one specimen (2.1%) is thrihedrally shaped. All the handaxes are unifacial, and most of the cleavers and picks are also unifacially made.

Dimension

The dimension of the total LCTs/HDTs at KGA6-A1 is summarized as follows:

Max.	241 × 136 × 90 mm,
Min.	74 × 46 × 19 mm,
Mean	146.5 × 97.9 × 48.8 mm,
SD	38.3 × 18.5 × 14.5 mm.

The different groups of the LCTs/HDTs show the following dimensions:

<u>Handaxes;</u>

Max.	214 × 133 × 81 mm,
Min.	74 × 46 × 19 mm,
Mean	139.3 × 93.0 × 41.5 mm,
SD	54.2 × 29.4 × 19.3 mm,

<u>Cleavers;</u>

Max.	195 × 124 × 61 mm,
Min.	133 × 85 × 38 mm,
Mean	156.0 × 111.0 × 50.8 mm,
SD	24.6 × 14.7 × 9.8 mm,

<u>Picks;</u>

Max.	241 × 136 × 90 mm,
Min.	95 × 65 × 31 mm,
Mean	175.7 × 93.1 × 60.0 mm,
SD	46.6 × 19.7 × 17.4 mm.

Cross-section

Most of the bifacial tools show trapezoidal or triangular cross-sections. Out of the 55 analyzed specimens, 22 artifacts (40.0%) show a trapezoidal cross-section and 19 pieces (34.5%) exhibit a triangular cross-section. The cross-sections of six artifacts (10.9%) are parallelogram, five (9.1%) plano-convex, two (3.6%) lenticular, and one (1.8%) double convex.

Sinuosity

The KGA6-A1 artifacts mostly show straight edges, due to the high frequency of unifacially worked materials. A total of 35 LCTs/HDTs (67.3%) have straight edges, 12 pieces (23.1%) exhibit sinuous edges, and five items (9.6%) show wavy edges. Except for one pick, all other instances of wavy edges are observed on unfinished and broken handaxes or blanks.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 88°, Min. = 35°, Mean = 61.2°, and SD = 12.3°.

The different groups of the LCTs/HDTs show the following edge angle values:

<u>Handaxes;</u>

Max. = 68°, Min. = 45°, Mean = 56.3°, and SD = 8.0°,

<u>Cleavers;</u>

Max. = 84°, Min. = 45°, Mean = 67.8°, and SD = 16.7°,

<u>Picks;</u>

Max. = 88°, Min. = 43°, Mean = 67.4°, and SD = 12.7°.

Biface butt plan

Out of the 44 analyzed tools, 13 artifacts (29.5%) exhibit a straight butt, another 13 pieces (29.5%) a V-shaped butt, and nine items (20.5%) a U-shaped butt. Three specimens (6.8%) retain cortex on their butt and one piece (2.3%) shows an irregular butt plan. Two biface butts (4.5%) are modified into tool and three biface butts (6.8%) are indeterminate.

Invasiveness

The artifacts at KGA6-A1 are modified by large flake scars, and thus the flake scars cover the tool surfaces invasively. While only three LCTs/HDTs (5.9%) show marginal retouch, 37 tools (72.5%) are invasively retouched, and 11 items (21.6%) exhibit semi-invasively retouched surfaces.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 20, Min. = 2, Mean = 7.9, and SD = 4.2.

The different groups of the LCTs/HDTs show the following flake scar count:

<u>Handaxes;</u>

Max. = 20, Min. = 7, Mean = 10.5, and SD = 4.4,

<u>Cleavers;</u>

Max. = 14, Min. = 3, Mean = 7.8, and SD = 4.1,

<u>Picks;</u>

Max. = 18, Min. = 5, Mean = 10.4, and SD = 3.5.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 100 mm, Min. = 13 mm, Mean = 51.9 mm, and SD = 19.6 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

<u>Handaxes;</u>

Max. = 76 mm, Min. = 24 mm, Mean = 50.6 mm, and SD = 21.6 mm,

<u>Cleavers;</u>

Max. = 100 mm, Min. = 38 mm, Mean = 63.8 mm, and SD = 24.9 mm,

<u>Picks;</u>

Max. = 80 mm, Min. = 37 mm, Mean = 55.3 mm, and SD = 13.2 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the five analyzed cleavers, three cleavers (60.0%) show a straight edge plan, one cleaver (20.0%) exhibits an oblique end and another one (20.0%) has a convex edge plan.

The cleavers recovered at KGA6-A1 show the following cleaver bit angle values:

Max. = 54°, Min. = 42°, Mean = 47.6°, and SD = 5.9°.

The cleaver bit dimensions are summarized as:

Max. = 108 mm, Min. = 55 mm, Mean = 81.0 mm, and SD = 20.9 mm.

KGA4-A2 (Plates 9–14)

Overview

General presentation of artifacts

The surface collection at KGA4-A2 is represented by 159 lithic artifacts, including 72 LCTs/HDTs (45.3%), 64 flakes (40.3%), nine chunks (5.7%), and 14 cores (8.8%).

General presentation of raw materials

The raw material used at KGA4-A2 is almost exclusively basalt (n=153, 96.2%), except for a few other raw materials, such as quartz (n=4, 2.5%) and siliceous rock (n=2, 1.3%).

General presentation of physical conditions

The majority of the lithic artifacts are moderately weathered (n=137, 86.2%). Out of 159 pieces, 18 lithics (11.3%) are weathered and only four lithics (2.5%) show a fresh appearance.

Large Cutting Tools & Heavy Duty Tools

Typology

A total of 72 LCTs/HDTs were recovered from KGA4-A2, including 20 handaxes (27.8%), 13 cleavers (18.1%), 26 picks (36.1%), one knife (1.4%), four large scrapers (5.6%), one core axe (1.4%), two part bifaces (2.8%), four modified pieces/blanks (5.6%), and one broken LCTs/HDTs (1.4%).

Raw material

All the 72 LCTs/HDTs at KG4-A2 are made on basalt, which we consider an easily accessible local raw material at the KGA4-A2 site.

Physical condition

All the LCTs/HDTs show a moderately weathered appearance, because they are all made on basalt and passed through more or less the same post-depositional processes.

Presence of cortex

The LCTs/HDTs recovered from the KGA4-A2 show different degree of the cortex preservation. Out of 72 pieces, 33 LCTs/HDTs (45.8%) have no cortex, 21 items (29.2%) exhibit cortex on less than 25% of their surface ("small amount"), 10 tools (13.9%) show "modest amount" (25–50% of the surface) of cortex, and six artifacts (8.3%) have "much" cortex (>50% of the surface). The remaining two pieces (2.8%) are indeterminate owing to weathering.

Primary form

Most of the primary forms are flake (n=45, 63.4%) and two LCTs/HDTs (2.8%) are made on cobble. The primary forms of the remaining 24 pieces (33.8%) are indeterminate due to either invasive retouch or weathering.

Flake type

Out of the 45 analyzed LCTs/HDTs made on flake, 18 tools (40.0%) are made on an end struck flake, and 13 (28.9%) are made on a side struck flake. The remaining 14 pieces (31.1%) are indeterminate owing to flaking on the ventral surface.

Unifacial/bifacial

The number of bifacial tools increases from KGA6-A2 to KGA4-A2. While 30 LCTs/HDTs (41.7%) are still unifacially produced, 16 tools (22.2%) are partly bifacial and 19 tools (26.4%) are fully bifacial. Seven pieces (9.7%) take a quadrilateral form.

Dimension

The dimension of the total LCTs/HDTs at KGA4-A2 is summarized as follows:

Max. 255 × 130 × 100 mm,

Min.	89 × 40 × 25 mm,
Mean	166.1 × 92.5 × 52.3 mm,
SD	35.4 × 17.7 × 15.8 mm.

The different groups of the LCTs/HDTs show the following dimensions:

Handaxes (excluding broken handaxes);

Max.	211 × 116 × 78 mm,
Min.	89 × 64 × 27 mm,
Mean	153.6 × 92.4 × 46.8 mm,
SD	30.3 × 15.3 × 13.1 mm,

Cleavers;

Max.	203 × 118 × 100 mm,
Min.	133 × 78 × 30 mm,
Mean	163.5 × 96.5 × 52.9 mm,
SD	24.3 × 12.6 × 17.0 mm,

Picks;

Max.	255 × 125 × 90 mm,
Min.	116 × 40 × 31 mm,
Mean	180.2 × 87.4 × 59.5 mm,
SD	41.6 × 20.8 × 16.6 mm.

Cross-section

The KGA4-A2 LCTs/HDTs show a variety of cross-sections and do not exhibit a specific tendency. A total of 16 tools (22.2%) have a trapezoidal cross-section. The cross-sections of 14 pieces (19.4%) are parallelogram, another 14 pieces (19.4%) triangular, and 13 pieces (18.1%) plano-convex. A biconical cross-section was observed on six tools (8.3%), double convex on five tools (6.9%), and lenticular on four pieces (5.6%).

Sinuosity

A large number of the LCTs/HDTs exhibit wavy edges. Out of 72 LCTs/HDTs, 35 specimens (48.6%) exhibit wavy edges, 21 pieces (29.2%) are sinuous, and 16 items (22.2%) are straight.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 110°, Min. = 40°, Mean = 64.4°, and SD = 12.4°.

The different groups of the LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 75°, Min. = 40°, Mean = 60.8°, and SD = 11.3°,

Cleavers;

Max. = 80°, Min. = 45°, Mean = 62.5°, and SD = 10.0°,

Picks;

Max. = 110°, Min. = 54°, Mean = 72.5°, and SD = 11.7°.

Biface butt plan

Out of the 68 analyzed tools, 23 artifacts (33.8%) exhibit a V-shaped butt, 20 pieces (29.4%) a U-shaped butt, and 11 items (16.2%) a straight butt. Nine specimens (13.2%) have a cortical butt, three biface butts (4.4%) are modified into tool, and two items (2.9%) show an irregular biface butt.

Invasiveness

As with the KGA6-A1 assemblage, the LCTs/HDTs at KGA4-A2 are modified by large flake scars which invasively cover their surfaces. Most of the LCTs/HDTs bear invasive flaking (n=49, 68.1%), 13 tools (18.1%) show semi-invasive flaking, and 10 pieces (13.9%) are modified by marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 34, Min. = 3, Mean = 12.7, and SD = 6.8.

The different groups of the LCTs/HDTs show the following flake scar counts:

Handaxes (excluding broken handaxes);

Max. = 34, Min. = 3, Mean = 11.9, and SD = 7.4,

Cleavers;

Max. = 18, Min. = 6, Mean = 10.4, and SD = 4.1,

Picks;

Max. = 33, Min. = 7, Mean = 16.5, and SD = 6.3.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 122 mm, Min. = 21 mm, Mean = 55.3 mm, and SD = 17.5 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 81 mm, Min. = 30 mm, Mean = 52.4 mm, and SD = 14.5 mm,

Cleavers;

Max. = 95 mm, Min. = 32 mm, Mean = 57.8 mm, and SD = 19.1 mm,

Picks;

Max. = 91 mm, Min. = 21 mm, Mean = 53.3 mm, and SD = 15.5 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the 12 analyzed cleavers, five pieces (41.7%) exhibit a convex edge plan, four pieces (33.3%) show an oblique end, and three (25.0%) have a straight edge plan.

The cleavers of KGA4-A2 show the following cleaver bit angle values:

Max. = 58°, Min. = 32°, Mean = 43.2°, and SD = 9.8°.

The cleaver bit dimension is summarized as:

Max. = 112 mm, Min. = 42 mm, Mean = 65.8 mm, and SD = 23.9 mm.

KGA10-A11 (Plates 15–21)

Overview

General presentation of artifacts

A total of 175 lithic artifacts were collected at KGA10-A11, including 54 LCTs/HDTs (30.9%), 61 flakes (34.9%), 21 chunks (12.0%), seven retouched/modified angular fragments (4.0%), two polyhedrons (1.1%), five core/choppers (2.9%), eight cores (4.6%), three split cobbles (1.7%), and 14 cobbles (8.0%).

General presentation of raw materials

As KGA10-A11 is located close to the quartz outcrops, a considerable number of quartz artifacts were recovered. Although the most frequent raw material is basalt (n=83, 49.7%), almost the same number of quartz tools were collected (n=72, 43.1%). The other lithics comprise seven ignimbrite specimens (4.2%), four on siliceous rocks (2.4%), and one on quartzite (0.6%).

General presentation of physical conditions

A large number of the lithics (n=88, 51.2%) exhibit a fresh condition, since all the quartz pieces retain the fresh condition. Out of the 172 analyzed specimens, 57 pieces (33.1%) are moderately weathered, 23 pieces (13.4%) are completely weathered, and four pieces (2.3%) are patinated.

Large Cutting Tools & Heavy Duty Tools

Typology

A total of 54 LCTs/HDTs were recovered from KGA10-A11, comprising 17 handaxes (31.5%), seven cleavers (13.0%), 13 picks (24.1%), one knife (1.9%), three large scrapers (5.6%), four core axes (7.4%), three part bifaces (5.6%), two modified pieces/blanks (3.7%), and four broken LCTs/HDTs (7.4%).

Raw material

Although numerous flakes, chunks and cores are made on quartz, only eight LCTs/HDTs (14.8%) are made on quartz, while the majority of the LCTs/HDTs (n=40, 74.1%) are made on basalt. This suggests that quartz tool production was undertaken at KGA10-A11. Besides basalt and quartz tools, five ignimbrite (9.3%) and one quartzite (1.9%) artifacts were collected.

Physical condition

More than half of the LCTs/HDTs (n=30, 55.6%) are moderately weathered and eight tools (14.8%) are weathered. Sixteen LCTs/HDTs (29.6%) show a fresh appearance.

Presence of cortex

Out of the 48 analyzed LCTs/HDTs, 22 items (45.8%) retain no cortex, 13 tools (27.1%) show "small amount" (<25% of the surface) of cortex, six specimens (12.5%) exhibit "modest amount" (25–50% of the surface) of cortex, four artifacts (8.3%) have "much" cortex (>50% of the surface), and three pieces (6.3%) are indeterminate owing to weathering.

Primary form

A total of 27 tools (56.3%) are made on flake, six pieces (12.5%) are made on cobble, and one tool (2.1%) is made on block. Fourteen specimens (29.2%) are indeterminate due to either invasive retouch or weathering.

Flake type

Out of the 30 analyzed LCTs/HDTs made on flake, 11 tools (36.7%) are made on a side struck flake, and 10 (33.3%) are made on an end struck flake. One piece (3.3%) exhibits a positive surface on the dorsal side too, which may suggest removal by the Kombewa method. The remaining eight pieces (26.7%) are indeterminate owing to flaking on the ventral surface.

Unifacial/bifacial

While a significant number of LCTs/HDTs are either fully bifacial (n=13, 27.1%) or partly bifacial (n=18, 37.5%), considerable numbers of tools (n=16, 33.3%) are still unifacial. One pick (2.1%) is quadrilaterally worked.

Dimension

The dimension of the total LCTs/HDTs at KGA10-A11 is summarized as follows:

Max.	304 × 143 × 91 mm,
Min.	81 × 54 × 16 mm,
Mean	164.7 × 100.2 × 54.2 mm,
SD	41.3 × 19.4 × 15.4 mm.

The different groups of the LCTs/HDTs show the following dimensions:

<u>Handaxes (excluding broken handaxes);</u>

Max.	267 × 135 × 75 mm,
Min.	114 × 70 × 30 mm,
Mean	169.3 × 104.7 × 52.6 mm,
SD	45.8 × 18.5 × 12.3 mm,

<u>Cleavers;</u>

Max. 304 × 143 × 91 mm,
Min. 132 × 96 × 24 mm,
Mean 185.1 × 114.9 × 47.6 mm,
SD 58.5 × 15.9 × 23.5 mm,

Picks;

Max. 184 × 120 × 80 mm,
Min. 85 × 54 × 37 mm,
Mean 149.1 × 91.6 × 61.7 mm,
SD 31.8 × 16.9 × 12.4 mm.

Cross-section

The most frequent cross-section type at KGA10-A11 is trapezoidal (n=15, 31.9%) and then parallelogram (n=10, 21.3%). Six LCTs/HDTs (12.8%) have a double convex cross-section. The cross-sections of five pieces (10.6%) are plano-convex, five pieces (10.6%) lenticular, five pieces (10.6%) triangular, and one piece (2.1%) irregular.

Sinuosity

Out of 48 analyzed LCTs/HDTs, 20 tools (41.7%) show wavy edges, 21 pieces (43.8%) show sinuous edges. The remaining seven artifacts (14.6%) exhibit straight edges.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 92°, Min. = 31°, Mean = 61.6°, and SD = 13.0°.

The different groups of the LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 75°, Min. = 42°, Mean = 59.7°, and SD = 8.7°,

Cleavers;

Max. = 75°, Min. = 31°, Mean = 55.6°, and SD = 15.7°,

Picks;

Max. = 92°, Min. = 57°, Mean = 73.3°, and SD = 10.4°.

Biface butt plan

Out of the 46 analyzed tools, 17 artifacts (37.0%) exhibit a V-shaped butt, 11 pieces (23.9%) a cortical butt, eight items (17.4%) a U-shaped butt, and five specimens (10.9%) a straight butt. Four biface butts (8.7%) are modified into tool, and one item (2.2%) shows an irregular biface butt.

Invasiveness

The surfaces of the most of the LCTs/HDTs are covered by invasive flaking (n=39, 83.0%). Eight tools (17.0%) show semi-invasive flaking and no pieces bear marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 27, Min. = 4, Mean = 11.3, and SD = 4.8.

The different groups of the LCTs/HDTs show the following flake scar count:

Handaxes (excluding broken handaxes);

Max. = 27, Min. = 4, Mean = 10.8, and SD = 5.6,

Cleavers;

Max. = 12, Min. = 7, Mean = 9.3, and SD = 2.0,

Picks;

Max. = 20, Min. = 7, Mean = 13.3, and SD = 4.0.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 104 mm, Min. = 18 mm, Mean = 57.0 mm, and SD = 17.8 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 86 mm, Min. = 38 mm, Mean = 54.5 mm, and SD = 14.5 mm,

Cleavers;

Max. = 92 mm, Min. = 33 mm, Mean = 63.9 mm, and SD = 22.1 mm,

Picks;

Max. = 104 mm, Min. = 28 mm, Mean = 56.1 mm, and SD = 18.4 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the seven analyzed cleavers, three pieces (42.9%) exhibit an oblique end edge plan, two pieces (28.6%) show a straight edge plan, one (14.3%) a convex, and another one (14.3%) an oblique side edge plan.

The cleavers of KGA10-A11 show the following cleaver bit angle values:

Max. = 50°, Min. = 25°, Mean = 38.0°, and SD = 9.5°.

The cleaver bit dimension is summarized as:

Max. = 125 mm, Min. = 52 mm, Mean = 83.4 mm, and SD = 23.6 mm.

KGA10-A6 (Plates 22–23)

A selective surface collection (all LCTs and HDTs) was undertaken at KGA10-A6 and a total of 20 LCTs/HDTs were recovered.

Large Cutting Tools & Heavy Duty Tools

Typology

The collected LCTs/HDTs consist of two handaxes (10.0%), 14 picks (70.0%), one core axe (5.0%), two part bifaces (10.0%), and one modified piece/blank (5.0%). No cleaver was found at this site. Picks and pointed handaxes are frequent at this site.

Raw material

KGA10-A6 is located adjacent to a small quartz outcrop. Therefore, the proportion of the quartz artifacts (n=9, 45.0%) is much higher than that at the other sites. Nevertheless, the most common raw material used is basalt (n=11, 55.0%), probably reflecting their preference of raw material selection.

Physical condition

While all the quartz artifacts show a fresh appearance (n=9, 45.0%), almost all the basalt pieces are weathered (n=10, 50.0%), except one moderately weathered specimen (5.0%).

Presence of cortex

Most of the tools more or less retain cortex, as the quartz artifacts were produced at the outcrops. Ten tools (58.8%) exhibit “small amount” (<25% of the surface) of cortex, and three artifacts (17.6%) have “modest amount” (25–50% of the surface) of cortex. The cortex of the remaining four tools (23.5%) was completely removed.

Primary form

Out of the 17 analyzed LCTs/HDTs, six tools (35.3%) are made on flake, four (23.5%) are on cobble, another four (23.5%) are on block, and three (17.6%) are indeterminate.

Flake type

Out of the four analyzed LCTs/HDTs on flake, three pieces (75.0%) are made on an end struck flake and one (25.0%) is made on a side struck flake.

Unifacial/bifacial

Interestingly, no unifacial tools were recovered at KGA10-A6. The two handaxes and six picks are fully bifacial (n=8, 47.1%). Four picks (23.5%) are thrihedrally made, and four picks and one core axe (n=5, 29.4%) are quadrilateral.

Dimension

The dimension of the total LCTs/HDTs at KGA10-A6 is summarized as follows:

Max.	209 × 93 × 95 mm,
Min.	88 × 53 × 138 mm,
Mean	156.8 × 68.8 × 58.9 mm,
SD	33.2 × 12.8 × 14.4 mm.

The different groups of the LCTs/HDTs show the following dimensions:

Handaxes (excluding broken handaxes);

Max.	183 × 83 × 53 mm,
Min.	110 × 71 × 43 mm,
Mean	146.5 × 77.0 × 48.0 mm,
SD	51.6 × 8.5 × 7.1 mm,

Picks;

Max.	209 × 93 × 95 mm,
Min.	88 × 53 × 38 mm,
Mean	163.6 × 67.7 × 59.2 mm,
SD	31.4 × 13.5 × 13.6 mm.

Cross-section

As the majority of the recovered LCTs/HDTs at KGA10-A6 are picks, the most frequent cross-section type is parallelogram (n=6, 35.3%). Biconical and trapezoidal cross-sections are also observed on four LCTs/HDTs (23.5%) each. The remaining three tools comprise one plano-convex (5.9%), one triangular (5.9%), and one irregular (5.9%) cross-sections.

Sinuosity

All the analyzed LCTs/HDTs exhibit sinuous edges. There are no LCTs/HDTs with straight edges, probably because no pieces are unifacially produced and almost half of the tools are made on quartz.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as the follows:

Max. = 95°, Min. = 70°, Mean = 82.5°, and SD = 8.2°.

The different groups of LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 72°, Min. = 70°, Mean = 71.0°, and SD = 1.4°,

Picks;

Max. = 95°, Min. = 71°, Mean = 84.1°, and SD = 7.7°.

Biface butt plan

Out of the 19 analyzed tools, seven artifacts (36.8%) exhibit a V-shaped butt and four pieces (21.1%) a straight butt. U-shaped, irregular, and square butts are represented by two tools (10.5%) each.

Invasiveness

Most of the KGA10-A6 artifacts are invasively retouched. A total of 15 tools (88.2%) show invasive flake scars, one (5.9%) exhibits semi-invasive flaking, and another (5.9%) has marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 26, Min. = 7, Mean = 15.9, and SD = 4.5.

The different groups of the LCTs/HDTs show the following flake scar count:

Handaxes (excluding broken handaxes);

Max. = 15, Min. = 14, Mean = 14.5, and SD = 0.7,

Picks;

Max. = 26, Min. = 7, Mean = 16.2, and SD = 4.9.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 88 mm, Min. = 32 mm, Mean = 49.4 mm, and SD = 13.6 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 55 mm, Min. = 34 mm, Mean = 44.5 mm, and SD = 14.9 mm,

Picks;

Max. = 88 mm, Min. = 32 mm, Mean = 49.9 mm, and SD = 14.4mm.

KGA7-A1 and A3 (Plates 24–28)

Overview

General presentation of artifacts

At KGA7-A1, a selective surface collection was undertaken and a total of 19 LCTs/HDTs were recovered. On the other hand, all lithic artifacts found at KGA7-A3 were recovered, and this resulted in a collection of 108 lithics. Thus, a total of 171 lithic specimens were collected at KGA7-A1 and A3, comprising 63 LCTs/HDTs (36.8%), 65 flakes (38.0%), 10 core/choppers (5.8%), 27 cores (15.8%), and six cobbles (3.5%).

General presentation of raw materials

The lithic raw material component at KGA7-A1 and A3 comprises 112 tools on basalt (65.9%), 45 on quartz (26.5%), 10 on quartzite (5.9%), and one each on metamorphic rock (0.6%), rhyolite (0.6%), and siliceous rock (0.6%).

General presentation of physical conditions

A total of 72 pieces (43.1%) show a moderately weathered appearance, 47 specimens (28.1%) show fresh condition, and 34 pieces (20.4%) are fully weathered. Thirteen specimens (7.8%) are patinated and one piece (0.6%) is eolised.

Large Cutting Tools & Heavy Duty Tools

Typology

A total of 63 LCTs/HDTs were recovered from KGA7-A1 and A3, including 15 handaxes (23.8%), four cleavers (6.3%), 33 picks (52.4%), one core axe (1.6%), four part bifaces (6.3%), three modified pieces/blanks (4.8%), and three broken LCTs/HDTs (4.8%).

Raw material

Despite the significant number of quartz flakes and cores, only two LCTs/HDTs (3.2%) are made on quartz. Most of the LCTs/HDTs (n=59, 93.7%) are made on basalt. One metamorphic rock (1.6%) and one rhyolite (1.6%) material are also used for LCTs/HDTs.

Physical condition

More than half of the LCTs/HDTs (n=37, 58.7%) are moderately weathered and 19 tools (30.2%) are weathered. Only six pieces (9.5%) show a fresh condition and one specimen (1.6%) is eolised.

Presence of cortex

Out of the 59 analyzed LCTs/HDTs, 19 items (32.2%) retain no cortex, 19 tools (32.2%) show "small amount" (<25% of the surface) of cortex, five specimens (8.5%) exhibit "modest amount" (25–50% of the surface) of cortex, seven artifacts (11.9%) have "much" cortex (>50% of the surface), and nine pieces (15.3%) are indeterminate owing to weathering.

Primary form

Unlike the other KGA sites, the largest number of LCTs/HDTs are made on cobble (n=29, 49.2%). Fourteen tools (23.7%) are made on flake and 16 specimens (27.1%) are indeterminate due to either invasive flaking or weathering.

Flake type

Out of the 13 analyzed LCTs/HDTs made on flake, six tools (46.2%) are made on an end struck flake, and one (7.7%) is made on a side struck flake. Six pieces (46.2%) are indeterminate owing to flaking on the ventral surface.

Unifacial/bifacial

Most of the LCTs/HDTs (n=38, 64.4%) at KGA7-A1 and A3 are fully bifacial and nine tools (15.3%) are partly bifacial. Only three specimens (5.1%) are unifacial, five tools (8.5%) are trihedral, and four items (6.8%) are quadrilateral.

Dimension

The dimension of the total LCTs/HDTs at KGA7-A1 and A3 is summarized as follows:

Max.	270 × 130 × 86 mm,
Min.	70 × 47 × 23 mm,
Mean	132.4 × 78.6 × 52.2 mm,
SD	34.3 × 17.8 × 15.2 mm.

The different groups of the LCTs/HDTs show the following dimensions:

<u>Handaxes (excluding broken handaxes);</u>

Max.	168 × 108 × 70 mm,
Min.	80 × 50 × 23 mm,
Mean	130.5 × 79.7 × 44.3 mm,
SD	24.6 × 18.3 × 13.6 mm,

<u>Cleavers;</u>

Max.	188 × 104 × 68 mm,
Min.	137 × 78 × 45 mm,
Mean	154.8 × 90.0 × 57.5 mm,
SD 2	2.7 × 12.1 × 10.8 mm,

<u>Picks;</u>

Max.	270 × 113 × 86 mm,
Min.	84 × 50 × 26 mm,
Mean	136.7 × 78.1 × 57.4 mm,
SD	37.7 × 16.1 × 13.4 mm.

Cross-section

The LCTs/HDTs at the KGA7-A1 and A3 show a variety of cross-section types. A total of 13 tools (22.0%) exhibit a biconical cross-section. The cross-sections of 12 pieces (20.3%) are trapezoidal, 10 specimens (16.9%) triangular, nine pieces (15.3%) plano-convex, seven artifacts (11.9%) double convex, five tools (8.5%) parallelogram, two tools (3.4%) lenticular, and one (1.7%) irregular.

Sinuosity

Out of the 57 analyzed LCTs/HDTs, 17 tools (29.8%) show wavy edges, 34 pieces (59.6%) show sinuous edges, and six artifacts (10.5%) exhibit straight edges.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 100°, Min. = 43°, Mean = 75.3°, and SD = 13.8°.

The different groups of the LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 93°, Min. = 43°, Mean = 67.1°, and SD = 12.9°,

Cleavers;

Max. = 70°, Min. = 48°, Mean = 63.0°, and SD = 10.4°,

Picks;

Max. = 100°, Min. = 55°, Mean = 81.6°, and SD = 11.4°.

Biface butt plan

Out of the 59 analyzed tools, 20 artifacts (33.9%) exhibit a cortical butt, 18 pieces (30.5%) a U-shaped butt, 11 items (18.6%) a V-shaped butt, six tools (10.2%) a straight butt, and two specimens (3.4%) an irregular butt. One biface butt (1.7%) is modified into tool and one biface butt (1.7%) is indeterminate.

Invasiveness

Most of the LCTs/HDTs exhibit invasive flaking (n=48, 81.4%). Seven tools (11.9%) show semi-invasive flaking and four pieces (6.8%) exhibit marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 37, Min. = 6, Mean = 17.3, and SD = 6.7.

The different groups of the LCTs/HDTs show the following flake scar count:

Handaxes (excluding broken handaxes);

Max. = 30, Min. = 9, Mean = 19.0, and SD = 5.7,

Cleavers;

Max. = 28, Min. = 9, Mean = 18.3, and SD = 7.9,

Picks;

Max. = 37, Min. = 8, Mean = 17.6, and SD = 7.1.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 77 mm, Min. = 20 mm, Mean = 44.2 mm, and SD = 11.7 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 61 mm, Min. = 25 mm, Mean = 42.5 mm, and SD = 10.2 mm,

Cleavers;

Max. = 64 mm, Min. = 40 mm, Mean = 47.3 mm, and SD = 11.4 mm,

Picks;

Max. = 77 mm, Min. = 20 mm, Mean = 45.9 mm, and SD = 12.4 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the four analyzed cleavers, three pieces (75.0%) have an oblique end edge plan and one piece (25.0%) shows a convex edge plan.

The cleavers of KGA7-A1 and A3 show the following cleaver bit angle values:

Max. = 50°, Min. = 25°, Mean = 35.8°, and SD = 10.5°.

The cleaver bit dimension is summarized as:

Max. = 93 mm, Min. = 28 mm, Mean = 52.3 mm, and SD = 35.4 mm.

KGA7-A2 (Plates 29–32)

A controlled surface collection was undertaken at KGA7-A2 and a total of 17 artifacts were recovered.

Large Cutting Tools & Heavy Duty Tools

Typology

The collected LCTs/HDTs consist of four handaxes (23.5%), eight cleavers (47.1%), one knife (5.9%), one modified piece/blank (5.9%), and three broken LCTs/HDTs (17.6%). No picks were found at this site.

Raw material

In contrast to the other KGA sites, the most common raw material used at KGA7-A2 is quartzite (n=12, 70.6%). Three LCTs/HDTs (17.6%) are made on basalt and two are made on quartz (11.8%).

Physical condition

As quartzite and quartz weather much slower than basalt, all the quartzite and quartz tools (n=14, 82.4%) show a fresh appearance. One basalt item (5.9%) is moderately weathered and two basalt artifacts (11.8%) are fully weathered.

Presence of cortex

Out of the 13 analyzed LCTs/HDTs, most of the LCTs/HDTs (n=11, 84.6%) retain no cortex. One tool (7.7%) has "small amount" (<25% of the surface) of cortex, and the remaining artifact (7.7%) shows "modest amount" (25–50% of the surface) of cortex.

Primary form

Except for one indeterminate piece (7.7%), all the analyzed LCTs/HDTs (n=12, 92.3%) at KGA7-A2 are made on flake.

Flake type

Out of the 12 analyzed LCTs/HDTs on flake, five pieces (41.7%) are made on a Kombewa flake and four of them are modified into cleavers. Four pieces (33.3%) are made on an end struck flake, two (16.7%) are made on a side struck flake, and one (8.3%) is indeterminate.

Unifacial/bifacial

Out of the 12 analyzed LCTs/HDTs, seven tools are unifacial (58.3%), one piece is partly bifacial (8.3%), and four artifacts (33.3%) are fully bifacial.

Dimension

The dimension of the total LCTs/HDTs at KGA7-A2 is summarized as follows:

Max.	218 × 129 × 70 mm,
Min.	66 × 58 × 25 mm,
Mean	149.2 × 95.7 × 46.5 mm,
SD	44.1 × 19.8 × 12.4 mm.

The different groups of the LCTs/HDTs show the following dimensions:

<u>Handaxes (excluding broken handaxes);</u>

Max.	198 × 117 × 60 mm,
Min.	141 × 74 × 38 mm,
Mean	172.5 × 97.3 × 50.3 mm,
SD	23.6 × 18.0 × 11.0 mm,

<u>Cleavers;</u>

Max.	218 × 129 × 63 mm,
Min.	116 × 58 × 37 mm,
Mean	161.9 × 100.1 × 46.6 mm,
SD	41.6 × 24.9 × 10.1 mm.

Cross-section

A large number of the LCTs/HDTs (n=6, 46.2%) show a triangular cross-section. The lenticular, parallelogram, and trapezoidal cross-sections are observed on two tools (15.4%) each. The remaining piece (7.7%) exhibits a double convex cross-section.

Sinuosity

Most of the LCTs/HDTs (n=10, 76.9%) show a straight edge, probably because they were unifacially worked. Two tools (15.4%) have a sinuous edge, and one piece (7.7%) exhibits a wavy edge.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 68°, Min. = 34°, Mean = 49.5°, and SD = 9.7°.

The different groups of the LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 68°, Min. = 41°, Mean = 53.3°, and SD = 12.9°,

Cleavers;

Max. = 60°, Min. = 34°, Mean = 48.1°, and SD = 8.7°.

Biface butt plan

Six artifacts (46.2%) exhibit a V-shaped butt, five pieces (38.5%) show a straight butt, and two items (15.4%) have a U-shaped butt.

Invasiveness

Nine LCTs/HDTs (69.2%) have invasive flake scars, one piece (7.7%) shows semi-invasive flaking, and three artifacts (23.1%) exhibit marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 22, Min. = 3, Mean = 9.9, and SD = 5.2.

The different groups of the LCTs/HDTs show the following flake scar count:

Handaxes (excluding broken handaxes);

Max. = 22, Min. = 12, Mean = 14.8, and SD = 4.9,

Cleavers;

Max. = 14, Min. = 3, Mean = 8.1, and SD = 3.9.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 74 mm, Min. = 37 mm, Mean = 52.3 mm, and SD = 11.6 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 61 mm, Min. = 42 mm, Mean = 51.5 mm, and SD = 9.4 mm,

Cleavers;

Max. = 74 mm, Min. = 37 mm, Mean = 52.8 mm, and SD = 13.1 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the eight analyzed cleavers, six pieces (75.0%) exhibit an oblique edge plan and two pieces (25.0%) have a straight edge plan.

The cleavers of KGA7-A2 show the following cleaver bit angle values:
Max. = 50°, Min. = 38°, Mean = 44.9°, and SD = 4.8°.
The cleaver bit dimension is summarized as:
Max. = 108 mm, Min. = 41 mm, Mean = 73.5 mm, and SD = 24.8 mm.

KGA8-A1 (Plates 33–42)

Overview

General presentation of artifacts

A total of 354 lithic artifacts were collected at KGA8-A1, comprising 201 LCTs/HDTs (56.8%), 31 flakes (8.8%), 50 chunks (14.1%), two retouched/modified angular fragments (0.6%), 11 polyhedrons (3.1%), 12 core/choppers (3.4%), 29 cores (8.2%), one split cobble (0.3%), 11 cobbles (3.1%), and six unidentified weathered pieces (1.7%).

General presentation of raw materials

Next to the basalt pieces, a substantial number of quartzite artifacts were collected at KGA8-A1. Out of the 354 pieces, 222 (62.7%) are on basalt, 64 pieces (18.1%) are on quartzite, and 58 (16.4%) are on quartz. In addition to these main raw materials, eight specimens on metamorphic rock (2.3%), one on rhyolite (0.3%), and one on siliceous rock (0.3%) were recovered.

General presentation of physical conditions

Almost half of the pieces (n=189, 53.4%) are weathered, 69 pieces (19.5%) are moderately weathered, and 93 pieces (26.3%) show a fresh surface. One lithic (0.3%) is eolised and two specimens (0.6%) are patinated.

Large Cutting Tools & Heavy Duty Tools

Typology

The collected 201 LCTs/HDTs at KGA8-A1 comprise 64 handaxes (31.8%), 48 cleavers (23.9%), 14 picks (7.0%), four knives (2.0%), 18 large scrapers (9.0%), one core axe (0.5%), 19 part bifaces (9.5%), 14 modified pieces/blanks (7.0%), and 19 broken LCTs/HDTs (9.5%).

Raw material

Out of the 201 LCTs/HDTs, 133 artifacts (66.2%) are made on basalt, 51 tools (25.4%) on quartzite, and 15 items (7.5%) on quartz. Besides, one LCT/HDT (0.5%) is made on rhyolite and another tool (0.5%) is made on siliceous rock.

Physical condition

Although more than half of the LCTs/HDTs are weathered (n=91, 45.3%) or moderately weathered (n=42, 20.9%), a large quantity of tools (n=68, 33.8%) show a fresh condition and most of them are made on either quartzite or quartz.

Presence of cortex

A total of 68 LCTs/HDTs (52.7%) show no cortex, whereas almost half of the tools retain some cortex: 42 pieces (32.6%) have "small amount" (<25% of the surface) of cortex, 12 pieces (9.3%) exhibit "modest amount" (25–50% of the surface) of cortex, and five artifacts (3.9%) have "much" cortex (>50% of the surface). Two pieces (1.6%) are indeterminate owing to weathering.

Primary form

Out of the 130 analyzed LCTs/HDTs, the majority of the tools (n=101, 77.7%) at KGA8-A1 are made on flake. Seven specimens (5.4%) are made on cobble and one piece (0.8%) is made on block. A total of 21 tools (16.2%) are indeterminate due to either invasive flaking or weathering.

Flake type

Out of the 101 analyzed LCTs/HDTs made on flake, 41 tools (40.6%) are made on an end struck flake, and 30 (29.7%) are made on a side struck flake. Two tools (2.0%), one cleaver and one large scraper, are made on a Kombewa flake. A total of 28 pieces (27.7%) are indeterminate owing to flaking on the ventral surface.

Unifacial/bifacial

Out of the 129 analyzed LCTs/HDTs, 52 tools (40.3%) are unifacially made, 22 items (17.1%) are partly bifacial, and 47 artifacts (36.4%) are fully bifacial. Eight picks (6.2%) are quadrilaterally worked.

Dimension

The dimension of the total LCTs/HDTs at KGA8-A1 is summarized as follows:

Max. 280 × 164 × 101 mm,
Min. 88 × 48 × 20 mm,
Mean 160.2 × 97.4 × 48.5 mm,
SD 33.8 × 18.1 × 13.4 mm.

The different groups of the LCTs/HDTs show the following dimensions:

Handaxes (excluding broken handaxes);

Max. 280 × 164 × 101 mm,
Min. 88 × 48 × 23 mm,
Mean 168.0 × 98.5 × 51.9 mm,
SD 38.2 × 19.4 × 13.6 mm,

Cleavers;

Max. 260 × 148 × 80 mm,
Min. 102 × 68 × 27 mm,
Mean 167.5 × 104.5 × 48.4 mm,
SD 28.2 × 15.6 × 11.2 mm,

Picks;

Max. 243 × 123 × 91 mm,
Min. 103 × 56 × 23 mm,
Mean 167.1 × 88.0 × 58.1 mm,
SD 36.1 × 19.2 × 18.8 mm.

Cross-section

The KGA8-A1 LCTs/HDTs show a variety of cross-section types. Thirty-six pieces (27.9%) show a trapezoidal cross-section. The cross-sections of 30 pieces (23.3%) are biconical, 22 pieces (17.1%) triangular, 17 pieces (13.2%) parallelogram, 10 pieces (7.8%) double convex, 10 pieces (7.8%) plano-convex, three pieces (2.3%) irregular, and one piece (0.8%) lenticular.

Sinuosity

While more than half of the LCTs/HDTs (n=68, 52.7%) show straight edges, only six tools (4.7%) exhibit a wavy edge. A total of 55 pieces (42.6%) show sinuous edge.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 105°, Min. = 35°, Mean = 64.4°, and SD = 14.1°.

The different groups of the LCTs/HDTs show the following edge angle values:

<u>Handaxes (excluding broken handaxes);</u>

Max. = 100°, Min. = 40°, Mean = 66.0°, and SD = 13.7°,

<u>Cleavers;</u>

Max. = 78°, Min. = 35°, Mean = 58.0°, and SD = 10.7°,

<u>Picks;</u>

Max. = 105°, Min. = 60°, Mean = 81.1°, and SD = 10.7°.

Biface butt plan

Out of the 127 analyzed tools, 42 artifacts (33.1%) exhibit a U-shaped butt, 37 pieces (29.1%) a V-shaped butt, 13 pieces (10.2%) an irregular butt, nine pieces (7.1%) a straight butt, and eight pieces (6.3%) are modified into tool. The remaining are six pieces (4.7%) each of cortex, square, and indeterminate butts.

Invasiveness

The surfaces of most of the LCTs/HDTs (n=106, 83.5%) are invasively covered by flake scars. Thirteen tools (10.2%) show semi-invasive flaking and eight pieces (6.3%) exhibit marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 30, Min. = 2, Mean = 12.0, and SD = 5.4.

The different groups of the LCTs/HDTs show the following flake scar count:

Handaxes (excluding broken handaxes);

Max. = 30, Min. = 5, Mean = 13.7, and SD = 5.4,

Cleavers;

Max. = 18, Min. = 2, Mean = 8.8, and SD = 4.2,

Picks;

Max. = 23, Min. = 10, Mean = 14.5, and SD = 4.4.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 108 mm, Min. = 5 mm, Mean = 51.4 mm, and SD = 16.3 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 108 mm, Min. = 20 mm, Mean = 49.3 mm, and SD = 15.2 mm,

Cleavers;

Max. = 99 mm, Min. = 5 mm, Mean = 56.0 mm, and SD = 18.1 mm,

Picks;

Max. = 71 mm, Min. = 28 mm, Mean = 46.8 mm, and SD = 12.0 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the 48 analyzed cleavers, 32 pieces (66.7%) are oblique end, seven pieces (14.6%) are straight, another seven pieces (14.6%) exhibit convex, one piece (2.1%) is concave, and another piece (2.1%) is irregular.

The cleavers of KGA8-A1 show the following cleaver bit angle values:

Max. = 65°, Min. = 28°, Mean = 44.2°, and SD = 7.9°.

The cleaver bit dimension is summarized as:

Max. = 110 mm, Min. = 30 mm, Mean = 67.1 mm, and SD = 17.9 mm.

KGA12-A1 (Plates 43–55)

Overview

General presentation of artifacts

A total of 744 lithic artifacts were collected at KGA12-A1, including 137 LCTs/HDTs (18.4%), 165 flakes (22.2%), 119 chunks (16.0%), three polyhedrons (0.4%), nine core/choppers (1.2%), 38 cores (5.1%), two split cobbles (0.3%), 26 cobbles (3.5%), and 245 unidentified weathered pieces (32.9%).

General presentation of raw materials

The lithic raw material at KGA12-A1 is mostly basalt (n=560, 75.5%), quartzite (n=73, 9.8%), and quartz (n=61, 8.2%). Eleven artifacts are on metamorphic rocks (1.5%), another 11 on ignimbrites (1.5%), 23 on rhyolites (3.1%), two on siliceous rocks (0.3%), and one piece is indeterminate (0.1%).

General presentation of physical conditions

Most of the lithics recovered from KGA12-A1 are either weathered (n=359, 48.3%) or moderately weathered (n=224, 30.1%). Only a limited number of lithics exhibit a fresh surface (n=126, 16.9%), mostly on quartzite or quartz. One piece (0.1%) is eolised and 34 pieces (4.6%) show patina.

Large Cutting Tools & Heavy Duty Tools

Typology

A total of 137 LCTs/HDTs were recovered from KGA12-A1, comprising 38 handaxes (27.7%), 31 cleavers (22.6%), 25 picks (18.2%), 11 knives (8.0%), two large scrapers (1.5%), six core axes (4.4%), seven part bifaces (5.1%), four modified pieces/blanks, (2.9%), and 13 broken LCTs/HDTs (9.5%).

Raw material

As for the general raw material component, most of the LCTs/HDTs are made on basalt (n=88, 64.2%). Succeeding the basalt artifacts, 24 tools (17.5%) are made on quartzite and 12 items (8.8%) are made on rhyolite, and eight pieces (5.8%) are made on ignimbrite. The remainder of the LCTs/HDTs are made on quartz (n=5, 3.6%).

Physical condition

A half of the LCTs/HDTs (n=68, 49.6%) are moderately weathered, and 18 tools (13.1%) are weathered, and 49 items (35.8%) show a fresh appearance.

Presence of cortex

Out of the 111 analyzed LCTs/HDTs, 54 items (48.6%) retain no cortex, 33 tools (29.7%) show "small amount" (<25% of the surface) of cortex, 14 specimens (12.6%) exhibit "modest amount" (25–50% of the surface) of cortex, seven artifacts (6.3%) have "much" cortex (>50% of the surface), and three pieces (2.7%) are indeterminate owing to weathering.

Primary form

Out of 108 analyzed LCTs/HDTs, 61 tools (56.5%) are made on flake, 15 pieces (13.9%) are made on cobble, and three tools (2.8%) are made on block. A total of 29 specimens (26.9%) are indeterminate due to either invasive flaking or weathering.

Flake type

Out of the 55 analyzed LCTs/HDTs made on flake, 24 tools (43.6%) are made on an end struck flake, and 27 (49.1%) are made on a side struck flake. One piece (1.8%) is probably made on a Kombewa flake, and the remaining three pieces (5.5%) are indeterminate owing to flaking on the ventral surface.

Unifacial/bifacial

The majority of the LCTs/HDTs are either fully bifacial (n=40, 36.0%) or partly bifacial (n=35, 31.5%). A total of 31 tools (27.9%) are unifacial and five picks (4.5%) take trihedral form.

Dimension

The dimension of the total LCTs/HDTs at KGA12-A1 is summarized as follows:

Max.	230 × 139 × 102 mm,
Min.	72 × 36 × 25 mm,
Mean	160.3 × 97.3 × 54.9 mm,
SD	30.4 × 17.7 × 16.2 mm.

The different groups of the LCTs/HDTs show the following dimensions:

Handaxes (excluding broken handaxes);

Max.	230 × 139 × 98 mm,
Min.	72 × 36 × 26 mm,
Mean	174.4 × 104.1 × 58.1 mm,
SD	31.3 × 18.3 × 16.3 mm,

Cleavers;

Max.	204 × 129 × 88 mm,
Min.	91 × 78 × 26 mm,
Mean	156.5 × 101.3 × 47.6 mm,
SD	27.5 × 13.3 × 13.4 mm,

Picks;

Max.	211 × 130 × 102 mm,
Min.	89 × 48 × 33 mm,
Mean	166.1 × 88.4 × 65.8 mm,
SD	28.1 × 16.6 × 15.8 mm.

Cross-section

The LCTs/HDTs from KGA12-A1 show a variety of cross-section types, comprising 20 plano-convex (18.3%), 19 (17.4%) biconical, 18 (16.5%) triangular, 17 (15.6%) double convex, 14 (12.8%) trapezoidal, 12 (11.0%) parallelogram, 8 (7.3%) lenticular, and one (0.9%) irregular.

Sinuosity

Out of the 112 analyzed LCTs/HDTs, considerable numbers of the LCTs/HDTs show straight edges (n=41, 36.6%). Forty tools (35.7%) show sinuous edges and 31 (27.7%) pieces exhibit wavy edges.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 96°, Min. = 25°, Mean = 63.6°, and SD = 13.6°.

The different groups of the LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 95°, Min. = 25°, Mean = 66.1°, and SD = 13.5°,

Cleavers;

Max. = 85°, Min. = 37°, Mean = 61.1°, and SD = 12.1°,

Picks;

Max. = 96°, Min. = 40°, Mean = 68.2°, and SD = 15.6°.

Biface butt plan

Out of the 107 analyzed tools, 37 artifacts (34.6%) exhibit a V-shaped butt, 21 pieces (19.6%) a U-shaped butt, 21 items (19.6%) a cortex butt, and 15 tools (14.0%) a straight butt. Four biface butts (3.7%) are modified into tool, and another four items (3.7%) show an irregular biface butt. Five pieces (4.7%) are indeterminate.

Invasiveness

The surfaces of the most of the LCTs/HDTs are covered by invasive flake scars (n=87, 79.1%). Out of the 110 analyzed LCTS/HDTS, 16 tools (14.5%) show semi-invasive flake scars and seven pieces (6.4%) bear marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 34, Min. = 2, Mean = 15.3, and SD = 7.1.

The different groups of the LCTs/HDTs show the following flake scar count:

<u>Handaxes (excluding broken handaxes);</u>

Max. = 34, Min. = 7, Mean = 19.0, and SD = 7.2,

<u>Cleavers;</u>

Max. = 20, Min. = 2, Mean = 10.4, and SD = 4.9,

<u>Picks;</u>

Max. = 32, Min. = 8, Mean = 16.6, and SD = 5.6.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 94 mm, Min. = 20 mm, Mean = 55.6 mm, and SD = 16.0 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

<u>Handaxes (excluding broken handaxes);</u>

Max. = 85 mm, Min. = 28 mm, Mean = 55.4 mm, and SD = 13.9 mm,

<u>Cleavers;</u>

Max. = 94 mm, Min. = 20 mm, Mean = 54.7 mm, and SD = 20.2 mm,

<u>Picks;</u>

Max. = 80 mm, Min. = 30 mm, Mean = 58.7 mm, and SD = 15.4 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the 30 analyzed cleavers, 17 pieces (56.7%) exhibit an oblique end edge plan, seven pieces (23.3%) have a convex, three (10.0%) a straight, and one (3.3%) an oblique side edge plan. The remaining two pieces (6.7%) show an irregular cleaver edge plan.

The cleavers of KGA12-A1 show the following cleaver bit angle values:

Max. = 93°, Min. = 25°, Mean = 44.4°, and SD = 12.3°.

The cleaver bit dimension is summarized as:

Max. = 101 mm, Min. = 28 mm, Mean = 61.8 mm, and SD = 18.2 mm.

KGA18-A1 (Plates 56–60)

A selective surface collection (100% collection of LCTs/HDTs) was undertaken at KGA18-A1a and b. A total of 58 LCTs/HDTs were found and collected.

Large Cutting Tools & Heavy Duty Tools

Typology

The collected 58 LCTs/HDTs at KGA18-A1 comprise 39 handaxes (67.2%), nine cleavers (15.5%), one knife (1.7%), four large scrapers (6.9%), two part bifaces (3.4%), one modified piece/blank (1.7%), and two broken LCTs/HDTs (3.4%).

Raw material

Except for one quartz tool (1.7%), all the LCTs/HDTs (n=57, 98.3%) are made on basalt.

Physical condition

Most of the LCTs/HDTs (n=46, 79.3%) from KGA18-A1 are fully weathered, because basalt weathers fast. Eleven pieces (19.0%) show moderately weathered surfaces and only one specimen (1.7%) exhibits a fresh condition.

Presence of cortex

Out of the 48 analyzed LCTs/HDTs, most of the tools (n=37, 77.1%) show no cortex. Seven items (14.6%) have "small amount" (<25% of the surface) of cortex, one piece (2.1%) exhibits "modest amount" (25–50% of the surface) of cortex, and another one (2.1%) has "much" cortex (>50% of the surface). Two pieces (4.2%) are indeterminate owing to weathering.

Primary form

All the LCTs/HDTs (n=37, 77.1%) which primary forms are determinable are made on flake. The remaining 11 items (22.9%) are indeterminate due to invasive flaking.

Flake type

Out of the 37 analyzed LCTs/HDTs made on flake, 13 tools (35.1%) are made on an end struck flake, and three (8.1%) are made on a side struck flake. More than half of the analyzed LCTs/HDTs (n=21, 56.8%) are indeterminate owing to flaking on the ventral surface.

Unifacial/bifacial

While the majority of the LCTs/HDTs are fully bifacial (n=35, 72.9%) or partly bifacial (n=11, 22.9%), only two pieces (4.2%) are unifacially made.

Dimension

The dimension of the total LCTs/HDTs at KGA18-A1 is summarized as follows:

Max.	243 × 117 × 53 mm,
Min.	82 × 43 × 18 mm,
Mean	155.8 × 85.7 × 38.2 mm,
SD	41.3 × 18.9 × 8.2 mm.

The different groups of the LCTs/HDTs show the following dimensions:

Handaxes (excluding broken handaxes);

Max.	243 × 117 × 53 mm,
Min.	82 × 43 × 22 mm,
Mean	154.0 × 83.0 × 39.4 mm,
SD	44.7 × 19.4 × 8.1 mm,

Cleavers;

Max.	241 × 115 × 46 mm,
Min.	122 × 80 × 33 mm,
Mean	171.2 × 96.3 × 39.4 mm,
SD	38.2 × 11.7 × 4.5 mm.

Cross-section

More than half of the LCTs/HDTs (n=25, 52.1%) show a double convex cross-section. The cross-section of seven pieces (14.6%) are biconical, another seven pieces (14.6%) parallelogram, five pieces (10.4%) plano-convex, three pieces (6.3%) trapezoidal, and one piece (2.1%) triangular.

Sinuosity

A large number of the LCTs/HDTs from KGA18-A1 (n=32, 65.3%) show straight edges and 16 tools (32.7%) exhibit sinuous edges. Only one item (2.0%) retains a wavy edge.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 82°, Min. = 30°, Mean = 59.3°, and SD = 13.3°.

The different groups of the LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 82°, Min. = 30°, Mean = 61.0°, and SD = 13.6°,

Cleavers;

Max. = 65°, Min. = 40°, Mean = 52.1°, and SD = 9.0°.

Biface butt plan

Out of the 48 analyzed tools, 29 artifacts (60.4%) exhibit a U-shaped butt, 11 pieces (22.9%) a V-shaped butt, three tools (6.3%) a straight butt, and one specimen (2.1%) a square butt. The biface butts of three LCTs/HDTs (6.3%) are modified into tool and one piece (2.1%) is indeterminate.

Invasiveness

The majority of the LCTs/HDTs (n=42, 87.5%) show invasive flake scars on the ventral and dorsal surfaces. Only four tools (8.3%) show semi-invasive flaking and two pieces (4.2%) exhibit marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 31, Min. = 8, Mean = 18.3, and SD = 5.4.

The different groups of the LCTs/HDTs show the following flake scar count:

Handaxes (excluding broken handaxes);

Max. = 28, Min. = 8, Mean = 18.8, and SD = 4.9,

Cleavers;

Max. = 31, Min. = 8, Mean = 16.0, and SD = 7.2.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 86 mm, Min. = 20 mm, Mean = 46.2 mm, and SD = 13.7 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 86 mm, Min. = 20 mm, Mean = 45.1 mm, and SD = 14.5 mm,

Cleavers;

Max. = 67 mm, Min. = 41 mm, Mean = 50.9 mm, and SD = 8.3 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the 9 analyzed cleavers, the five pieces (55.6%) exhibit an oblique end edge plan, two pieces (22.2%) show a straight edge plan, and another two pieces (22.2%) have a convex edge plan.

The cleavers of KGA18-A1 show the following cleaver bit angle values:

Max. = 55°, Min. = 25°, Mean = 38.2°, and SD = 8.7°.

The cleaver bit dimension is summarized as:

Max. = 69 mm, Min. = 38 mm, Mean = 52.9 mm, and SD = 11.5 mm.

KGA20-A1 and A2 (Plates 61–66)

Overview

General presentation of artifacts

The surface collection at KGA20-A1 and A2 is represented by 46 lithic artifacts, including 28 LCTs/HDTs (60.9%) and 18 flakes (39.1%).

General presentation of raw materials

The most common raw material used at KGA20-A1 and A2 is basalt (n=40, 87.0%) and the other raw materials are rarer: three on quartzite (6.5%), one on metamorphic rock (2.2%), and two on rhyolites (4.3%).

General presentation of physical conditions

In contrast to the other KGA sites, no lithics from KGA20-A1 and A2 are categorized as weathered. A large number of the lithics are considered moderately weathered (n=34, 73.9%) and 12 lithics (26.1%) exhibit a fresh appearance.

Large Cutting Tools & Heavy Duty Tools

Typology

A total of 28 LCTs/HDTs were recovered from KGA20-A1 and A2, including 16 handaxes (57.1%), eight cleavers (28.6%), and four picks (14.3%).

Raw material

Most of the LCTs/HDTs at KGA20-A1 and A2 (n=25, 89.3%) are made on basalt. Only one tool (3.6%) is made on quartzite, and two pieces (7.1%) are made on rhyolite.

Physical condition

Substantial LCTs/HDTs (n=23, 82.1%) show a moderately weathered appearance and the remaining five tools (17.9%) exhibit fresh surfaces.

Presence of cortex

Out of the 28 analyzed LCTs/HDTs, 16 pieces (57.1%) have no cortex, five items (17.9%) exhibit "small amount" (<25% of the surface) of cortex, three pieces (10.7%) show "modest amount" (25–50% of the surface) of cortex, and another three artifacts (10.7%) have "much" cortex (>50% of the surface). One piece (3.6%) is indeterminate owing to weathering.

Primary form

Almost half of the LCTs/HDTs (n=13, 46.4%) from KGA20-A1 and A2 do not allow determination of primary form due to invasive flaking. Eleven LCTs/HDTs (39.3%) are made on flake and four tools (14.3%) are made on cobble.

Flake type

Out of the 11 analyzed LCTs/HDTs made on flake, four tools (36.4%) are made on an end struck flake, and one (9.1%) is made on a side struck flake. More than half of the analyzed pieces (n=6, 54.5%) are indeterminate owing to flaking on the ventral surface.

Unifacial/bifacial

The number of the fully bifacial tools at KGA20-A1 and A2 is much larger than at the other sites. While 24 LCTs/HDTs (85.7%) are fully bifacial, only four tools are partly bifacial (n=2, 7.1%) or unifacial (n=2, 7.1%).

Dimension

The dimension of the total LCTs/HDTs at KGA20-A1 and A2 is summarized as follows:

Max.	280 × 156 × 65 mm,
Min.	100 × 57 × 24 mm,
Mean	167.3 × 99.4 × 46.3 mm,
SD	43.8 × 23.1 × 10.1 mm.

The different groups of the LCTs/HDTs show the following dimensions:

<u>Handaxes (excluding broken handaxes);</u>

Max.	203 × 133 × 60 mm,
Min.	115 × 74 × 28 mm,
Mean	153.0 × 94.4 × 45.5 mm,
SD	26.8 × 14.6 × 8.6 mm,

<u>Cleavers;</u>

Max.	280 × 156 × 61 mm,
Min.	100 × 57 × 24 mm,
Mean	205.8 × 112.6 × 46.0 mm,
SD	58.5 × 34.8 × 11.7 mm,

<u>Picks;</u>

Max.	160 × 109 × 65 mm,
Min.	134 × 78 × 36 mm,
Mean	147.8 × 92.5 × 50.3 mm,
SD	11.6 × 15.3 × 14.4 mm.

Cross-section

The majority of the LCTs/HDTs from KGA20-A1 and A2 show well-proportioned cross-sections, including double convex (n=11, 39.3%), plano-convex (n=6, 21.4%), and lenticular (n=7, 25.0%). The other cross-section types are rare: one biconical (3.6%), two parallelogram (7.1%), and one triangular (3.6%).

Sinuosity

More than half of the LCTs/HDTs (n=16, 57.1%) exhibit straight edges, nine tools (32.1%) show sinuous edges, and three pieces (10.7%) have wavy edges.

Edge angle

The edge angle values of the total LCTs/HDTs are summarized as follows:

Max. = 95°, Min. = 40°, Mean = 60.0°, and SD = 12.9°.

The different groups of the LCTs/HDTs show the following edge angle values:

Handaxes (excluding broken handaxes);

Max. = 80°, Min. = 45°, Mean = 59.6°, and SD = 8.6°,

Cleavers;

Max. = 80°, Min. = 40°, Mean = 53.8°, and SD = 14.1°,

Picks;

Max. = 95°, Min. = 55°, Mean = 74.0°, and SD = 17.6°.

Biface butt plan

Out of the 25 analyzed tools, nine artifacts (36.0%) exhibit a U-shaped butt, six pieces (24.0%) a straight butt, four items (16.0%) a cortex butt, and three specimens (12.0%) a V-shaped butt. One piece (4.0%) is modified into tool, and the remaining two specimens are either irregular (4.0%) or indeterminate (4.0%).

Invasiveness

Most of the LCTs/HDTs at KGA20-A1 and A2 bear invasive flake scars (n=22, 78.6%). Only four tools (14.3%) show semi-invasive flaking and two pieces (7.1%) are modified by marginal retouch.

Flake scar number

The flake scar count for the total LCTs/HDTs is summarized as follows:

Max. = 60, Min. = 5, Mean = 26.4, and SD = 11.5.

The different groups of the LCTs/HDTs show the following flake scar count:

Handaxes (excluding broken handaxes);

Max. = 60, Min. = 16, Mean = 30.0, and SD = 10.5,

Cleavers;

Max. = 48, Min. = 5, Mean = 24.1, and SD = 13.2,

Picks;

Max. = 21, Min. = 11, Mean = 16.3, and SD = 4.6.

Maximum dimension of flake scars

The maximum dimension of the LCT/HDT flake scars is summarized as follows:

Max. = 83 mm, Min. = 28 mm, Mean = 51.2 mm, and SD = 12.8 mm.

The different groups of the LCTs/HDTs exhibit the following maximum dimensions of the flake scars:

Handaxes (excluding broken handaxes);

Max. = 65 mm, Min. = 28 mm, Mean = 48.9 mm, and SD = 9.5 mm,

Cleavers;

Max. = 83 mm, Min. = 35 mm, Mean = 58.3 mm, and SD = 17.7 mm,

Picks;

Max. = 55 mm, Min. = 35 mm, Mean = 46.3 mm, and SD = 9.8 mm.

Cleaver edge plan, bit angle, bit dimension

Out of the eight analyzed cleavers, three pieces (37.5%) exhibit a straight edge plan, another three pieces (37.5%) show a convex end, and two (25.0%) show an oblique end edge plan.

The cleavers of KGA20-A1 and A2 show the following cleaver bit angle values:

Max. = 38°, Min. = 20°, Mean = 30.4°, and SD = 6.8°.

The cleaver bit dimension is summarized as:

Max. = 73 mm, Min. = 32 mm, Mean = 45.3 mm, and SD = 12.7 mm.

3.3 SELECTED ARTIFACT DESCRIPTIONS

KGA6-A1 (12 artifacts)

Handaxes

KGA6-A1 O100 (Plate 1)

This is a bifacially made thick handaxe on basalt, classified as an irregular elongate ovate handaxe. The flaking is exhaustive and the flake scars are invasive and deep. The piece is fully bifacial. It was found on surface adjacent to the KGA6-A1 excavation.

KGA6-A1 2013-02 (Plate 2)

This is a unifacial handaxe made on a large end struck basalt flake. The platform is reduced by a dorsal flake scar located at the left corner of the distal edge. The dorsal face shows large invasive flake scars and is fully worked. The proximal end forms a point.

KGA6-A1 Loc. C E11-13 (Plate 3)

This is one of the few *in situ* excavated handaxes. It is a unifacially worked handaxe on an end struck basalt flake. It has an elongate double pointed plan form. The dorsal face shows large invasive flake scars covering the total surface. The artifact has straight edges and a plano-convex cross-section. The invasive flaking on the dorsal surface removed most of the striking platform. The lateral sides show continuous small, inverse retouch. The retouch covers all of the dorsal right side edge and the proximal to middle part of the left side edge.

Cleavers

KGA6-A1 Loc. C O3 (Plate 3)

This is a divergent cleaver on a side struck basalt flake. The flake scar that creates the cleaver bit is very invasive and covers ~½ of the surface. This scar may suggest preparation of the core before detaching the cleaver blank flake. There are no flake scars on the ventral face. The left side of the dorsal face was regularized by removal of large flake scars. This piece was surface collected in the 2003 field season just at the KGA6-A1 locus C excavation. It was not observed two years earlier, and must have eroded out in the time-interval. An encrusted patch of carbonated sediment occurs on its ventral surface.

KGA6-A1 2013-05 (Plate 4)

This is a large and heavy obliquely convergent cleaver on an end struck basalt flake. The dorsal face shows few large invasive flake scars. The whole dorsal face is worked. The ventral face has two flake scars at its proximal end. The cleaver bit shows few dorsal and ventral secondary irregular retouch which might have resulted from use. These retouch extend all over the dorsal right lateral edge.

Picks

KGA6-A1 7 (Plate 4)

This piece is classified as a beaked pick. It is made on a basalt flake with few dorsal and ventral flake scars. The ventral face shows a large invasive flake scar that was made before the piece was trimmed to be a pick. The bit is trimmed by two or three small secondary retouch flake scars, whereas the butt is left unworked (retains cortex). This piece is crudely worked but the notch in its mid-distal part makes it a pick.

KGA6-A1 2013-01 (Plate 5)

This is a thick and large double pointed, notched pick made on a basalt flake. The dorsal face retains more than 50% of cortex. The edges are worked with few large, deep and abrupt flake scars on the dorsal face The bit (pick tip) is well made. It looks a little "twisted" to the dorsal left side, made by a notch like abrupt flake scar. The dorsal right side has also received a huge blow which resulted in a semi-abrupt large flake scar. The butt is also pointed, shaped by a large semi-abrupt flake scar on one lateral side and inversely applied shallow and invasive flake scar on the other lateral side.

KGA6-A1 O96 (Plate 6)

This is a large and thick trihedral pick on a large end struck basalt flake. The flake blank was knocked off from a large angular block. The cortical edge of the original block is preserved and forms the central dorsal ridge. The dorsal left side is more exhaustively worked with abrupt and deep flake scars. The distal tip is a little twisted to the dorsal right side. The platform is plain. The ventral face is left unworked. It was found on the surface adjacent to the locus C excavation area.

KGA6-A1 O98 (Plate 7)

This is a large trihedral pick on a basalt flake. It has a triangular cross-section. The ventral face is left unworked except for a single large flake at its proximal edge. It is thick and pointed with a slight "twist" to the dorsal right side. The flake scars are deep and abrupt. It was a surface collection from the lag adjacent to the locus C excavation area.

KGA6-A1 1 (Plate 7)

This is a high backed pick made on a large end struck basalt flake. The piece has cortex on 75% of its dorsal face. The distal part (1/3 of the piece) has been worked by abrupt flake scars on the dorsal face creating the pick point (bit) which shows a trihedral cross-section. Both lateral sides of the worked part show some secondary flake scars (possibly from use). Its dorsal right middle/proximal part has one large and deep flake scar which created a sharp edge. This part also shows some inversely flaked irregular retouch.

KGA6-A1 2013-03 (Plate 8)

This is a large and heavy high backed double ended pointed pick on a basalt flake. The middle/proximal dorsal face retains cortex. Both lateral sides are made by abrupt large flake scars on the dorsal face. The distal end is made using two large flake scars. This piece shows that a large boulder was split open and a part of it was shaped into the pick.

KGA6-A1 Loc. C G14-S3 (Plate 8)

This is a unifacially made pick made on a basalt flake. The ventral face is left unworked, whereas the dorsal face shows intensive flaking (>18 flake scars of >1 cm). The distal end shows that this part was deliberately shaped into a pointed tip. Two dorsal deep flake scars were applied on both lateral sides to create the tip. The proximal end has been exhaustively worked by dorsal flake scars which are sometimes invasive and less abrupt.

KGA4-A2 (9 artifacts)

Handaxes

KGA4-A2 2 (Plate 9)

This is a thick elongate ovate handaxe on basalt. Like the other handaxes, it is made by large, invasive and semi-abrupt flake scars. There are 17 flake scars each on the dorsal and ventral faces. It is fully bifacially worked. The edges are sinuous because of exhaustive flaking on both faces. It shows a relatively better plan form symmetry when compared with other handaxes from the same site. It has a bi-conical cross-section.

KGA4-A2 29 (Plate 10)

This is a small elongate ovate handaxe on an end struck basalt flake. It is made by large, deep and invasive flake scars. The edges are sinuous. The butt is worked and U-shaped. Plan form symmetry is not yet fully attained.

Cleavers

KGA4-A2 23 (Plate 10)

This is a convergent cleaver on an end struck basalt flake. The cleaver bit is straight. The piece retains a small area of cortical surface. The dorsal left side and the platform (proximal) area have been modified by flake scars.

KGA4-A2 4 (Plate 11)

This is a double ended/bitted cleaver made on an end struck large basalt flake. It has two convex cleaver bits (at the distal and proximal ends). The cleaver bit flake scars were removed during core preparation stage (before detachment of the cleaver blank from the core). This is indicative of a technique whereby the cleaver form (the end product) was already determined prior to the detachment of the blank. The platform shows some modification and the proximal cleaver bit shows some shaping retouch. The left side (viewed dorsally) is worked by alternate flake scars (on both faces). The cleaver shows divergent plan form when oriented with the large cleaver bit to the distal end.

Picks

KGA4-A2 35 (Plate 12)

This is a large, thick trihedral pick made on basalt. Its dorsal face is made by large, deep and abrupt flake scars, whereas the ventral face is made by large and invasive and semi-abrupt flake scars. The edges are sinuous. The butt is V-shaped and fully flaked.

KGA4-A2 20 (Plate 13)

This is a large trihedral pick made on basalt. It preserves cortex on the proximal dorsal face. The dorsal face shows large and deep flake scars. The butt is left unworked. The ventral face shows invasive flake scars. The bit is pointed with some secondary flaking.

KGA4-A2 56 (Plate 13)

This is a unifacially worked pick on basalt. The platform is located at the proximal angle and is plain. Its butt is unworked. This is a beaked pick with a slight "twist" of its point (to the dorsal right side) made by a notch. Several abrupt flake scars have created the edges. The mid-dorsal face and the proximal part show cortex.

KGA4-A2 36 (Plate 14)

This is a pick made on basalt. It is trihedrally worked. Flake scars are very large, abrupt, deep and invasive covering almost half of the surface on both faces. The butt is worked on both faces and the bit is very pointed. The edges are sinuous. The cross-section is sort of irregular. One lateral edge (left in dorsal view) shows a large denticulation (bec) made by deep notches. This pick has a central dorsal ridge running from bit to proximal end.

KGA4-A2 59A (Plate 14)

This is a bifacially worked beaked pick made on a side struck basalt flake. The beak is made by a large notch on the dorsal left side of the distal part. The dorsal flake scars are abrupt and semi-abrupt. The ventral flake scars are shallow and invasive. The central part of dorsal face retains some cortex. The butt is worked by dorsal flake scars. Some edge shaping flake scars are present in the middle/proximal area.

KGA10-A11 (8 artifacts)
Handaxes
KGA10-A11a 73 (Plate 15)
This is a double pointed handaxe on a large basalt flake. Proximal and distal ends are shaped to make points. The distal bit is better worked with shallower and invasive flake scars. The proximal end is worked with notch like deep flake scars. The edges are sinuous. Minimal flaking is applied to make the handaxe. The cross-section is an irregular double convex.
KGA10-A11a 182 (Plate 16)
This is a large pointed ovate handaxe made on a side struck basalt flake. The dorsal face retains more than 75% cortex. The flaking is peripheral and semi-abrupt or abrupt. The proximal dorsal part is left unworked. It is flattish piece with one edge which is straight and the other sinuous. Where it is worked on the ventral face, the platform is removed by two large flake scars. The plan form is almost symmetrical. The edges show denticulation on both lateral sides. The butt is an open U-shape.
KGA10-A11a 187 (Plate 17)
This is a thick elongate biseau-bitted handaxe on a large basalt flake. The dorsal face is worked by large deep semi-abrupt and invasive flake scars. The butt shows a small area of cortex (<25%). Both lateral sides have sinuous edges. The point (distal end) is a little constricted by deep notches made by dorsal flake scars on both sides. The distal end also shows a narrow cleaver like bit. The ventral face is worked only at the side where the platform was situated.
Cleavers
KGA10-A11a 181 (Plate 18)
This is a large parallel sided cleaver on a side struck quartzite flake. The flake scars are very large and this could make the piece pass as a core-cleaver or core axe. Its dorsal face shows at least seven large flake scars and the ventral has four flake scars of which two are large. The platform is cut ventrally by large flake scars. The cleaver bit is transversally convex and the butt is V-shaped. The edges are sinuous. This is an exceptional unique piece, very heavy and among the largest in the KGA collection.
KGA10-A11a 66 (Plate 19)
This is a thick parallel-sided cleaver on an end struck quartz flake. This piece has two platforms and two bulbs (or ventral flake faces) and is a Kombewa flake. The cleaver bit is oblique, and shows some secondary retouch which might have resulted from use. The butt has an open V-shape and retains the original surface of the block that has been used. The lateral sides are worked bifacially, with flakes detached to regularize both edges. The dorsal face shows some battering, and the flake scars are large, deep, and abrupt or semi-abrupt all along the edges. The ventral flake scars are shallower and semi-invasive.
Pick
KGA10-A11a 68 (Plate 20)
This is a core/trihedral pick on an ignimbrite flake. The piece retains some cortex at its middle proximal area (~25%). The pick has straight edges and a triangular cross-section. Large flake scars occur on its dorsal face. The butt is V-shaped. The point exhibits a burin-like oblique blow on both its ventral and dorsal faces. A notch occurs close to the bit on the dorsal right side.

Knife

KGA10-A11a 184 (Plate 20)

This is a knife made on a side struck basalt flake. The dorsal face is worked from the proximal end to the left mid-lateral side by six flake scars which created a denticulated edge. The mid-lateral to distal tip of the same side is unworked and sharp. The ventral face shows three marginal semi-abrupt flake scars that removed the platform.

Part biface

KGA10-A11a 26 (Plate 21)

This is a large biface made on a quartzite flake. Its peripheries show bifacial flake removals on the left side edge (seen dorsally) and mostly dorsally on the opposite side. The mid to distal edge of one side shows a continuous scraper-like retouch, whereas the opposite side edge shows denticulation by larger flaking. The distal end (bit) is fully worked on the ventral face with invasive flaking. It has a little "twist" to the dorsal left side with a small truncated bit. The dorsal face preserves some cortex around the mid to proximal area. This artifact can also be regarded as a large scraper.

KGA10-A6 (4 artifacts)

Handaxe

KGA10-A6 1 (Plate 22)

This is a pointed handaxe on an end struck quartz flake. It is made by large semi-abrupt flake scars on both dorsal and ventral faces. One lateral side shows a sinuous edge, whereas the edge of the other side is wavy. The butt is fully worked and has a V-shape. Its cross-section is parallelogram.

Picks

KGA10-A6 7 (Plate 22)

This is a bifacial pick on a quartz block. It is made by large semi-abrupt flake scars on dorsal and ventral faces. The butt preserves some cortex on both faces and is V-shaped. The cross-section is thick and bi-conical. One lateral side shows a sinuous edge, whereas the edge of the other side is wavy.

KGA10-A6 20 (Plate 23)

This is a bifacial pick made on basalt. The flake scars are semi-abrupt and invasive on both faces. The piece has a thick cortical butt, worked ventrally. The bit is pointed and shaped by both dorsal and ventral flake scars. The edges are sinuous.

KGA10-A6 21 (Plate 23)

This is a bifacial pick made on basalt. Both dorsal and ventral faces are exhaustively worked by invasive and semi-abrupt flake scars. The dorsal right side edge shows some secondary shaping flake scars. The edges are sinuous on one side and denticulate on the other.

KGA7-A1, A3 (10 artifacts)

Handaxes

KGA7-A1 10 (Plate 24)

This is a crudely made small ovate elongate handaxe on a basalt flake. The butt is trimmed with bifacial flake scars. The distal end is also worked by flake scars on both faces to give it a flattish and slightly round nosed shape as in most handaxes from this site.

KGA7-A1 17 (Plate 24)

This is a small pointed handaxe on basalt. It is made by semi-abrupt flake scars. Both dorsal and ventral faces are worked.

KGA7-A3b 19 (Plate 24)

This is an ovate elongate handaxe on an end struck basalt flake. The edges are sinuous on one side and straight on the other. The butt is U-shaped and the tip is a rounded point. Plan form symmetry is somewhat advanced. The section is triangular. Flake scars are semi-abrupt on both dorsal and ventral faces. The tip area is thinned by invasive flake scars.

Cleavers

KGA7-A1 15 (Plate 25)

This is an ultra-convergent cleaver made on a basalt cobble. The butt is not worked; the natural surface of the rounded cobble is left untouched and shows moderate weathering. The dorsal and ventral faces exhibit large flake scars.

KGA7-A3a 6 (Plate 25)

This is a convergent cleaver on a large basalt flake. The dorsal face is made by large and abrupt flake scars with some trimming at its proximal end. The ventral face also shows large semi-abrupt flake scars around its periphery. The lateral edges are sinuous.

Picks

KGA7-A1 1 (Plate 26)

This is a long trihedral pick on an oblong basalt cobble. It has a triangular cross-section. It becomes thinner continuously from the butt towards the bit. The butt has some cortex and shows abrupt flake scars. It has battering which might have resulted from use (perhaps as a hammer). Flake scars are abrupt, large and deep. This piece is comparable with the KGA7-A1 9 specimen.

KGA7-A1 9 (Plate 27)

This is a trihedral pick made on an oblong basalt cobble/block. The piece is long and pointed at its bit, and wider and thicker at its butt. The heavy butt is cortical and rounded. It shows battering marks. The flake scars are deep and abrupt on all three faces. They are detached in all directions. The pointed bit shows that it was carefully shaped by two shallow notches on two sides and few semi-invasive flaking on the dorsal and the ventral faces. The pick may have been used, its proximal end for crushing and battering and its distal end for digging or cutting.

KGA7-A3b 4 (Plate 27)

This is a medium sized pick made on a basalt cobble/block. It is thick at its mid-proximal part, with a triangular cross-section. The bit is shaped by deep and large flake scars. The butt is a thick U-shape and preserves cortex. It has a ridge on the dorsal face giving this piece an additional platform from which flakes are removed on the dorsal face.

KGA7-A3a 7 (Plate 28)

This is a small trihedral pick on basalt. The flake scars are abrupt, deep and invasive. Both dorsal and ventral faces are fully worked by large flake scars. The dorsal face has 10 flake scars, whereas ventral face shows six flake scars. The bit is pointed with a large flake scar. The butt is U-shaped. It has a parallelogram cross-section. The lateral sides have sinuous edges.

Core axe

KGA7-A1 3 (Plate 28)

This is a core axe made on basalt. It has a trihedral cross-section, and shows three directional flaking. Both the bit and the butt are pointed. Flake scars are large and deep.

KGA7-A2 (5 artifacts)

Handaxe

KGA7-A2 19 (Plate 29)

This is an elongate ovate handaxe made on a quartzite flake. The flake morphology is pointed at the tip. It is a Kombewa flake but exhaustively worked on both faces. The proximal end and left lateral side (viewed dorsally) are exhaustively flaked but the opposite lateral edge middle to distal area is left unworked.

Cleavers

KGA7-A2 1 (Plate 29)

This is a side cleaver/knife on a quartzite Kombewa flake. It has a bulb on both positive faces. The platforms are plain and located at the proximal end. The butt is thick. The dorsal right edge is worked with four semi-abrupt and invasive flake scars, whereas the left side is bifacially worked and shows a denticulated edge at its mid-proximal area.

KGA7-A2 12 (Plate 30)

This is a side cleaver made on a large quartzite Kombewa flake. Its middle to proximal edge is trimmed with invasive flake scars. The platform is cut by large flake scars on both faces giving the proximal end a V-shape. The middle to distal edge is left intact and unworked. It shows a natural sharp cutting edge made in the process of core preparation.

KGA7-A2 18 (Plate 31)

This is a large side cleaver made on a quartzite Kombewa flake. Two platforms are present at its proximal end. The left lateral edge (viewed dorsally) is worked by bifacial marginally made flake scars. The other lateral edge is worked by marginal continuous flaking, creating a denticulate side scraper-like shape.

KGA7-A2 13 (Plate 32)

This is a thick parallel-sided cleaver made on a quartzite Kombewa flake. The cleaver bit is straight. The butt is thick and angular/irregular V-shaped. Its dorsal right side shows three large semi-abrupt flake scars. The edge of the other side shows a ventrally applied blow. The proximal end shows a large abrupt flake scar which removed part of the butt.

KGA8-A1 (13 artifacts)

Handaxes

KGA8-A1c 34 (Plate 33)

This is so far the largest handaxe (elongate ovate) at KGA (280 mm in length). It is made on an end struck basalt flake. Both faces are fully worked with large and invasive flake scars. The plan form exhibits advanced symmetry. The edges are straight at its mid to distal part, and gets slightly sinuous at its mid to proximal portion where the handaxe tends to be thicker. The mid-proximal lateral edge shows secondary retouch which might be result of use. The distal part shows thinning. The right lateral side on the ventral face shows shallow, invasive flake scars which suggest soft hammer use. However, it is indeterminate whether they were made by organic or soft stone hammers. The butt (proximal) is worked and has a U-shape. The striking platform is removed.

KGA8-A1c 53 (Plate 34)

This is a large, thick elongate ovate handaxe made on basalt. It is worked on a thick flake. The edges are sinuous and cross-section is bi-conical. It is fully bifacially worked. The butt is trimmed and is U-shaped. Its distal 1/3 part has been worked more finely, whereas the remaining 2/3 is thick. Similar tip thinning technique is observed on other handaxes from the same site and at KGA12-A1.

KGA8-A1 68 (Plate 35)

This is a large bifacially worked elongate ovate handaxe made on a basalt flake. The flake scars are invasive on both faces. Both lateral sides have straight edges and is finely retouched and thinned on both faces. It shows advanced plan form symmetry. The butt is U-shaped. The cross-section is double convex. On both faces, the distal shows probable use of the soft hammer technique.

KGA8-A1b 36 (Plate 36)

This is a pointed handaxe made on a basalt flake. The dorsal face retains cortex on the mid-proximal part, whereas the ventral face is fully worked by invasive flake scars on the mid-distal part and by abrupt flake scars on the proximal area. The dorsal face shows large and semi-abrupt flakes scars. The edges are sinuous. Its plan form symmetry is advanced and its butt is U-shaped.

Cleavers

KGA8-A1c 26 (Plate 36)

This is a divergent cleaver with an oblique bit on an end struck quartzite flake. The cleaver bit was made during the blank preparation stage. The main flake scars on the dorsal face indicate that the core was prepared centripetally before the detachment of the cleaver blank from the core. The lateral sides show semi-abrupt large and medium sized flake scars. Some secondary retouch, 1–2 cm long, are present on both lateral sides. The platform is plain and reduced by flaking before the blank was detached from the core. There are no flake scars on the ventral face.

KGA8-A1c 2 (Plate 37)

This is a divergent cleaver on a quartzite Kombewa flake. It is end struck. The cleaver bit is convex shape. Large and abrupt to semi-abrupt flake scars are present on the dorsal face of both lateral edges and proximal end. The ventral face is not worked. The sharp cleaver bit shows some retouch that might have resulted from use.

KGA8-A1c 43 (Plate 38)

This is a divergent cleaver on a side struck basalt flake. The cleaver bit is oblique end. The dorsal right side is worked by abrupt flake scars. The ventral face remains unworked except for two large semi-abrupt flake scars that cut the platform. There are some secondary retouch at the proximal left side on the ventral face. The butt is V-shaped. Note the reduction of the striking platform, which is characteristic of side struck cleavers.

KGA8-A1b 59 (Plate 39)

This is a large parallel-sided cleaver on a side struck quartzite flake. The cleaver bit is convex shape. The dorsal face is worked by centripetal invasive and semi-abrupt flake scars. The flake scar that created the cleaver bit was removed at preparation stage, before detaching the cleaver blank from the core. The dorsal face shows some secondary flake scars. The ventral face has semi-invasive flake scars on both sides. The edges are sinuous by alternate flaking on both faces.

KGA8-A1 21 (Plate 40)

This is a double ended cleaver on a side struck quartzite flake. The distal cleaver bit is oblique. The dorsal face shows large and invasive flake scars. The ventral face shows two flake scars used to remove the platform. The V-shaped proximal cleaver bit has some retouch.

KGA8-A1b 61 (Plate 40)

This is an ultra convergent cleaver on a basalt flake. The cleaver bit shows convex shape. Both dorsal and ventral faces are made by large invasive and semi-abrupt flake scars. Both lateral edges show tendency towards a straight edge.

Pick

KGA8-A1b 25 (Plate 41)

This is a large trihedral pick made on basalt. It is worked by large and abrupt flake scars on all the three faces. The bit shows a “twist” made by deep flake scars.

Large scrapers

KGA8-A1c 18 (Plate 41)

This is a large scraper on an end struck quartzite flake. The piece preserves cortex on the proximal area of its dorsal face. The dorsal face is worked by large semi-abrupt and invasive flake scars on its middle to distal area and by large abrupt flake scars on its proximal edge. The proximal end is modified into a large end scraper edge.

KGA8-A1b 23 (Plate 42)

This is a large side scraper (peripherally worked unifacial handaxe) on a large flake detached from a quartzite block. This scraper shows a large flake scar on its dorsal face, which was also detached from the same platform. The platform is plain. There are no flake scars on the ventral face. The bit is shaped by few small and semi-abrupt flake scars.

KGA12-A1 (17 artifacts)

Handaxes

KGA12-A1a 1 (Plate 43)

This is a large handaxe on a side struck basalt flake. The dorsal face is fully worked with semi-abrupt invasive flake scars. The distal end (bit) is well shaped. The piece has an elongate ovate plan form. The platform is trimmed by large flake scars that cover the lateral edge. The cross-section is plano-convex, with dorsal flake scars that left a small area with cortex at the proximal end. The ventral right side edge is straight (unworked side) and the opposite side edge is sinuous (ventrally worked side). Secondary shaping flake scars are present but not many.

KGA12-A1a 60 (Plate 44)

This is a large pointed handaxe make on basalt. It is fully bifacially worked with the butt trimmed with large, deep, semi abrupt and invasive flake scars. The plan form symmetry is moderately advanced. The edges are sinuous. This handaxe shows the decisive and controlled blows applied in its making.

KGA12-A1a 50 (Plate 45)

This is a medium sized pointed ovate handaxe on basalt. This piece is fully bifacially worked. The edges are sinuous, but plan form symmetry is advanced. Although thick, the piece also shows some symmetry in its section (tending towards 3-dimensional symmetry). The butt is trimmed. The cross-section is bi-conical.

KGA12-A1b N9 (Plate 45)

This is a pointed handaxe on rhyolite. The piece is fully bifacially worked. The dorsal face is worked by semi-abrupt and invasive flake scars. The ventral face shows abrupt flaking on the proximal 2/3, but more refined treatment distally, with fine flake scars, secondary retouch and edge/tip shaping. In particular, the distal lateral part of the ventral face shows carefully removed shallow invasive flake scars, characteristic of soft hammer retouch. This part is finely made, although the entire piece retains a thick cross-section.

KGA12-A1a 3 (Plate 46)

This is a finely made elongate ovate handaxe on a side struck rhyolite flake. The edges are sinuous. The ventral face has few semi-abrupt flake scars. The dorsal face is worked with invasive and semi-invasive flake scars. The butt shows weathering of the core from which it was detached. The cross-section is double convex. This piece was shaped by flaking to some degree of plan form symmetry.

KGA12-A1a 63 (Plate 47)

This is a thick elongate ovate handaxe made on a side struck quartzite flake. The piece is fully worked on its dorsal face by semi-abrupt invasive flake scars. The dorsal face retains a middle ridge that runs longitudinally from its distal to proximal end. The ventral face shows trimming of the platform at the proximal end. The plan form has advanced symmetry. The right side of the dorsal face is little worked giving it a straight edge. The opposite side edge is sinuous. This handaxe is a good example of a near-unifacial handaxe that retains a straight edge. When partially bifacially worked, handaxes show a sinuous edge on the bifacially worked edge and a straight edge on the unworked (or less worked) side.

KGA12-A1c 9 (Plate 47)

This piece is a pointed handaxe made on basalt. It is fully bifacially worked by semi-abrupt invasive flake scars. The edges are sinuous. Both faces are worked exhaustively. The butt is trimmed. The bit shows shaping retouch. It seems that the original form was a large flake. It has no cortex.

KGA12-A1a 17 (Plate 48)

This is a large partly bifacial ovate handaxe made on an end struck quartzite flake. The butt has been removed by dorsal successive flake scars on the proximal end. The left lateral edge shows few invasive flake scars, whereas the right edge shows alternate semi-invasive and semi-abrupt flake scars on both dorsal and ventral faces.

KGA12-A1a 8 (Plate 49)

This is a large unifacial ovate handaxe made on a side struck basalt flake. The platform is ventrally reduced. Large semi-abrupt flake scars cover the dorsal face. It is made on a large side struck flake with faceted platform. The edges are straight. The handaxe shows, relative to its size, few but large flake scars. There is also a large flake scar at the center of the dorsal face which may be indicative of core preparation.

KGA12-A1b N15 (Plate 50)

This is a unifacial handaxe made on a side struck basalt flake. Its platform is removed by ventral flaking. Its dorsal face shows semi-abrupt, large invasive flake scars. One large triangular flake scar struck from its proximal end toward its center cuts all previous flake scars which were struck from both lateral sides. Its platform is broken. This large flake scar mimics characteristics of a preconceived flaking technique analogous to the proto-Levallois. This flake scar measures 80 × 85 mm. This and the previous specimen are examples at KGA12 that suggests a certain degree of preparation in defining the shape of large flakes.

Cleavers

KGA12-A1a 52 (Plate 51)

This is a convergent oblique bitted cleaver on a side struck quartzite flake. The dorsal face shows few large and invasive flake scars. The ventral face shows few invasive flake scars at its proximal area. The platform has been reduced by few abrupt inversely made flake scars. The butt is reduced by large flake scars and is V-shaped.

KGA12-A1a 37 (Plate 52)

This is an oblique bitted cleaver on a side struck basalt flake. The striking platform is reduced by two large flake scars on the ventral face and one on the dorsal face. The dorsal face shows large and invasive flake scars mostly on the right side. The proximal end has a U-shape and was worked with semi-abrupt continuous retouch which makes it denticulate. The proximal end and dorsal right side shows some secondary retouch which might have resulted from use. Note the reduction of the striking platform characteristic of sides struck cleavers.

Picks

KGA12-A1b N14 (Plate 53)

This is a trihedral pick on a quartzite flake. It has a high back with a ridge that runs from its butt to distal bit. The flake scars are large, abrupt and invasive. Flakes were also removed on both sides of the central ridge. The bit shows some secondary retouch from all faces to give it a very pointed shape.

KGA12-A1c 2 (Plate 53)

This is a trihedral pick on rhyolite. It is worked on all three faces. Its butt retains cortex. This is a typical pick with deep and abrupt flake scars. The tip/bit shows some trimming/shaping.

Cleaver biface

KGA12-A1a 21 (Plate 54)

This is partially bifacially worked cleaver biface made on ignimbrite. Its dorsal face retains 50% cortex on its left lateral and proximal surface. On the dorsal face, the distal and right sides are made with few invasive flake scars. On the ventral face, the distal and middle lateral edges are worked by large and invasive flake scars.

Knife

KGA12-A1a 41 (Plate 54)

This is a large knife made on an end struck flake. Dorsally, the left lateral edge shows continuous retouch, whereas the right side remains unworked. It can be considered a large side scraper. The dorsal proximal part shows a large flake scar that shows a flake removed from the same platform from which the knife blank was detached.

Part biface

KGA12-A1a 39 (Plate 55)

This is a part biface with a thick butt made on basalt. The ventral face was worked from both sides by large, semi-abrupt invasive flake scars which attain 70 mm in length. Five large flake scars cover the whole ventral face. The dorsal face shows a large flake scar and edge trimming on only one side.

KGA18-A1 (8 artifacts)

Handaxes

KGA18-A1b 1 (Plate 56)

This is a large elongate ovate handaxe made on a basalt end struck flake. It is made by invasive flake scars. Both dorsal and ventral faces are fully worked. The tip is pointed while the butt is V-shaped. The plan form has advanced symmetry. The edges are straight. The piece shows a flattish double convex cross-section. The distal area is very thinly made. Few secondary retouch are present.

KGA18-A1b 2 (Plate 57)

This is a finely made elongate ovate handaxe on a basalt flake. It is fully bifacially worked by invasive flake scars. It shows straight edges and finely thinned butt which is an open U-shape. This piece has an advanced symmetric plan form with a thin double convex cross-section.

KGA18-A1b 6 (Plate 57)

This is an elongate ovate handaxe made on a basalt flake. The piece is fully bifacially worked by large invasive and semi-abrupt flake scars. The edges are sinuous. The cross-section is double convex. The plan form has advanced symmetry. The proximal and distal parts are well made.

KGA18-A1b 10 (Plate 58)

This is a finely made elongate ovate handaxe on a basalt flake. It is fully bifacially worked with a pointed tip and an open U-shaped butt. The flake scars are invasive. The edges are straight. The cross-section is double convex. This piece shows an advanced symmetric plan form. Some secondary retouch are present. The distal part is finely worked. The straight edges and shallow flake scars suggest use of soft hammer technique.

KGA18-A1b 15 (Plate 58)

This is a small pointed handaxe on a basalt flake. The handaxe is made fully bifacially with abrupt and semi-abrupt flake scars. The butt is U-shaped. There is some edge thinning.

Cleavers

KGA18-A1b 5 (Plate 59)

This is a large parallel sided cleaver on an end struck basalt flake. The cleaver bit is oblique. The butt shows flake removal and is V-shaped. The left edge (viewed dorsally) is straight, whereas the right edge is sinuous. The dorsal face is fully worked by invasive flake scars. The proximal and middle lateral sides of the ventral face are fully worked, making the butt pointed.

KGA18-A1b 12 (Plate 60)

This is a parallel sided cleaver on an end struck basalt flake. The platform is plain. The cleaver bit (distal) is straight. The edges and the butt contour are straight. The lateral sides show flake scars, one side bifacially and the other ventrally. The flake scars are shallow so that they did not affect the straightness of the edges. Some of the flake scars suggest soft hammer flaking.

Cleaver biface

KGA18-A1b 3 (Plate 60)

This is a cleaver biface on a side struck basalt flake. The dorsal face has been fully worked by invasive flake scars, whereas only six shallow and marginal flake scars are seen ventrally. One edge is straight, whereas the other edge is sinuous because of the ventral flake scars. This biface has received some edge shaping retouch. The distal cleaver end also shows secondary retouch. Its cross-section is thin double convex. The proximal end also shows a cleaver bit which is oblique with some secondary retouch. It is possible to consider this piece a double ended cleaver with an ovate plan form. Because this borders on cleaver and biface, we call it a cleaver biface.

KGA20-A1, A2 (8 artifacts)

Handaxes

KGA20-A2b 1 (Plate 61)

This is a finely made ovate handaxe made on an end struck quartzite flake. This piece is very finely made with straight edges and an ovate plan form that is symmetric. Three-dimensional symmetry is approximated by a double convex cross-section. The flake scars are invasive and shallow. Edge shaping flaking is intensively done. The piece shows soft hammer use. Thirty-seven flake scars are present on the dorsal and 23 on the ventral face. The butt is an open U-shape.

KGA20-A2b 2 (Plate 62)

This is an ovate elongate handaxe on a basalt flake. It was made using very few but fully invasive flake scars on the ventral face and with a greater number of flake scars on its dorsal face. The edges are straight. The plan form has advanced symmetry. The cross-section is double convex. The butt is worked and U-shaped. The flake scars are invasive on both faces. There is an indication of possible reuse of this handaxe. The dorsal bit area shows four flake scars that show a different patina from the remainder of the piece.

KGA20-A1 1 (Plate 63)

This is a medium sized double pointed/bitted handaxe on a basalt flake. It is fully bifacially worked with a double pointed elongate ovate plan form. The piece is worked with invasive flake scars. The cross-section is double convex. One edge is sinuous, whereas the other edge is straight with slight sinuosity due to the continuous small edge shaping flake scars. The bit/distal end is well thinned. Both ends show soft hammer retouch.

KGA20-A2a 20 (Plate 63)

This is an ovate handaxe made on a basalt flake. The piece is partially bifacially worked by invasive semi-abrupt flake scars on the dorsal face. The dorsal face retains a small amount of cortex at its proximal left side. The ventral face is made by semi-invasive and marginal flake scars on both lateral sides and proximal end. The lateral edges are straight on one side and sinuous on the other side.

KGA20-A2a 41 (Plate 64)

This is an elongate ovate handaxe on a siliceous rock. It is made on an end struck flake. The edges are straight and the plan form has advanced symmetry. The butt exhibits some thinning flake scars. The bulb on the ventral face is left intact and only peripheral flake scars are present on both lateral edges of the ventral face. The cross-section is double convex. A similar technique is observed at KGA12-A1.

KGA20-A2a 13 (Plate 64)

This is an elongate ovate handaxe made on an end struck basalt flake. It retains a cortical striking platform. The piece is made by invasive flake scars on both dorsal and ventral faces. The edges are straight and show some edge shaping flake scars. The cross-section is double convex. The piece shows advanced plan form symmetry.

Cleavers

KGA20-A1 2 (Plate 65)

This is a large ultra convergent cleaver made on an end struck flake. It is made with large invasive flake scars on both faces. The large flake scars show that they were made at blank preparation stage prior to the detachment of the piece from its core. The edges are regularized by secondary flaking which resulted in shallow flaking suggestive of soft hammer techniques. The butt is worked and U-shape. The middle distal part of the piece is well thinned relative to the middle proximal part. The edges are straight. The cross-section is lenticular. The plan form shows advanced symmetry.

KGA20-A1 3 (Plate 66)

This is a large ultra convergent cleaver with a convex cleaver bit. It is made on an end struck basalt flake. The piece is very thin relative to its length and breadth. It exhibits shallow and invasive flake scars. The middle distal part of the edges is thinner and straight. The piece shows advanced symmetry in plan form. It preserves cortex on its mid to proximal part. It has a thin lenticular cross-section.

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CHAPTER 4

Technological and Cognitive Advances Inferred from the Konso Acheulean Assemblages

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4.1 INTRODUCTION

The chronologic range of the over 30 archaeological occurrences of the Konso Formation (listed in Chapter 2) spans the ~1.9 Ma to ~0.85 Ma time period. The use of large flakes (larger than 10 cm following Kleindienst, 1962) as blanks for handaxes, cleavers, and picks is generally accepted as the hallmark of the Acheulean technology. Isaac (1969) considered the production of large flakes greater than 10 cm as indicative of the formulation of new techniques not seen in the earlier Oldowan technology. Field workers in Africa and elsewhere have further developed the notion that the production of large flake blanks and shaping large cutting tools from them are technologically and cognitively important distinctions from the Oldowan (e.g., Semaw et al., 2009; Sharon, 2009; Beyene et al., 2013).

We considered an assemblage to represent the early Acheulean technological complex based on the production of large flake blanks (>10 cm and frequently exceeding ~20 cm) and modification of these large blanks and similar-sized cobbles into handaxes, cleavers, and picks (Beyene et al., 2013). While assemblages without large cutting tools (LCTs) and/or picks were found from the ~1.9 Ma stratigraphic levels of the Konso Formation (at KGA4 and KGA11) and assigned to the Oldowan, the earliest Acheulean assemblage so far recognized at Konso occurs at KGA6-A1 and is dated at ~1.75 Ma. More typical early Acheulean large bifacial tools are known from KGA4-A2 at ~1.6 Ma. Subsequently, Acheulean assemblages are seen at many Konso localities, including those of KGA10-A11, KGA10-A6, KGA7-A1/A3, KGA7-A2 and KGA8-A1, and KGA12-A1. These well-preserved Acheulean assemblages range from ~1.45 Ma to ~1.25 Ma, and show variability in typology and raw material among sites. A large number of handaxes and cleavers were also collected from the younger ~0.85 Ma stratigraphic levels at KGA18-A1 and KGA20-A1/A2.

In this chapter, we analyze and interpret the significance of the suite of lithic characteristics outlined in the site by site analysis of Chapter 3. We do this in a comparative framework in terms of both chronology and inter-site variation when possible. The latter is predominantly restricted to the ~1.45 to ~1.25 Ma time-period which is represented by multiple assemblages within a relatively short time interval.

4.2 INTER-SITE COMPARISONS: TECHNO-MORPHOLOGY AND TEMPORAL TRENDS

Tool types and raw materials

Systematic field work at Konso has resulted in an abundant Acheulean lithic collection; a total of 1,860 lithic specimens were collected, comprising 711 LCTs, such as handaxes and cleavers or heavy duty tools (HDTs), 439 flakes, 211 chunks, nine retouched/modified angular fragments, 16 polyhedrons, 40 core/choppers, 117 cores, six split cobbles, 60 cobbles, and 251 unidentified weathered pieces (Appendix Table A2.1). The Konso Acheulean assemblages are characterized by the large numbers of handaxes (n=223, 31.4%), cleavers (n=133, 18.7%), and picks (n=144, 20.3%). Besides the three main Acheulean tool types, 19 knives (2.7%), 33 large scrapers (4.6%), 14 core axes (2.0%), 43 part bifaces (6.0%), 51 blanks/modified flakes (7.2%), and 51 broken LCTs/HDTs (7.2%) were recovered (Appendix Table A2.4).

Except at KGA7-A2, basalt is the most frequently used lithic raw material at all the KGA sites (Appendix Tables A2.2, A2.5). Next to basalt, a substantial number of artifacts are made on quartzite at KGA7-A2, KGA8-A1, and KGA12-A1, probably due to accessibility of quartzite outcrops at these western sites situated relatively closer to the Precambrian basin margin. A cluster of quartz artifacts was found at KGA10-A6, where a quartz outcrop is exposed nearby. At KGA10-A6 as well as at KGA10-A11, quartz is the second dominant raw material. Quartz veins occur near these sites today, and can be inferred to have been locally present in the past as well. The other raw materials used for making the Konso Acheulean tools are scarce (Fig. 4.1). Only limited numbers of rhyolite and ignimbrite were utilized. Lithic artifacts made on quartzite and quartz tend to exhibit a fresh condition, while most of the basalt artifacts are weathered or moderately weathered (Appendix Tables A2.3, A2.6).

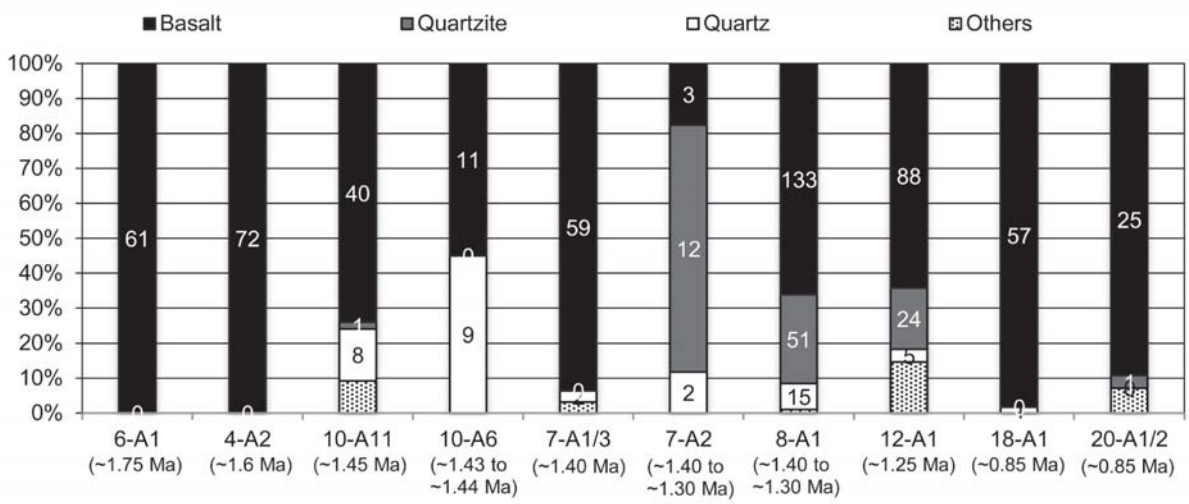

Fig. 4.1. Raw material component used for large cutting tools and picks.

At the ~1.75 Ma KGA6-A1 and ~1.6 Ma KGA4-A2 Konso Acheulean sites, the pick is the dominant tool type (Appendix Table A2.4; Fig. 4.2). Picks were made on thick flake blanks and were roughly shaped by abrupt flaking (Plates 4–8, 12–14). One of the lateral sides towards the tip was often concavely modified, sometimes accentuated into a notch-like form. In contrast, the butt was crudely modified or remained unworked and formed a rounded outline. These morphological features may indicate either functional and/or stylistic intent. The handaxes of these assemblages were made on flake blanks and roughly modified by crude and minimal flaking (Plates 1, 2, Plate 3: KGA6-A1 Loc C E11-13, Plate 9, Plate 10: KGA4-A2 29). Some of the handaxes are of intermediate morphology between handaxes and picks. The HDT-like rather than LCT-like morphology is representative of the Konso early Acheulean techno-morphological complex. However, in comparison with the KGA6-A1 homologues, at KGA4-A2 some refinement of handaxes is also seen, so as to give the impression of an increased occurrence of more "typical" handaxes.

At the ~1.45 Ma KGA10-A11 site, the number of handaxes is greater than that of picks. However, picks numerically dominate some of the even younger assemblages such as those of KGA10-A6 and KGA7-A1/A3. These are dated between 1.44 Ma and ~1.40 Ma. In these cases, specificity of raw material utilization, such as frequent quartz use at KGA10-A6 (Fig. 4.1) and the preferential use of basalt cobbles as blanks at KGA7-A1/A3 (Appendix Table A2.8), may be a possible reason for the larger number of picks (Fig. 4.2). However, at KGA7-A1/A3, a distinctive pick morphology represented by thick, rounded butts and narrow pointed tips, combined with use-wear-like traces on both ends (battering marks on the butt and flute-like scars on the tip) (Plate 26, Plate 27: KGA7-A1 9), imply specific functions. Hence, typological and technological variability among the ~1.45 Ma to ~1.40 Ma Konso assemblages might also reflect functional differences among sites.

After ~1.4–1.3 Ma, handaxes (at KGA8-A1, KGA12-A1, KGA18-A1, and KGA20-A1/A2) and cleavers (at KGA7-A2) were the most frequently produced tool types, and it appears that picks were less often produced. At Konso, it seems that demand for the LCTs increased after ~1.4–1.3 Ma, and picks became rare by ~0.85 Ma (KGA18-A1 and 20-A1/A2).

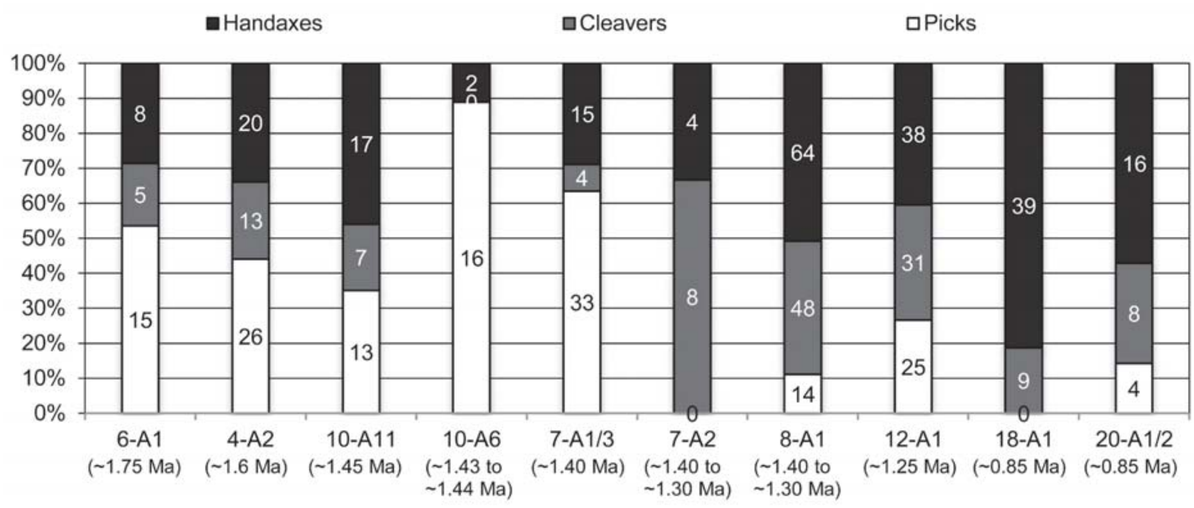

Fig. 4.2. Frequency of handaxes, cleavers, and picks among the Konso Acheulean sites.

Techno-morphological refinements

Temporal refinement of the Acheulean tools can be evaluated by a combination of attributes analyzed in Chapter 3. Blank modification flaking techniques exhibited in the artifacts show substantial temporal changes in Acheulean tool manufacture between ~1.75 Ma and ~0.85 Ma.

While most of the LCTs and picks from the KGA6-A1 site are unifacially worked, the number of partly or fully bifacial artifacts slightly increased at KGA4-A2. Thereafter, the ratio of bifacial tools tends to be higher with progression of age (Appendix Table A2.10). Since picks were more or less multi-facially prepared to produce thick pointed tips, and cleavers, in contrast, were often of unifacial form to keep an unretouched sharp edge, we compared the unifacial-bifaical ratio among handaxes alone (Fig. 4.3). It can be seen that the unifacial-bifacial ratio shows a progressive increase of bifacially flaked handaxes. It is especially remarkable that more than 80% of the handaxes from both of the two ~0.85 Ma sites (KGA18-A1 and KGA20-A1/A2) were mostly fully bifacial. Other than at these sites, the extremely high ratio of bifacial handaxes seen at only one of the other sites (the ~1.4 Ma KGA7-A1/A3) stems from a particular site-context. Multi-facially prepared picks numerically dominate this site, and handaxes at this site are also morphologically similar to picks, and hence tend to be multi-facially worked.

The above outlined temporal trend seen in the bifacial tool ratio is interrelated with frequency of cross-section type. At KGA6-A1, 74.5% of the Acheulean tools show either trapezoidal or triangular cross-section shapes (Appendix Table A2.12; Fig. 4.4). This ratio is similar to the unifacial to bifacial/trihedral ratio of LCTs/picks at this site. The frequencies of the other cross-section types increased from KGA4-A2 to the later sites. In particular, the double convex, plano-convex, and lenticular cross-section shapes reflect advanced bifacial tool manufacture skill (Shelley, 1990). The ratio of these cross-section types exceeds 40% at KGA12-A1, and reached 62.5% at KGA18-A1 and 85.7% at KGA20-A1/A2. The overall trend towards thin biconvex or semi-biconvex cross-section types represents technological refinement in the production of Acheulean tools.

An advanced flaking technology is needed for the production of comparatively straight working edges (Appendix Table A2.13; Fig. 4.5). The high ratios of straight edges at KGA6-A1 and KGA7-A2, however, result from a large number of unifacial tools and do not reflect refined technology in edge formation. In the other assemblages, while only low frequencies of LCTs/picks

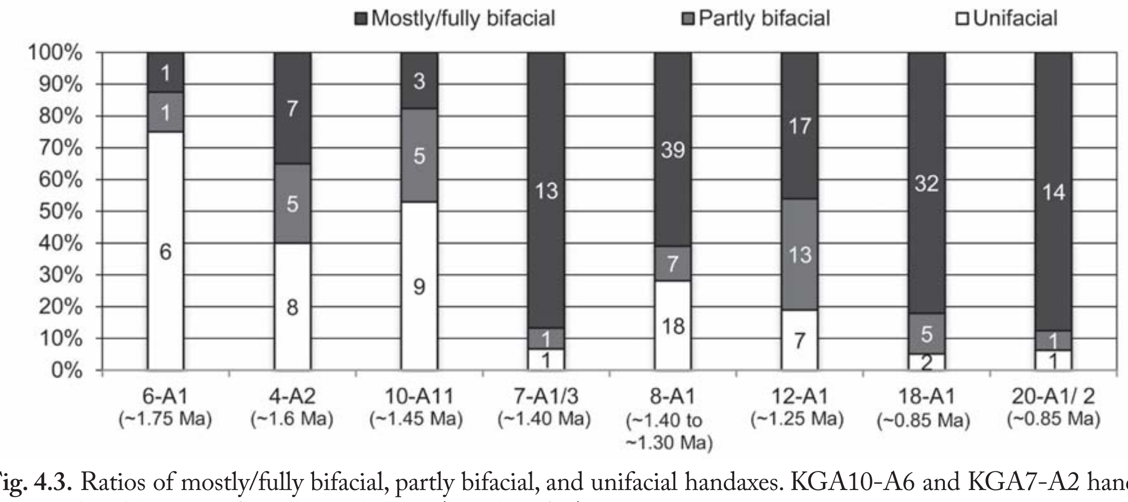

Fig. 4.3. Ratios of mostly/fully bifacial, partly bifacial, and unifacial handaxes. KGA10-A6 and KGA7-A2 handaxes are not ploted because of small sample sizes (less than five).

show straight edges prior to ~1.4 Ma (at KGA4-A2, KGA10-A11, KGA10-A6, and KGA7-A1/A3), numerous Acheulean tools exhibit comparatively straight edges after ~1.4 Ma (KGA8-A1, KGA12-A1, KGA18-A1, and KGA20-A1/A2) (Plates 35, 56, 57, 59-65). The increase in frequency of straight-edged tools relates to both LCT dominance (over picks) and to refinement of LCT shape.

Advanced workmanship of the LCTs was achieved not only by finer flaking, but also by more intensive edge flaking (Beyene et al., 2013). While the flake scar counts of the handaxes at KGA6-A1 and KGA4-A2 are generally lower than the overall median value, the handaxes from KGA18-A1 and KGA20-A1/A2 show greater counts (Fig. 4.6). Cleavers also show an increase of flake scar count at ~0.85 Ma. That many of the LCTs at KGA18-A1 and KGA20-A1/A2 do not allow determination of primary form and flake type (Appendix Tables A2.8 and A2.9) reflects the intensive, invasive flaking of the ventral surfaces.

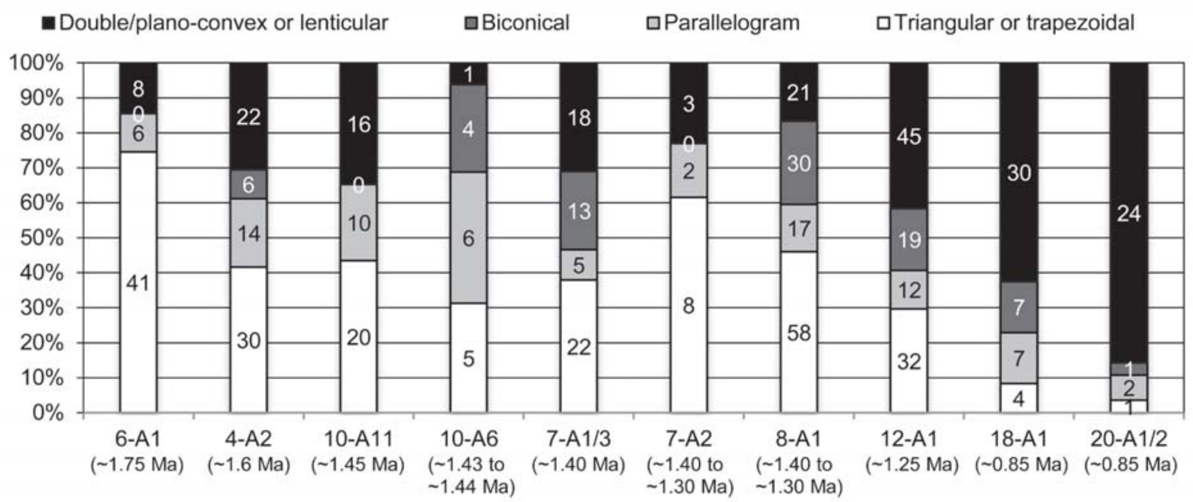

Fig. 4.4. Frequency of cross-section types among the Konso Acheulean sites.

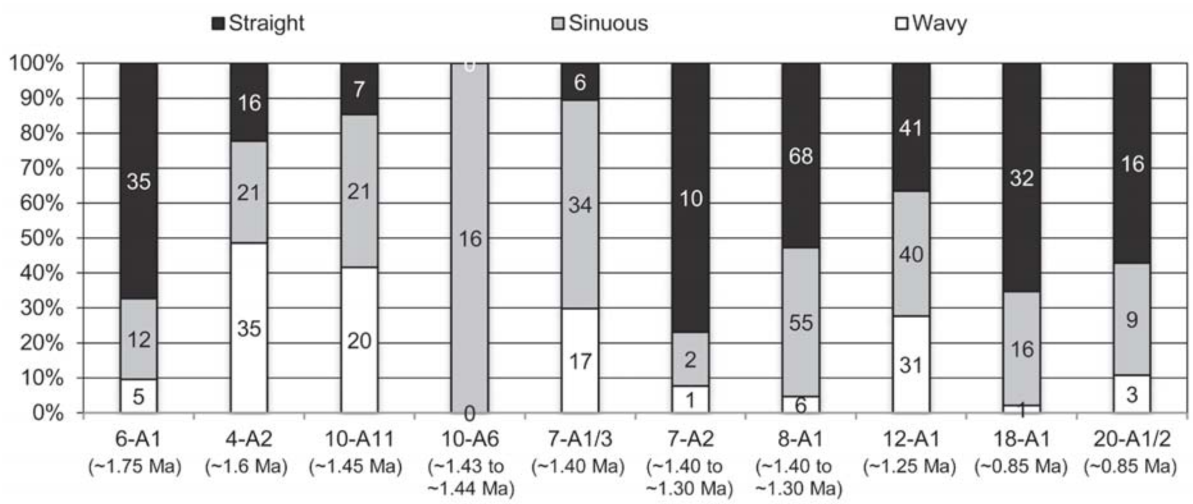

Fig. 4.5. Edge sinuosity of the Konso Acheulean tools.

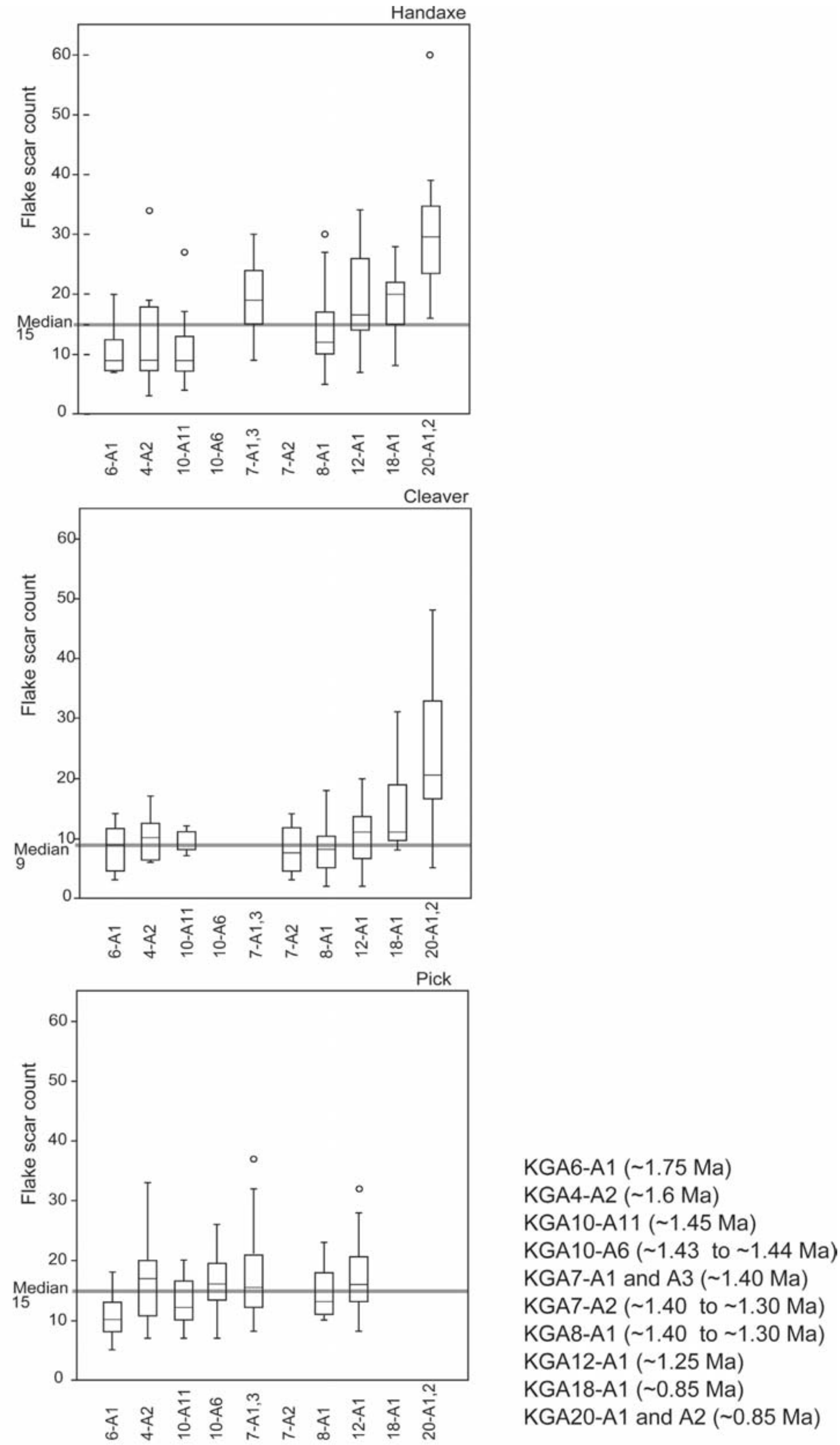

Fig. 4.6. Box plots of flake scar counts in hadaxes, cleavers, and picks. KGA10-A6 and KGA7-A2 handaxes, KGA10-A6 and KGA7-A1 and A3 cleavers, and KGA7-A2, KGA18-A1, and KGA20-A1 and A2 picks are not ploted because of small sample sizes (less than five). Gray lines show median of the total flake scar counts of handaxes, cleavers, and picks.

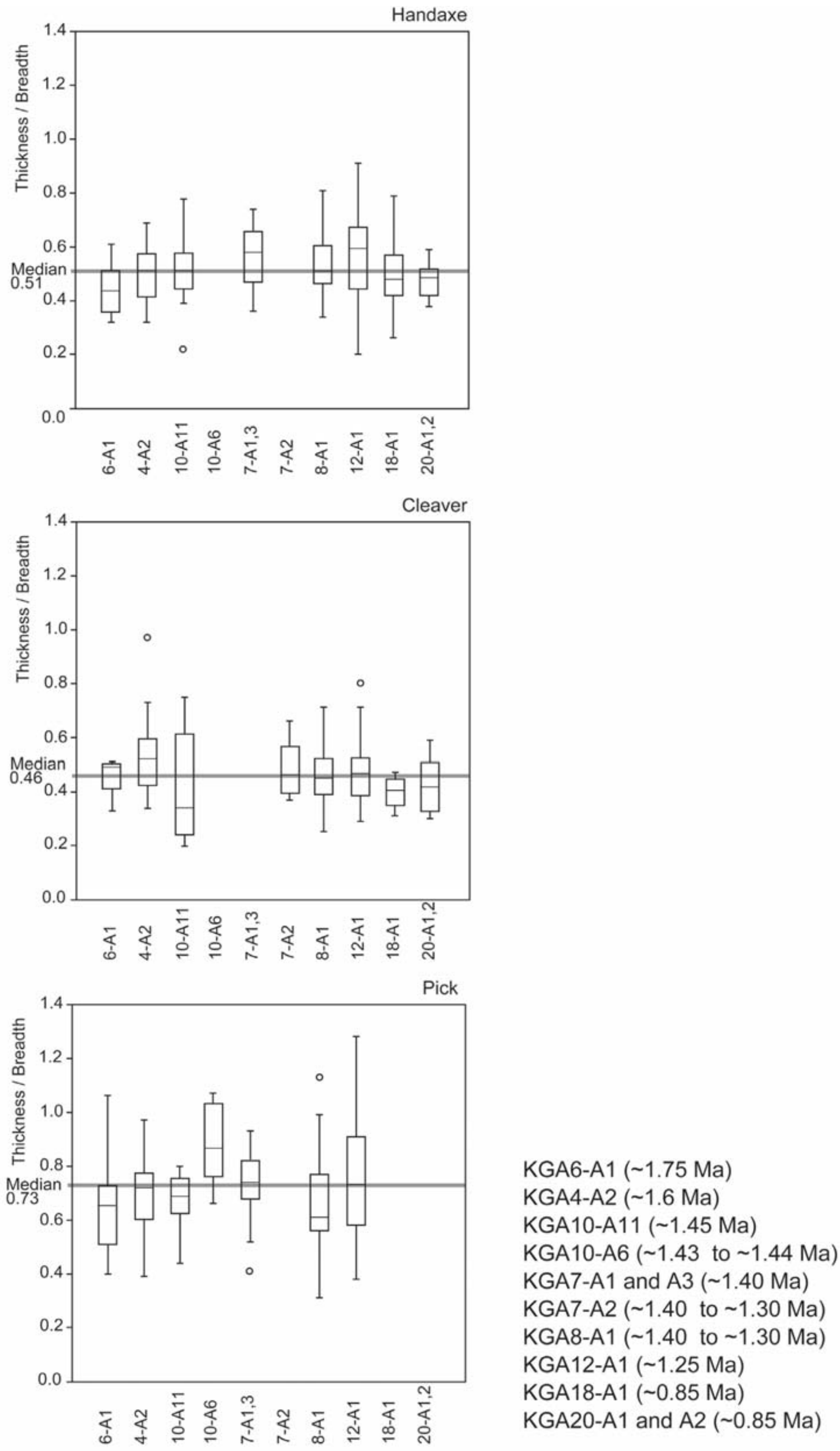

Fig. 4.7. Box plots of relative thickness (thickness/breadth) in hadaxes, cleavers, and picks. KGA10-A6 and KGA7-A2 handaxes, KGA10-A6 and KGA7-A1 and A3 cleavers, and KGA7-A2, KGA18-A1, and KGA20-A1 and A2 picks are not ploted because of small sample sizes (less than five). Gray lines show median of the total thickness/breadth values of handaxes, cleavers, and picks.

The thickness/breadth ratios of handaxes and cleavers at KGA18-A1 and KGA20-A1/A2 are lower than those of the chronologically older KGA sites (Fig. 4.7). The anomalously low value of relative thickness of the KGA6-A1 handaxes is due to the fact that unifacially produced handaxes dominate this small sample. Scatter plots of relative thickness against flake scar count (Fig. 4.8) show that, at Konso, intensive flaking of handaxes prior to 1.2 Ma did not result in a reduction of thickness. On the contrary, a slight increase of relative thickness accompanies intensive flaking. This tendency is caused by edge modification involving relatively steeper flaking that reduces tool breadth, but does not result in thinning. On the other hand, at ~0.85 Ma, the Konso LCTs were thinned by flaking. Unlike the >1.2 Ma handaxes repeated flaking did not result in thicker tools (Fig. 4.8). The ability to control LCT thicknesses during intensive modifications is a technological advance that involves shallow, invasive flaking, probably representing routine/intensive use of the soft hammer technique.

The tendency for thinner LCTs in the ~0.85 Ma Konso assemblages is clearly seen from the thickness values at KGA18-A1 and KGA20-A1/A2 (Appendix Table A2.11). The low thickness values of the KGA6-A1 and KGA7-A1/A3 handaxes are due to their overall smaller dimensions. Otherwise, it can be seen that the handaxe and cleaver mean thicknesses are much lower at KGA18-A1 than at the other sites. The KGA18-A1 LCTs are thin, even though their flake scar counts are low and comparable to the chronologically earlier KGA12-A1 counts (Table A2.17). This is because the thin KGA18-A1 LCTs were made on thinner flake blanks. Thus, the ~0.85 Ma knappers obtained better-shaped thin handaxes and cleavers by means of two advanced technological strategies: 1) shallower flaking and 2) production of thinner blanks.

Summary of temporal trends

The Konso Acheulean assemblages demonstrate obvious temporal advances in multiple aspects of techno-morphology. The picks are typologically most dominant at KGA6-A1 and KGA4-A2. They are crudely made and are massive in appearance. They often exhibit a characteristically notched tip. The morphological similarities between the older KGA6-A1 and the more abundant KGA4-A2 picks can be inferred as a functional and/or stylistic continuity of picks from ~1.75 Ma to ~1.6 Ma. On the other hand, the frequency of bifacially made picks and handaxes slightly increases at KGA4-A2, and the handaxes tend to be better shaped than at KGA6-A1.

Between ~1.6 Ma and ~1.25 Ma, while the Konso Acheulean assemblages are characteristically diverse, there is a clear increase of workmanship/skill manifested in the handaxes and cleavers, especially those from the ~1.4–1.3 Ma KGA8-A1 and the ~1.25 Ma KGA12-A1 sites. Not only do handaxes of these assemblages tend to be better-shaped, the LCTs (handaxes, cleavers and knives) numerically dominate over picks. A finer bifacial flaking technology resulted in increased frequencies of straight edges and biconvex or semi-biconvex cross-section types. Moreover, a greater number of LCTs exhibits symmetric plan outlines and thinner tips.

Finally, at ~0.85 Ma, the previously dominant heavy-duty type picks are not as abundant, and handaxe/cleaver frequency exceeds 80%. These handaxes and cleavers, at KGA18-A1 and KGA20-A1/A2, are more clearly refined in plan form, edge sinuosity, and cross-section shape. This refinement is based on the combination of an advanced flake-blank detaching technology for production of large thin blanks, and the common application of shallow, invasive flaking capacities. The better-made handaxes and cleavers of this time period tend to be standardized in morphology, exhibiting a substantially thin, 3-dimensionally symmetric form with fine straight edges.

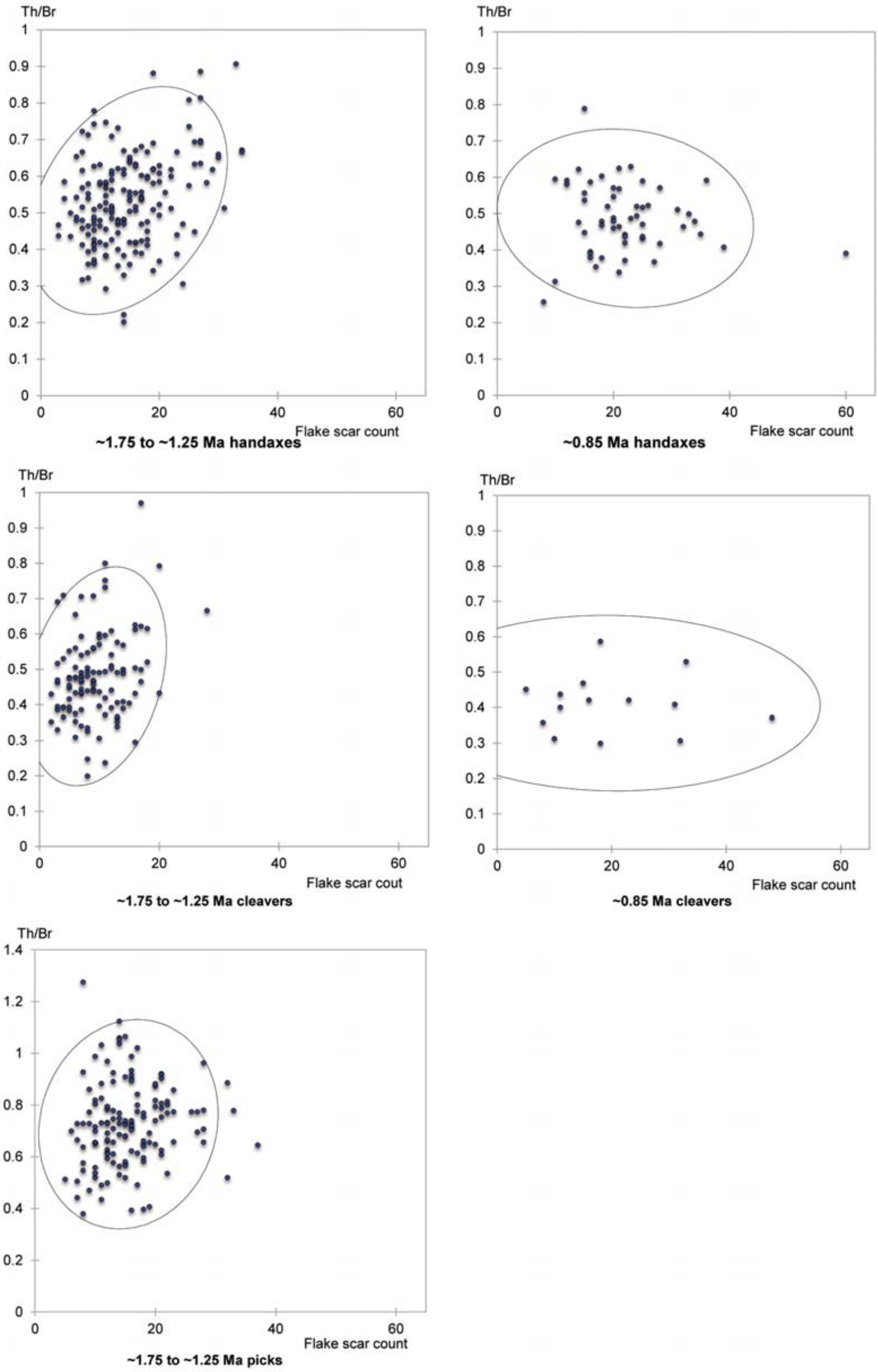

Fig. 4.8. Scatterplots of relative thickness vs. flake scar count. In the ~1.75 to ~1.25 Ma assemblages, relative thickness of handaxes and cleavers increases with flake scar counts: handaxes (n =168), r = 0.350, P < 0.001; cleavers (n = 113), r = 0.263, P = 0.005; picks (n = 140), r = 0.105, P = 0.218. In the ~0.85 Ma handaxes and cleavers, a positive correlation was not observed: hadaxes (n = 55), r = -0.096, P = 0.484; cleavers (n = 14), r = -0.027, P = 0.947.

4.3 BLANK PREDETERMINATION TECHNOLOGY

The Konso early Acheulean is characterized by a strong preference for utilizing large flake blanks, consistently from ~1.75 Ma through ~0.85 Ma. In the above section, we focused on the techno-morphological characteristics of the Konso assemblages as seen primarily from the attribute analysis. In this section, we outline some other more qualitative aspects of the advanced knapping capacities seen in the Konso early Acheulean technology.

Large Cores

The Konso LCTs are made on large flake blanks, often exceeding 20 cm maximum diameters. This forecasts the presence of giant cores. We observed such large cores at several localities as surface finds. Although no giant core was recovered from our limited excavations, the few surface occurrences of giant cores are undoubtedly associated with the Acheulean LCTs. This is clear from an example of *in situ* occurrence of a giant core that we observed in summer 2013 at KGA10 just northwest of the quartz-tool rich KGA10-A6 to KGA10-A8 area (Fig. 4.9).

This giant core is on a quartz slab, and was observed partially exposed in the near-vertical erosional section (of the silt/sand/small gravel section) at approximately the same stratigraphic level as inferred for the KGA10-1 *Homo erectus* mandible (at KGA10-A1) and the KGA10-A6 artifacts. Because of the much lower energy inferred for the encasing sediments (predominantly silt and sands), this giant core was probably moved to its location (by hominids) and knapped multi-directionally. Other giant and large cores (as defined by Sharon, 2009; see also Clark and Schick,

Fig. 4.9. Giant quartz core embedded in a section at KGA10 northwest of the KGA10-A6 to KGA10-A8 area (August 8, 2013, Berhane Asfaw pointing to the quartz core).

2000) made on quartz blocks were found on the surface at multiple locations of the south face of KGA10, mostly at or near the KGA10-A6 to A8 site areas (see Chapter 2 Fig. 2.4 for locations of KGA10-A6 and A8). These giant cores are either bi-directionally or multi-directionally flaked. Their occurrences at KGA10 coincide with occurrence of quartz vein outcrops in the general vicinity today and also probably at the time of deposition. Judging from the quartz-rich component of many of the KGA10 assemblages (e.g., KGA10-A6), but not at most other localities, a predominantly local procurement and use of raw materials is suggested broadly at the locality scale (<1 to at most several kilometers) (see Chapter 2 Fig. 2.3 for locality placements and sizes).

A large and heavy polyhedron made on quartz was collected as a surface find probably from the KGA10-A6 stratigraphic level (Plate 67). It measures 220 × 200 × 190 mm, and its circumference is 650 mm. It has a small portion of the cortex/talon preserved, which was used as a platform. At least five large flakes were removed from this platform, the largest three of these flake scars measure 125 × 93 mm, 102 × 82 mm, and 75 × 80 mm. Other medium-sized or small flake scars occur, totaling >28. This polyhedron was extensively used and shows strong battering on all its face, especially the ridges which were crushed and battered and became rounded. The size of the flake scars testifies that the polyhedron began as a core and then was used as a large and heavy hammer stone. This might have been used by the swing method (Semaw et al., 2009) to detach large flakes from big boulders or to crush and extract marrow from large mammal bones, or to perform both activities.

At KGA8 giant core quartzite slabs were found, similar to the quartz slabs of KGA10. Some of these show *éclat entame* (opening cortical flake) scars and subsequent flaking of a large single flake. A notable cluster of several of these examples was observed ~70 meters west of the KGA8-A1 collection site, albeit in secondary context (farmed outcrop). We simply note that KGA8-A1 is characterized by high frequencies of quartzite LCTs and that some of these exhibit possibly platforms indicative of slab cores (Plate 42). Of interest is to establish the original source or parental rock quarry of these giant cores, which are so far elusive. The KGA8 sediments are in fault contact with or overlie the Precambrian basement, which today forms the marginal hillslopes, the possible source of the quartzite cores. As with the KGA10 evidence, a predominantly local procurement and manufacture of the giant cores is suggested.

We collected two examples of giant cores, one near the KGA6-A1 site (1.75 Ma) (Plate 68), and another at KGA4-EE (~1.45 Ma) (Plate 69). The latter is an outcrop patch, east of the KGA4 collecting area, that was established during the follow-up survey of 2010. Here representative artifacts were collected without designating specific site names. Both of these giant cores are on basalt. The entire artifact assemblages at both localities are dominated by basalt. As was the case with the quartz and quartzite examples discussed above, these basalt giant cores were almost certainly locally collected and used. These cores were probably boulders that were brought to the site by the hominids, and the quarry site was probably close by. At KGA4-EE, a basalt hill occurs adjacent to the sediment patch, and large boulders were probably abundantly available at the time of deposition. At KGA6, the current Kayle River bed-load exhibits similar-sized basalt boulders that derive from nearby basalt outcrop sources. At the time of deposition, such outcrop sources must have also existed nearby.

The KGA6-2013-0 core (Plate 68) was discovered on the surface at KGA6 several tens of meters north of the KGA6-A1 excavation site. It is possible that it eroded out from stratigraphic levels equivalent to the KGA6-A1 archaeological horizon. The core is made on a basalt boulder and is multi-directionally flaked. A large, in part, denticulated edge is formed by the intersection of large flake scars made on both faces. The size of this core is 270 × 180 × 180 mm. Flake scars measure 150 × 99 mm, 135 × 105 mm, 105 × 105 mm, and 143 × 100 mm. The flake scar sizes are indicative of large blanks suitable for making LCTs.

KGA4-EE-A (Plate 69) is a large and heavy bi-directionally worked core on a basalt boulder with large flake scars. The core measures 310 × 250 × 245 mm. The detached flakes were large and could have been used as blanks for making LCTs. The length and breadth of the largest flake scar measures 204 × 182 mm and the second largest flake scar measures 178 × 164 mm. The source of the basalt boulders are inferred to have been nearby (see above). Together with the abundance of basalt LCTs that we observed at KGA4-EE, the giant core suggests local raw material use and on site making of the large cutting tools.

Radially flaked large cores

In addition to the giant or large cores used in the production of large flake blanks for making the LCTs and picks, we also discovered highly distinctive large–medium sized cores at a number of localities. Some of these exhibit features suggesting a preconceived sequence of core reduction. Two of these examples are illustrated in Plates 70 and 71, both collected at KGA4-EE. They are in the form of large discoidal cores >150 mm in maximum diameter. Another example was collected at KGA12 (Plate 72) from one gully west of the KGA12-A1 site. This is a large radially flaked bifacial centripetal core on basalt, measuring 206 × 156 × 118 mm. Large flakes were removed from both faces in a centripetal direction. There are 20 flake scars each on the dorsal and ventral faces. One large flake (138 × 78 mm) was ventrally removed with a blow from the proximal end. On the dorsal face, flake scars were also removed from the mid-ridge in a localized fashion towards both lateral sides. This core shows the application of a prepared core technique for the removal of a large flake, perhaps a cleaver.

The Kombewa core technique

The KGA7-A2 site is unique in the occurrence of large flake tools which are almost exclusively made on quartzite (12 out of a total of 17 pieces). This assemblage is dominated by large cutting tools made on flakes. Five of these LCTs (cleavers and knives) are made on Kombewa flakes, all of them on quartzite (Plates 29–32). One piece shows a thick platform from which both dorsal and ventral faces were detached, showing two bulbs and two positive surfaces (Plate 32: KGA7-A2 13). Others have two platforms (Plate 29: KGA7-A2 1 and Plate 31: KGA7-A2 18). The platforms are usually removed by flaking. The cleavers made on Kombewa flakes are either parallel sided with a straight cleaver bit at the distal end or are side cleavers. Some have been retouched with scraper-like flaking. Differentiating between side cleavers and knives is sometimes difficult, either typologically or technologically.

The KGA7-A2 Kombewa technique shows the ease with which these flake blanks were removed. Similar quartzite tools occur at KGA8-A1, >1 km from KGA7-A2. The assemblages from the two sites are possibly time equivalent (see Chapter 2). At KGA8-A1, as with the KGA7-A2 assemblage, Kombewa flakes were used to make LCTs. However, the Kombewa flakes at KGA8-A1 are less frequent, perhaps in part because of difficulty in identifying them due to the exhaustive flaking. Only two Kombewa flakes were identified with certainty, one made into a cleaver (Plate 37: KGA8-A1c 2) and another into a large scraper. The platforms are at the proximal end, and show modification (removal) by flaking. There are instances of considerable similarity of Kombewa flake-based LCTs, for example between two end struck Kombewa flakes, one from KGA7-A2 (Plate 32: KGA7-A2 13) and the other from KGA8-A1 (Plate 37: KGA8-A1c 2). The similarities are in workmanship and in the applied technique. This resulted in a thick proximal platform worked by large flake scars.

At KGA12-A1, a Kombewa flake tool was recovered. The Kombewa flake blank on quartzite was used to make a cleaver (KGA12-A1 12, not figured). This piece shows two blank flaking surfaces. Its ventral flaking surface is worked exhaustively. The platforms are removed by large, semi-abrupt and invasive flake scars.

Other prepared core techniques

At KGA8-A1 we found a number of LCTs which show prepared core techniques that are not either Levallois or Kombewa. The resulting LCTs are mostly cleavers and knives. A notable example is an LCT that exhibits successive flaking from a single large quartzite slab (Plate 42: KGA8-A1 23). In this technique, flakes were detached using the same platform and same detaching direction. In other words, the platform of the former blank negative and the platform of the present flake blank were continuous. This is indicative of a simple pattern applied in exploiting the same slab/core using the same platform.

Other pieces from KGA8-A1 show knapping of blanks with predefined forms (Plates 36–40). The technique applied involves the knocking off of a flake to determine the desired cleaver bit at the preparation stage of the core (before detaching the cleaver flake blank) and some more flakes shaping the lateral sides. The dorsal face of the resulting blank shows centripetal invasive and semi-abrupt flake scars. The platform is prepared with few blows and at last the LCT blank is detached with a decisive blow from the core. The proximal area of the blanks is usually thick and the blank gets progressively thinner towards the distal end. In most cases, the platform and the bulb are reduced by abrupt/semi-abrupt flaking. The mid-lateral to distal area shows an oblique cleaver/knife type of natural sharp cutting edge (either on one side or on both sides of the blank) which is left unmodified.

Although only one Kombewa flake was identified at KGA12-A1, a considerable number of artifacts attest to core preparation during LCT manufacture (Plates 51, 52). This is evident in both quartzite and basalt. The flaking technique on the dorsal face shows that centripetal flaking was applied from two to three sides before the blank was detached from the core. Two examples exhibit a large negative flake scar at the center of the dorsal face (Plates 49, 50). These pieces give an impression of a crude Levallois-like preparation of cores. However, because the frequency of such flake scars are minimal, and there appear to be no indication of standardization of such dorsal flakes, these were probably accidental products that mimic later prepared core standardized flaking.

Discussion

As noted in Sharon (2009) the purpose of the process of knocking off large flakes is to consistently acquire usable desired-shaped large flakes. Such large flakes were preconceived prior to their detachment via a "prepared core" thought process.

At Konso, it is possible that the earliest Acheulean at the ~1.75 Ma KGA6-A1 and ~1.6 Ma KGA4-A2 sites exhibit actual examples of production of desired-shaped blanks. This is seen in the cleavers (Plate 11: KGA4-A2 4) that exhibit flaking patterns that approximate "predetermined" formation of a cleaver working edge, and suggests that such advanced technology might extend back to the dawn of the Acheulean. An *in situ* cleaver from the excavation at KGA6-A1 (Plate 3: KGA6-A1-Loc.C O3) is another example, testifying to the complex technological template from the earliest Acheulean. However, since the number of such examples is still limited, these may also be from chance factor.

Higher in the Konso sequence, especially after ~1.4 Ma, a remarkably high frequency of a variety of core preparation techniques appear to have been applied prior to LCT blank detachment.

These include the Kombewa technology, successive flaking from single platforms of slab cores, centripetal core preparation, and platform preparation suggested from multifaceted platforms. The emergence of this suite of techniques appears to correspond in timing with the comparatively refined morphologies of the KGA8-A1 and KGA12-A1 handaxes. This indicates that, at this time, the entire LCT production operation was being refined with regards to both final shape-product and efficiency of manufacture.

4.4 SUMMARY AND CONCLUSIONS

The earliest Konso Acheulean occurs at ~1.75 Ma, which broadly coincides with the emergence of the oldest Acheulean lithic artifacts known at west of Lake Turkana (Lepre et al., 2011). The near-simultaneous appearance of the earliest Acheulean assemblages in both the Turkana and Konso basins indicates that this new technology was somewhat widespread by at least ~1.75 Ma (Beyene et al., 2013). The recently refined Turkana basin chronology shows that the earliest definite and well-provenanced *H. erectus* fossil, KNM-ER 3733, is best dated at 1.7–1.65 Ma (Suwa et al., 2007; Lepre and Kent, 2010; McDougall et al., 2012). Thus, the emergence of the earliest crude Acheulean technology must have broadly corresponded with, or closely preceded, the emergence of a *H. erectus*-like morphology within the early *Homo* lineage.

It is worth noting that most of the ~1.75 Ma KGA6-A1 Acheulean tools were made on large, thick flakes. The predominant use of large flake blanks than cobbles at KGA6-A1 and the other Konso sites almost certainly stems from easy access to basalt boulders. This allowed the hominids to detach large flakes and adopt a new lithic manufacture system characteristic of the Acheulean technology (Semaw et al., 2009; Sharon, 2008, 2009). Nonetheless, form modification was still by means of minimal and crude flaking, and mostly unifacial. Flake scar counts remained low. Almost one fourth of the LCTs/picks retained cortex on over 50% of their dorsal surface. Consequently, these ~1.75 Ma Acheulean tools exhibited thick pointed tips and roughly- or non-modified butts, and were consistently triangular or trapezoidal in cross-section form. The west Lake Turkana ~1.75 Ma Acheulean assemblages also seem to share these features (Roche, 2003; Texier et al., 2006; Leper et al., 2011).

While the earliest Acheulean tools made on large flake blanks imply advanced motor skill and cognition, the predominance of picks and an overall heavy duty-like morphology of the LCTs suggest that these were at an early stage of the Acheulean technology. These Acheulean tools might have needed substantial bulk and weight that was advantageous in their use. Despite the still crude workmanship of the ~1.75 Ma Acheulean tools, the new tool inventory of handaxes, cleavers, and picks might have allowed early *Homo erectus* to expand into new activities, or engage more effectively in activities already based on the Oldowan technology, such as wood-chopping, cutting and scraping, butchering, and perhaps extracting/processing of underground storage organs (Keeley and Toth, 1981; Lemorini et al., 2014).

Although the ~1.6 Ma KGA4-A2 assemblage exhibits techno-morphological similarities with the KGA6-A1 assemblage, some more typical Acheulean features are manifested. This is seen in the increase in handaxe and cleaver frequencies and their better-shaped morphologies. The KGA4-A2 Konso assemblages seem broadly analogous in workmanship with the early Acheulean of Olduvai Gorge middle Bed II (Leakey, 1971), such as represented at EF-HR (~1.6–1.5 Ma). At Konso, both handaxes and cleavers exhibit a clear trend towards gradual refinement and standardization of morphology through time. By 1.4–1.25 Ma, advanced workmanship is seen in cross-section form, edge sinuosity, tip thinning, and plan form symmetry, and these are especially enhanced at KGA8-A1 and KGA12-A1. In contrast, such functionally relevant refinement seems to be less conspicuous in picks. Although the picks from KGA7-A1/A3 exhibit a distinctive morphology which may have been caused by the use of cobles as a blank or some functional requirement, the general style of the Konso picks represented by a massive butt and a pointed narrow tip with steep-angled edges did not change much through time. This relatively consistent shape of picks suggests that pick functions were already fulfilled by the earlier ~1.75 Ma to ~1.6 Ma shapes and technologies.

Simultaneously with the increase of LCT workmanship, blank predetermination technologies seem to have taken on a diverse and sophisticated repertoire. This is amply documented at KGA7-A2, KGA8-A1, and KGA12-A1, and includes application of the Kombewa technique and the common use of centripetal core preparation, platform preparation, and planned sequential blank removal. Despite the limited samples, the presence of these advanced techniques, especially at the ~1.4–1.25 Ma levels of the Konso Acheulean sequence, suggests that production technology changed from the primary simple method centered on production of large thick flakes with little modification to methods that involve additional steps of predetermination aimed for efficiency. Thus, blank predetermination and blank shaping technologies both seem to have advanced through time, noticeably between ~1.6 Ma and ~1 Ma.

Sometime after ~1 Ma, either late *Homo erectus* or their descendent lineages attained additional levels of advanced flaking technology. These would be the techniques that enabled the detaching of thin blanks, as well as the routine use of soft hammer techniques in extensive and refined shaping of the blanks. The substantial reduction of LCT thickness seen in the ~0.85 Ma Konso assemblages was thus obtained by using thinner blanks and by shallower flaking of the blank surfaces.

The inclination for thinner LCTs was probably a response to enhanced functional requirements in cutting activities. This is also reflected in the high frequency of handaxes and cleavers and their increasingly straight edges. Experimental studies indicate that Acheulean handaxes usefully functioned in cutting skin and meat, and that bifacially flaked straight edges are more durable than unretouched flakes (Jones, 1980; Mitchell, 1995, 1997). The large early Acheulean handaxes with long edges and an enormous butt is advantageous in butchering, in efficiently removing skin, in cutting meat, and for expending energy in holding the handaxe (butt) especially in disjointing (Jones, 1980). Despite the limited examples of use-wear analysis of Acheulean handaxes (Mitchel, 1995, 1997), carcass processing was probably a prime task of the Acheulean handaxes. Their advanced morphological refinement and assumed functional enhancement suggest an increase in demand for meat procurement. This technologically supported change in diet probably resulted in enhanced energy budget capacities needed as a background for growing and evolving larger brains (Martin, 1996; Snodgrass et al., 2009).

Advanced flaking technologies enabled advanced LCT standardization, leading to substantially thinned and symmetric LCTs in both cross-section and outline that qualify as approaching "three-dimensional symmetry" (Wynn, 2002). Manufacture of 3-dimensionally symmetric tools is considered to require advanced mental imaging capacities. Such tools might have emerged in association with advanced spatial and navigational cognition, perhaps related to an enhanced mode of hunting adaptation.

At Konso, advanced-shaped LCTs occur at the ~0.85 uppermost stratigraphic levels. In Ethiopia, similarly advanced LCTs have been recovered from the Melka Kunture Gombore II site dated at ~0.8 Ma (Gallotti et al., 2010). However, the known ~0.95 Ma Acheulean assemblages of Bouri, Ethiopia (Clark, 2000) do not include comparably advanced 3-dimensionally symmetric Acheulean tools. At the ~0.7 to <1.0 Ma sites in Kenya, variable LCTs were reported with some presence of refined handaxes (Isaac, 1977; Gowlett, 1988, 2011; Roche et al., 1988; Potts et al., 1999). It would be of interest to pursue the spatio-temporal processes of this technological advance, as this may reflect cognitive evolution (Stout, 2011).

The long Acheulean sequence at Konso spanning ~1.75 to ~0.85 Ma importantly reveals new aspects of the emergence and development of the Acheulean technology. This in turn leads to a better understanding of the behavioral and biological evolution of the genus *Homo*.

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APPENDIX 1

Coding System of Artifact Attributes: Large Cutting Tools + Heavy Duty Tools

1. RAW MATERIAL
    - 1: Basalt
    - 2: Quartzite
    - 3: Quartz
    - 4: Limestone
    - 5: Metamorphic Indet.
    - 6: Ignimbrite
    - 7: Sandstone
    - 8: Rhyolite
    - 9: Siliceous rocks (e.g., chert)
2. PHYSICAL CONDITION
    - 1: Fresh
    - 2: Moderately weathered
    - 3: Weathered
    - 4: Eolised
    - 5: Patina
3. SPECIFIC TOOL TYPE (Large Cutting Tools / Heavy Duty Tools)
    - 0: Discoid
    - 1: Pointed handaxe
    - 2: Elongate ovate handaxe
    - 3: Ovate handaxe
    - 4: Double pointed handaxe
    - 5: Acuminate ovate handaxe
    - 6: Pointed handaxe
    - 7: Triangular handaxe
        - a. Triangular
        - b. Elongate
        - c. Sub triangular
    - 8: Unifacial handaxe
    - 9: Limande
    - 10: Biseau-bitted handaxe
    - 11: Ultra convergent cleaver
    - 12: Convergent cleaver
    - 13: Parallel sided cleaver
    - 14: Divergent cleaver
    - 15: Side cleaver
    - 16: Double ended cleaver
    - 17: Splayed cleaver
    - 18: Asymmetric convergent cleaver

19: Atypical cleaver (accidental/opportunistic)
20: Pick
a. Trihedral
b. Bifacial
c. Roughly trimmed butt
d. High backed
e. Spindle
f. Untrimmed butt
g. Beaked
h. Cobble
i. Block
j. Core
k. Double pointed
l. Irregular
k. Quadrilateral
21: Knife
22: Large scraper
23: Cleaver biface
24: Core axe
25: Blank/modified flake
(25 or 25a: part bifaces, unfinished handaxe, 25b: blank/modified flake)
26: Levallois cleaver
99: Broken LCTs/HDTs

4. PRESENCE OF CORTEX
0: None
1: Small amount (<25% of the surface)
2: Modest (25-50% of the surface)
3: Much (>50 % of the surface)
8: Weathering surface (non cortical)
9: Indeterminate

5. PRIMARY FORM
1: Flake
2: Cobble
3: Indeterminate
4: Block

6 FLAKE TYPE
1: End struck
2: Side struck
3: Kombewa
4: Indeterminate

7. UNIFACIAL/BIFACIAL
1: Unifacial
2: Partly bifacial
3: Mostly/fully bifacial
4: Trihedral
5: Quadrilateral

(Note: trihedral and quadrilateral are taken for mostly fully flaked pieces)

8. DIMENSION
    1: LENGTH
    2: BREADTH maximum
    3: BREADTH 2 cm from tip
    4: BREADTH distal mid
    5: BREADTH proximal mid
    6: THICKNESS
    7: THCKNESS 2 cm from tip
9. CROSS-SECTION
    1: Double convex
    2: Plano-convex
    3: Lenticular
    4: Biconical
    5: Parallelogram
    6: Trapezoidal
    7: Triangular
    8: Irregular
10. SINUOSITY
    1: Wavy
    2: Sinuous
    3: Straight
11. EDGE ANGLE
12. BIFACE BUTT PLAN
    1: U-shaped
    2: V-shaped
    3: Straight
    4: Cortex
    5: Irregular
    6: Square
    7: Tools
    9: Indeterminate
13. INVASIVENESS
    1: Marginal
    2: Semi-invasive
    3: Invasive
14. FLAKE SCARS (Dorsal or "A" or "main")
15. FLAKE SCARS (Ventral or "B" or "secondary")
16. MAXIMUM DIMENSION OF FLAKE SCAR
17. CLEAVER EDGE PLAN
    1: Straight
    2: Convex
    3: Oblique/end
    4: Oblique/side
    5: Concave
    6: Irregular

18. CLEAVER BIT ANGLE
19. CLEAVER BIT DIMENSION

This coding system was developed by Y.B., the senior author of this volume, in conjunction with the late J. Desmond Clarke through collaborative work during the early to middle 1990s. The attribute coding system is based on terminology and definitions outlined in Clark and Schick (2000) and Kleindeinst (1962).

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APPENDIX 2

Tables of attribute analysis

Appendix 2 includes the following listings of Konso Acheulean lithic artifacts.

Table A2.1. Lithic categories of all collectged pieces. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
LCTs/HDTs	61	72	54	20	63	17	201	137	58	28	711
Flakes	35	64	61	-	65	-	31	165	-	18	439
Chunks	12	9	21	-	0	-	50	119	-	0	211
Retouched angular fragments	0	0	7	-	0	-	2	0	-	0	9
Polyhedrons	0	0	2	-	0	-	11	3	-	0	16
Core/choppers	4	0	5	-	10	-	12	9	-	0	40
Cores	1	14	8	-	27	-	29	38	-	0	117
Split cobbles	0	0	3	-	0	-	1	2	-	0	6
Cobbles	3	0	14	-	6	-	11	26	-	0	60
Unidentified weathered pieces	0	0	0	-	0	-	6	245	-	0	251
Total	116	159	175	20	171	17	354	744	58	46	1860

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
LCTs/HDTs	52.6%	45.3%	30.9%	100.0%	36.8%	100.0%	56.8%	18.4%	100.0%	60.9%	38.2%
Flakes	30.2%	40.3%	34.9%	-	38.0%	-	8.8%	22.2%	-	39.1%	23.6%
Chunks	10.3%	5.7%	12.0%	-	0.0%	-	14.1%	16.0%	-	0.0%	11.3%
Retouched angular fragments	0.0%	0.0%	4.0%	-	0.0%	-	0.6%	0.0%	-	0.0%	0.5%
Polyhedrons	0.0%	0.0%	1.1%	-	0.0%	-	3.1%	0.4%	-	0.0%	0.9%
Core/choppers	3.4%	0.0%	2.9%	-	5.8%	-	3.4%	1.2%	-	0.0%	2.2%
Cores	0.9%	8.8%	4.6%	-	15.8%	-	8.2%	5.1%	-	0.0%	6.3%
Split cobbles	0.0%	0.0%	1.7%	-	0.0%	-	0.3%	0.3%	-	0.0%	0.3%
Cobbles	2.6%	0.0%	8.0%	-	3.5%	-	3.1%	3.5%	-	0.0%	3.2%
Unidentified weathered pieces	0.0%	0.0%	0.0%	-	0.0%	-	1.7%	32.9%	-	0.0%	13.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.2. Lithic raw materials of all collected pieces. Numbers and percentages by site.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Basalt	112	153	83	11	112	3	222	560	57	40	1353
Quartzite	1	0	1	0	10	12	64	73	0	3	164
Quartz	1	4	72	9	45	2	58	61	1	0	253
Metamorphic indet.	0	0	0	0	1	0	8	11	0	1	21
Ignimbrite	0	0	7	0	0	0	0	11	0	0	18
Rhyolite	0	0	0	0	1	0	1	23	0	2	27
Siliceous rock	1	2	4	0	1	0	1	2	0	0	11
Indeterminate	1	0	0	0	0	0	0	1	0	0	2
Total	116	159	167	20	170	17	354	742	58	46	1849

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Basalt	96.6%	96.2%	49.7%	55.0%	65.9%	17.6%	62.7%	75.5%	98.3%	87.0%	73.2%
Quartzite	0.9%	0.0%	0.6%	0.0%	5.9%	70.6%	18.1%	9.8%	0.0%	6.5%	8.9%
Quartz	0.9%	2.5%	43.1%	45.0%	26.5%	11.8%	16.4%	8.2%	1.7%	0.0%	13.7%
Metamorphic indet.	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	2.3%	1.5%	0.0%	2.2%	1.1%
Ignimbrite	0.0%	0.0%	4.2%	0.0%	0.0%	0.0%	0.0%	1.5%	0.0%	0.0%	1.0%
Rhyolite	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%	3.1%	0.0%	4.3%	1.5%
Siliceous rock	0.9%	1.3%	2.4%	0.0%	0.6%	0.0%	0.3%	0.3%	0.0%	0.0%	0.6%
Indeterminate	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.3. Lithic physical condition of all collected pieces. Numbers and percentages by site.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Fresh	21	4	88	9	47	14	93	126	1	12	415
Moderately weathered	68	137	57	1	72	1	69	224	11	34	674
Weathered	27	18	23	10	34	2	189	359	46	0	708
Eolised	0	0	0	0	1	0	1	1	0	0	3
Patinated	0	0	4	0	13	0	2	34	0	0	53
Total	116	159	172	20	167	17	354	744	58	46	1853

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Fresh	18.1%	2.5%	51.2%	45.0%	28.1%	82.4%	26.3%	16.9%	1.7%	26.1%	22.4%
Moderately weathered	58.6%	86.2%	33.1%	5.0%	43.1%	5.9%	19.5%	30.1%	19.0%	73.9%	36.4%
Weathered	23.3%	11.3%	13.4%	50.0%	20.4%	11.8%	53.4%	48.3%	79.3%	0.0%	38.2%
Eolised	0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%	0.1%	0.0%	0.0%	0.2%
Patinated	0.0%	0.0%	2.3%	0.0%	7.8%	0.0%	0.6%	4.6%	0.0%	0.0%	2.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.4. Typological categories of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Handaxes	8	20	17	2	15	4	64	38	39	16	223
Cleavers	5	13	7	0	4	8	48	31	9	8	133
Picks	15	26	13	14	33	0	14	25	0	4	144
Knives	0	1	1	0	0	1	4	11	1	0	19
Large scrapers	2	4	3	0	0	0	18	2	4	0	33
Core axes	0	1	4	1	1	0	1	6	0	0	14
Part bifaces	4	2	3	2	4	0	19	7	2	0	43
Blanks/modified flakes	21	4	2	1	3	1	14	4	1	0	51
Broken LCTs/HDTs	6	1	4	0	3	3	19	13	2	0	51
Total	61	72	54	20	63	17	201	137	58	28	711

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Handaxes	13.1%	27.8%	31.5%	10.0%	23.8%	23.5%	31.8%	27.7%	67.2%	57.1%	31.4%
Cleavers	8.2%	18.1%	13.0%	0.0%	6.3%	47.1%	23.9%	22.6%	15.5%	28.6%	18.7%
Picks	24.6%	36.1%	24.1%	70.0%	52.4%	0.0%	7.0%	18.2%	0.0%	14.3%	20.3%
Knives	0.0%	1.4%	1.9%	0.0%	0.0%	5.9%	2.0%	8.0%	1.7%	0.0%	2.7%
Large scrapers	3.3%	5.6%	5.6%	0.0%	0.0%	0.0%	9.0%	1.5%	6.9%	0.0%	4.6%
Core axes	0.0%	1.4%	7.4%	5.0%	1.6%	0.0%	0.5%	4.4%	0.0%	0.0%	2.0%
Part bifaces	6.6%	2.8%	5.6%	10.0%	6.3%	0.0%	9.5%	5.1%	3.4%	0.0%	6.0%
Blank/modified flakes	34.4%	5.6%	3.7%	5.0%	4.8%	5.9%	7.0%	2.9%	1.7%	0.0%	7.2%
Broken LCTs/HDTs	9.8%	1.4%	7.4%	0.0%	4.8%	17.6%	9.5%	9.5%	3.4%	0.0%	7.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.5. Raw materials of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
LCT/HDT Basalt	61	72	40	11	59	3	133	88	57	25	549
LCT/HDT Quartzite	0	0	1	0	0	12	51	24	0	1	89
LCT/HDT Quartz	0	0	8	9	2	2	15	5	1	0	42
LCT/HDT Metamorphic indet.	0	0	0	0	1	0	0	0	0	0	1
LCT/HDT Ignimbrite	0	0	5	0	0	0	0	8	0	0	13
LCT/HDT Rhyolite	0	0	0	0	1	0	1	12	0	2	16
LCT/HDT Siliceous rock	0	0	0	0	0	0	1	0	0	0	1
LCT/HDT Indeterminate	0	0	0	0	0	0	0	0	0	0	0
Total	61	72	54	20	63	17	201	137	58	28	711

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
LCT/HDT Basalt	100.0%	100.0%	74.1%	55.0%	93.7%	17.6%	66.2%	64.2%	98.3%	89.3%	77.2%
LCT/HDT Quartzite	0.0%	0.0%	1.9%	0.0%	0.0%	70.6%	25.4%	17.5%	0.0%	3.6%	12.5%
LCT/HDT Quartz	0.0%	0.0%	14.8%	45.0%	3.2%	11.8%	7.5%	3.6%	1.7%	0.0%	5.9%
LCT/HDT Metamorphic indet.	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
LCT/HDT Ignimbrite	0.0%	0.0%	9.3%	0.0%	0.0%	0.0%	0.0%	5.8%	0.0%	0.0%	1.8%
LCT/HDT Rhyolite	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	0.5%	8.8%	0.0%	7.1%	2.3%
LCT/HDT Siliceous rock	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.1%
LCT/HDT Indeterminate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.6. Physical condition of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1,A 2	Total
LCT/HDT Fresh	13	0	16	9	6	14	68	49	1	5	181
LCT/HDT Moderately weathered	37	72	30	1	37	1	42	68	11	23	322
LCT/HDT Weathered	11	0	8	10	19	2	91	18	46	0	205
LCT/HDT Eolised	0	0	0	0	1	0	0	1	0	0	2
LCT/HDT Patinated	0	0	0	0	0	0	0	1	0	0	1
Total	61	72	54	20	63	17	201	137	58	28	711

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
LCT/HDT Fresh	21.3%	0.0%	29.6%	45.0%	9.5%	82.4%	33.8%	35.8%	1.7%	17.9%	25.5%
LCT/HDT Moderately weathered	60.7%	100.0%	55.6%	5.0%	58.7%	5.9%	20.9%	49.6%	19.0%	82.1%	45.3%
LCT/HDT Weathered	18.0%	0.0%	14.8%	50.0%	30.2%	11.8%	45.3%	13.1%	79.3%	0.0%	28.8%
LCT/HDT Eolised	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%	0.7%	0.0%	0.0%	0.3%
LCT/HDT Patinated	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.7. Cortex ratio on the surfaces of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
None	26	33	22	4	19	11	68	54	37	16	290
Small amont (<25%)	7	21	13	10	19	1	42	33	7	5	158
Modest (25-50%)	5	10	6	3	5	1	12	14	1	3	60
Much (>50%)	13	6	4	0	7	0	5	7	1	3	46
Indeterminate	4	2	3	0	9	0	2	3	2	1	26
Total	55	72	48	17	59	13	129	111	48	28	580

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
None	47.3%	45.8%	45.8%	23.5%	32.2%	84.6%	52.7%	48.6%	77.1%	57.1%	50.0%
Small amont (<25%)	12.7%	29.2%	27.1%	58.8%	32.2%	7.7%	32.6%	29.7%	14.6%	17.9%	27.2%
Modest (25-50%)	9.1%	13.9%	12.5%	17.6%	8.5%	7.7%	9.3%	12.6%	2.1%	10.7%	10.3%
Much (>50%)	23.6%	8.3%	8.3%	0.0%	11.9%	0.0%	3.9%	6.3%	2.1%	10.7%	7.9%
Indeterminate	7.3%	2.8%	6.3%	0.0%	15.3%	0.0%	1.6%	2.7%	4.2%	3.6%	4.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.8. Primary forms of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Flake	53	45	27	6	14	12	101	61	37	11	367
Cobble	2	2	6	4	29	0	7	15	0	4	69
Indeterminate	2	24	14	3	16	1	21	29	11	13	134
Block	0	0	1	4	0	0	1	3	0	0	9
Total	57	71	48	17	59	13	130	108	48	28	579

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Flake	93.0%	63.4%	56.3%	35.3%	23.7%	92.3%	77.7%	56.5%	77.1%	39.3%	63.4%
Cobble	3.5%	2.8%	12.5%	23.5%	49.2%	0.0%	5.4%	13.9%	0.0%	14.3%	11.9%
Indeterminate	3.5%	33.8%	29.2%	17.6%	27.1%	7.7%	16.2%	26.9%	22.9%	46.4%	23.1%
Block	0.0%	0.0%	2.1%	23.5%	0.0%	0.0%	0.8%	2.8%	0.0%	0.0%	1.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.9. Flake types: detaching methods of flake blanks. Numbers and percentages by site.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
End struck	34	18	10	3	6	4	41	24	13	4	157
Side struck	11	13	11	1	1	2	30	27	3	1	100
Kombewa	0	0	1	0	0	5	2	1	0	0	9
Indeterminate	8	14	8	0	6	1	28	3	21	6	95
Total	53	45	30	4	13	12	101	55	37	11	361

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
End struck	64.2%	40.0%	33.3%	75.0%	46.2%	33.3%	40.6%	43.6%	35.1%	36.4%	43.5%
Side struck	20.8%	28.9%	36.7%	25.0%	7.7%	16.7%	29.7%	49.1%	8.1%	9.1%	27.7%
Kombewa	0.0%	0.0%	3.3%	0.0%	0.0%	41.7%	2.0%	1.8%	0.0%	0.0%	2.5%
Indeterminate	15.1%	31.1%	26.7%	0.0%	46.2%	8.3%	27.7%	5.5%	56.8%	54.5%	26.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.10. Ratios of unifacial, partly bifacial, mostly/fully bifacial, trihedral, and quadrilateral tools. Numbers and percentages by site.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Unifacial	35	30	16	0	3	7	52	31	2	2	178
Partly bifacial	9	16	18	0	9	1	22	35	11	2	123
Mostly/fully bifacial	2	19	13	8	38	4	47	40	35	24	230
Trihedral	1	0	0	4	5	0	0	5	0	0	15
Quadrilateral	0	7	1	5	4	0	8	0	0	0	25
Total	47	72	48	17	59	12	129	111	48	28	571

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Unifacial	74.5%	41.7%	33.3%	0.0%	5.1%	58.3%	40.3%	27.9%	4.2%	7.1%	31.2%
Partly bifacial	19.1%	22.2%	37.5%	0.0%	15.3%	8.3%	17.1%	31.5%	22.9%	7.1%	21.5%
Mostly/fully bifacial	4.3%	26.4%	27.1%	47.1%	64.4%	33.3%	36.4%	36.0%	72.9%	85.7%	40.3%
Trihedral	2.1%	0.0%	0.0%	23.5%	8.5%	0.0%	0.0%	4.5%	0.0%	0.0%	2.6%
Quadrilateral	0.0%	9.7%	2.1%	29.4%	6.8%	0.0%	6.2%	0.0%	0.0%	0.0%	4.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.11. Dimension of handaxes, cleavers, picks, and all LCTs/HDTs. Mean length, breadth, and thickness by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Ave.
Handaxe mean length	139.3	153.6	169.3	146.5	130.5	172.5	168.0	174.4	154.0	153.0	156.1
Handaxe mean breadth	93.0	92.4	104.7	77.0	79.7	97.3	98.5	104.1	83.0	94.4	92.4
Handaxe mean thickness	41.5	46.8	52.6	48.0	44.3	50.3	51.9	58.1	39.4	45.5	47.8
Cleaver mean length	156.0	163.5	185.1	-	154.8	161.9	167.5	156.5	171.2	205.8	169.1
Cleaver mean breadth	110.0	96.5	114.9	-	90.0	100.1	104.5	101.3	96.3	112.6	102.9
Cleaver mean thickness	50.8	52.9	47.6	-	57.5	46.6	48.4	47.6	39.4	46.0	48.5
Pick mean length	175.7	180.2	149.1	163.6	136.7	-	167.1	166.1	-	147.8	160.8
Pick mean breadth	93.1	87.4	91.6	67.7	78.1	-	88.0	88.4	-	92.5	85.8
Pick mean thickness	60.0	59.5	61.7	59.2	57.4	-	58.1	65.8	-	50.3	59.0
All LCT/HDT mean length	146.5	166.1	164.7	156.8	132.4	149.2	160.2	160.3	155.8	167.3	155.9
All LCT/HDT mean breadth	97.9	92.5	100.2	68.8	78.6	95.7	97.4	97.3	85.7	99.4	91.3
All LCT/HDT mean thickness	48.8	52.3	54.2	58.9	52.2	46.5	48.5	54.9	38.2	46.3	50.1

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Ave.
Handaxe length/breadth	1.50	1.66	1.62	1.90	1.64	1.77	1.71	1.68	1.85	1.62	1.69
Handaxe thickness/breadth	0.45	0.51	0.50	0.62	0.56	0.52	0.53	0.56	0.48	0.48	0.52
Cleaver length/breadth	1.42	1.69	1.61	-	1.72	1.62	1.60	1.54	1.78	1.83	1.65
Cleaver thickness/breadth	0.46	0.55	0.41	-	0.64	0.47	0.46	0.47	0.41	0.41	0.48
Pick length/breadth	1.89	2.06	1.63	2.42	1.75	-	1.90	1.88	-	1.60	1.89
Pick thickness/breadth	0.64	0.68	0.67	0.87	0.73	-	0.66	0.74	-	0.54	0.69
All LCT/HDT length/breadth	1.50	1.80	1.64	2.28	1.69	1.56	1.65	1.65	1.82	1.68	1.73
All LCT/HDT thickness/breadth	0.50	0.57	0.54	0.86	0.66	0.49	0.50	0.56	0.45	0.47	0.56

Table A2.12. Cross-section types of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty. tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Double convex	1	5	6	0	7	1	10	17	25	11	83
Plano-convex	5	13	5	1	9	0	10	20	5	6	74
Lenticular	2	4	5	0	2	2	1	8	0	7	31
Biconical	0	6	0	4	13	0	30	19	7	1	80
Parallelogram	6	14	10	6	5	2	17	12	7	2	81
Trapezoidal	22	16	15	4	12	2	36	14	3	0	124
Triangular	19	14	5	1	10	6	22	18	1	1	97
Irregular	0	0	1	1	1	0	3	1	0	0	7
Total	55	72	47	17	59	13	129	109	48	28	577

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Double convex	1.8%	6.9%	12.8%	0.0%	11.9%	7.7%	7.8%	15.6%	52.1%	39.3%	14.4%
Plano convex	9.1%	18.1%	10.6%	5.9%	15.3%	0.0%	7.8%	18.3%	10.4%	21.4%	12.8%
Lenticular	3.6%	5.6%	10.6%	0.0%	3.4%	15.4%	0.8%	7.3%	0.0%	25.0%	5.4%
Biconical	0.0%	8.3%	0.0%	23.5%	22.0%	0.0%	23.3%	17.4%	14.6%	3.6%	13.9%
Parallelogram	10.9%	19.4%	21.3%	35.3%	8.5%	15.4%	13.2%	11.0%	14.6%	7.1%	14.0%
Trapezoidal	40.0%	22.2%	31.9%	23.5%	20.3%	15.4%	27.9%	12.8%	6.3%	0.0%	21.5%
Triangular	34.5%	19.4%	10.6%	5.9%	16.9%	46.2%	17.1%	16.5%	2.1%	3.6%	16.8%
Irregular	0.0%	0.0%	2.1%	5.9%	1.7%	0.0%	2.3%	0.9%	0.0%	0.0%	1.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.13. Sinuosity of lateral edges of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Wavy	5	35	20	0	17	1	6	31	1	3	119
Sinuous	12	21	21	16	34	2	55	40	16	9	226
Straight	35	16	7	0	6	10	68	41	32	16	231
Total	52	72	48	16	57	13	129	112	49	28	576

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Wavy	9.6%	48.6%	41.7%	0.0%	29.8%	7.7%	4.7%	27.7%	2.0%	10.7%	20.7%
Sinuous	23.1%	29.2%	43.8%	100.0%	59.6%	15.4%	42.6%	35.7%	32.7%	32.1%	39.2%
Straight	67.3%	22.2%	14.6%	0.0%	10.5%	76.9%	52.7%	36.6%	65.3%	57.1%	40.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.14. Lateral edge angle of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Ave.
Handaxe Mean	56.3	60.8	59.7	71.0	67.1	53.3	66.0	66.1	61.0	59.6	62.1
Handaxe Max.	68	75	75	72	93	68	100	95	82	80	100
Handaxe Min.	45	40	42	70	43	41	40	25	30	45	25
Handaxe SD	8.0	11.3	8.7	1.4	12.9	12.9	13.7	13.5	13.6	8.6	3.9
Cleaver Mean	67.8	62.5	55.6	-	63.0	48.1	58.0	61.1	52.1	53.8	58.0
Cleaver Max.	84	80	75	-	70	60	78	85	65	80	85
Ceaver Min.	45	45	31	-	48	34	35	37	40	40	31
Cleaver SD	16.7	10.0	15.7	-	10.4	8.7	10.7	12.1	9.0	14.1	2.9
Pick Mean	67.4	72.5	73.3	84.1	81.6	-	81.1	68.2	-	74.0	75.3
Pic Max.	88	110	92	95	100	-	105	96	-	95	110
Pick Min.	43	54	57	71	55	-	60	40	-	55	40
Pick SD	12.7	11.7	10.4	7.7	11.4	-	10.7	15.6	-	17.6	3.1
ALL LCT/HDT Mean	61.2	64.4	61.6	82.5	75.3	49.5	64.4	63.6	59.3	60.0	64.2
ALL LCT/HDT Max.	88	110	92	95	100	68	105	96	82	95	110
ALL LCT/HDT Min.	35	40	31	70	43	34	35	25	30	40	25
ALL LCT/HDT SD	12.3	12.4	13.0	8.2	13.8	9.7	14.1	13.6	13.3	12.9	1.9

Table A2.15. Biface butt plan of LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
U-shaped	9	20	8	2	18	2	42	21	29	9	160
V-shaped	13	23	17	7	11	6	37	37	11	3	165
Straight	13	11	5	4	6	5	9	15	3	6	77
Cortex	3	9	11	0	20	0	6	21	0	4	74
Irregular	1	2	1	2	2	0	13	4	0	1	26
Square	0	0	0	2	0	0	6	0	1	0	9
Tool	2	3	4	1	1	0	8	4	3	1	27
Indeterminate	3	0	0	1	1	0	6	5	1	1	18
Total	44	68	46	19	59	13	127	107	48	25	556

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Toal
U-shaped	20.5%	29.4%	17.4%	10.5%	30.5%	15.4%	33.1%	19.6%	60.4%	36.0%	28.8%
V-shaped	29.5%	33.8%	37.0%	36.8%	18.6%	46.2%	29.1%	34.6%	22.9%	12.0%	29.7%
Straight	29.5%	16.2%	10.9%	21.1%	10.2%	38.5%	7.1%	14.0%	6.3%	24.0%	13.8%
Cortex	6.8%	13.2%	23.9%	0.0%	33.9%	0.0%	4.7%	19.6%	0.0%	16.0%	13.3%
Irregular	2.3%	2.9%	2.2%	10.5%	3.4%	0.0%	10.2%	3.7%	0.0%	4.0%	4.7%
Square	0.0%	0.0%	0.0%	10.5%	0.0%	0.0%	4.7%	0.0%	2.1%	0.0%	1.6%
Tool	4.5%	4.4%	8.7%	5.3%	1.7%	0.0%	6.3%	3.7%	6.3%	4.0%	4.9%
Indeterminate	6.8%	0.0%	0.0%	5.3%	1.7%	0.0%	4.7%	4.7%	2.1%	4.0%	3.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.16. Invasiveness of flake scars on LCTs/HDTs. Numbers and percentages by site. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Marginal	3	10	0	1	4	3	8	7	2	2	40
Semi-invasive	11	13	8	1	7	1	13	16	4	4	78
Invasive	37	49	39	15	48	9	106	87	42	22	454
Total	51	72	47	17	59	13	127	110	48	28	572

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Marginal	5.9%	13.9%	0.0%	5.9%	6.8%	23.1%	6.3%	6.4%	4.2%	7.1%	7.0%
Semi-invasive	21.6%	18.1%	17.0%	5.9%	11.9%	7.7%	10.2%	14.5%	8.3%	14.3%	13.6%
Invasive	72.5%	68.1%	83.0%	88.2%	81.4%	69.2%	83.5%	79.1%	87.5%	78.6%	79.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.17. Summary of flake scar numbers of handaxes, cleavers, picks and all LCTs/HDTs. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Ave.
Handaxe Mean	10.5	11.9	10.8	14.5	19.0	14.8	13.7	19.0	18.8	30.0	16.3
Handaxe Max.	20	34	27	15	30	22	30	34	28	60	60
Handaxe Min.	7	3	4	14	9	12	5	7	8	16	3
Handaxe SD	4.4	7.4	5.6	0.7	5.7	4.9	5.4	7.2	4.9	10.5	2.5
Cleaver Mean	7.8	10.4	9.3	-	18.3	8.1	8.8	10.4	16.0	24.1	12.6
Cleaver Max.	14	18	12	-	28	14	18	20	31	48	48
Ceaver Min.	3	6	7	-	9	3	2	2	8	5	2
Cleaver SD	4.1	4.1	2.0	-	7.9	3.9	4.2	4.9	7.2	13.2	3.3
Pick Mean	10.4	16.5	13.3	16.2	17.6	-	14.5	16.6	-	16.3	15.2
Pic Max.	18	33	20	26	37	-	23	32	-	21	37
Pick Min.	5	7	7	7	8	-	10	8	-	11	5
Pick SD	3.5	6.3	4.0	4.9	7.1	-	4.4	5.6	-	4.6	1.2
ALL LCT/HDT Mean	7.9	12.7	11.3	15.9	17.3	9.9	12.0	15.3	18.3	26.4	14.7
ALL LCT/HDT Max.	20	34	27	26	37	22	30	34	31	60	60
ALL LCT/HDT Min.	2	3	4	7	6	3	2	2	8	5	2
ALL LCT/HDT SD	4.2	6.8	4.8	4.5	6.7	5.2	5.4	7.1	5.4	11.5	2.1

Table A2.18. Summary of maximum dimension of flake scars on handaxes, cleavers, picks and all LCTs/HDTs. LCT = large cutting tool, HDT = heavy duty tool.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Ave.
Handaxe Mean	50.6	52.4	54.5	44.5	42.5	51.5	49.3	55.4	45.1	48.9	49.5
Handaxe Max.	76	81	86	55	61	61	108	85	86	65	108
Handaxe Min.	24	30	38	34	25	42	20	28	20	28	20
Handaxe SD	21.6	14.5	14.5	14.9	10.2	9.4	15.2	13.9	14.5	9.5	3.6
Cleaver Mean	63.8	57.8	63.9	-	47.3	52.8	56.0	54.7	50.9	58.3	56.2
Cleaver Max.	100	95	92	-	64	74	99	94	67	83	100
Ceaver Min.	38	32	33	-	40	37	5	20	41	35	5
Cleaver SD	24.9	19.1	22.1	-	11.4	13.1	18.1	20.2	8.3	17.7	5.3
Pick Mean	55.3	53.3	56.1	49.9	45.9	-	46.8	58.7	-	46.3	51.5
Pic Max.	80	91	104	88	77	-	71	80	-	55	104
Pick Min.	37	21	28	32	20	-	28	30	-	35	20
Pick SD	13.2	15.5	18.4	14.4	12.4	-	12.0	15.4	-	9.8	2.6
ALL LCT/HDT Mean	51.9	55.3	57.0	49.4	44.2	52.3	51.4	55.6	46.2	51.2	51.5
ALL LCT/HDT Max.	100	122	104	88	77	74	108	94	86	83	122
ALL LCT/HDT Min.	13	21	18	32	20	37	5	20	20	28	5
ALL LCT/HDT SD	19.6	17.5	17.8	13.6	11.7	11.6	16.3	16.0	13.7	12.8	2.8

Table A2.19. Cleaver edge plan. Numbers and percentages by site.

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Straight	3	3	2	-	0	2	7	3	2	3	25
Convex	1	5	1	-	1	0	7	7	2	3	27
Oblique/end	1	4	3	-	3	6	32	17	5	2	73
Oblique/side	0	0	1	-	0	0	0	1	0	0	2
Concave	0	0	0	-	0	0	1	0	0	0	1
Irregular	0	0	0	-	0	0	1	2	0	0	3
Total	5	12	7	-	4	8	48	30	9	8	131

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Total
Straight	60.0%	25.0%	28.6%	-	0.0%	25.0%	14.6%	10.0%	22.2%	37.5%	19.1%
Convex	20.0%	41.7%	14.3%	-	25.0%	0.0%	14.6%	23.3%	22.2%	37.5%	20.6%
Oblique/end	20.0%	33.3%	42.9%	-	75.0%	75.0%	66.7%	56.7%	55.6%	25.0%	55.7%
Oblique/side	0.0%	0.0%	14.3%	-	0.0%	0.0%	0.0%	3.3%	0.0%	0.0%	1.5%
Concave	0.0%	0.0%	0.0%	-	0.0%	0.0%	2.1%	0.0%	0.0%	0.0%	0.8%
Irregular	0.0%	0.0%	0.0%	-	0.0%	0.0%	2.1%	6.7%	0.0%	0.0%	2.3%
Total	100.0%	100.0%	100.0%	-	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table A2.20. Summary of cleaver bit angle

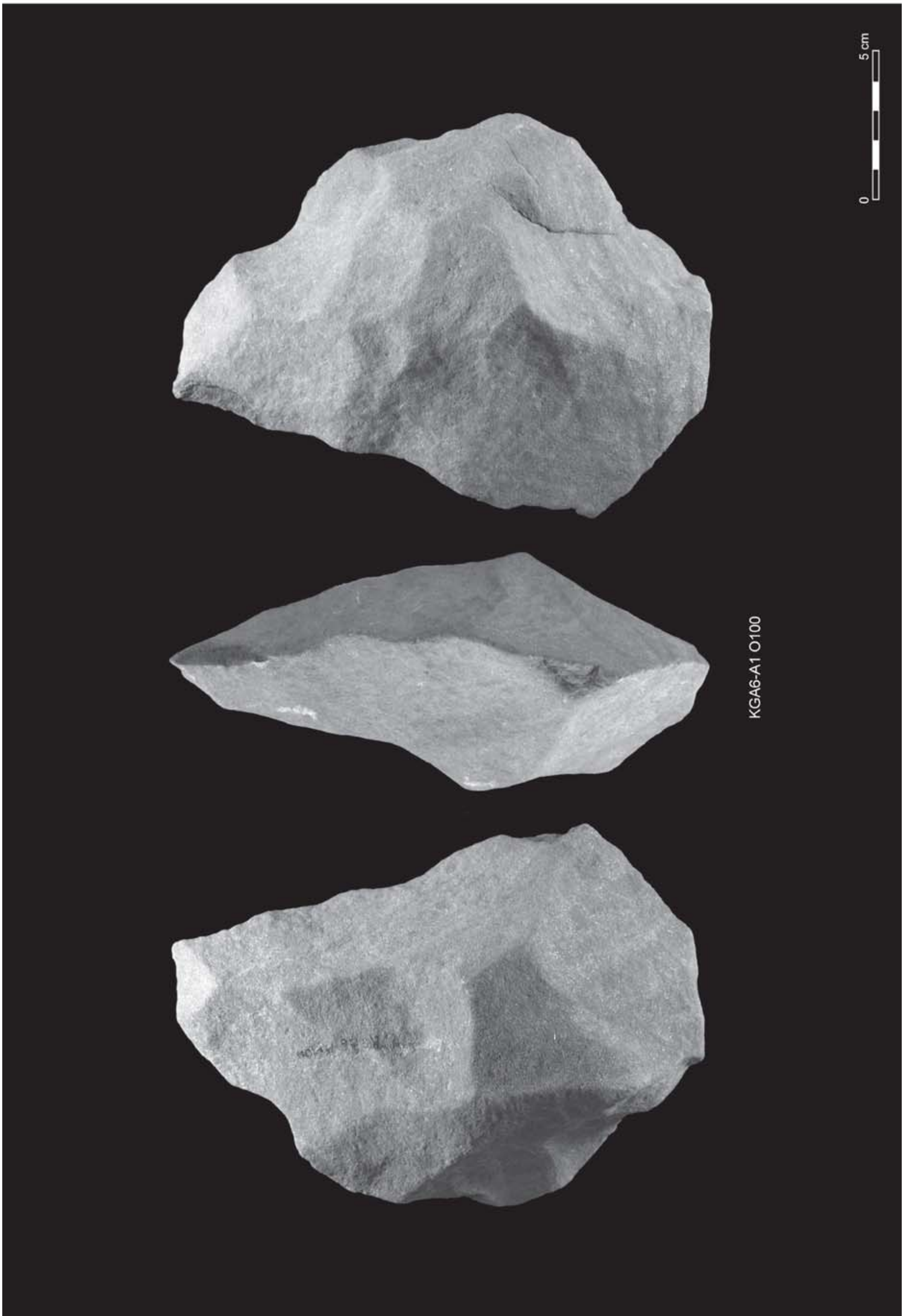
	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Ave.
Cleaver bit angle mean	47.6	43.2	38.0	-	35.8	44.9	44.2	44.4	38.2	30.4	40.7
Cleaver bit angle Max.	54	58	50	-	50	50	65	93	55	38	93
Cleaver bit angle Min.	42	32	25	-	25	38	28	25	25	20	20
Cleaver bit angle SD	5.9	9.8	9.5	-	10.5	4.8	7.9	12.3	8.7	6.8	2.4

Table A2.21. Summary of cleaver bit dimension

	6-A1	4-A2	10-A11	10-A6	7-A1, A3	7-A2	8-A1	12-A1	18-A1	20-A1, A2	Ave.
Cleaver bit dimension mean	81.0	65.8	83.4	-	52.3	73.5	67.1	61.8	52.9	45.3	64.8
Cleaver bit dimension Max.	108	112	125	-	93	108	110	101	69	73	125
Cleaver bit dimension Min.	55	42	52	-	28	41	30	28	38	32	28
Cleaver bit dimension SD	20.9	23.9	23.6	-	35.4	24.8	17.9	18.2	11.5	12.7	7.2

PLATES

Plate 1



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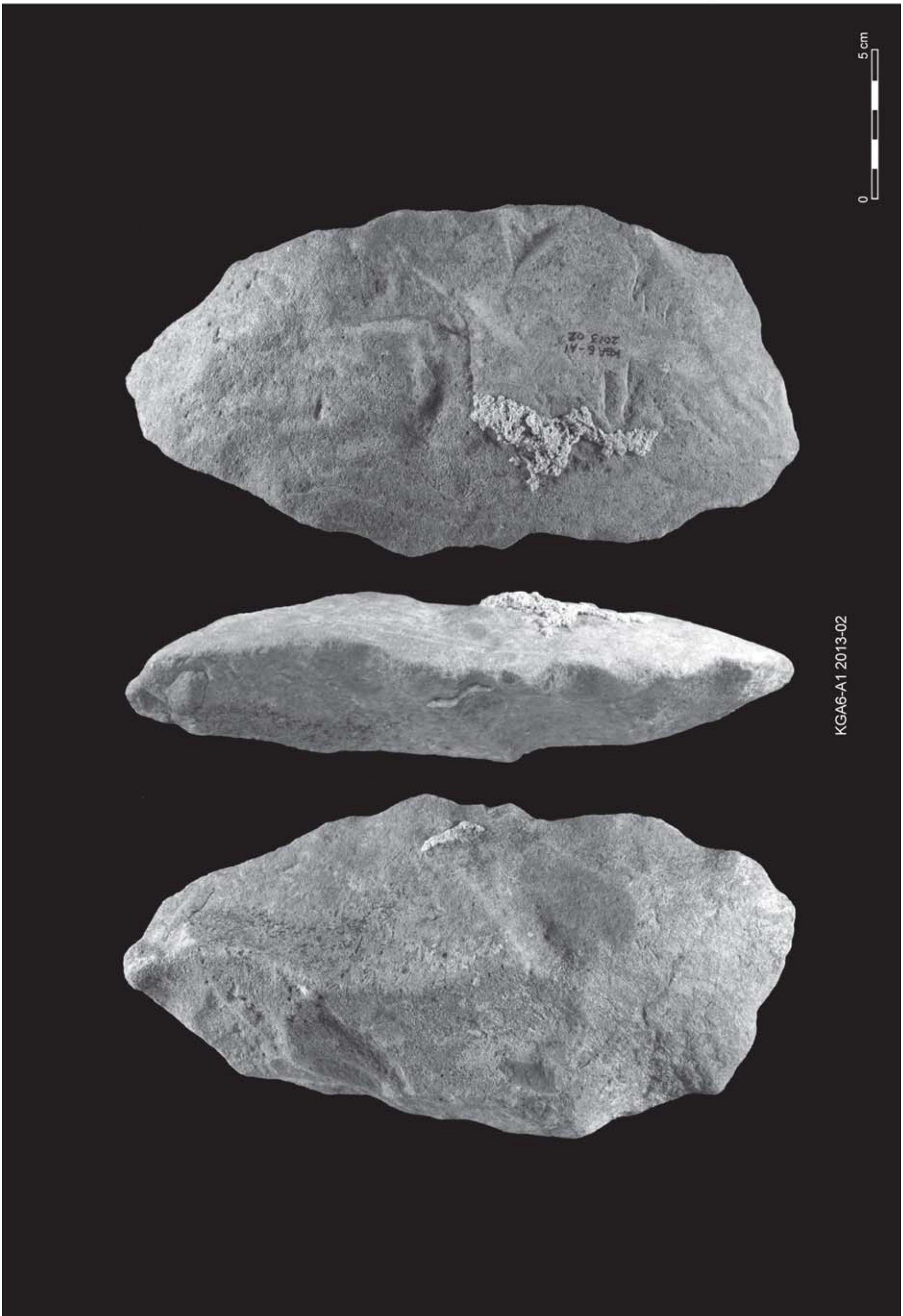

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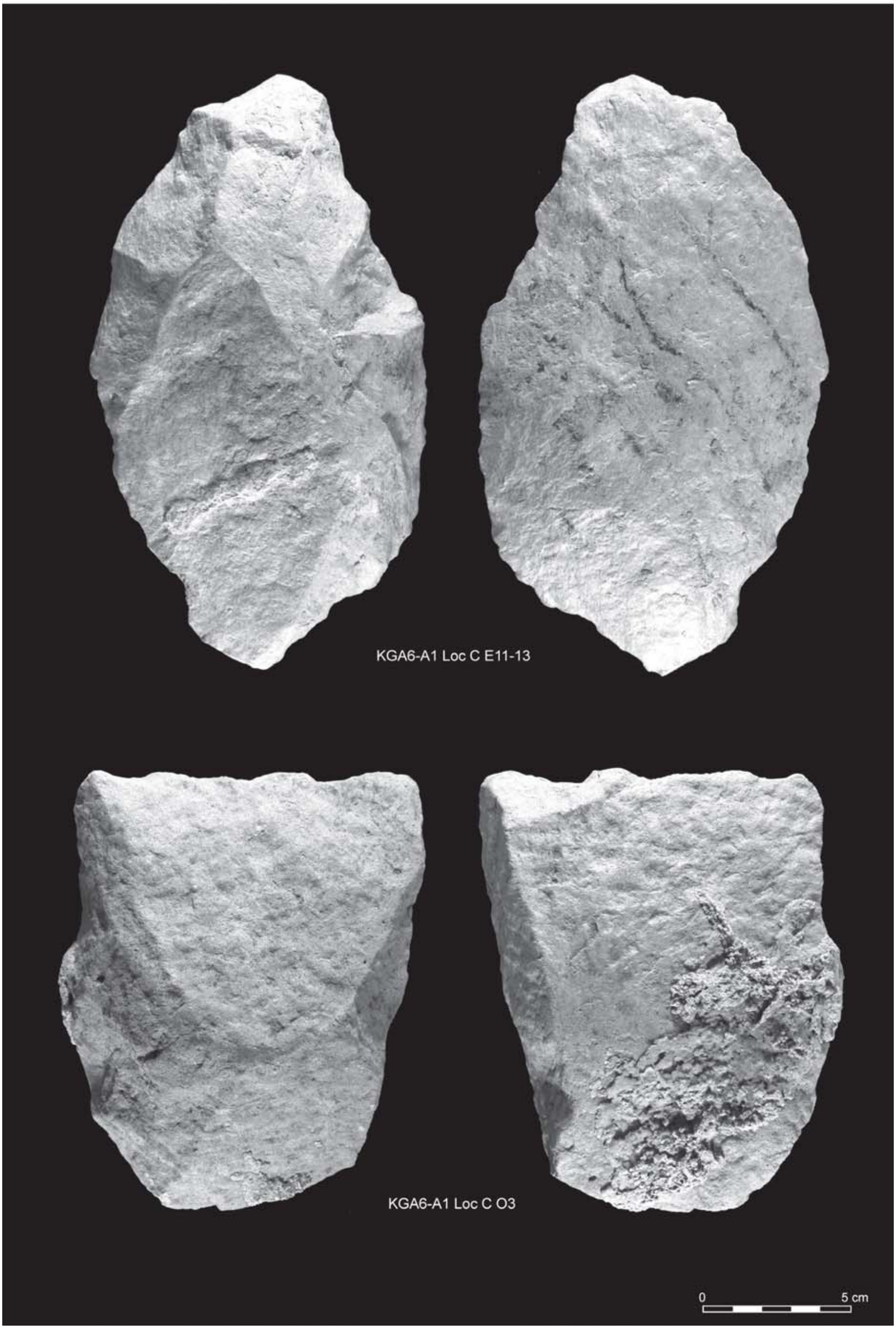

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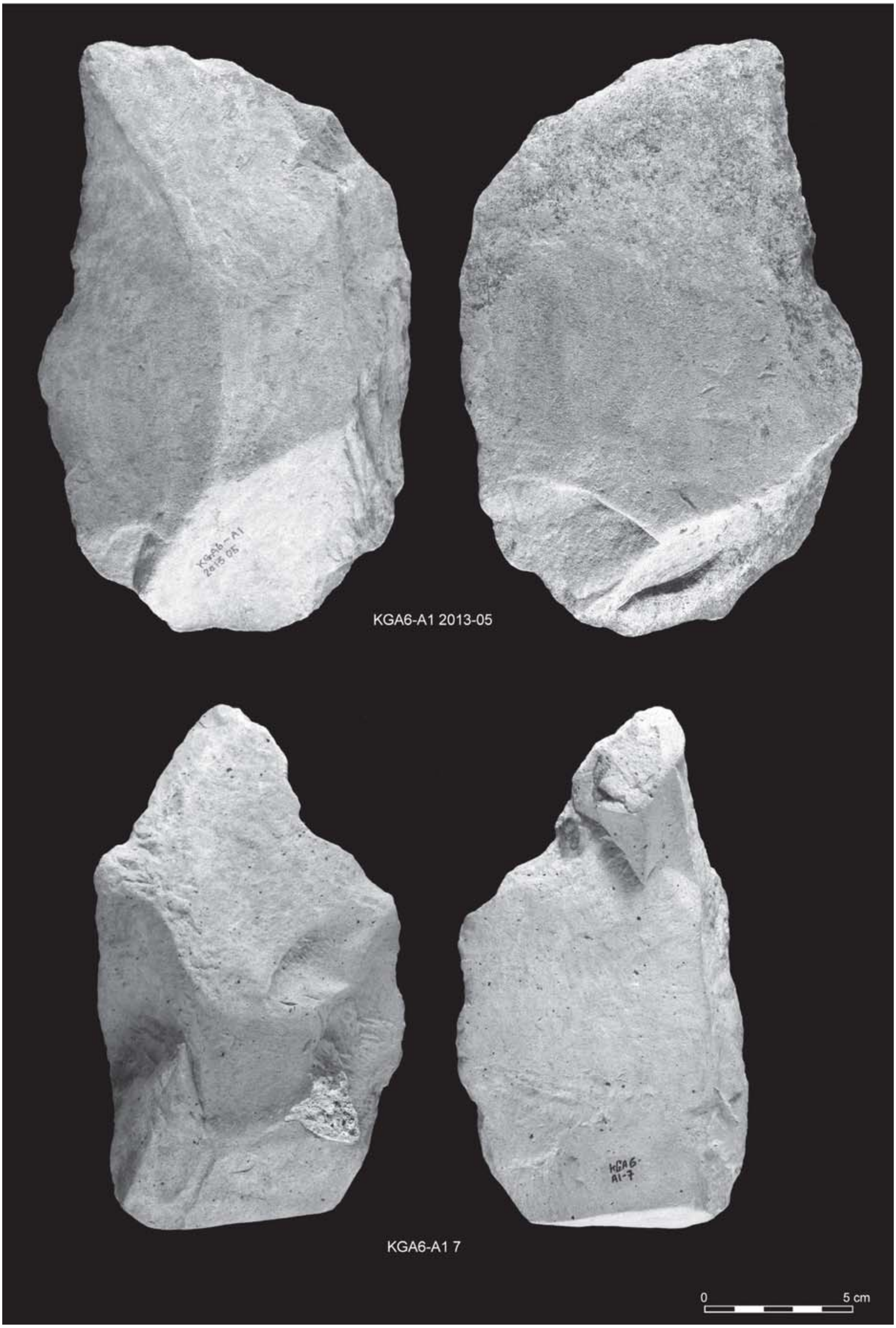

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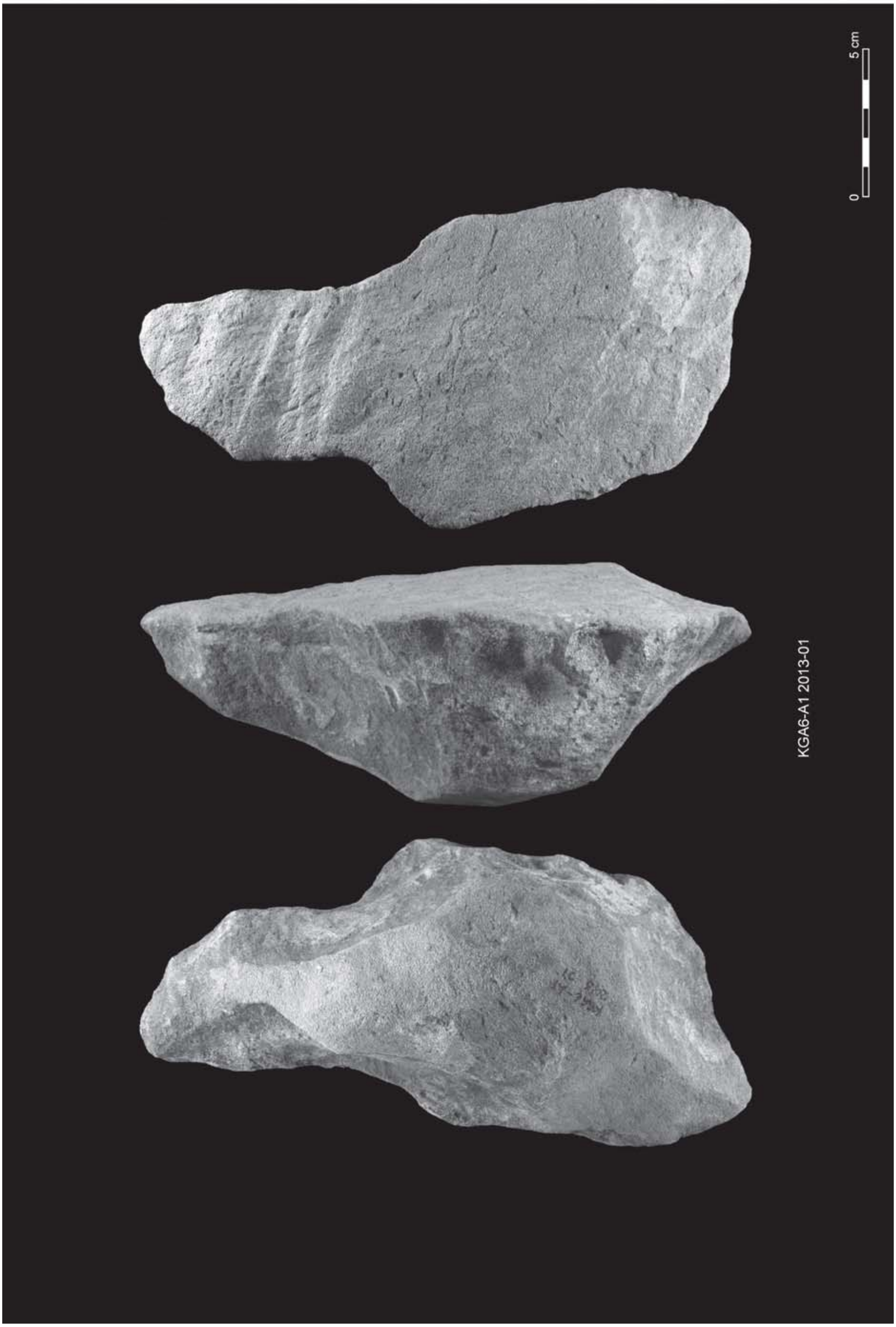

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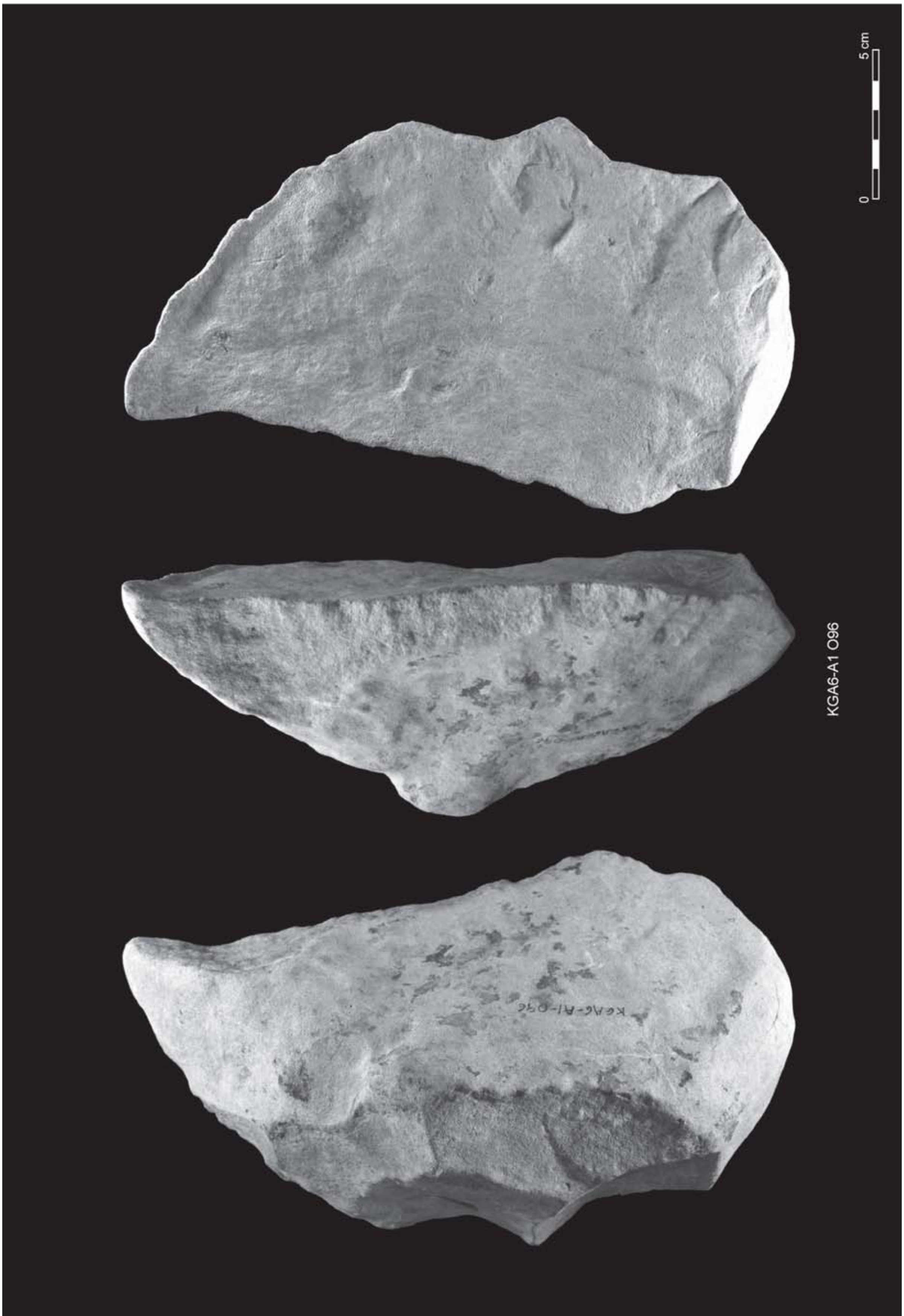

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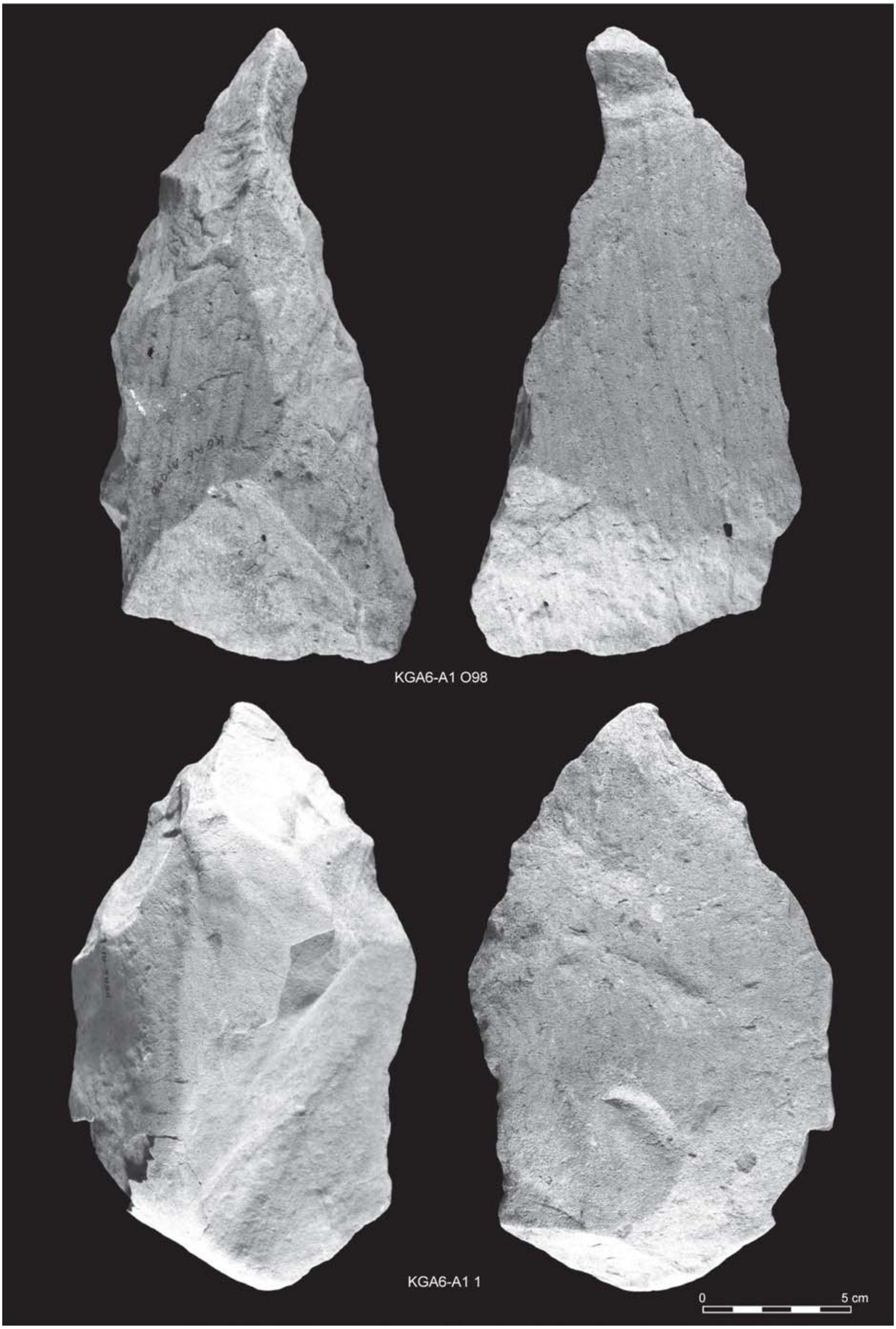

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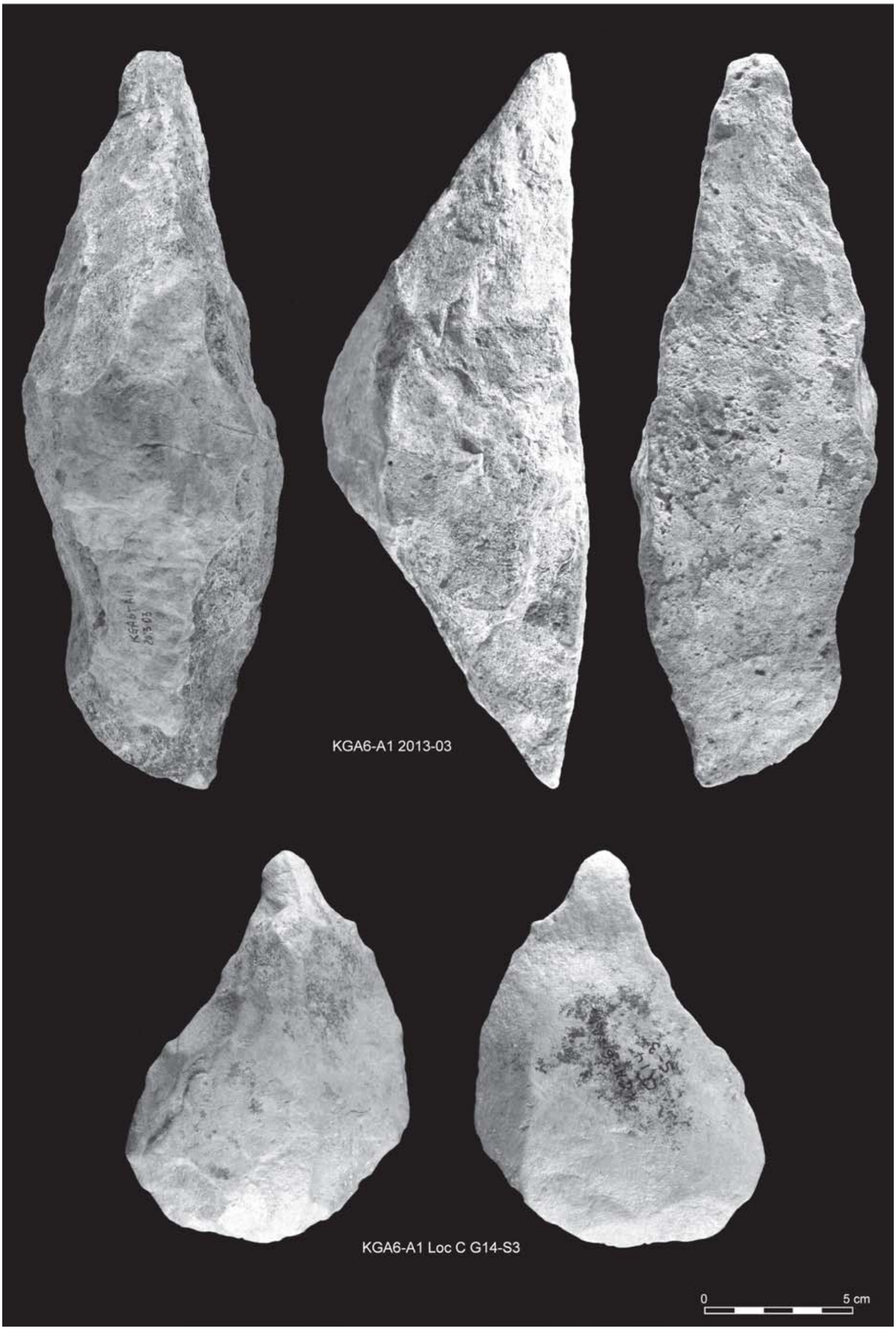

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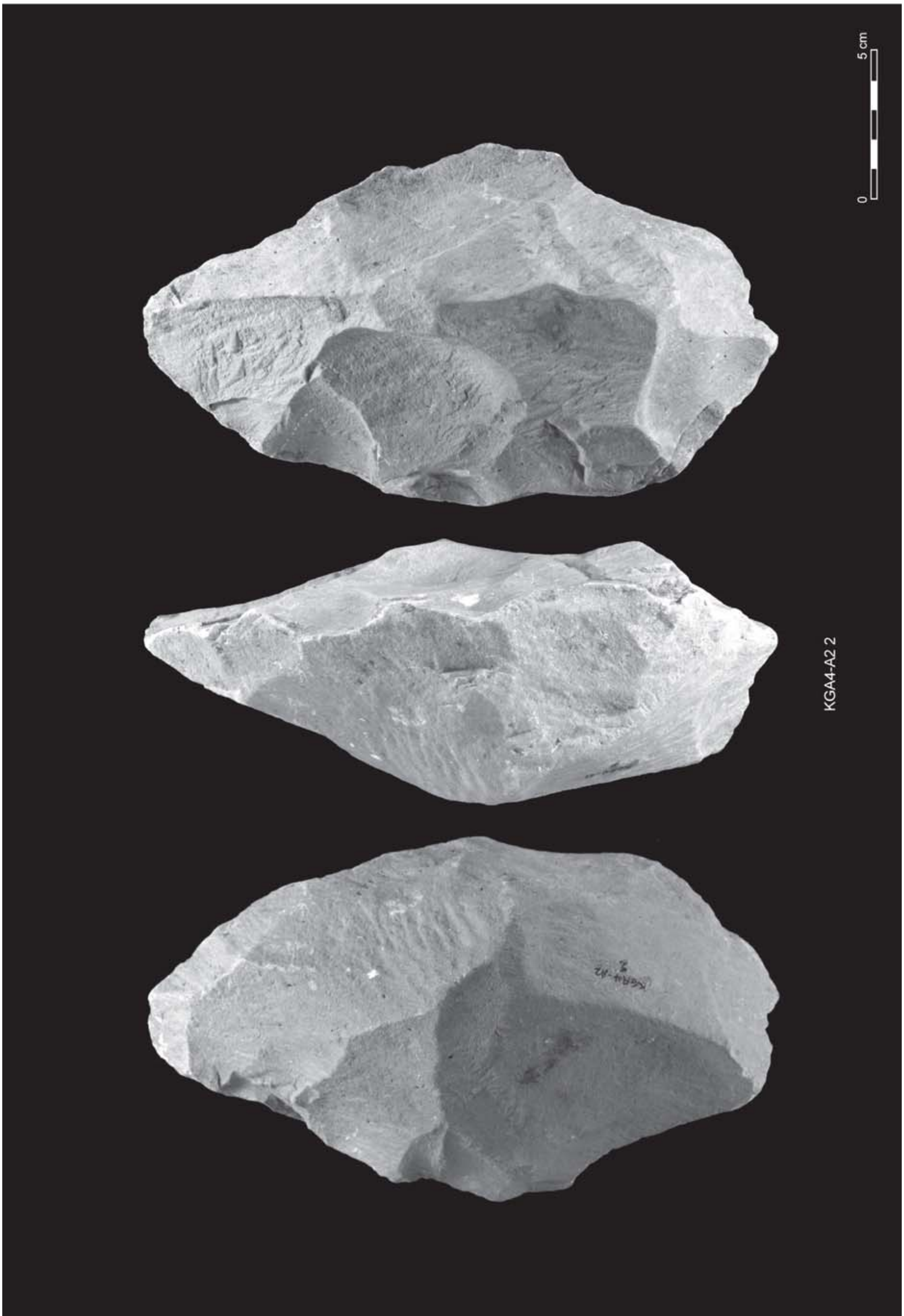

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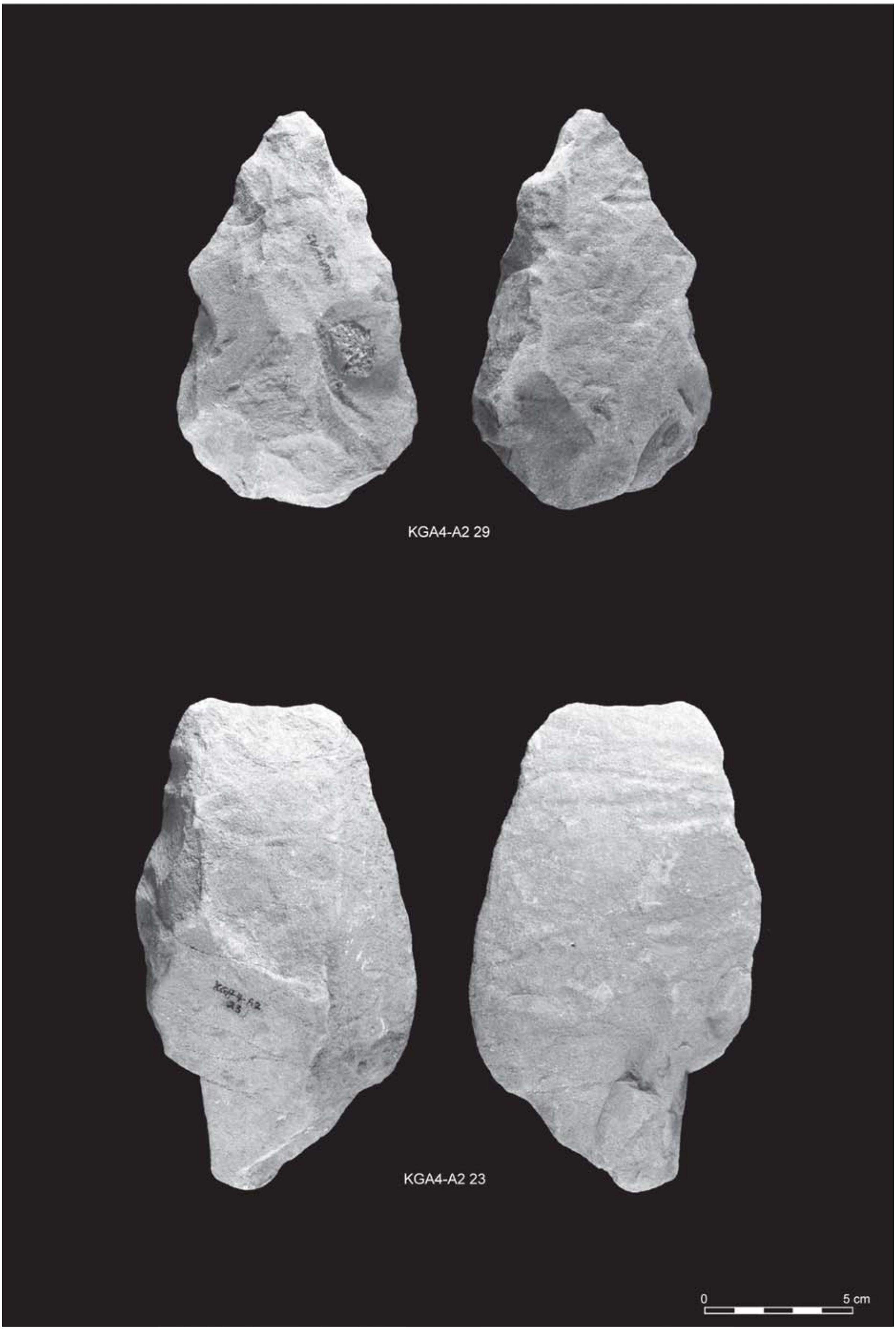

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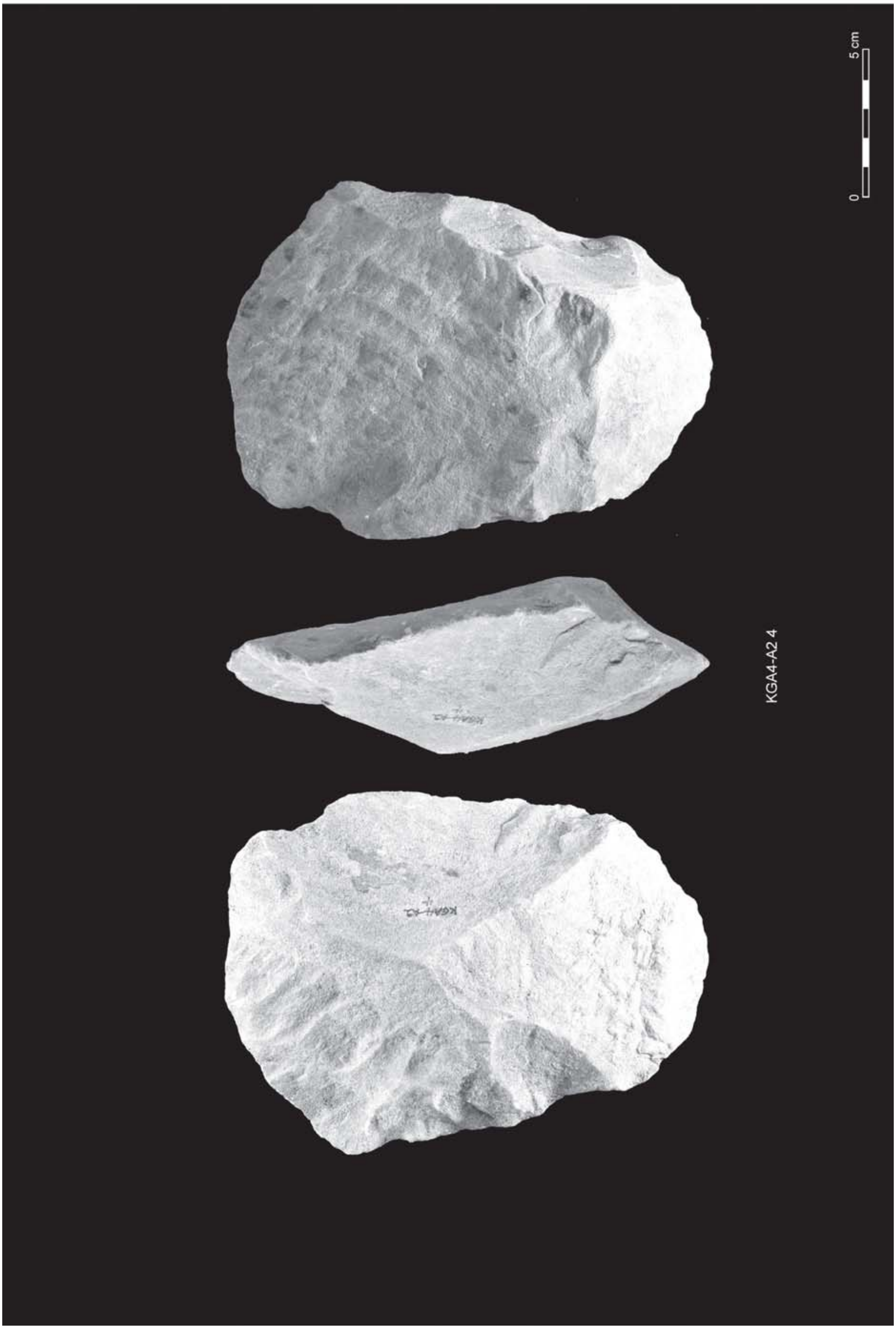

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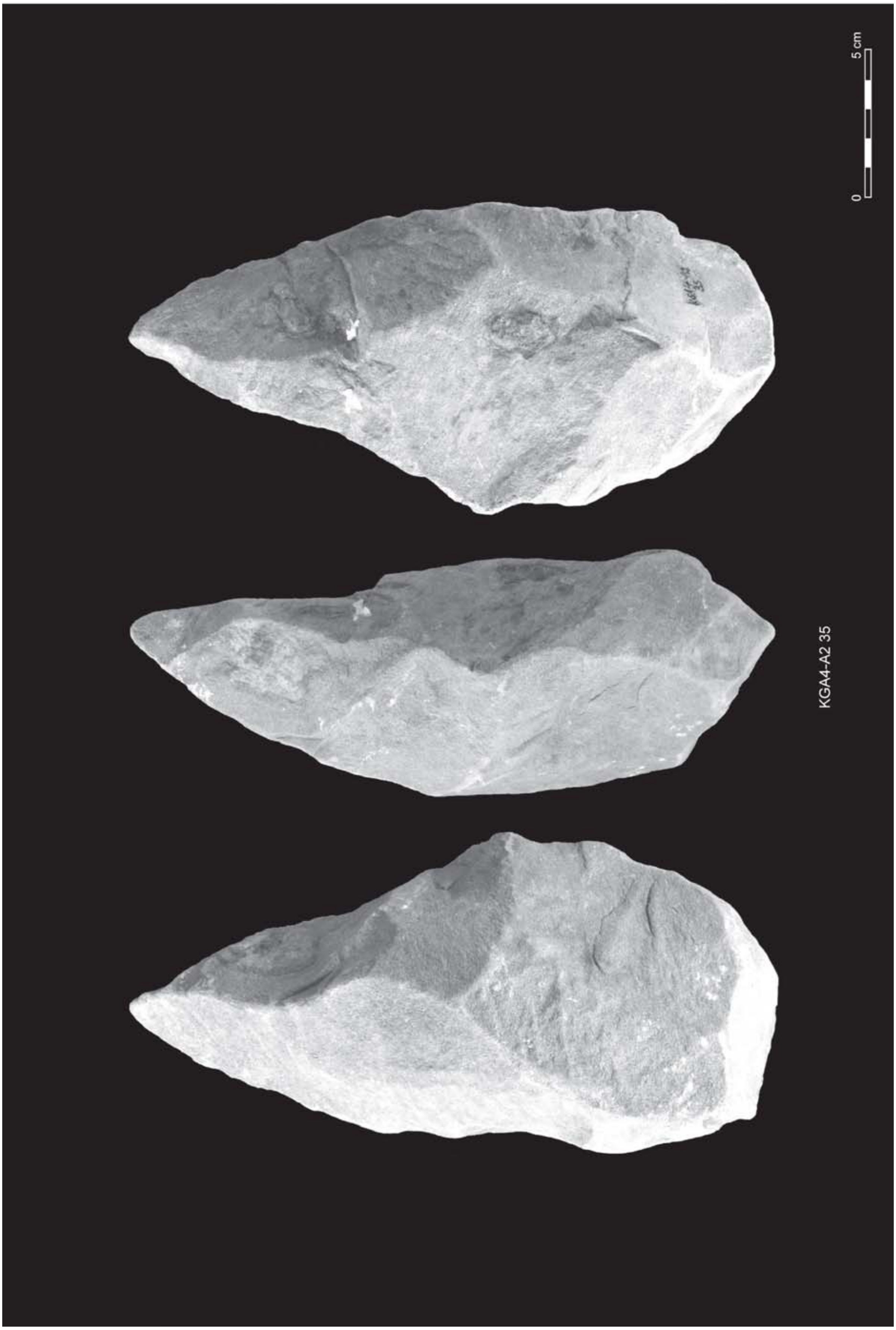

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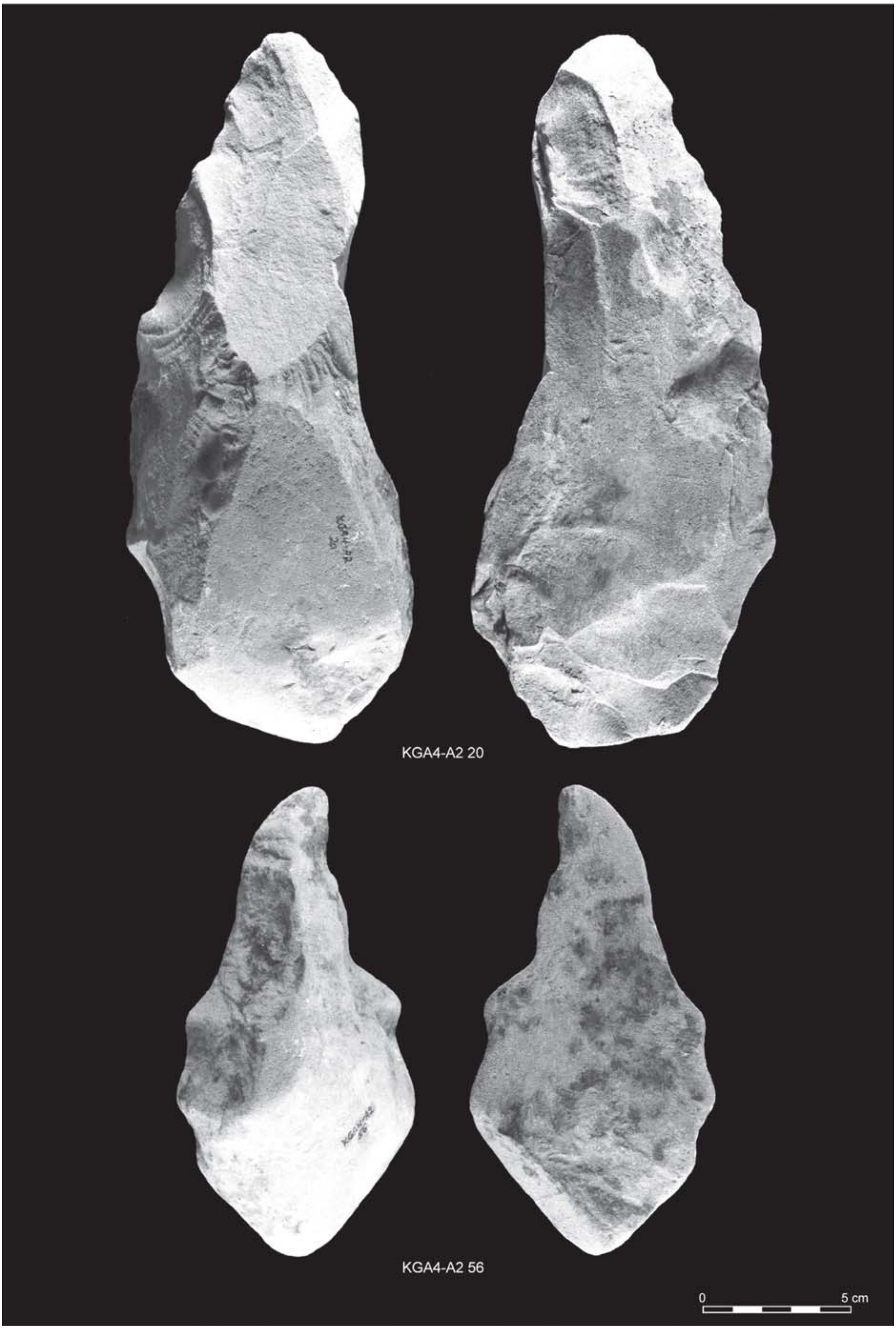

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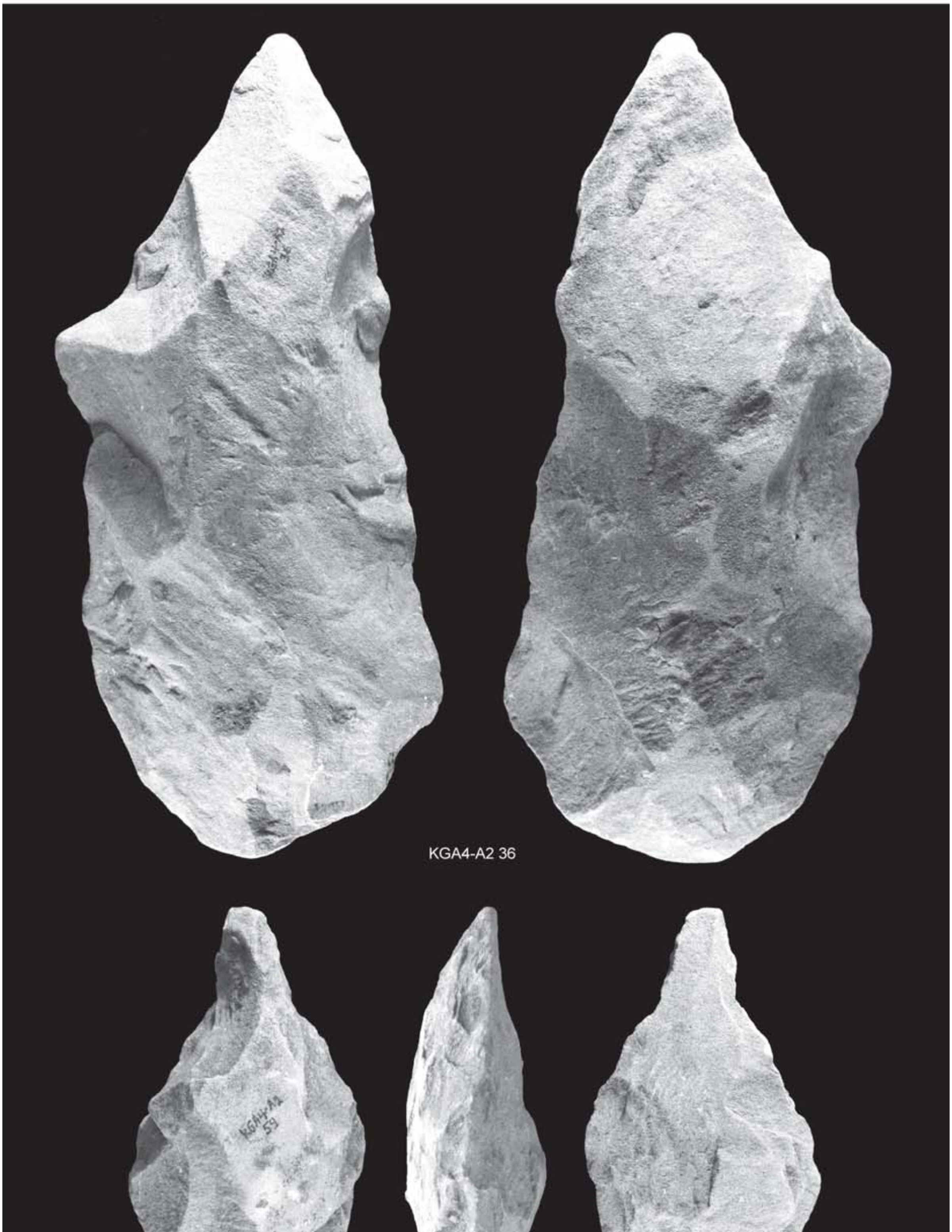

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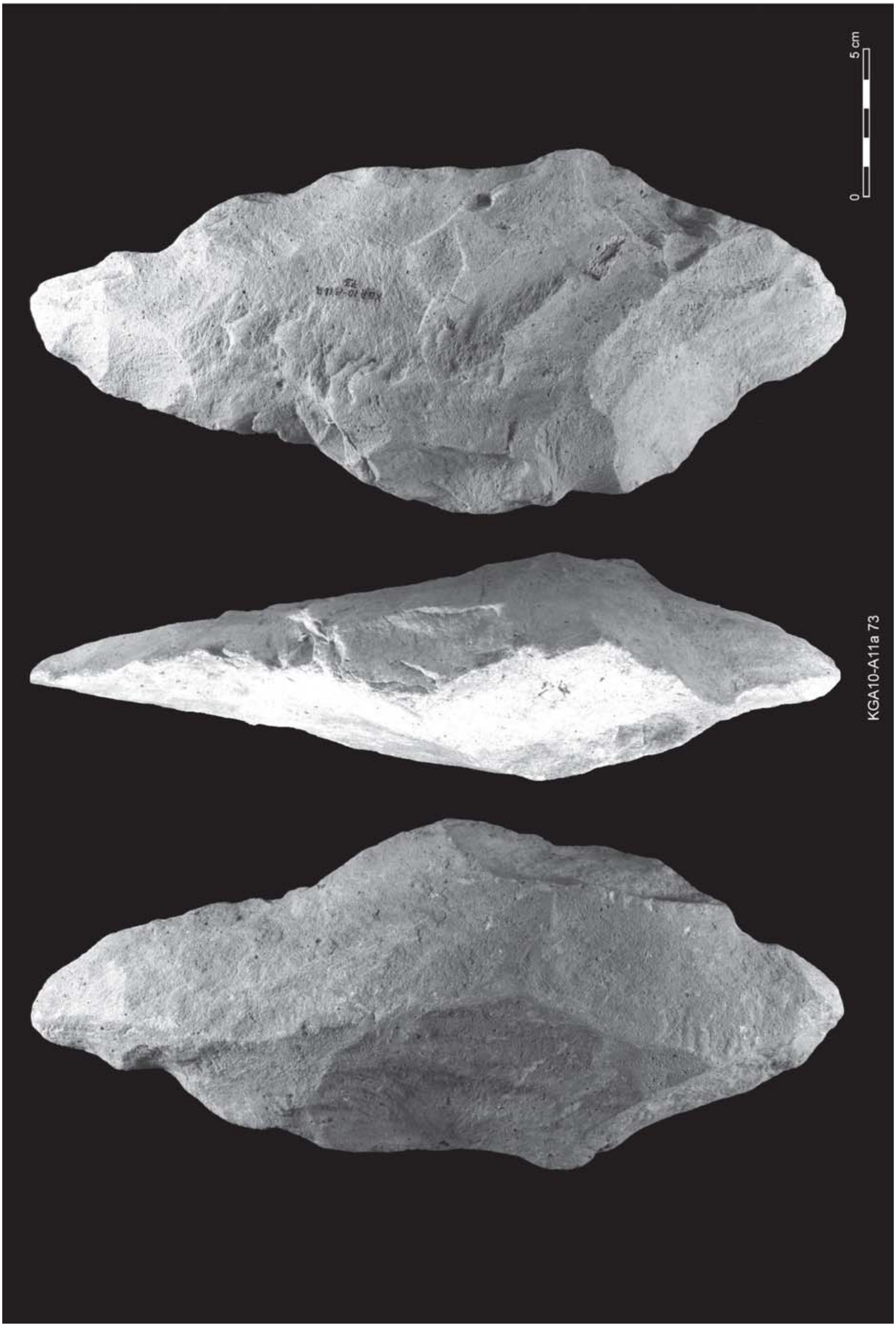

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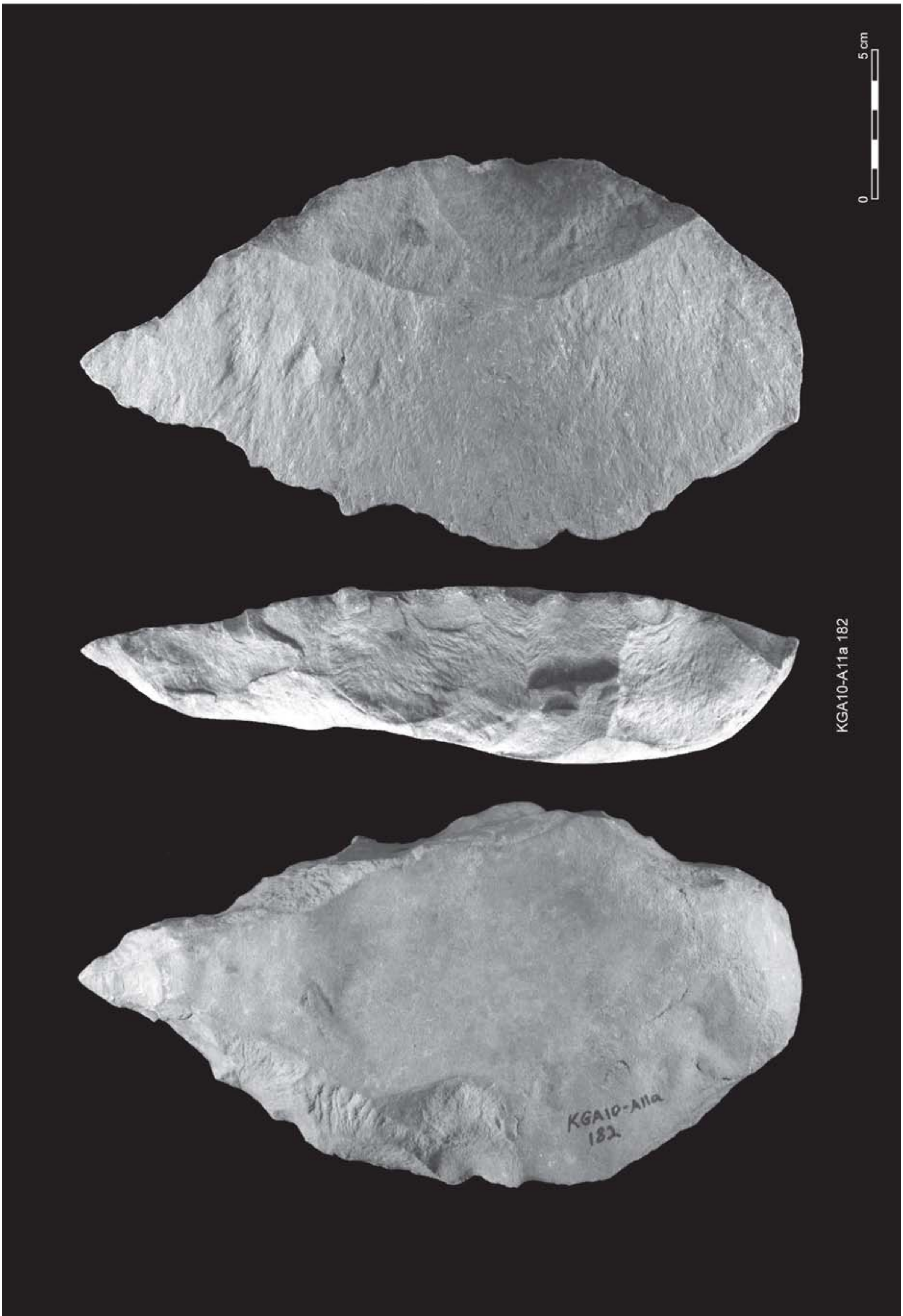

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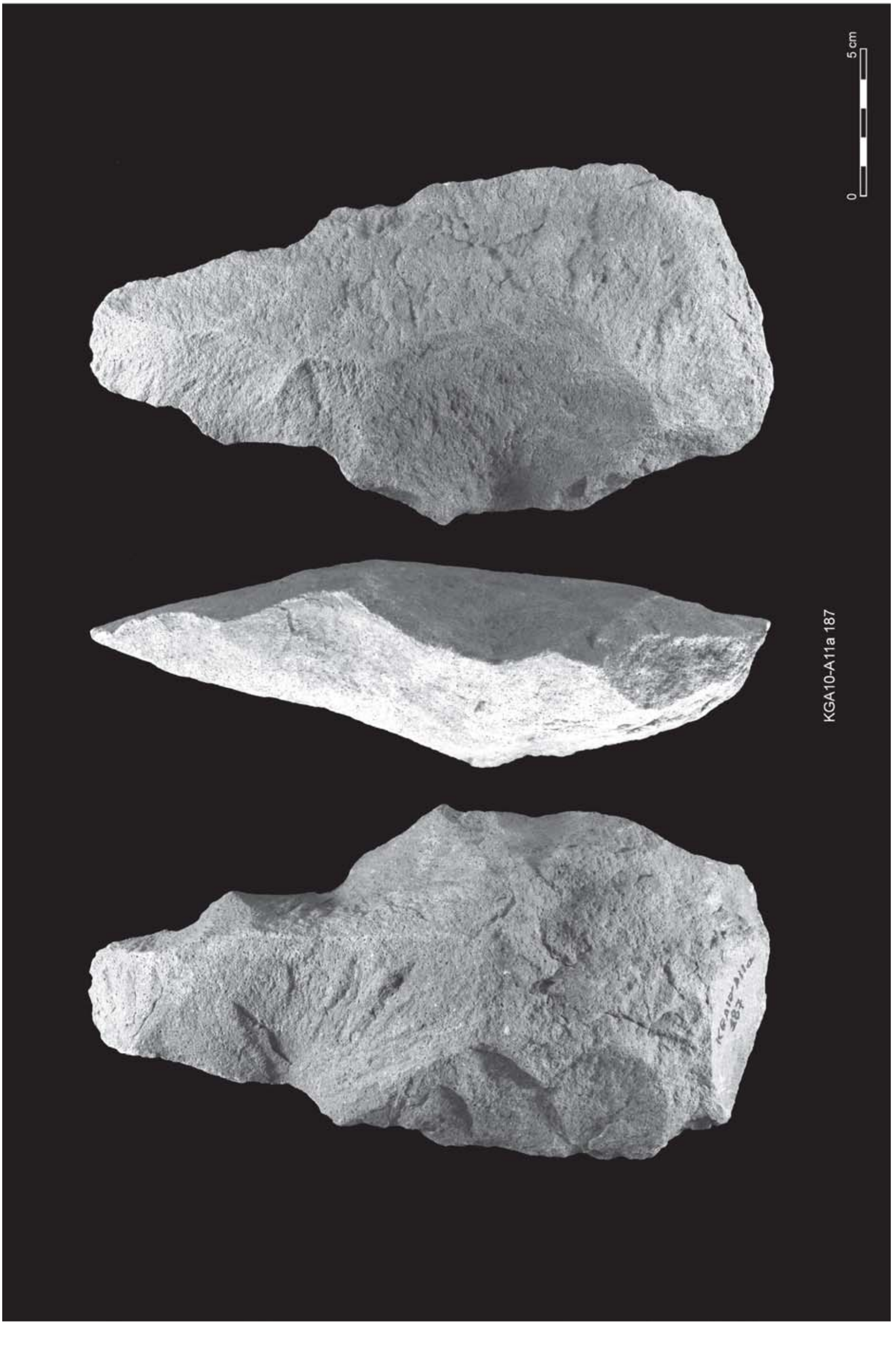

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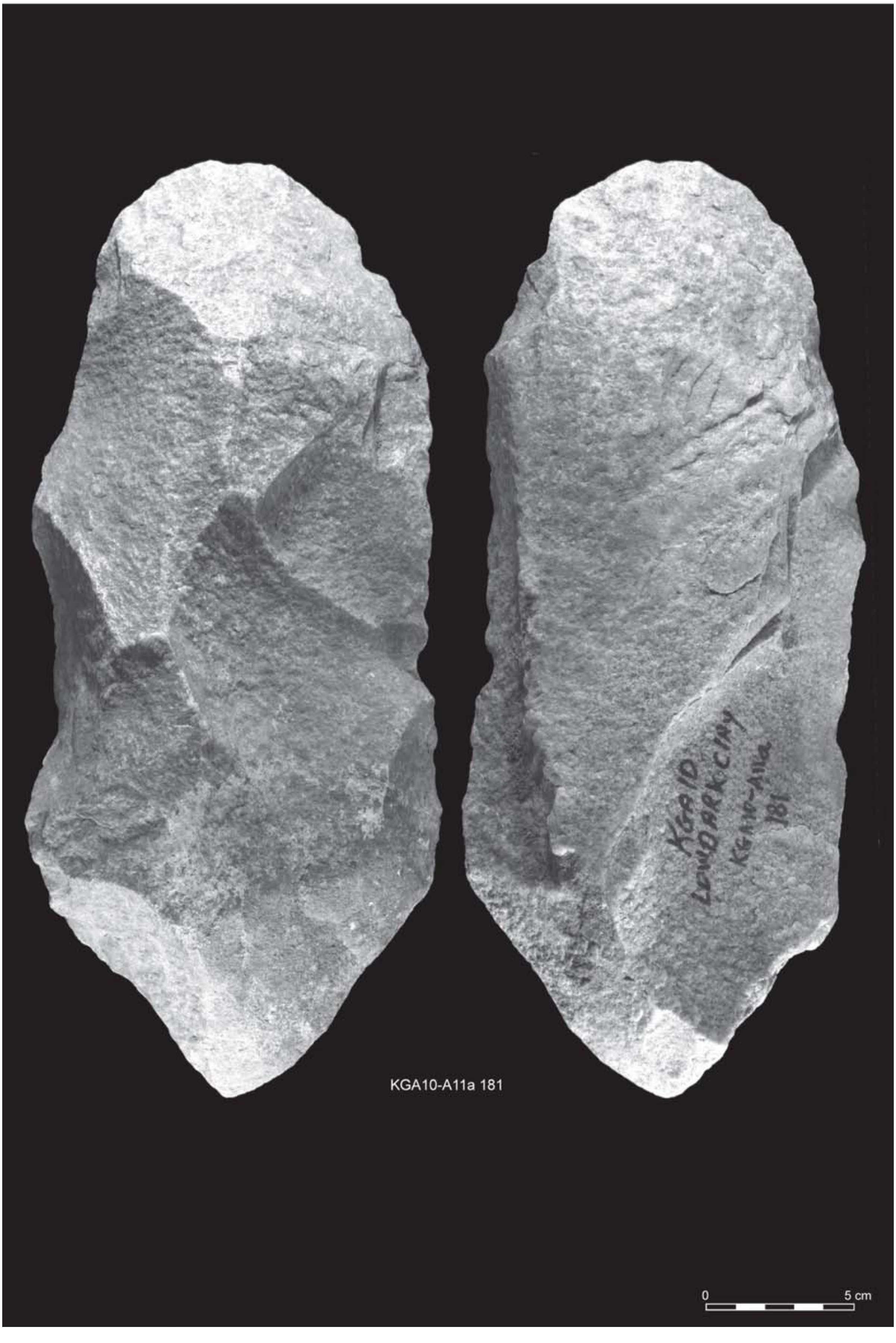

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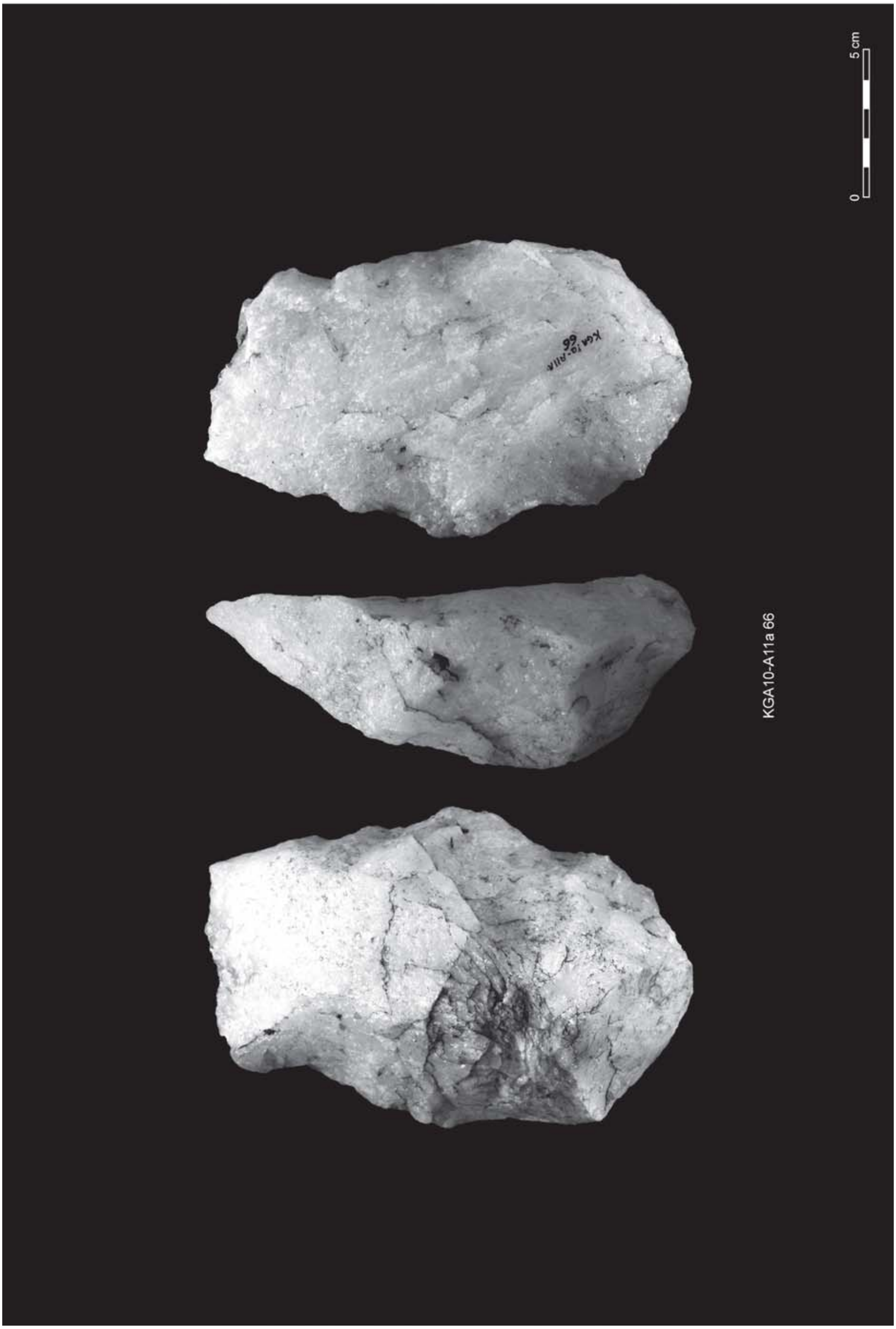

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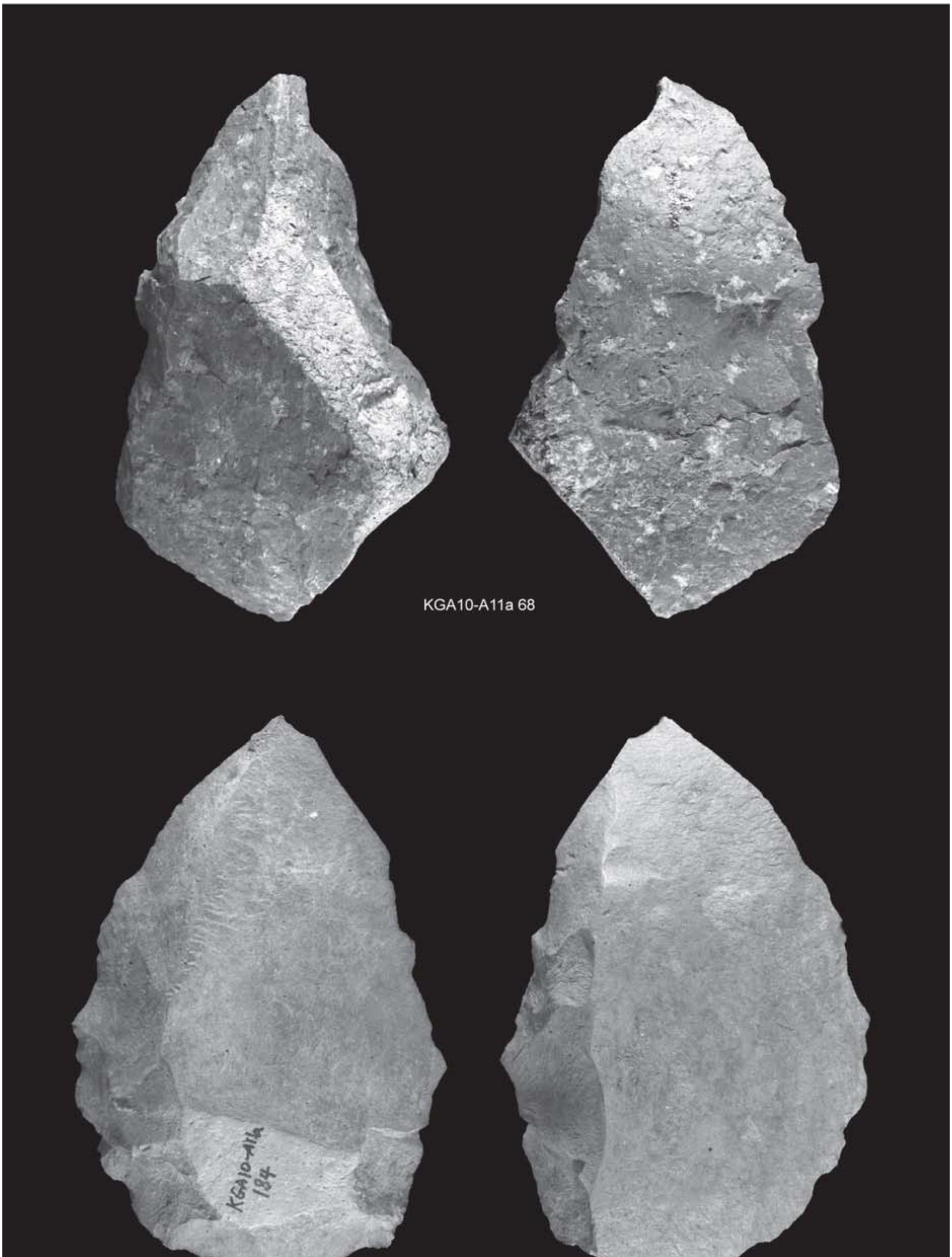

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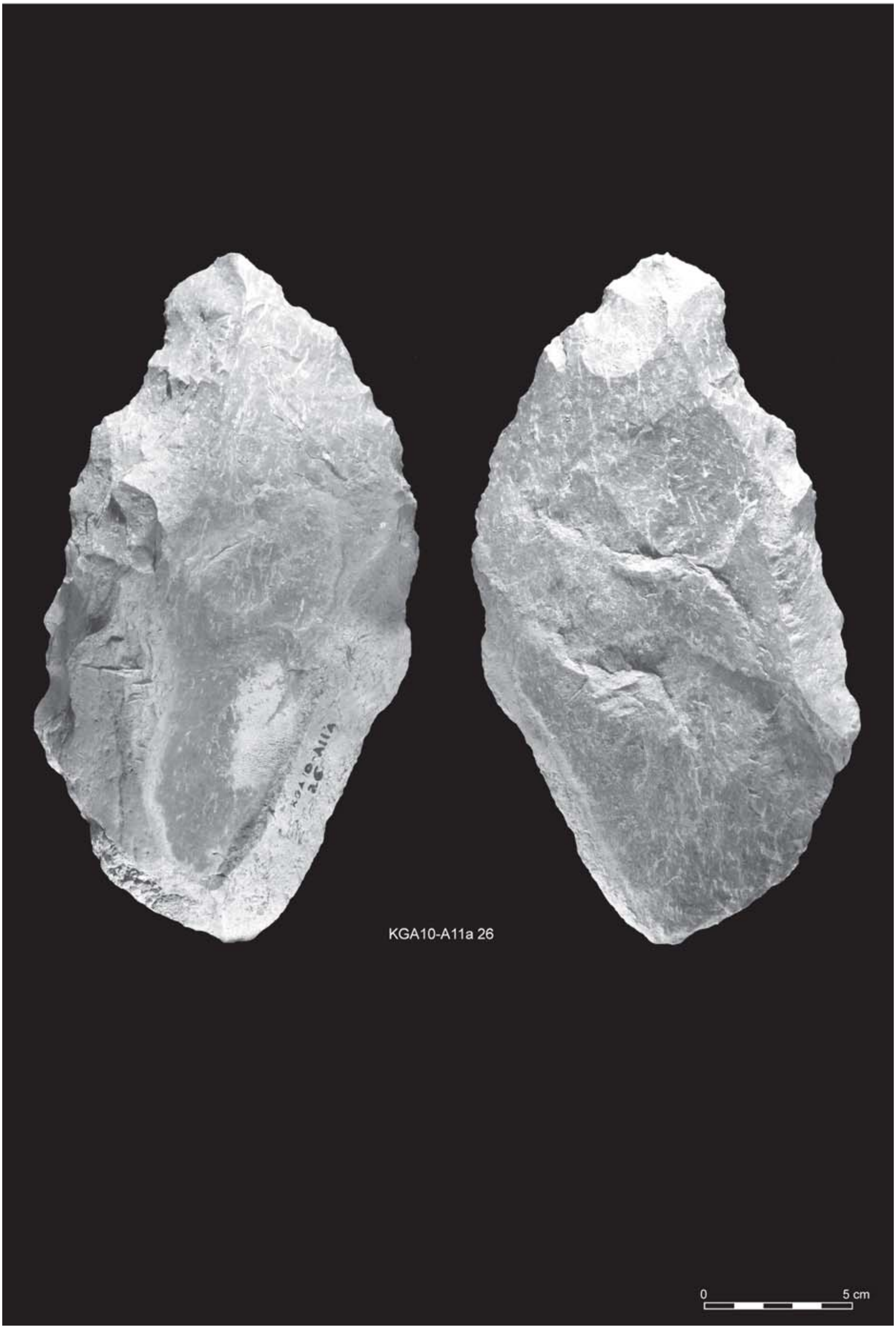

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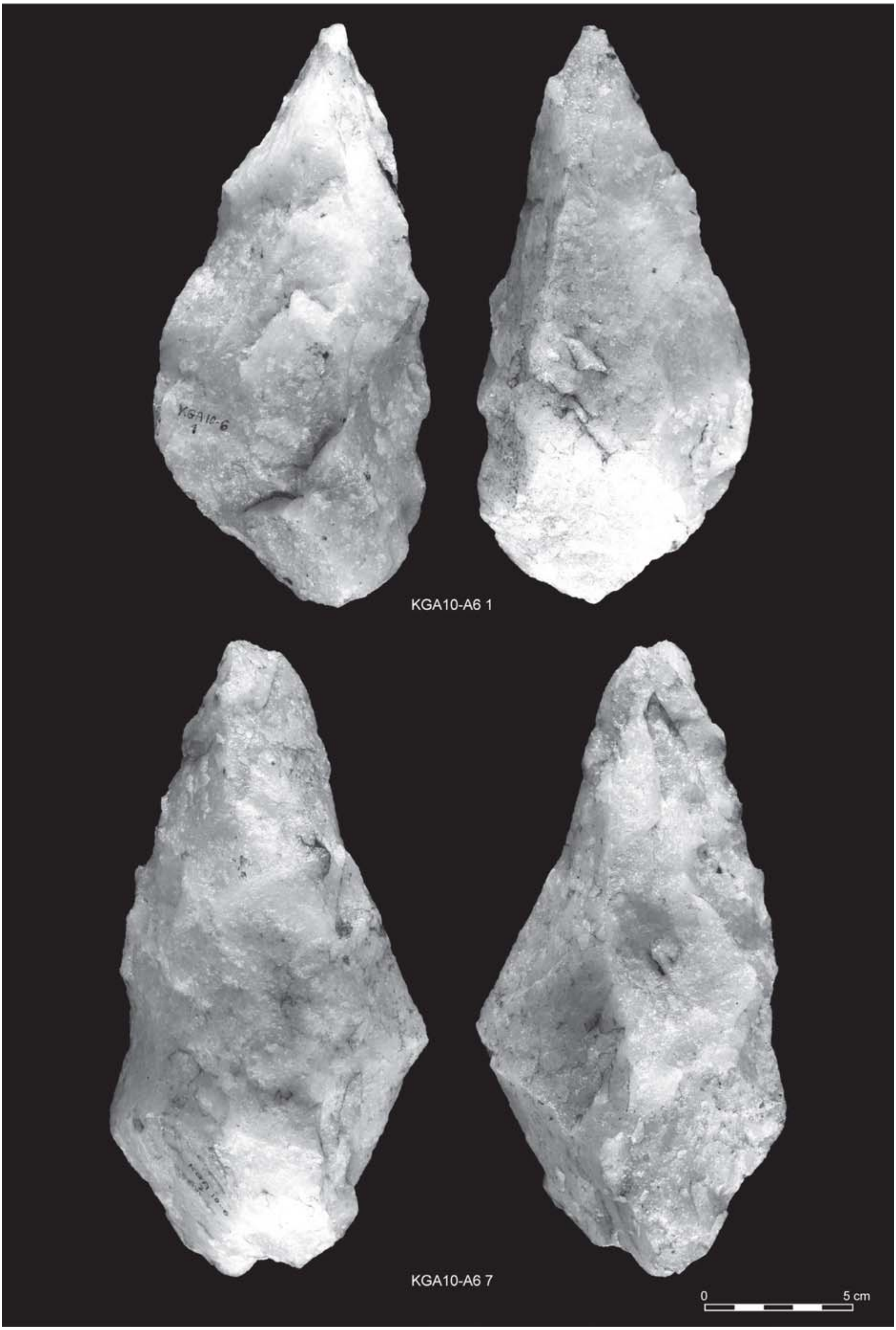

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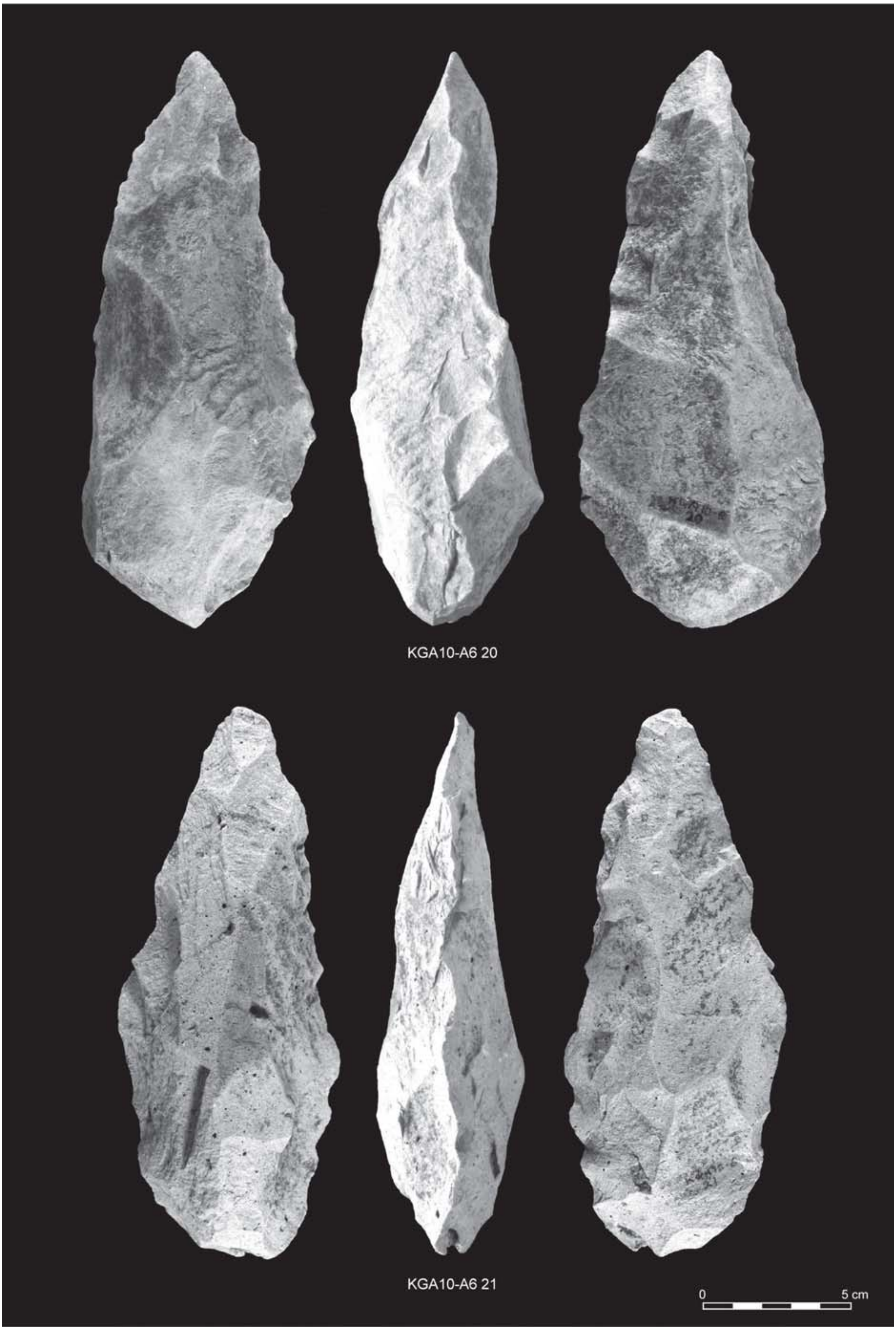

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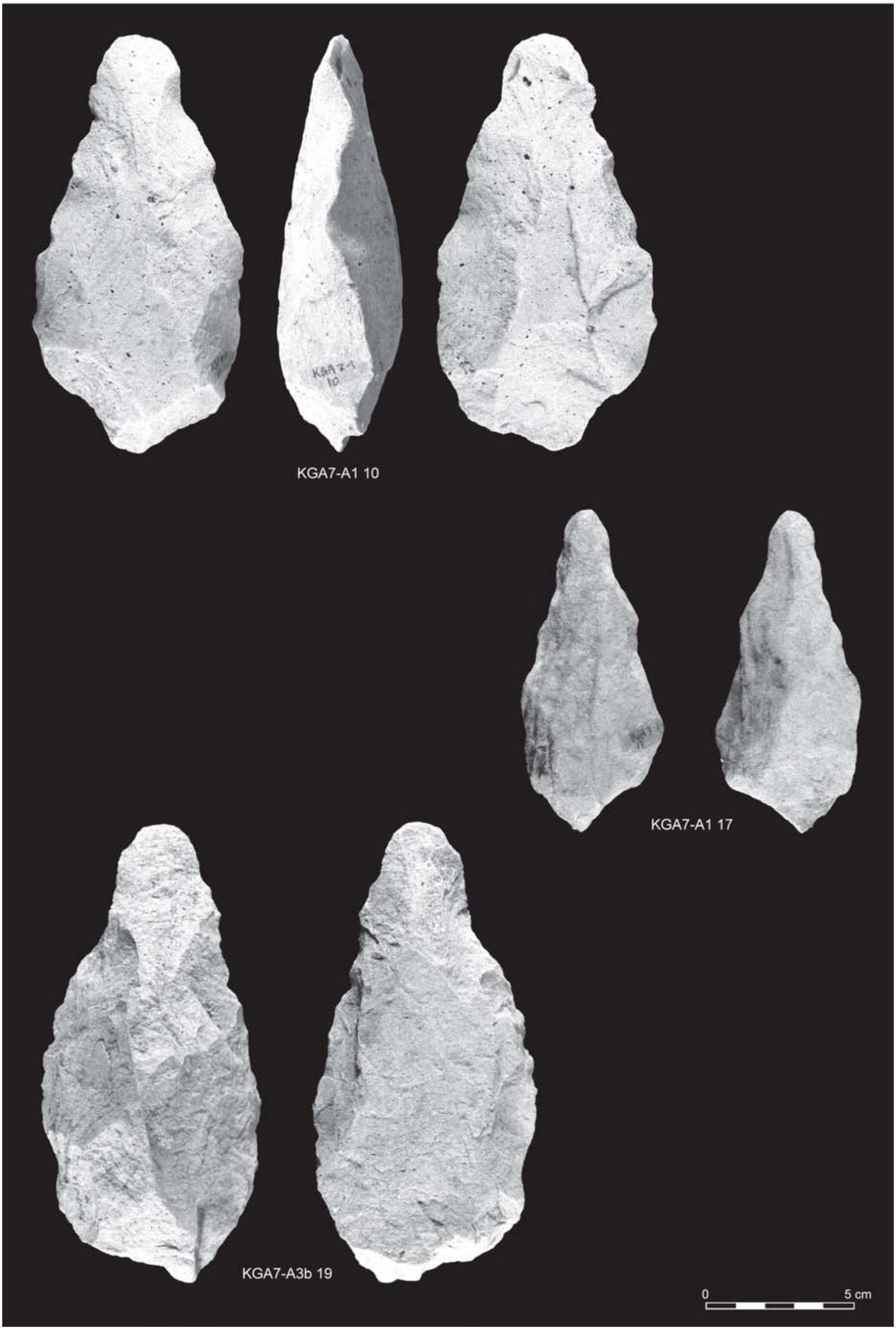

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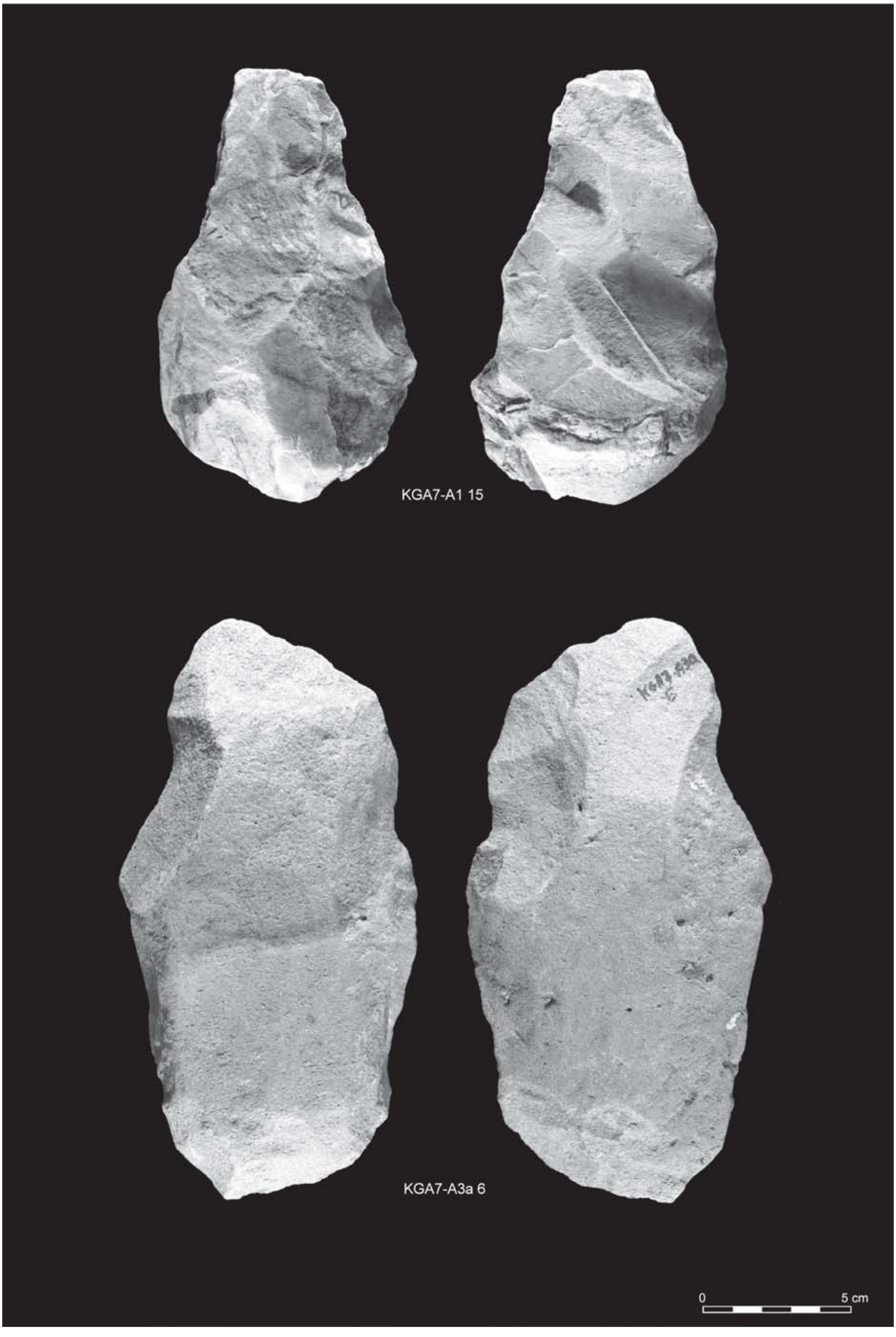

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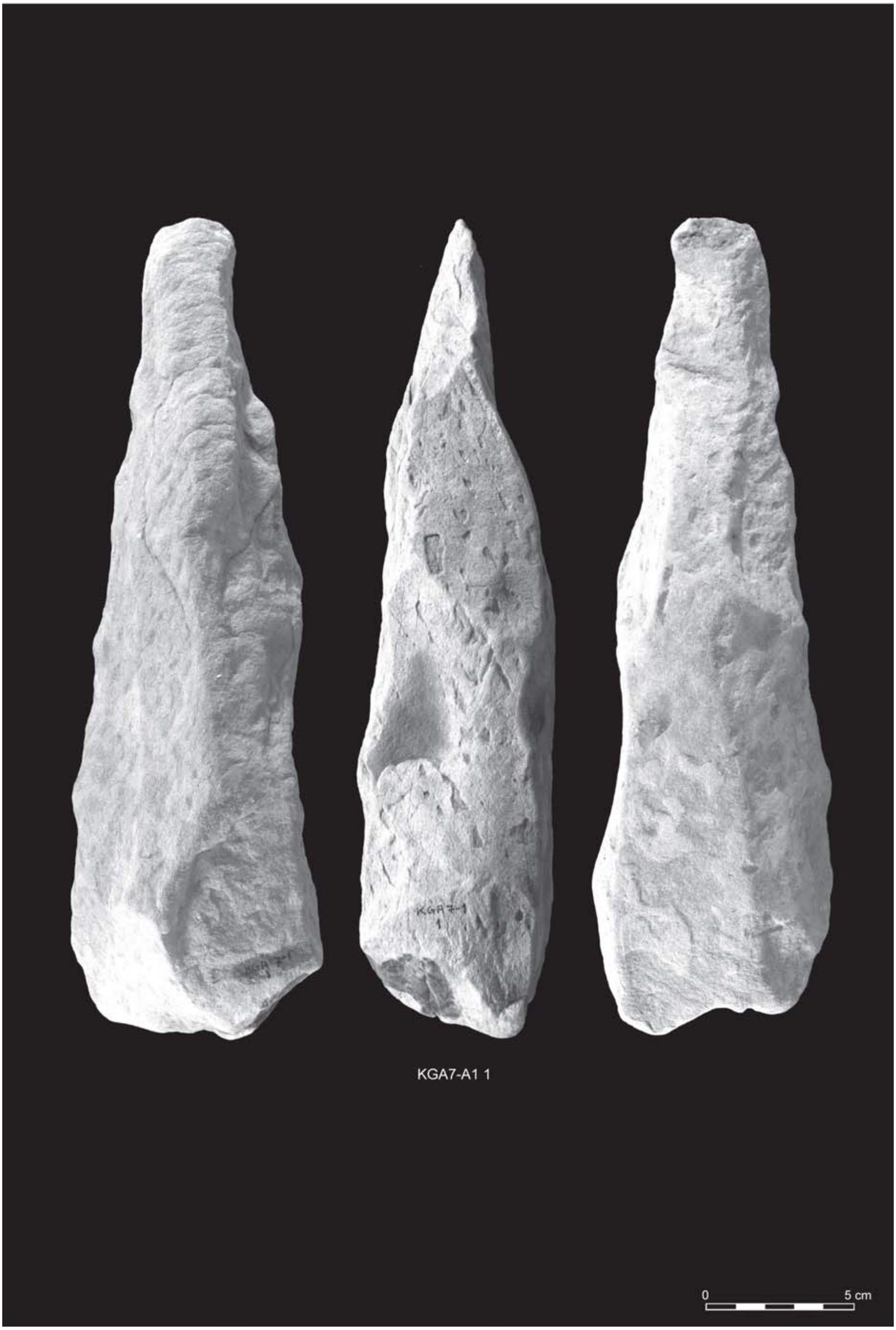

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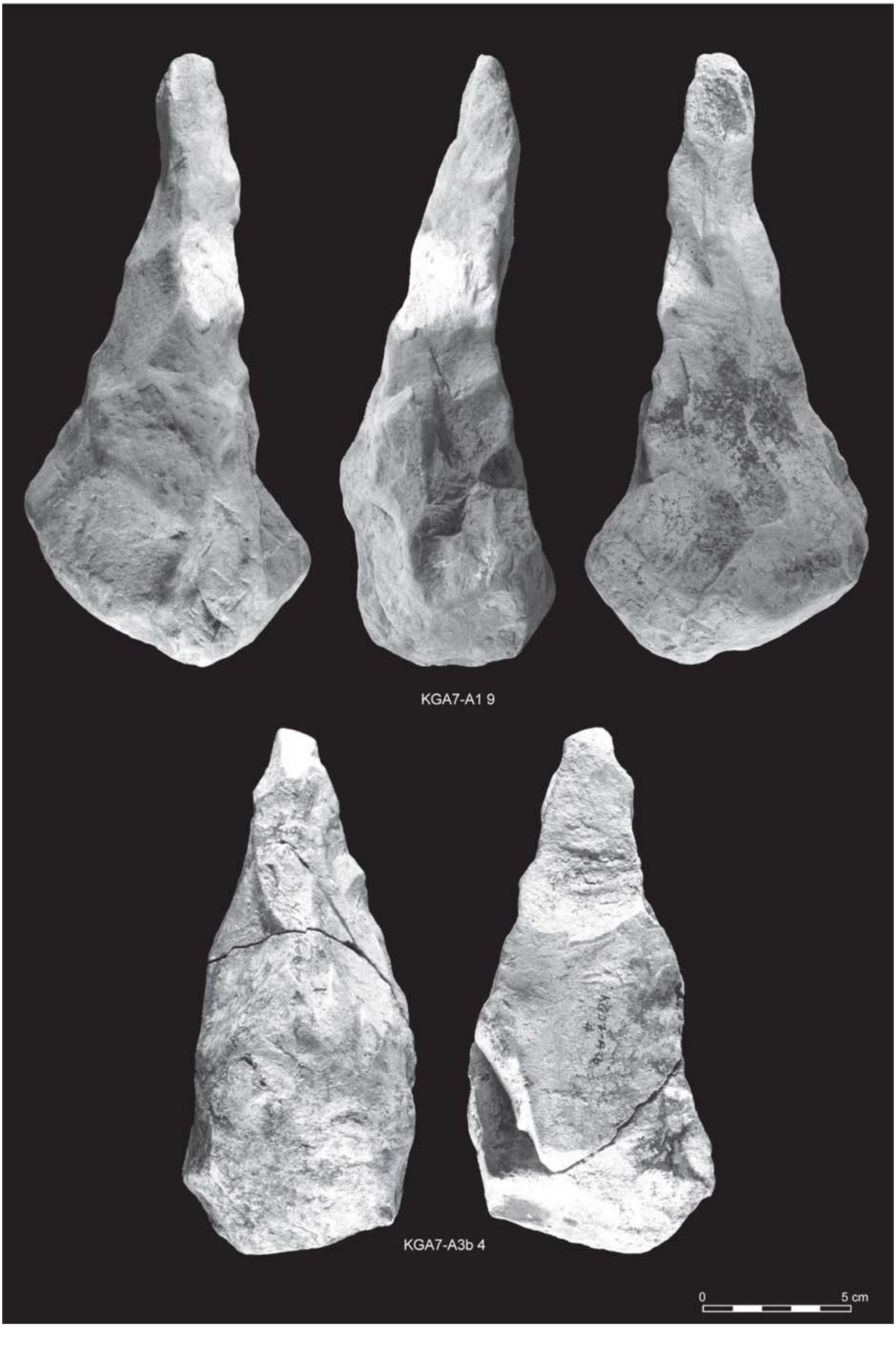

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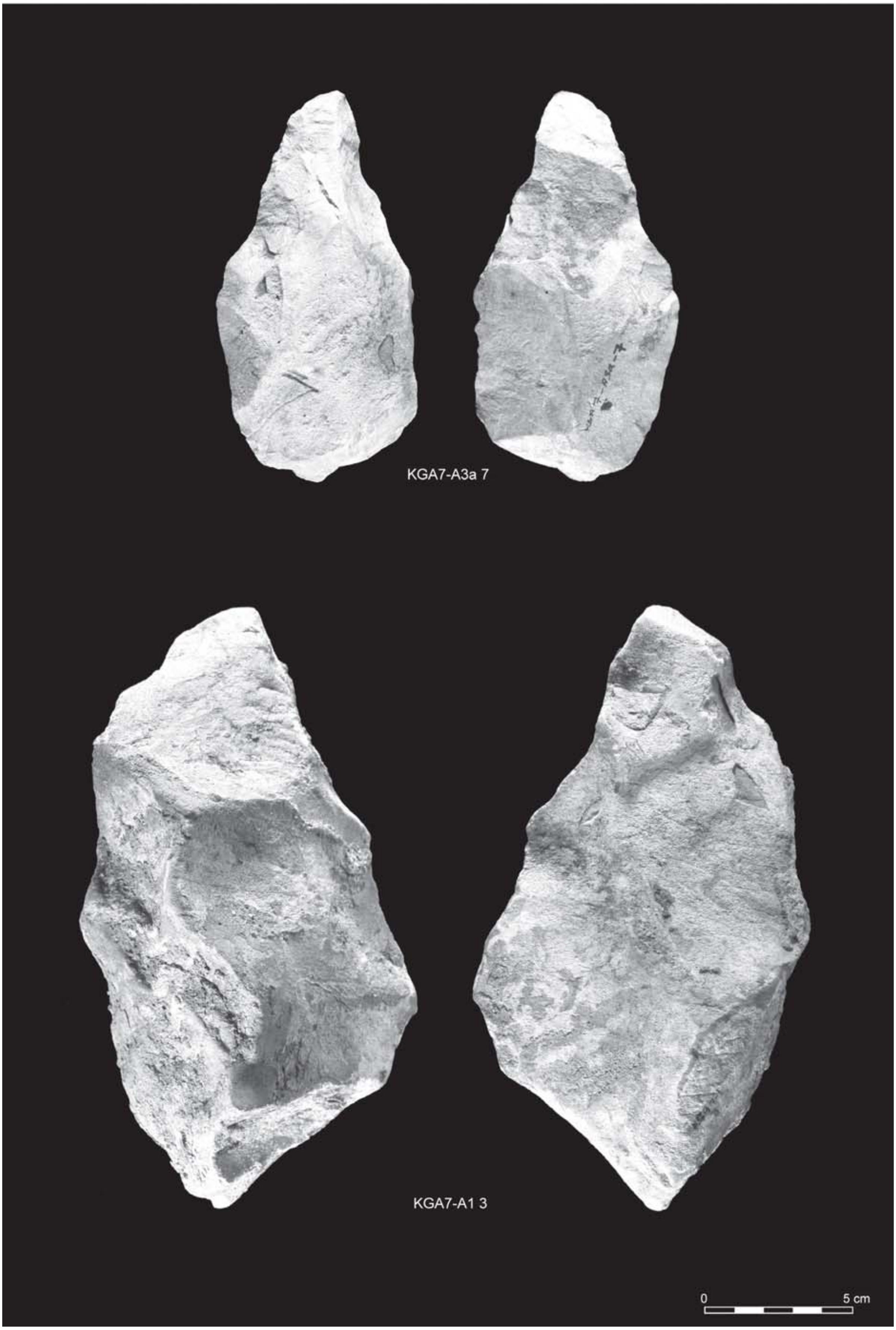


Plate 29

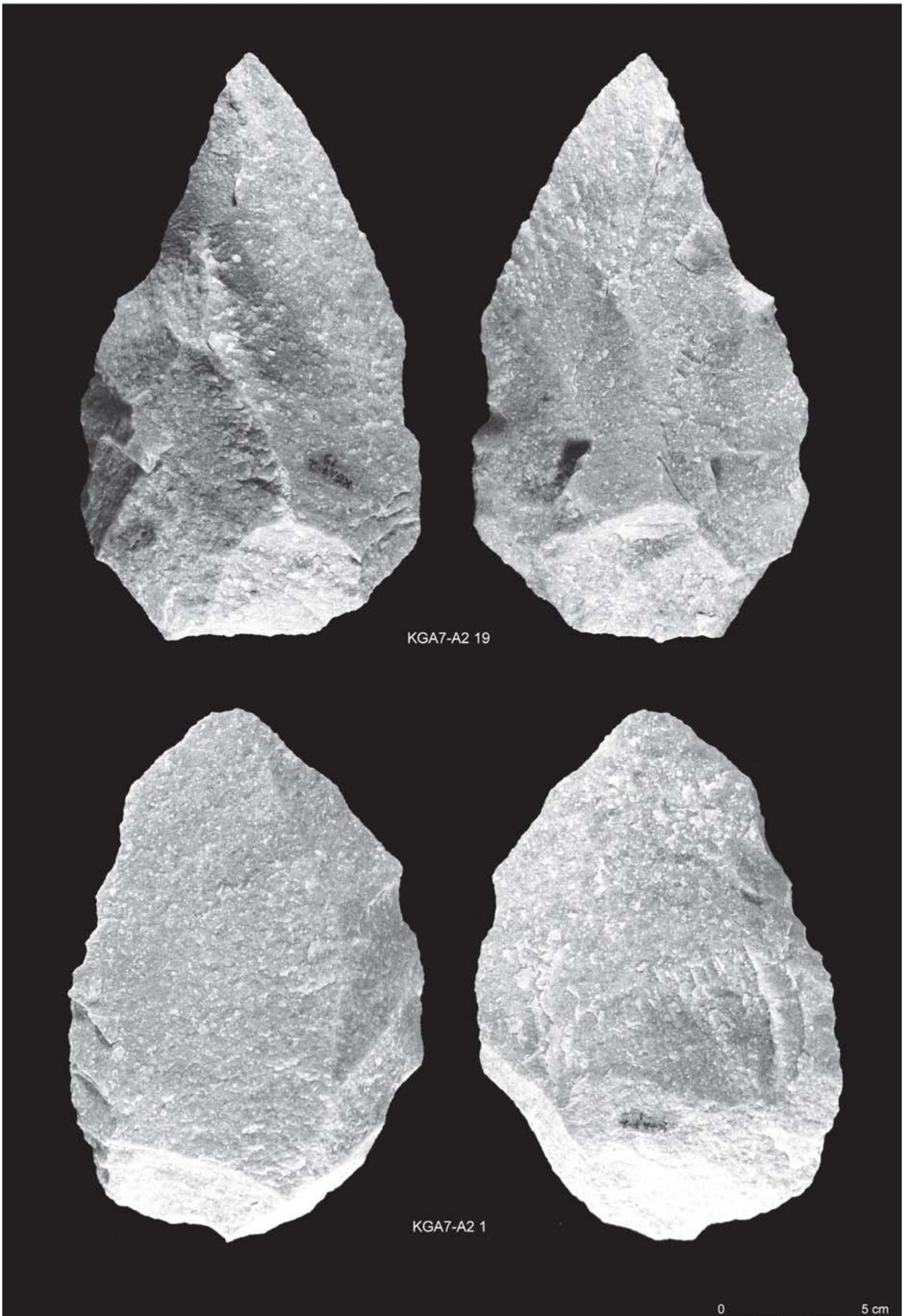


Plate 30

Plate 31

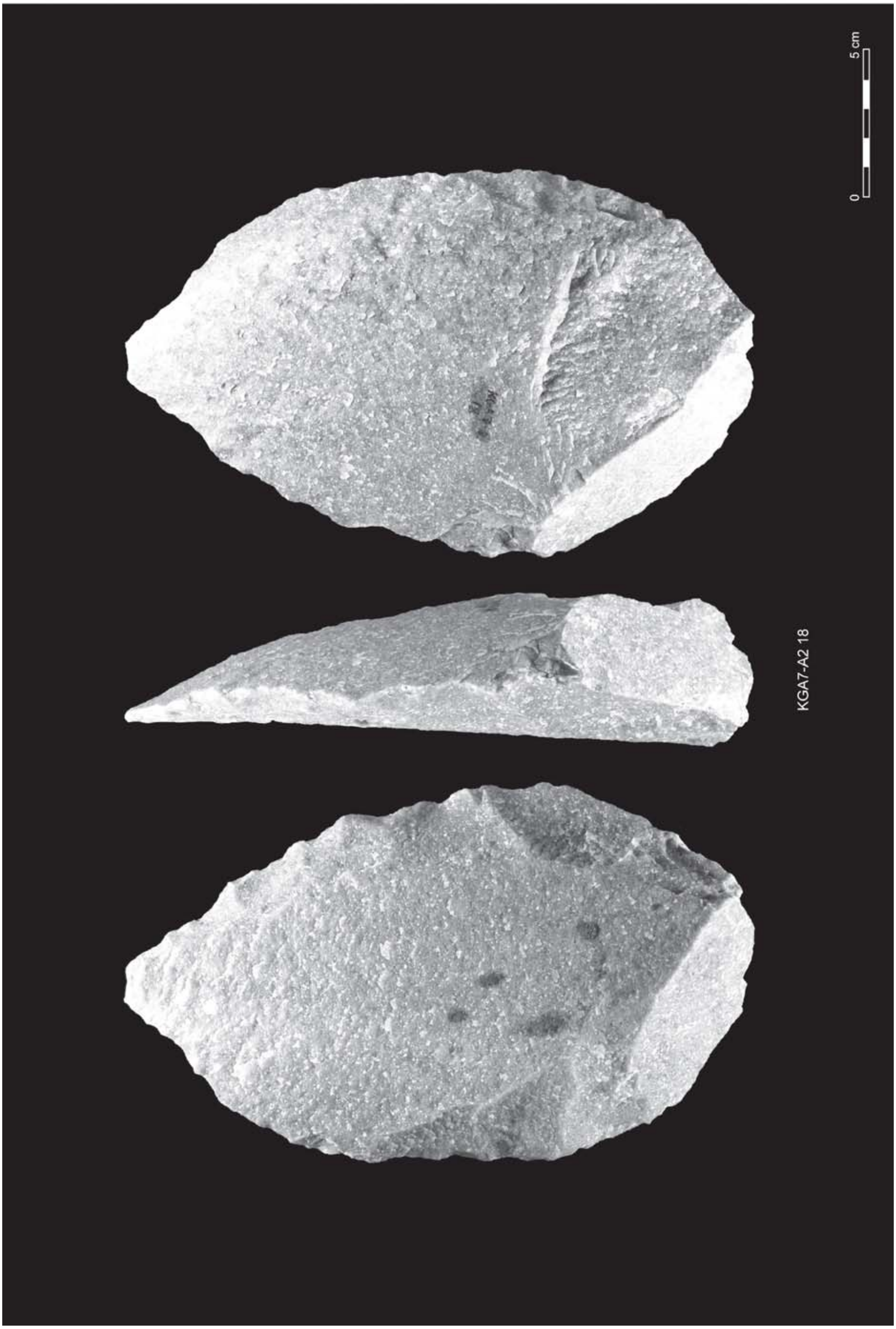


Plate 32

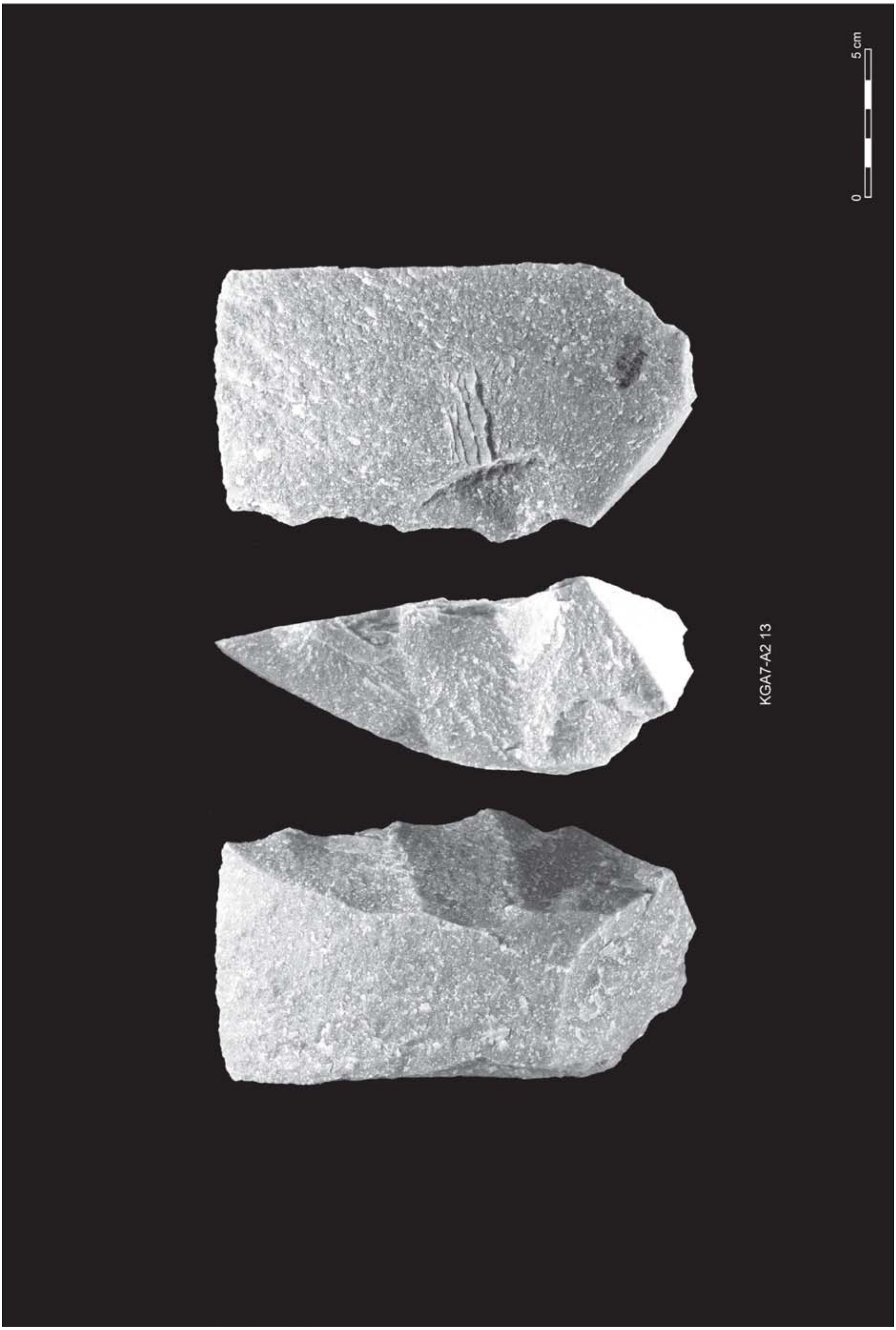


Plate 33

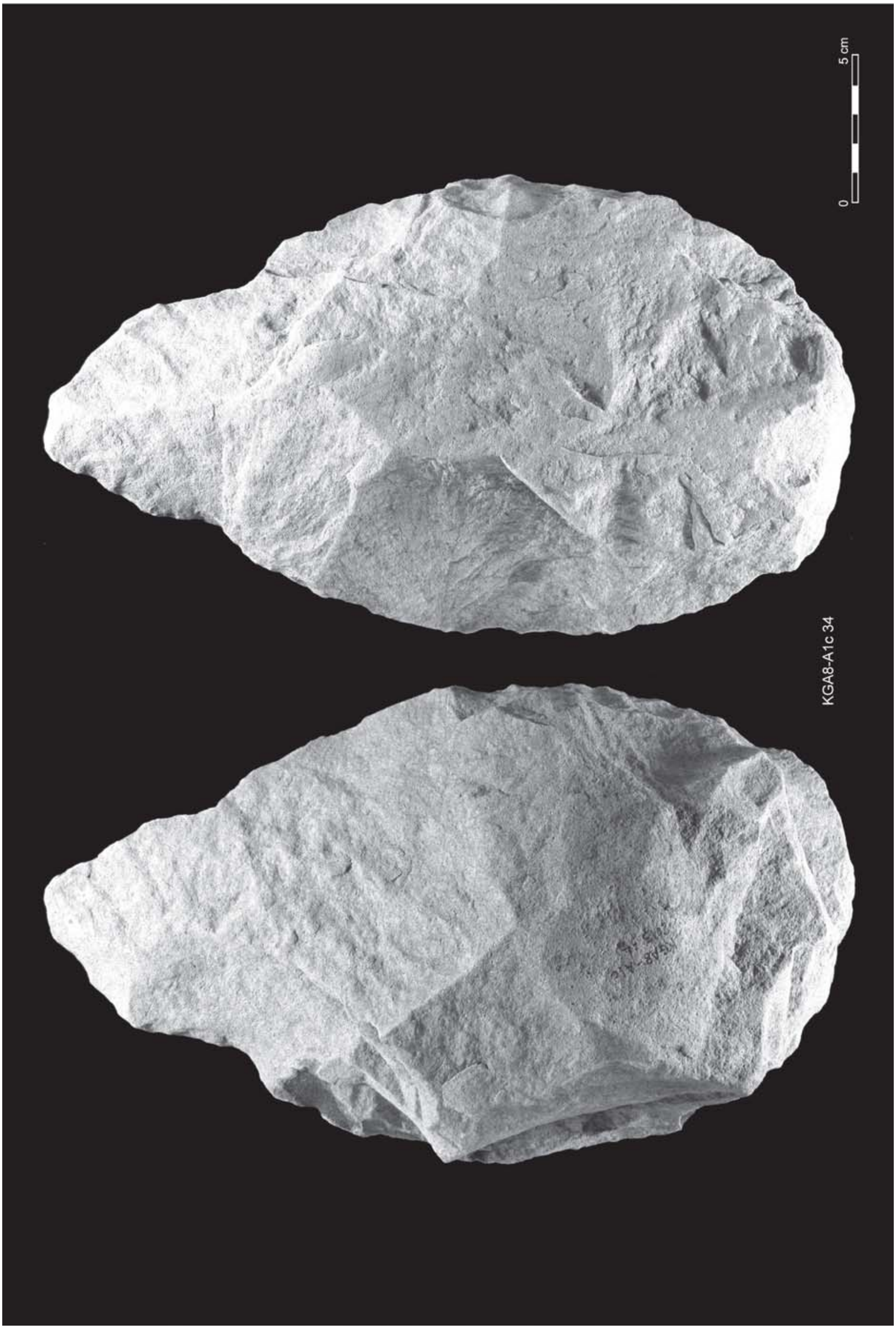


Plate 34

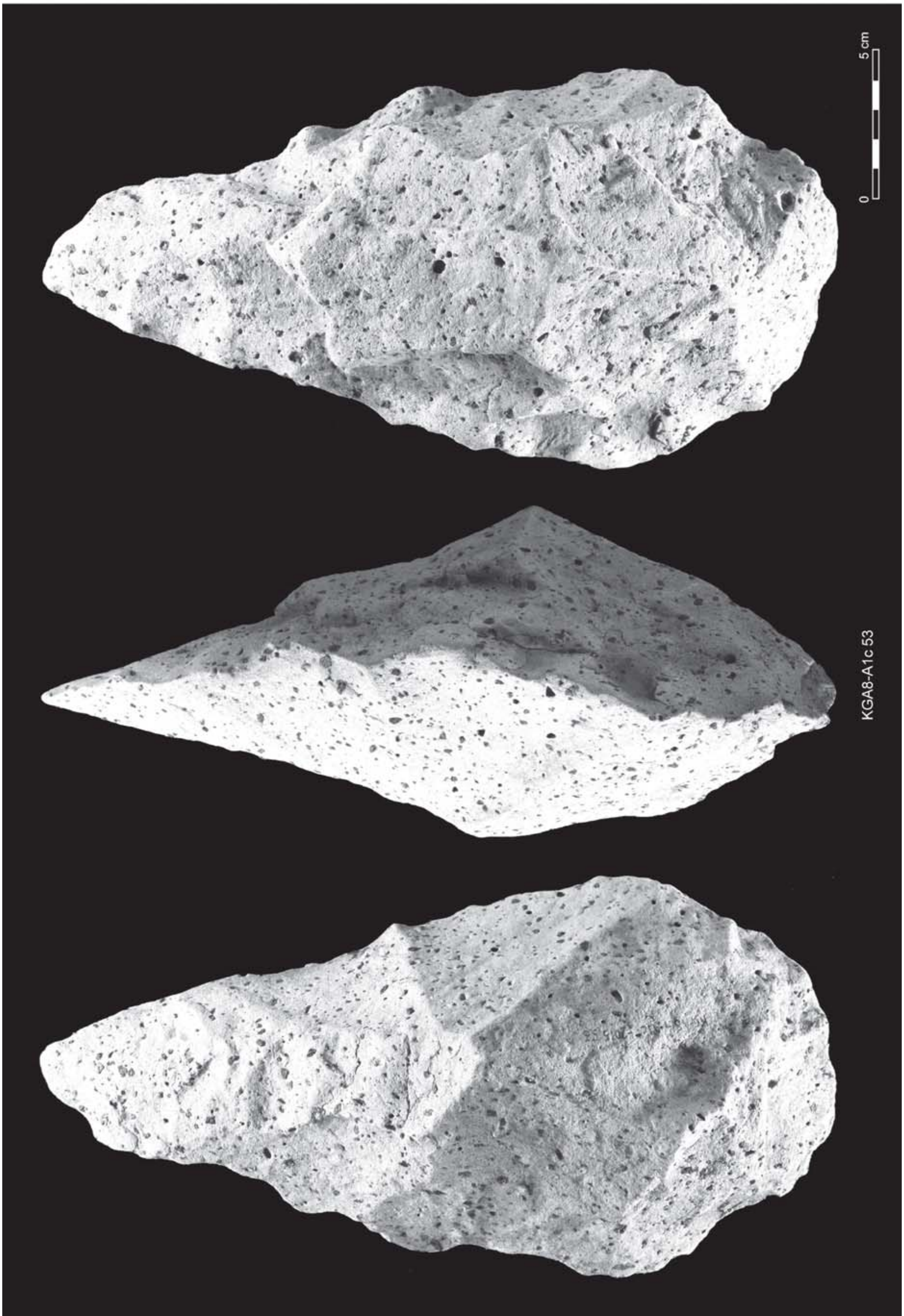


Plate 35

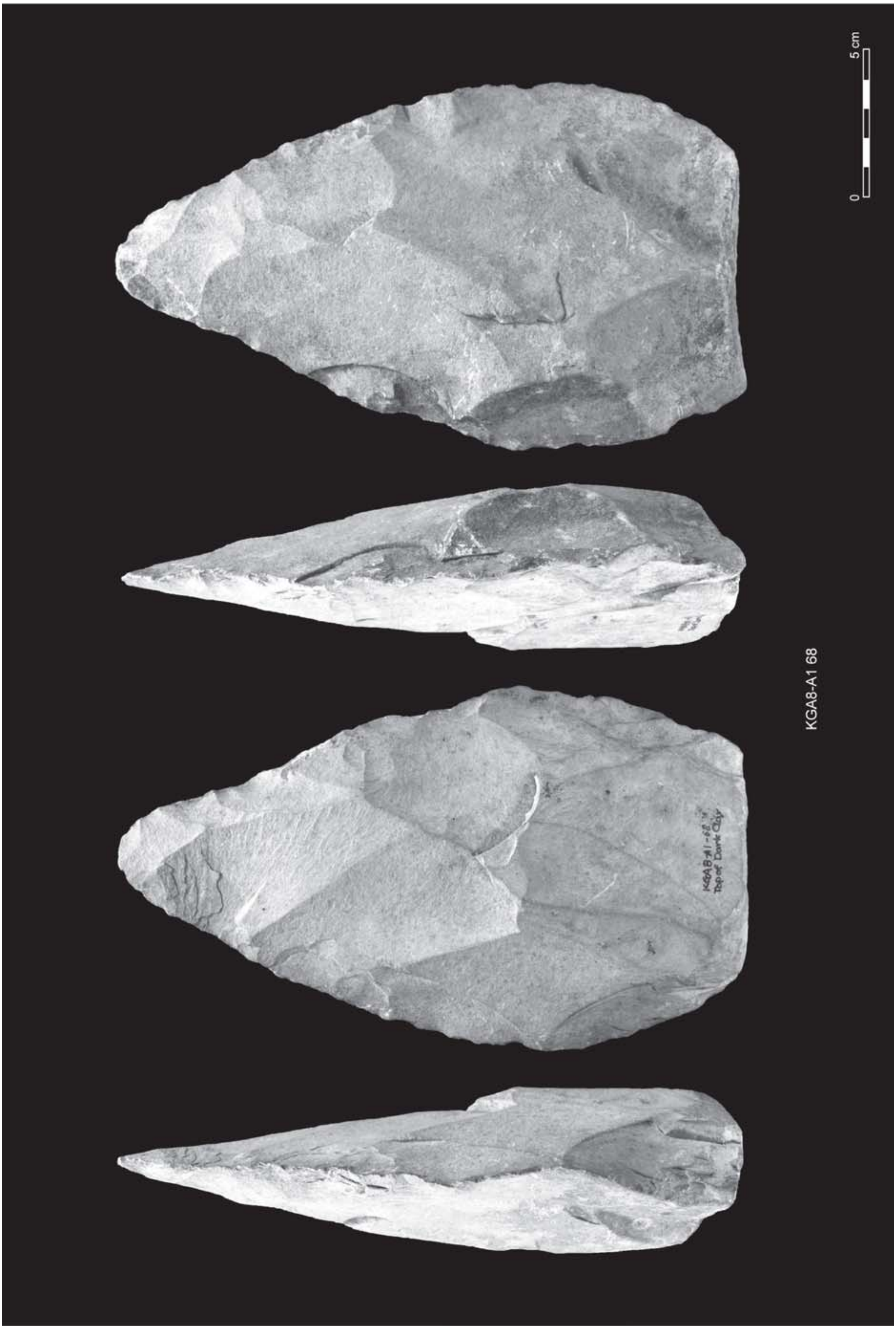


Plate 36

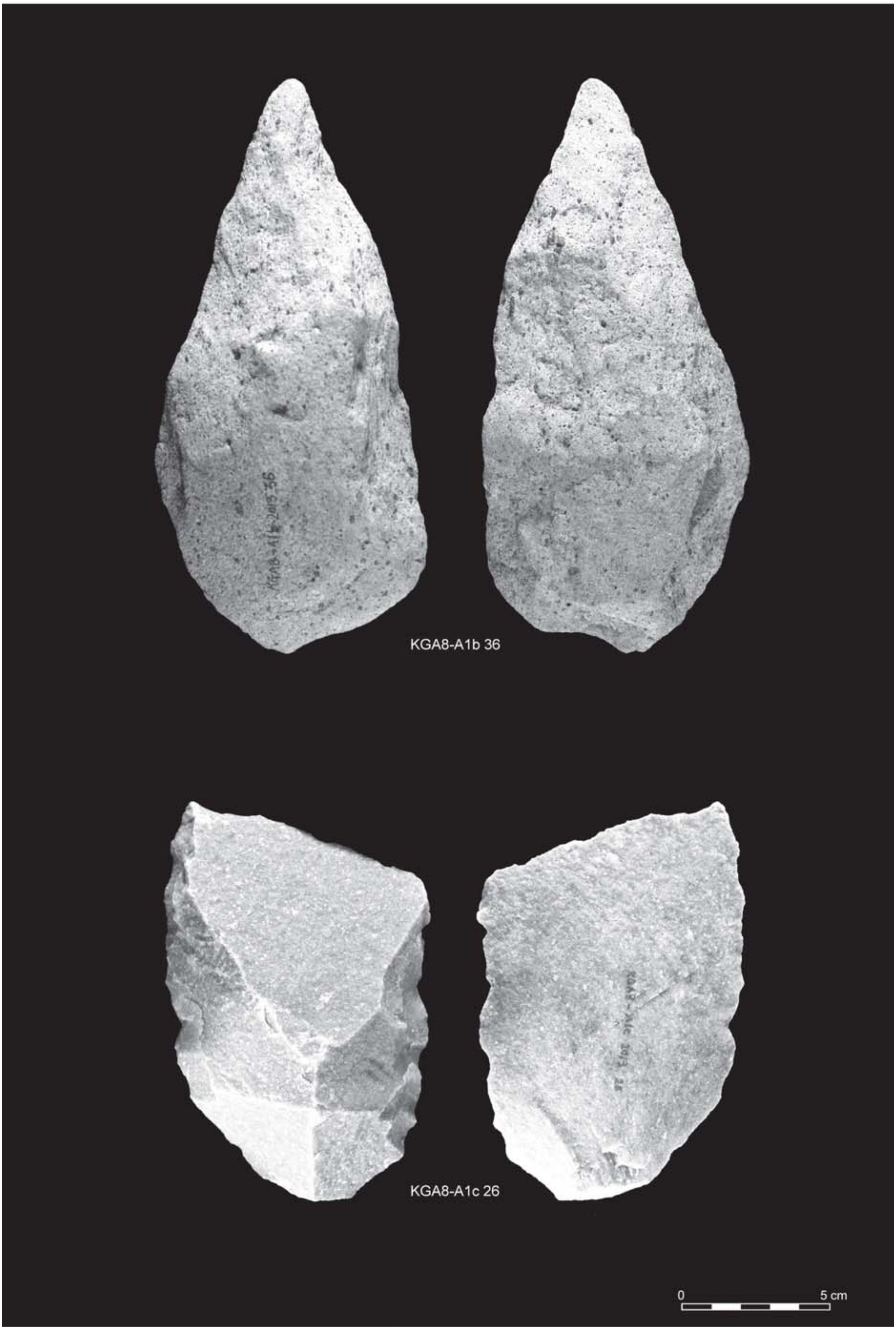


Plate 37

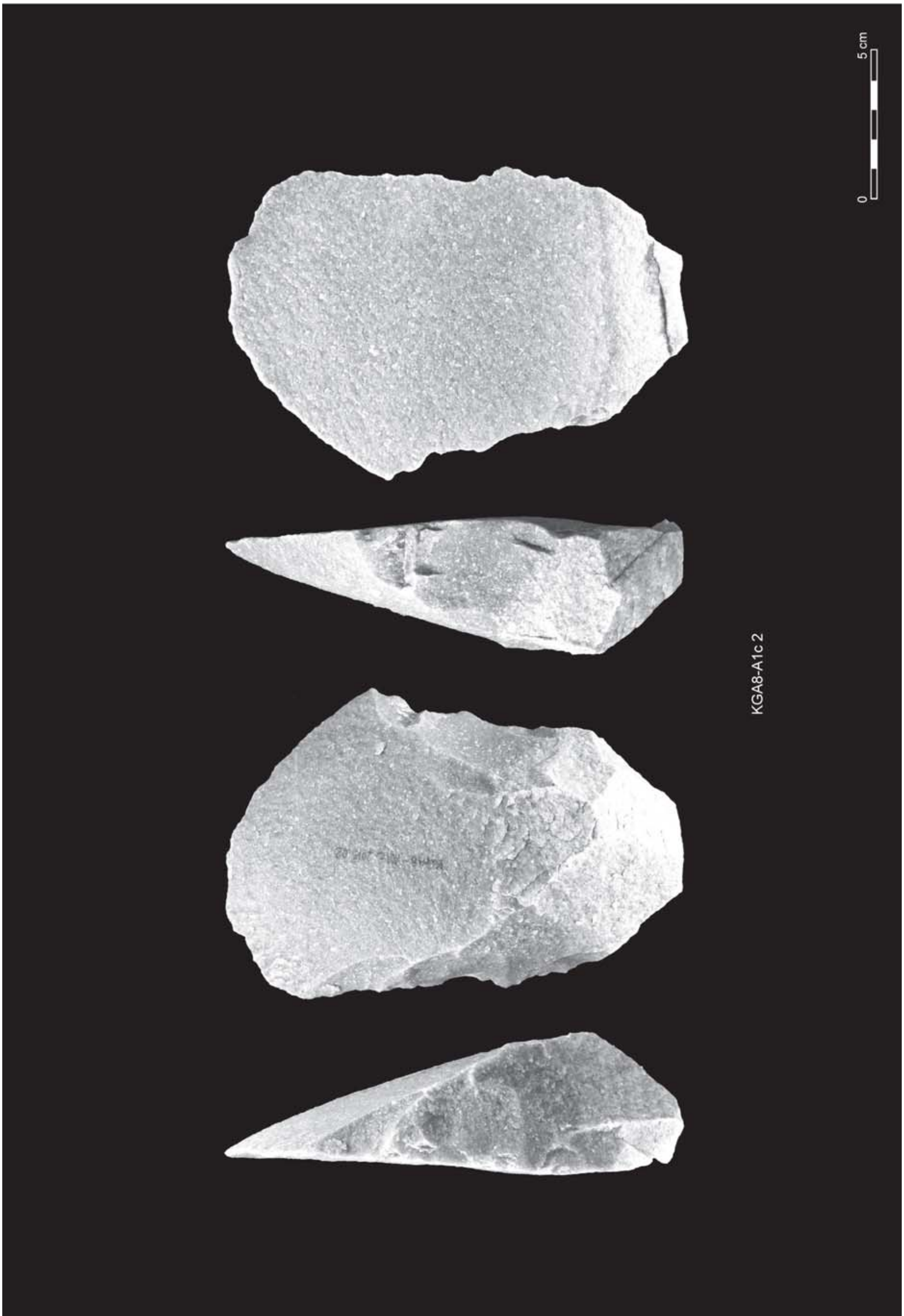


Plate 38

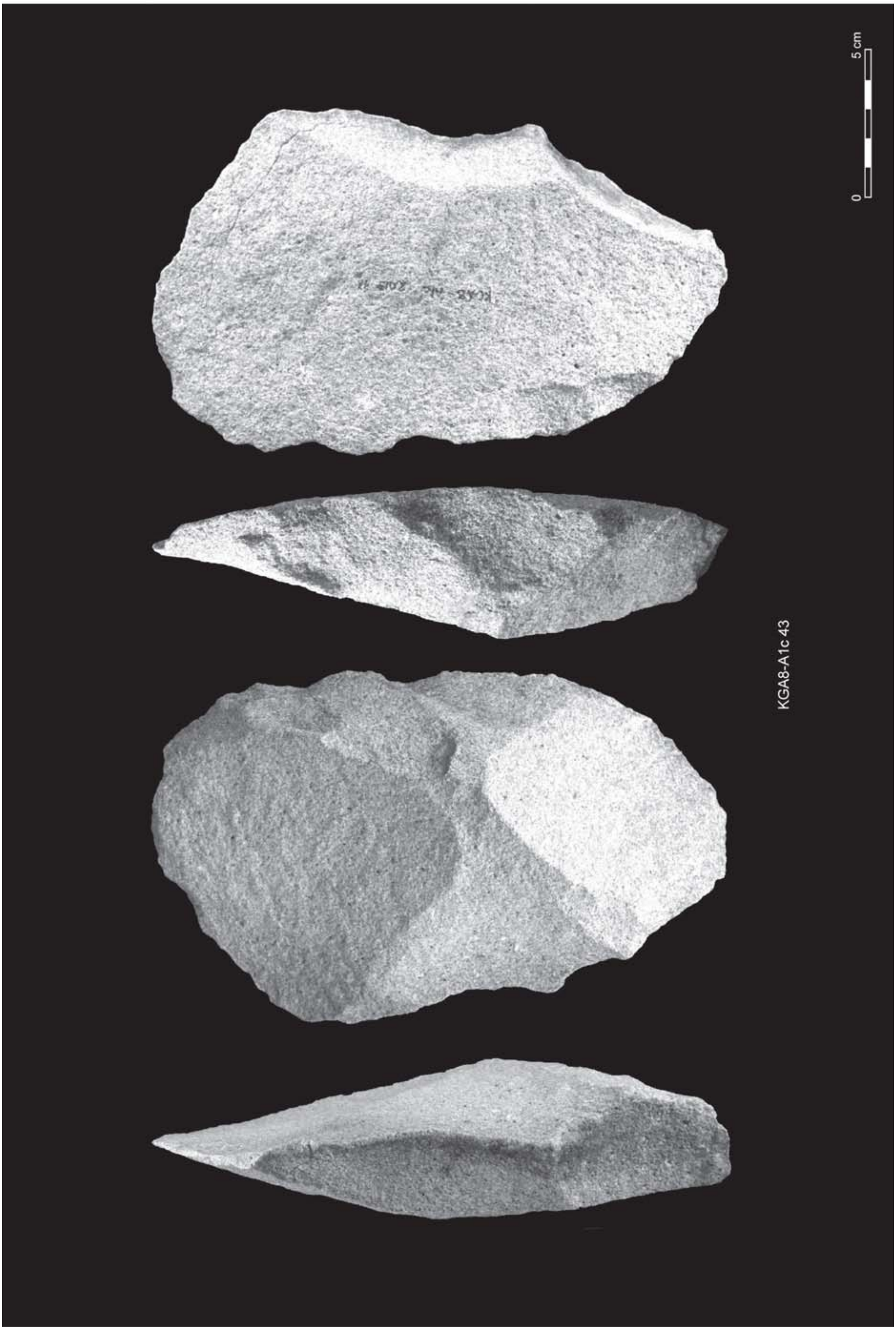


Plate 39

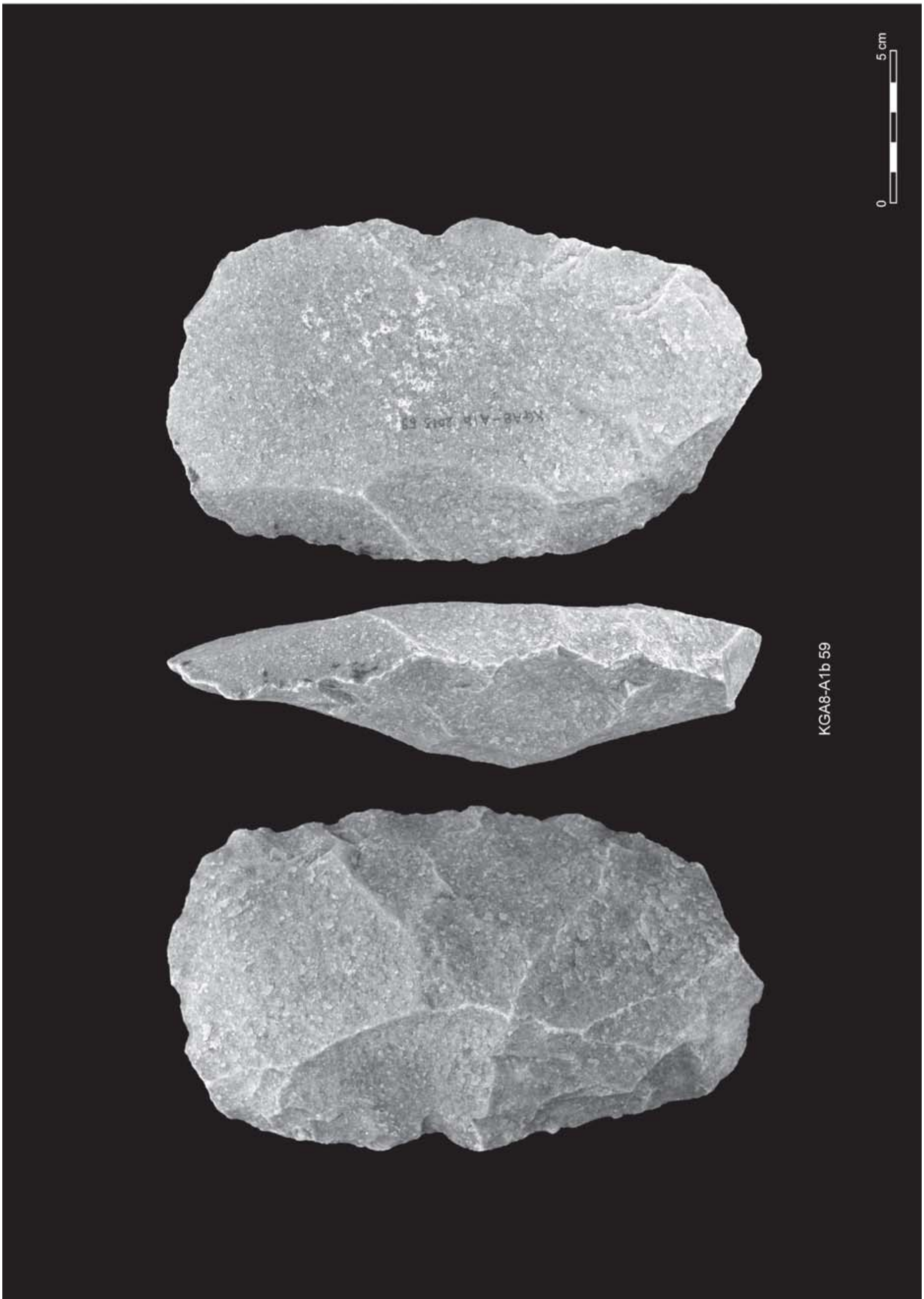


Plate 40

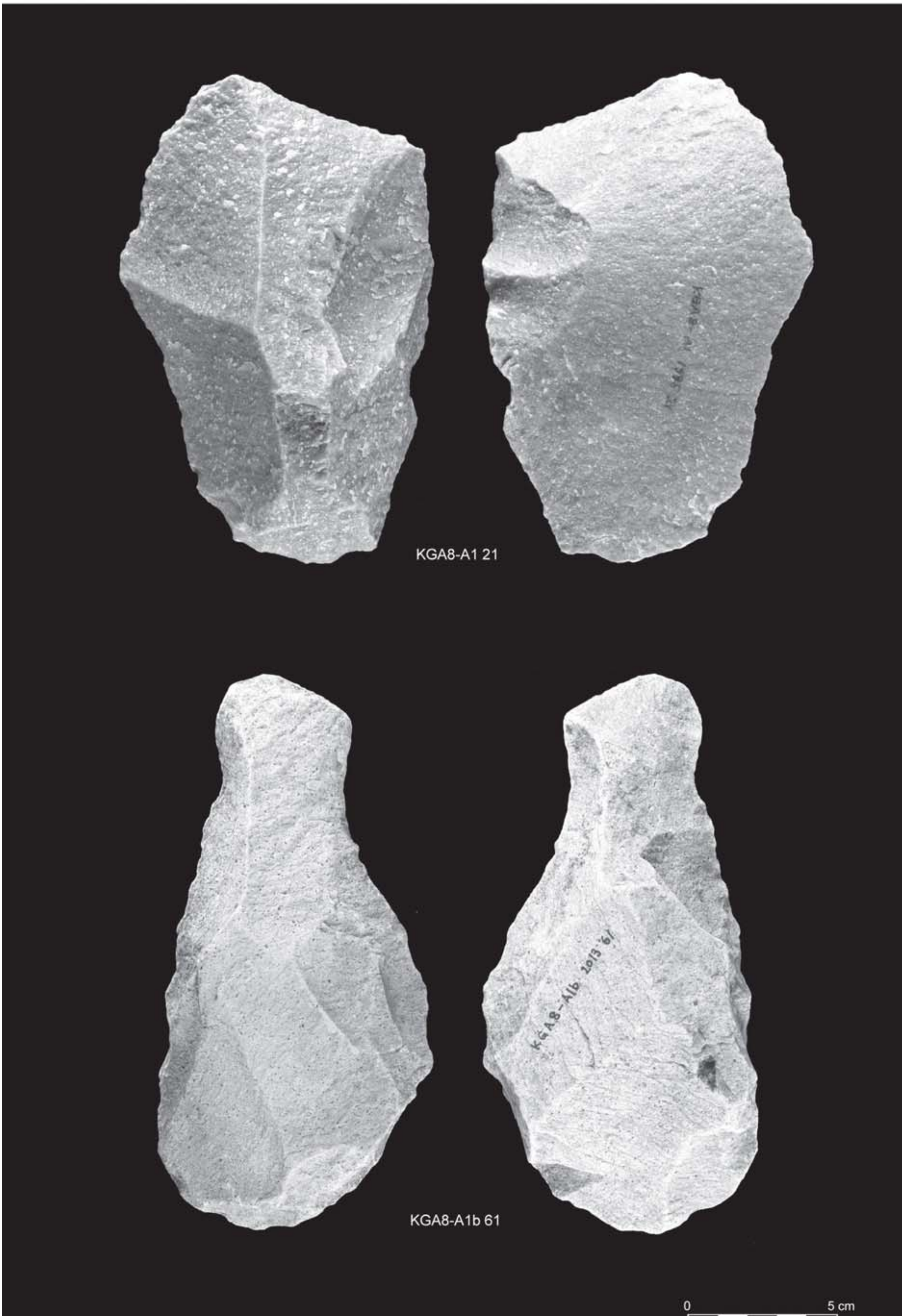
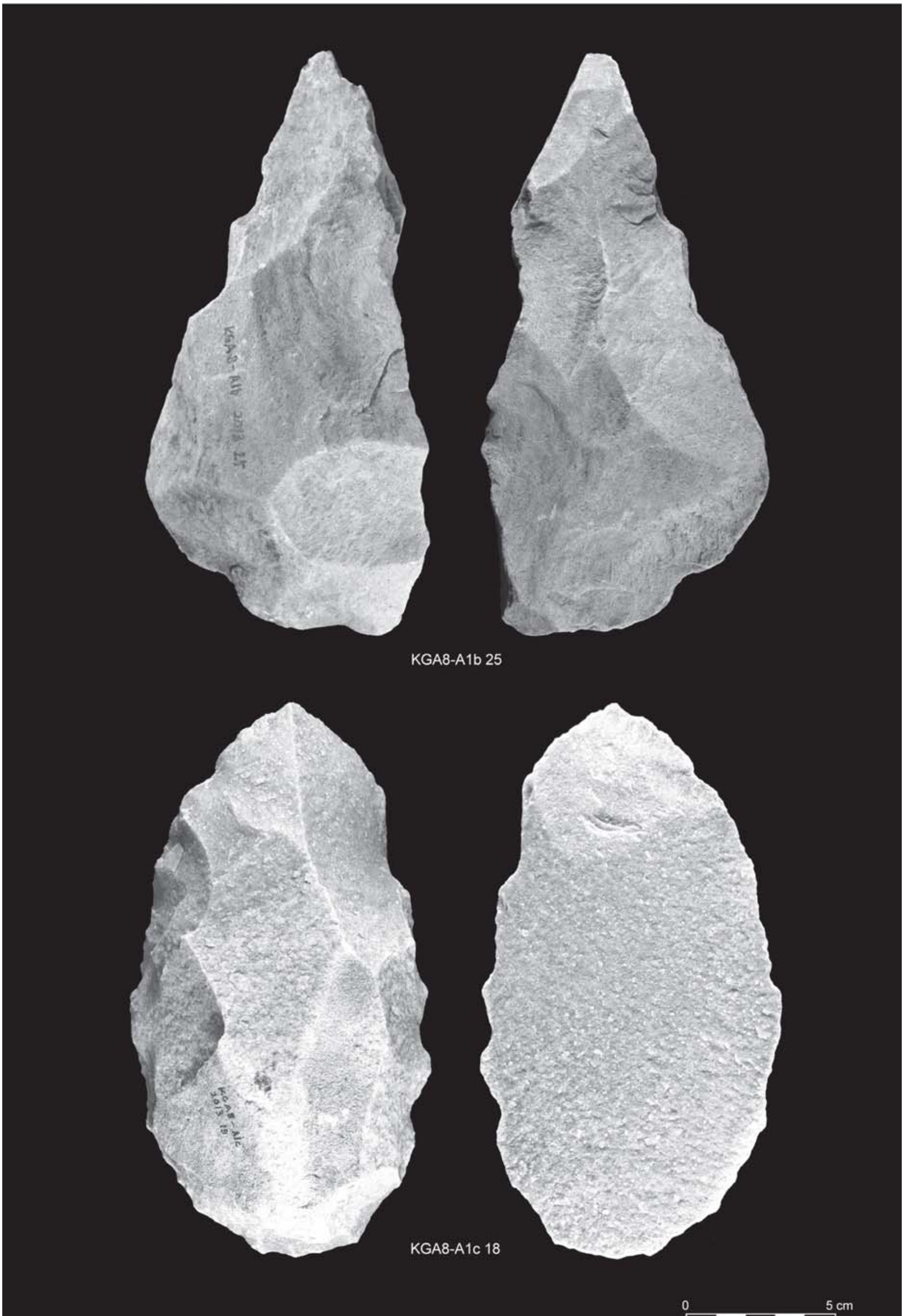


Plate 41



KGA8-A1b 25

KGA8-A1c 18

Plate 42

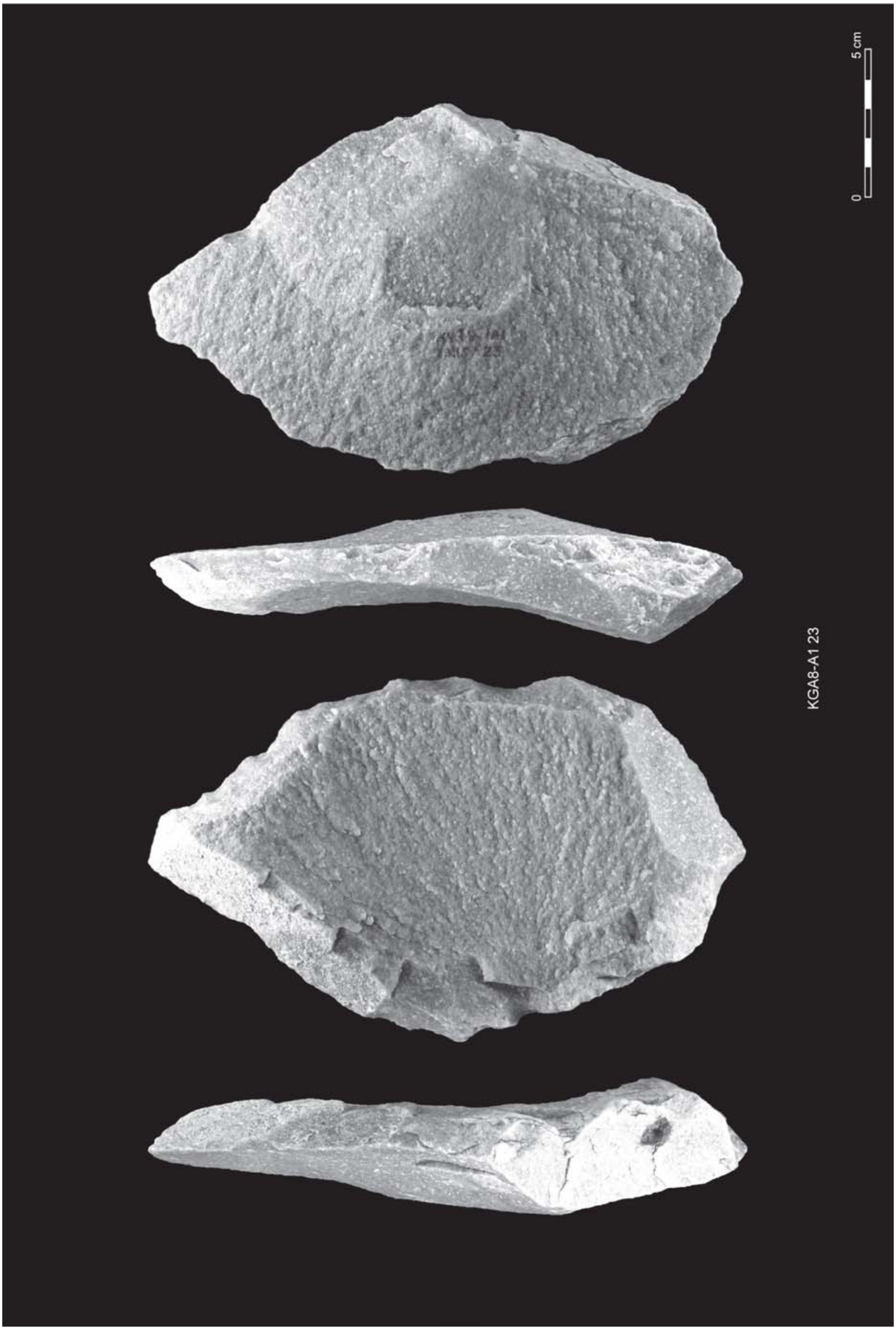


Plate 43

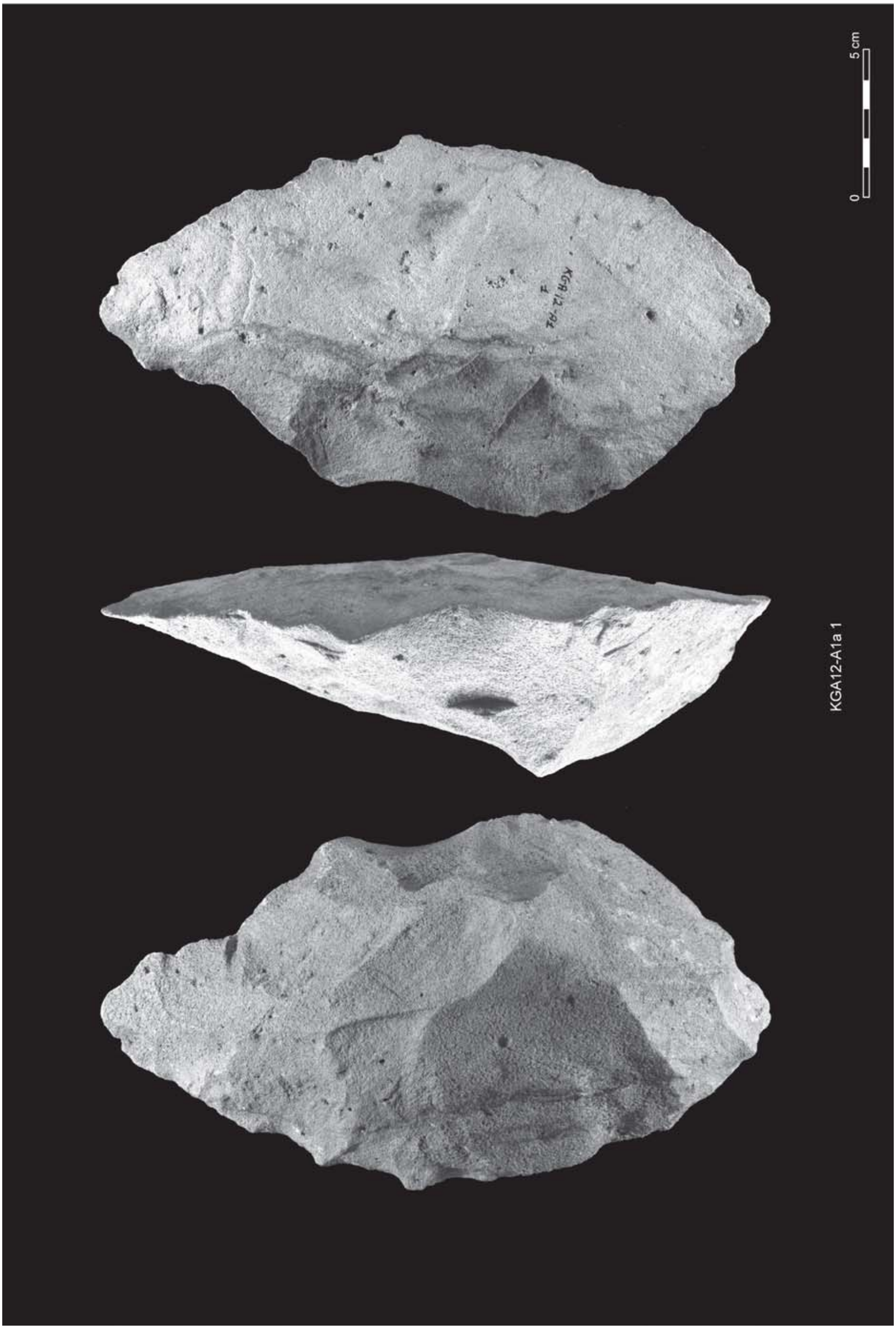


Plate 44

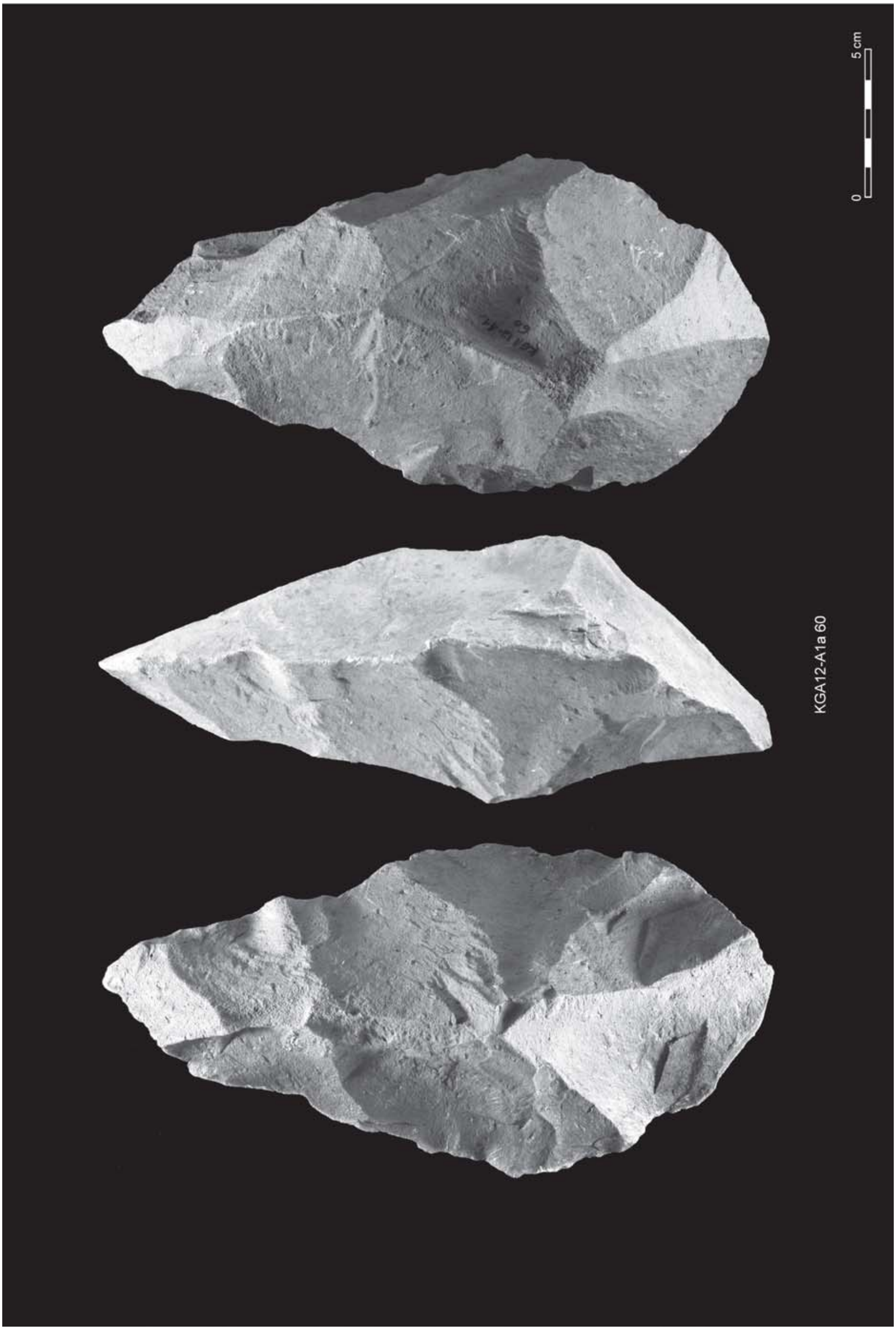
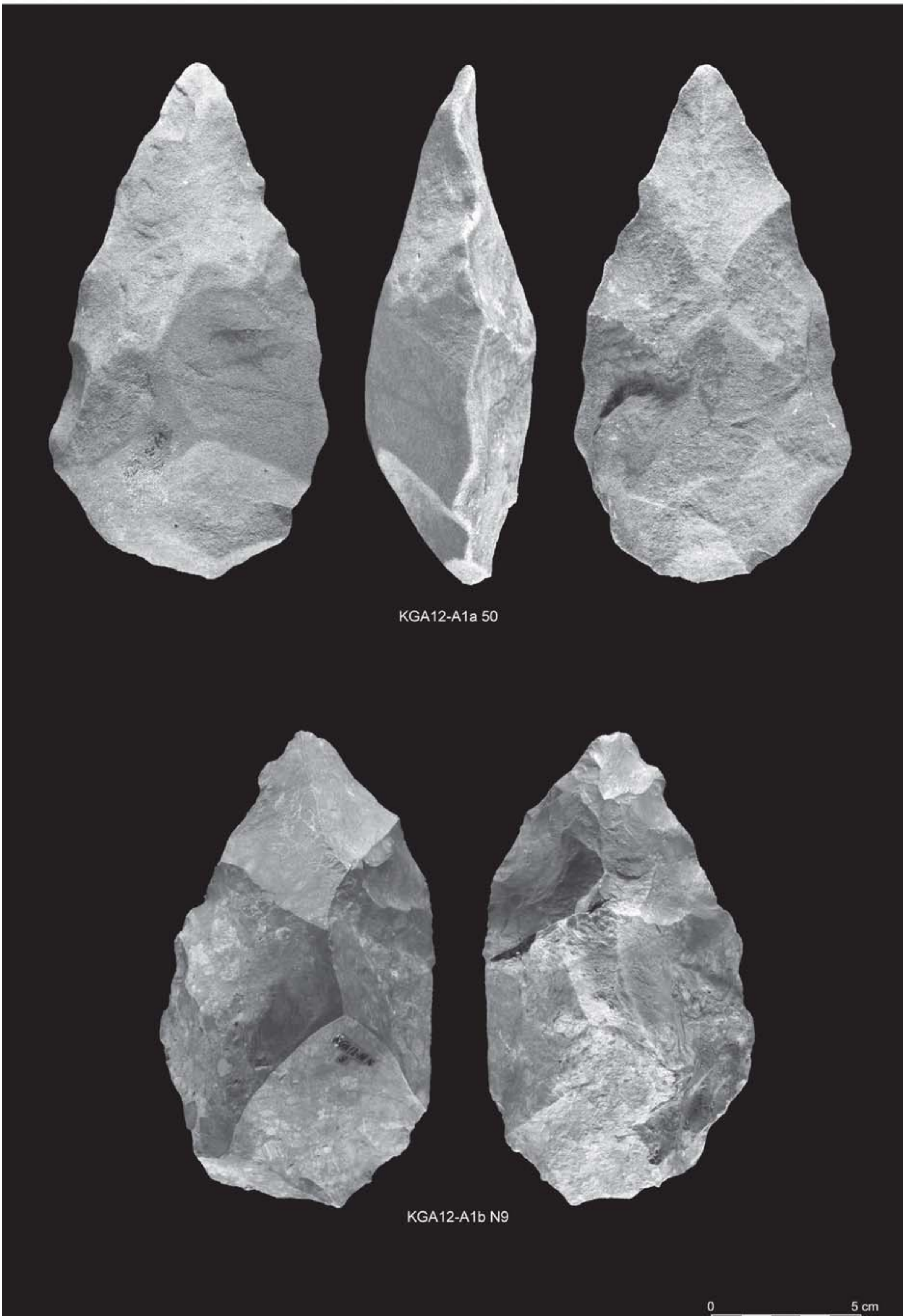


Plate 45



KGA12-A1a 50

KGA12-A1b N9

Plate 46

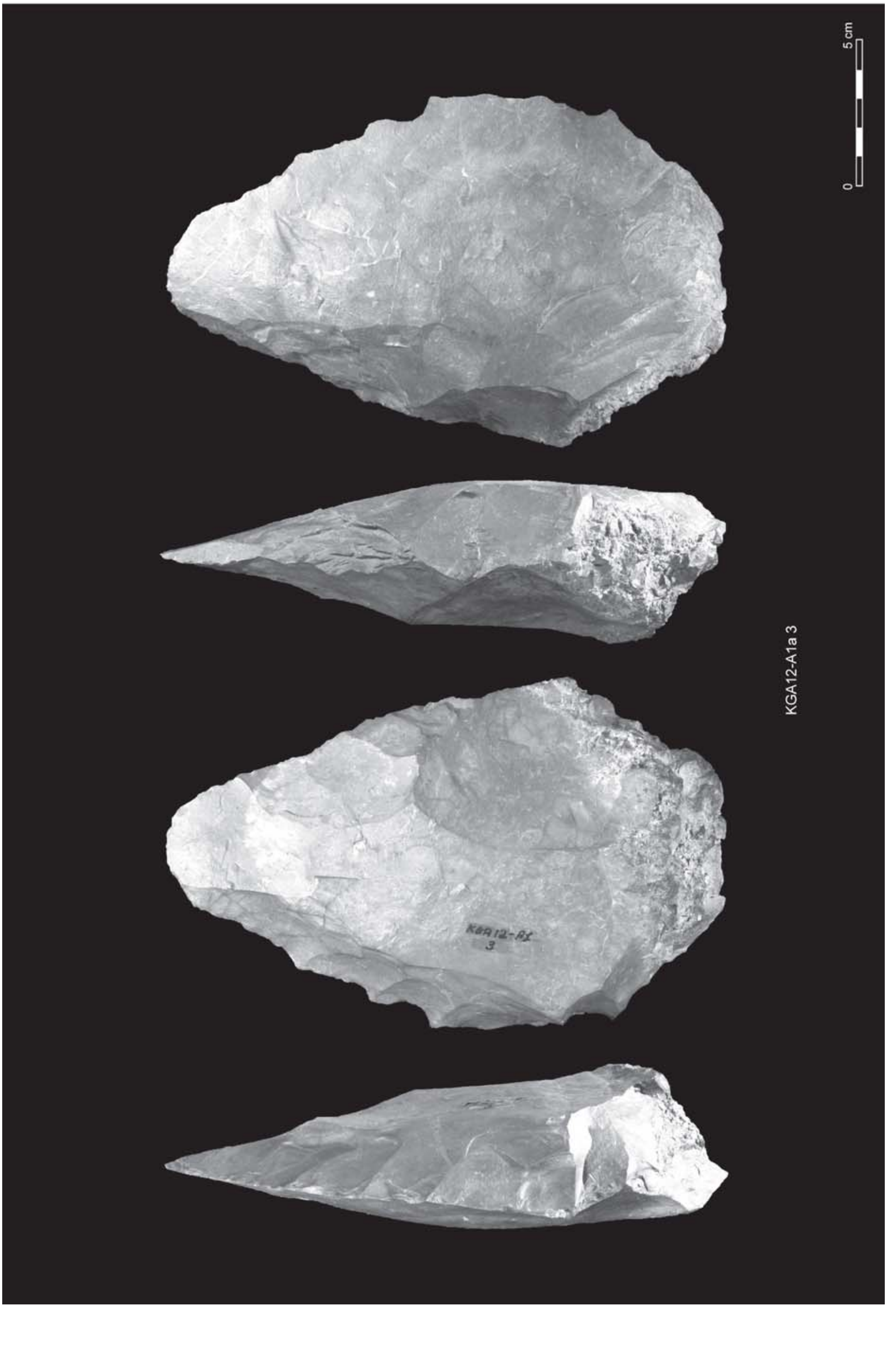


Plate 47

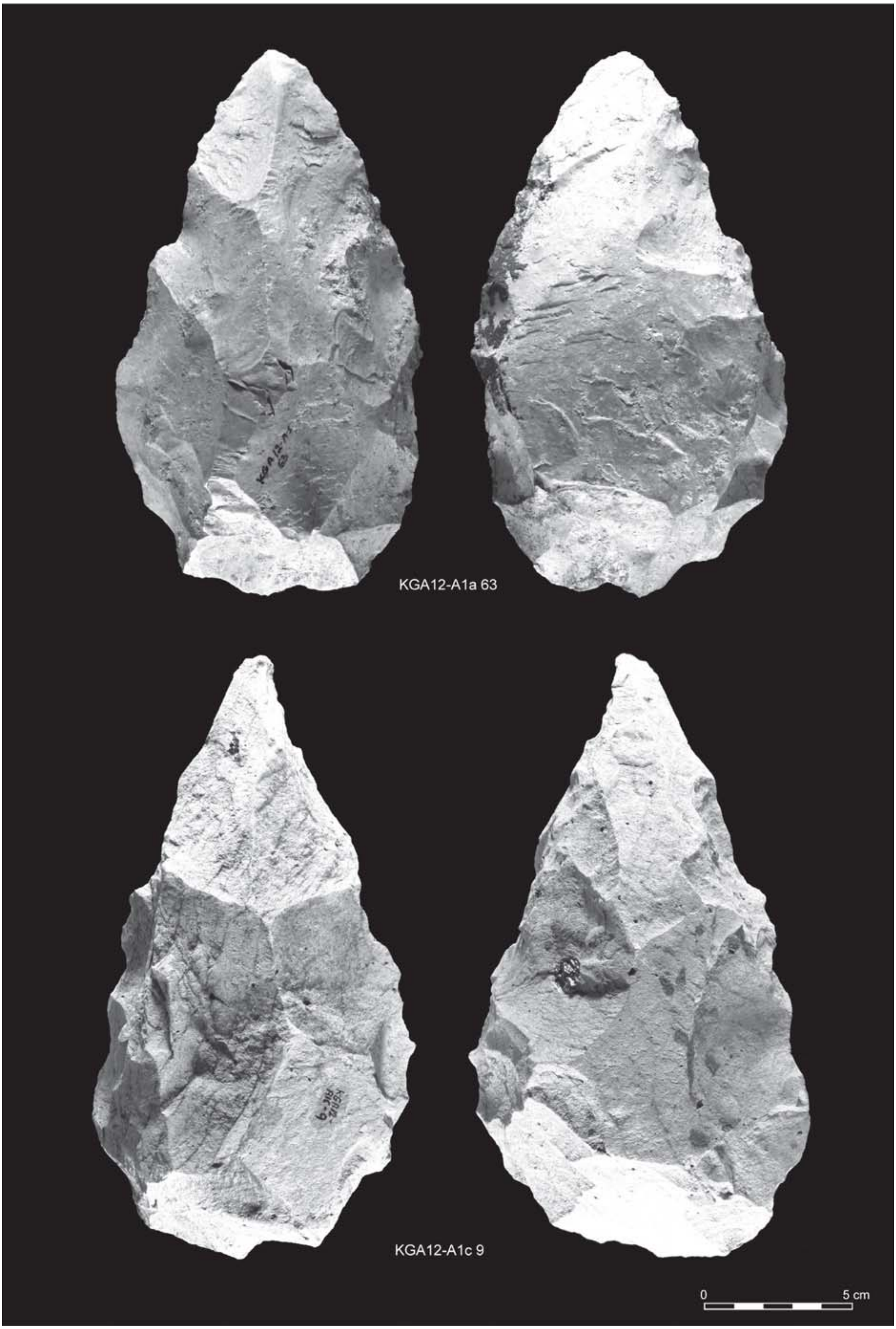


Plate 48

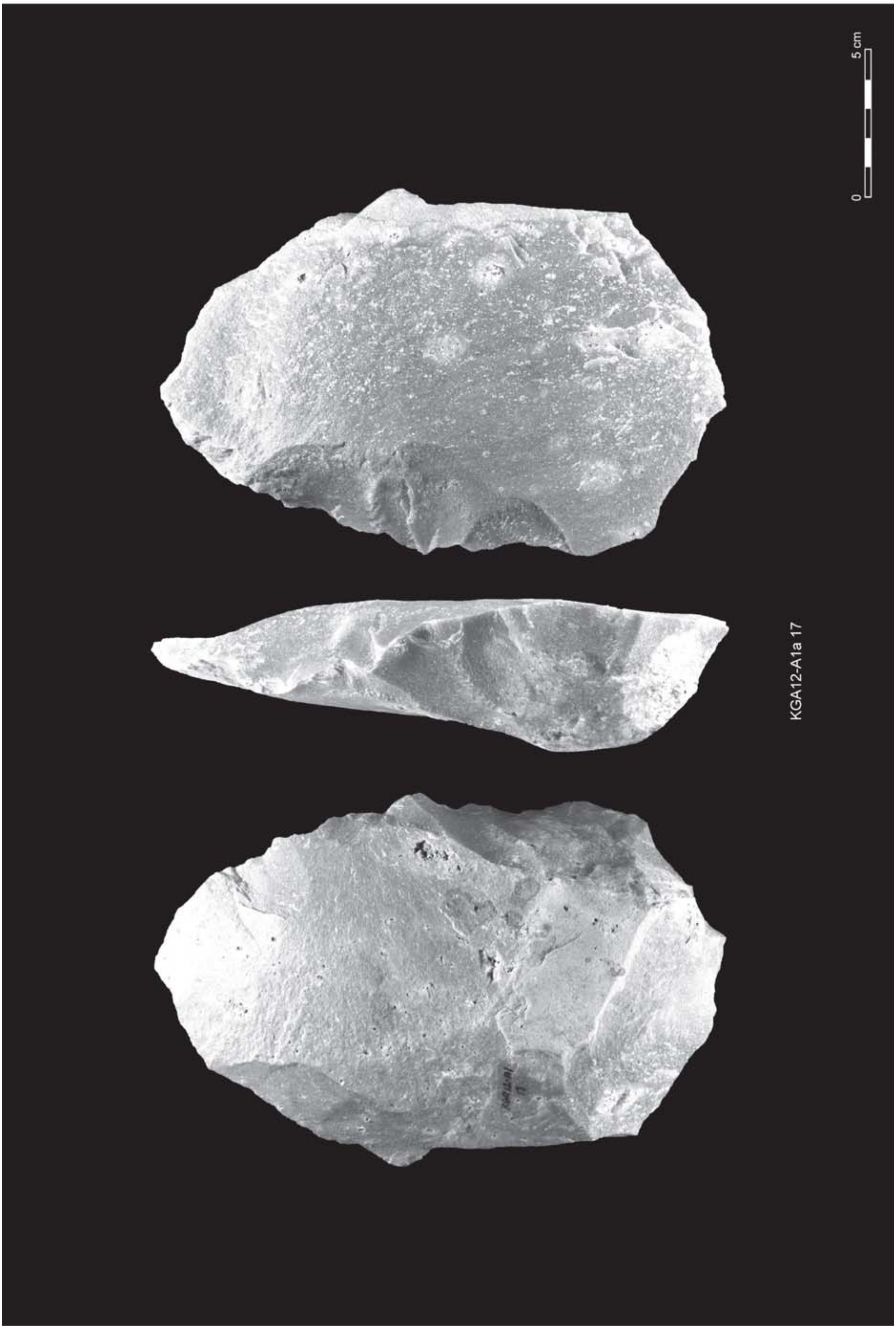


Plate 49

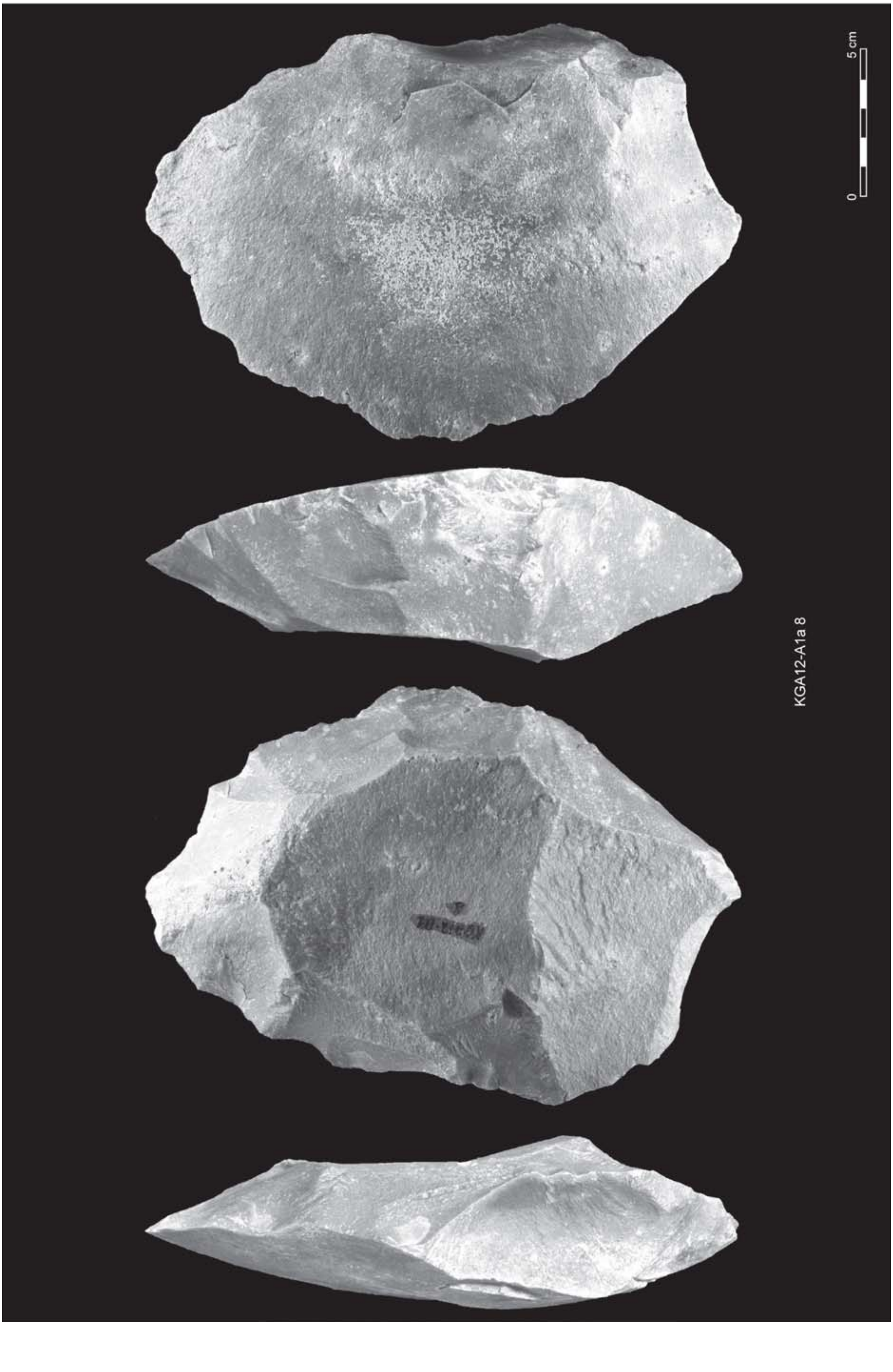


Plate 50

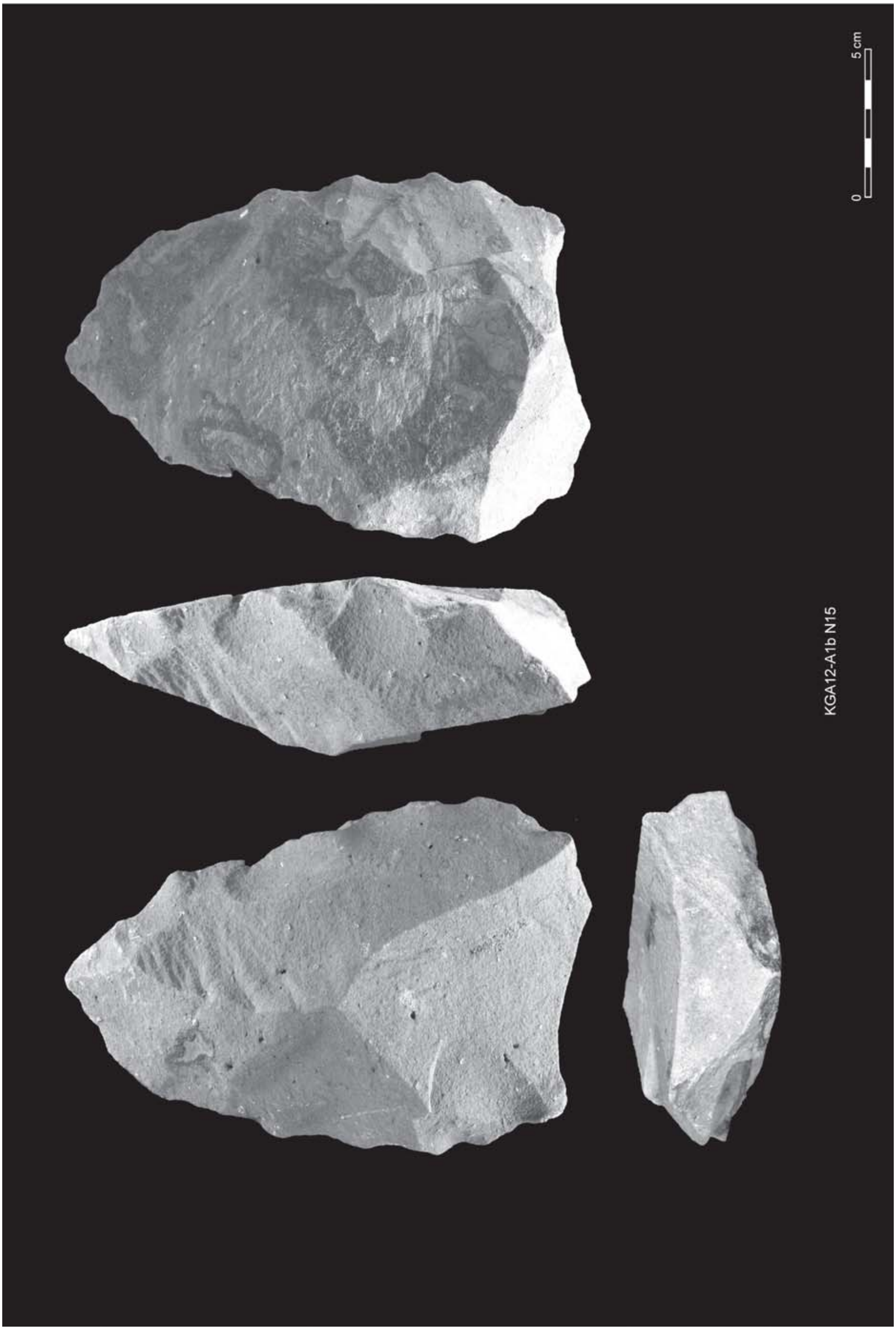


Plate 51

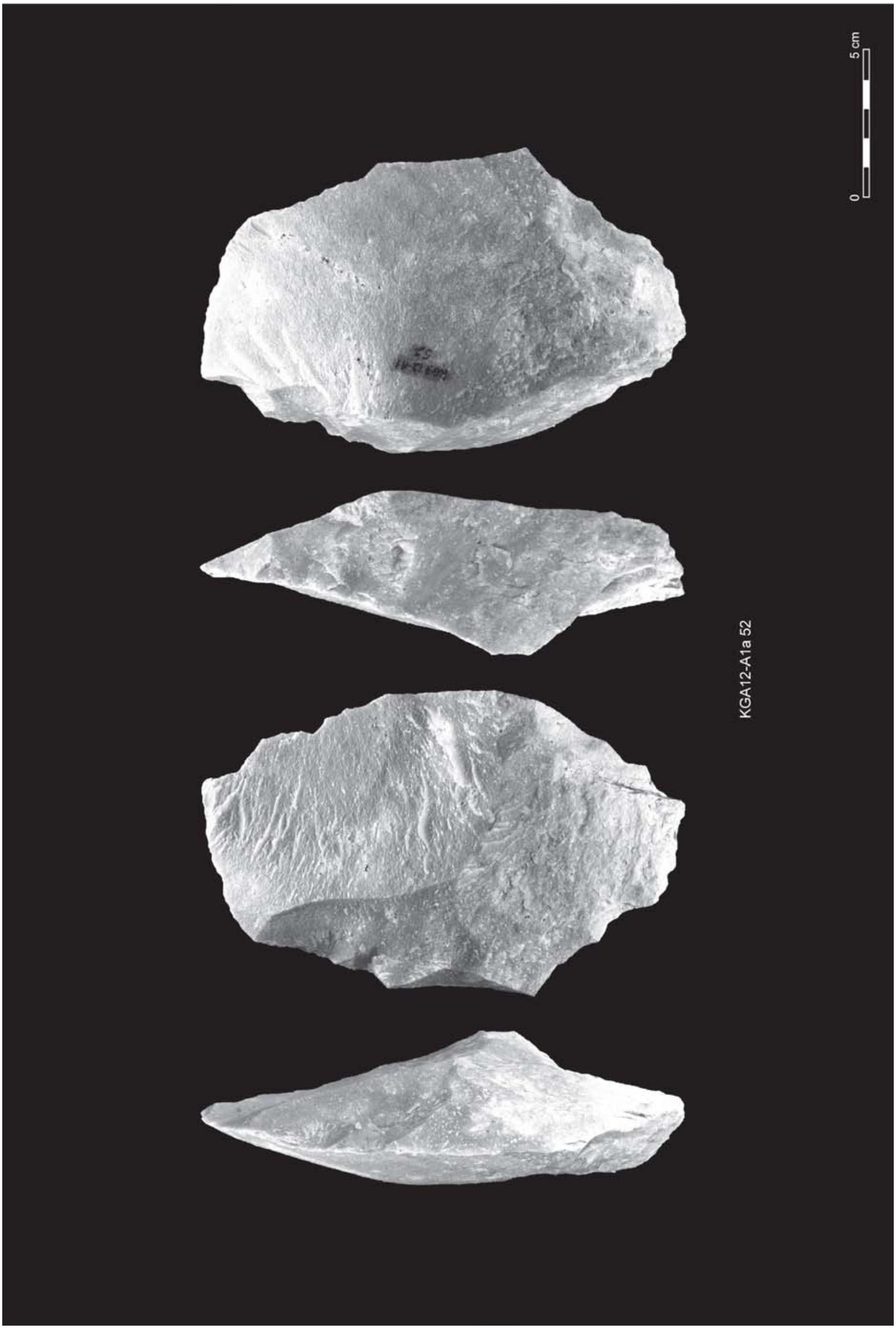


Plate 52

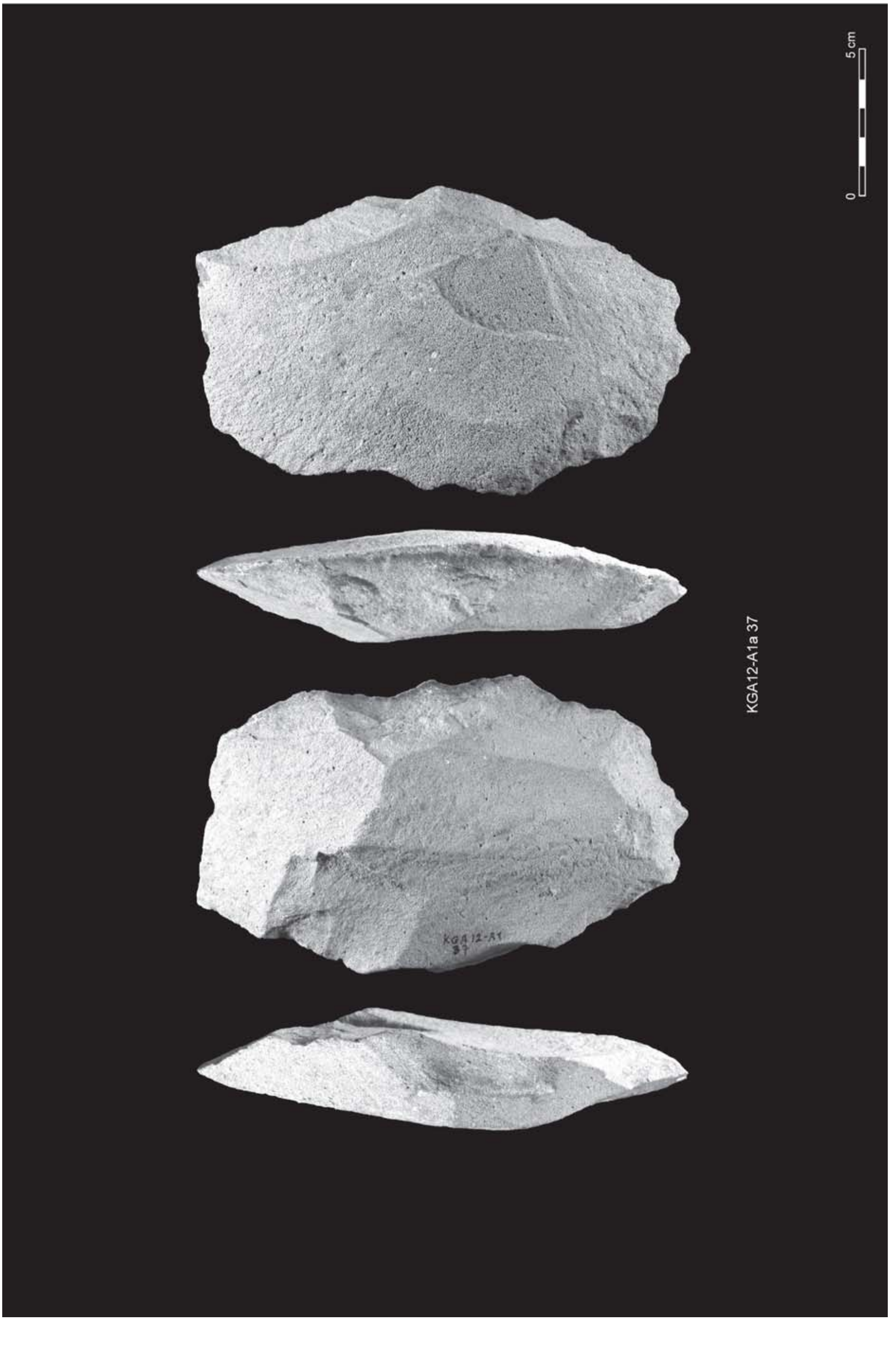


Plate 53

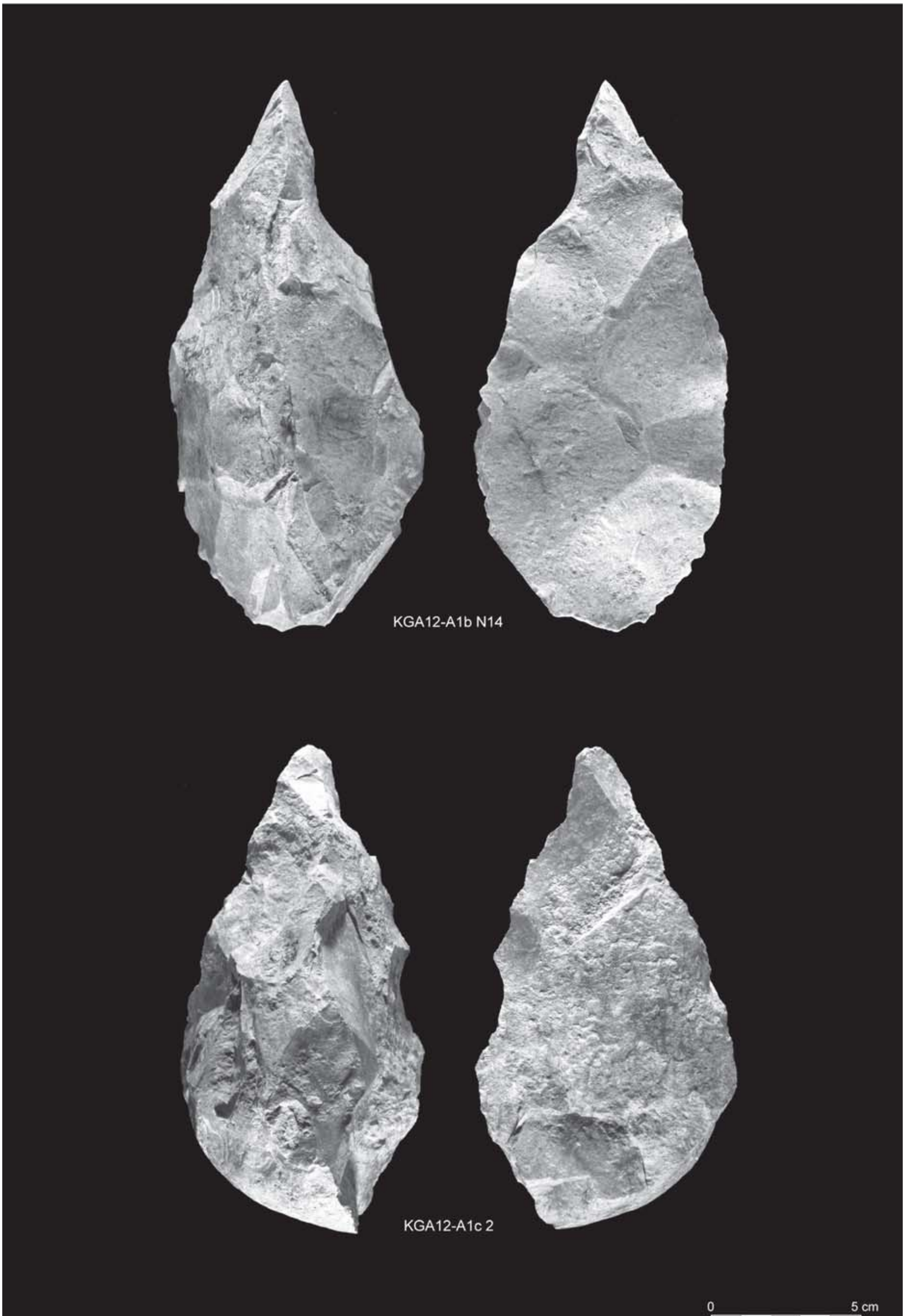


Plate 54

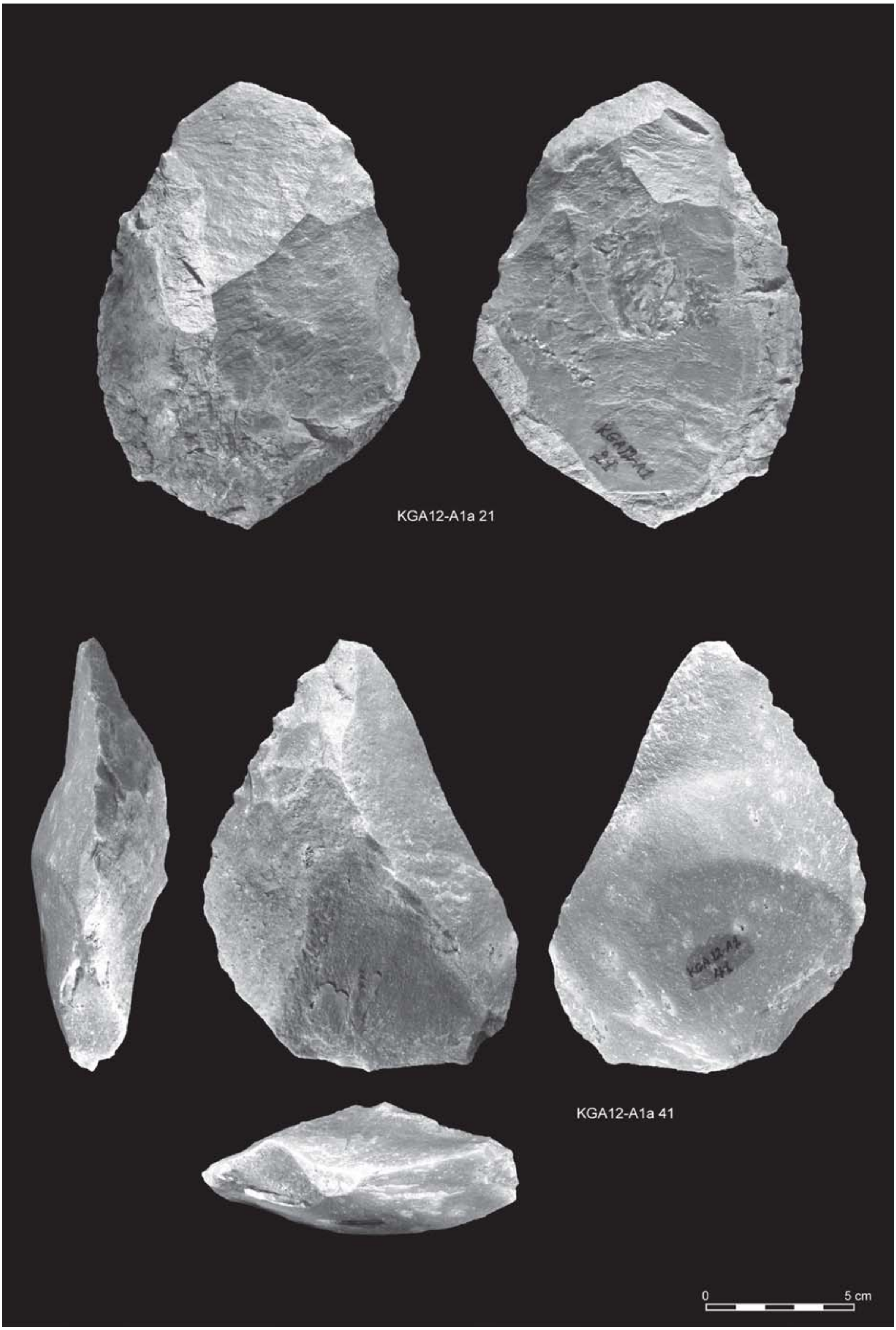


Plate 55

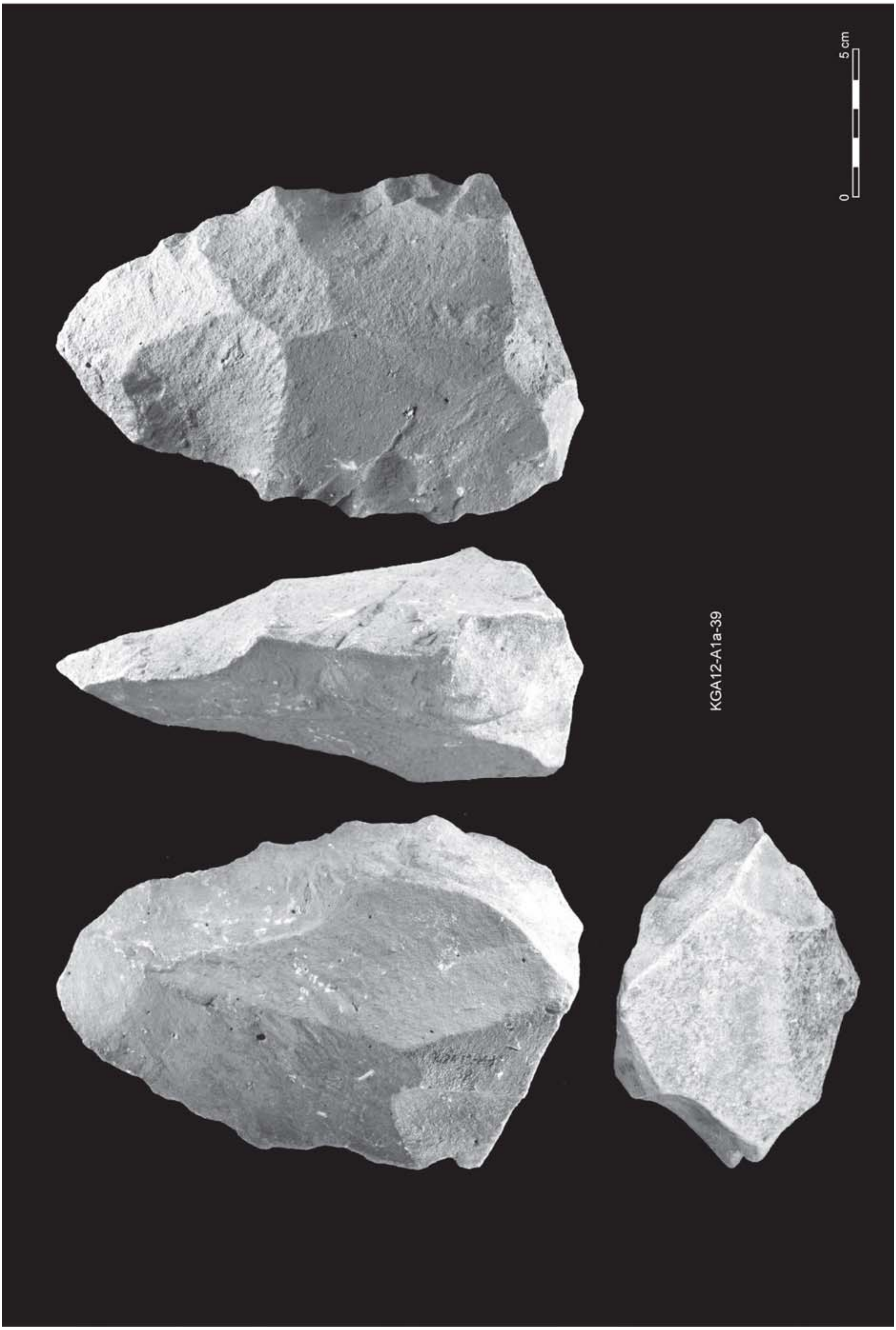
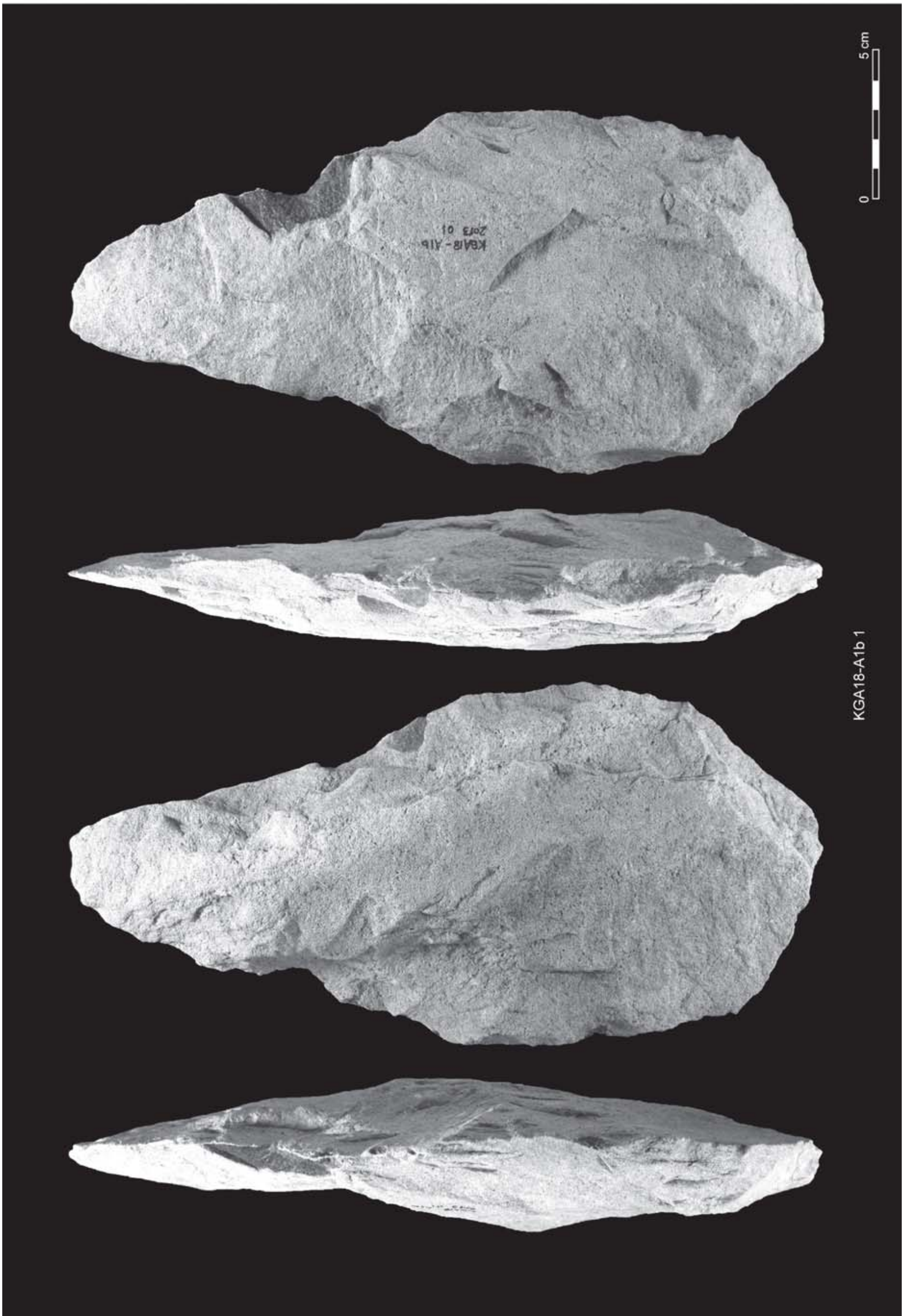


Plate 56



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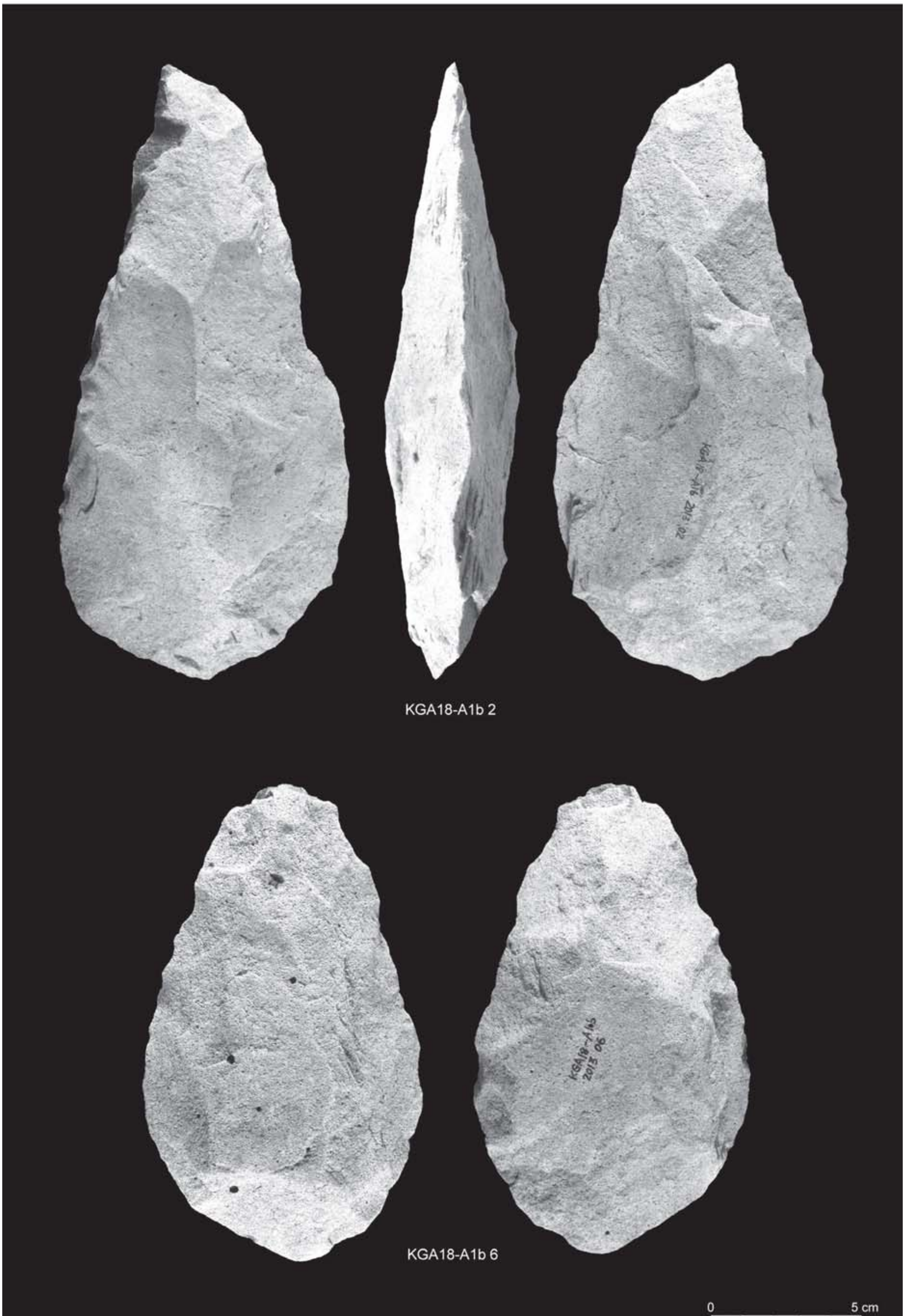


KGA18-A1b 2

KGA18-A1b 6

Plate 58

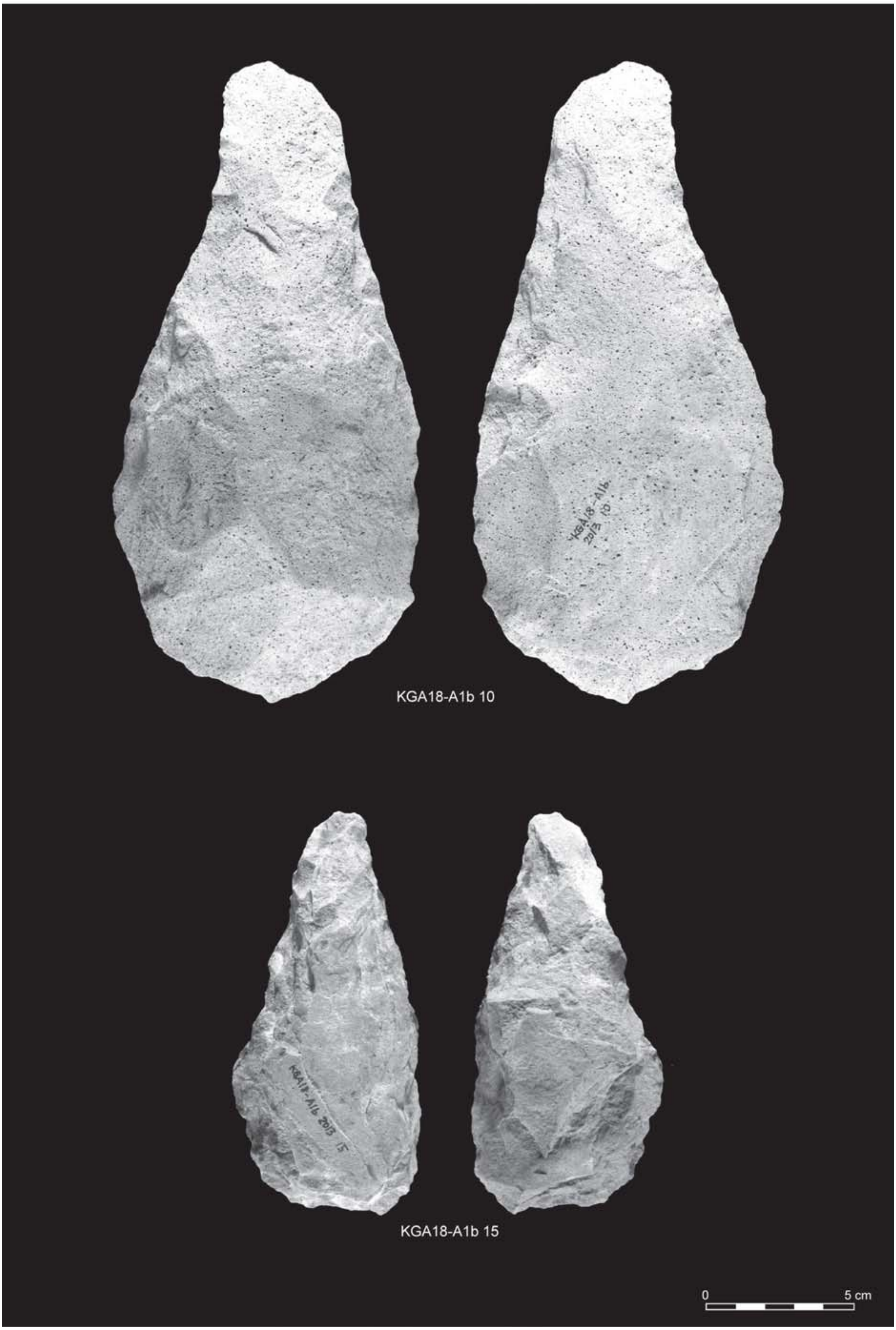


Plate 59

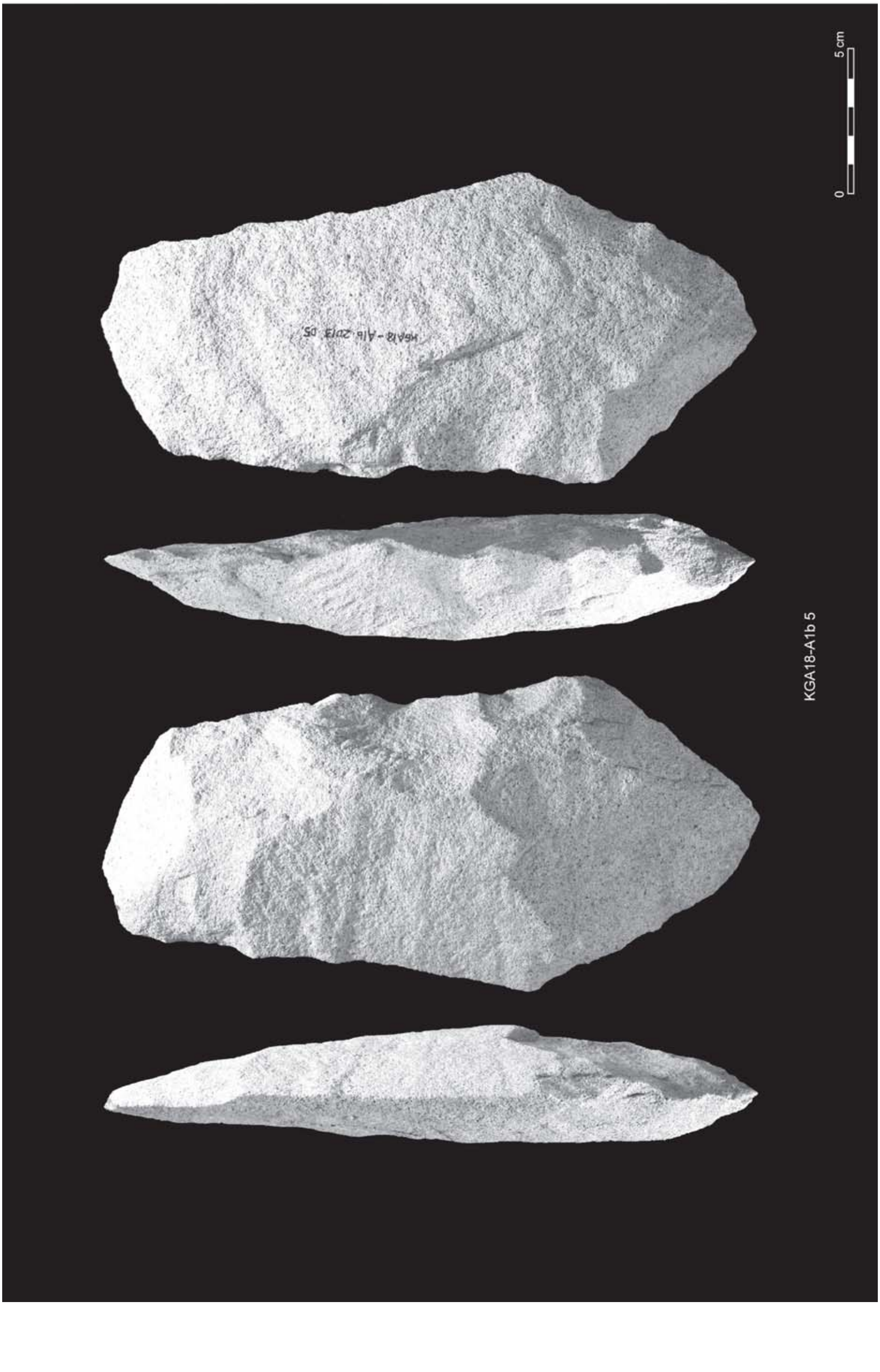
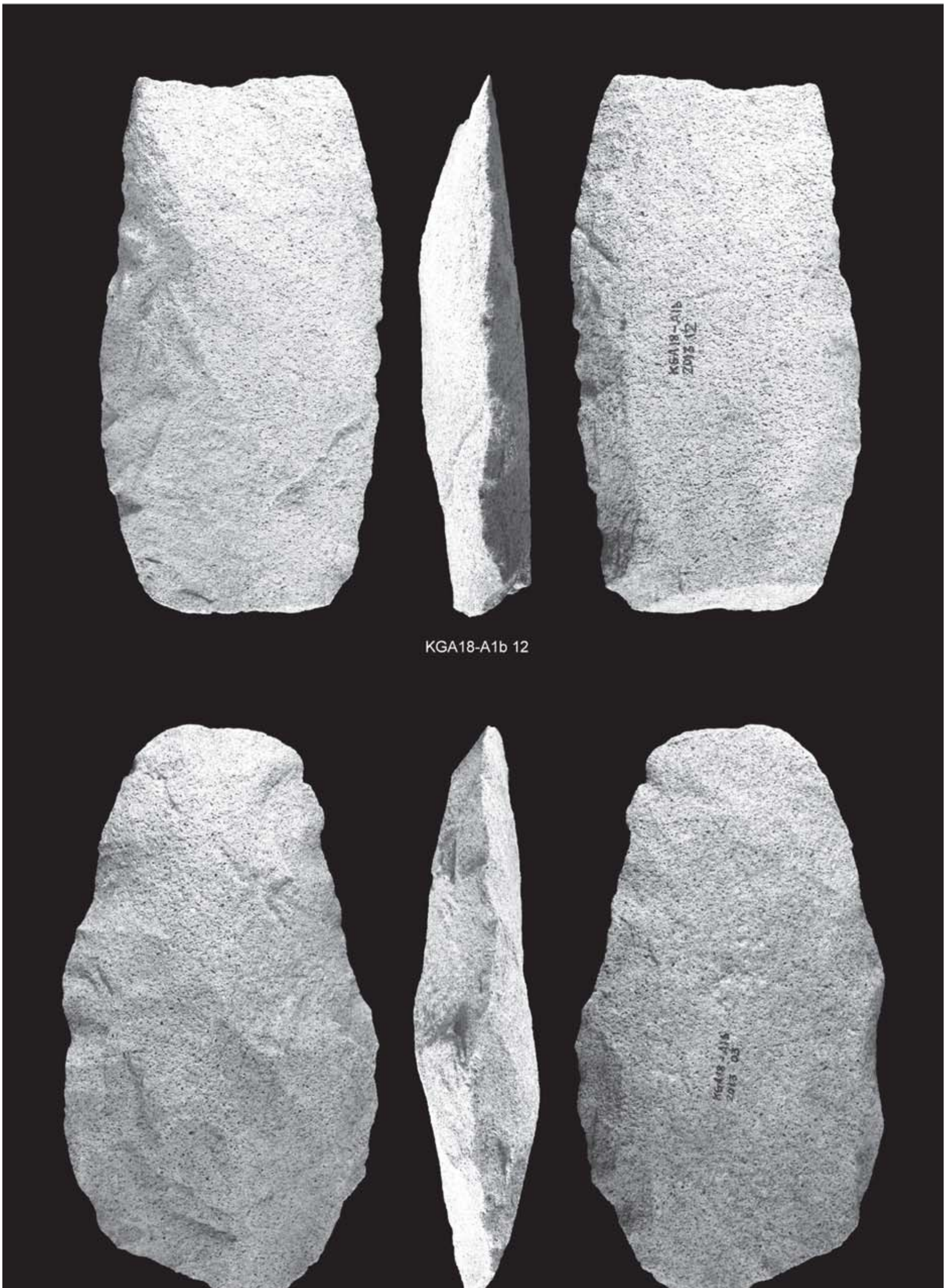


Plate 60



KGA18-A1b 12

KGA18-A1b 3

Plate 61

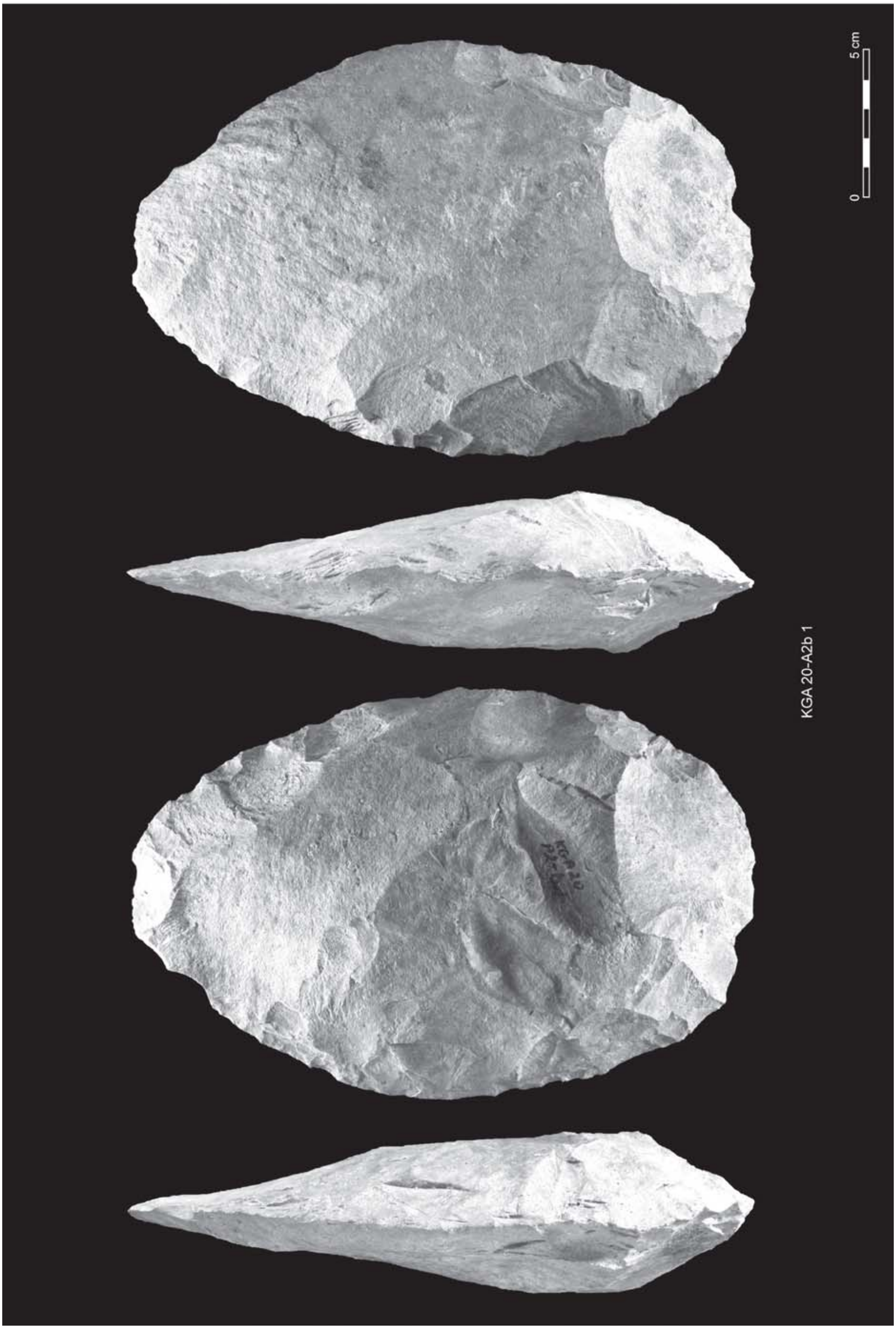


Plate 62

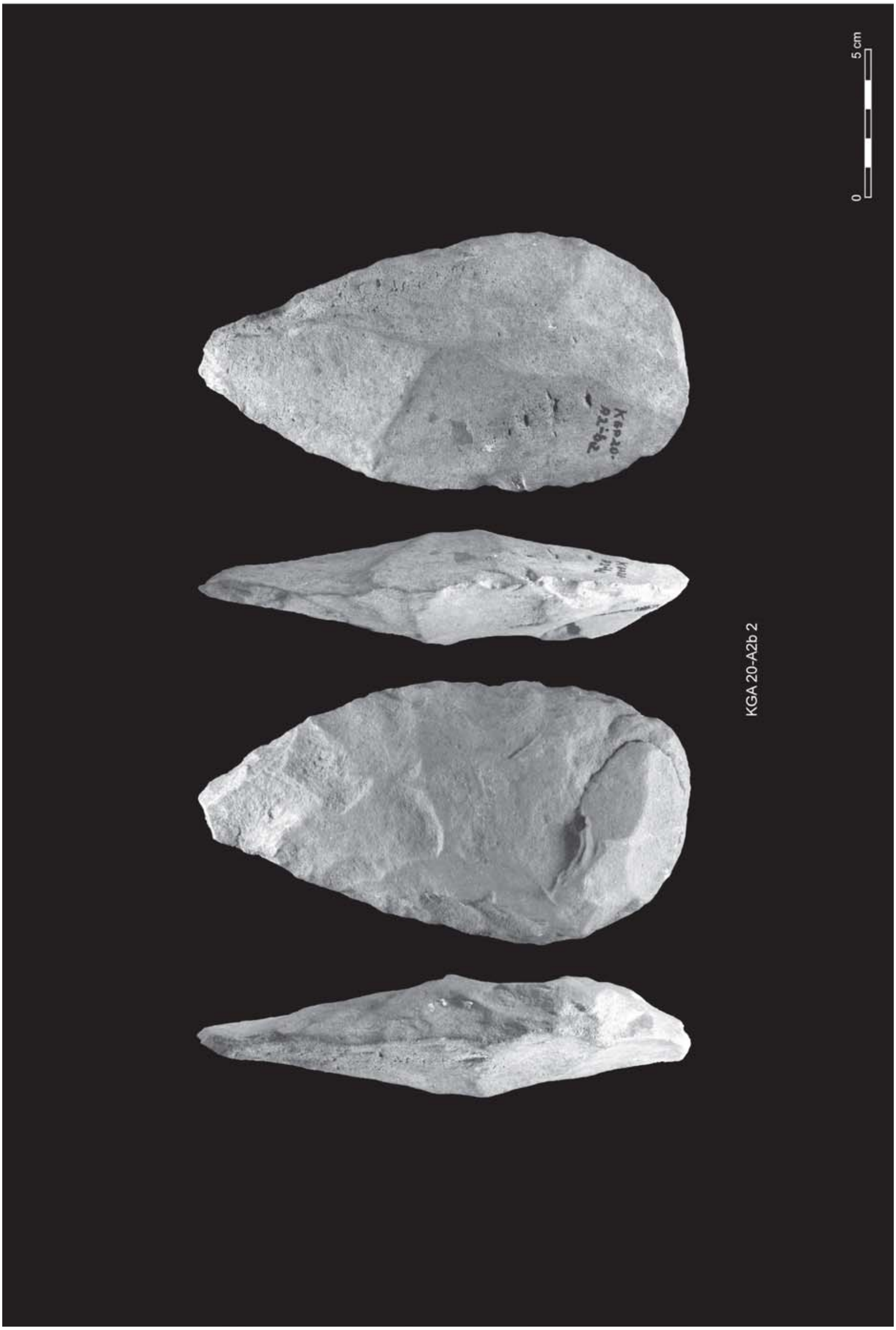
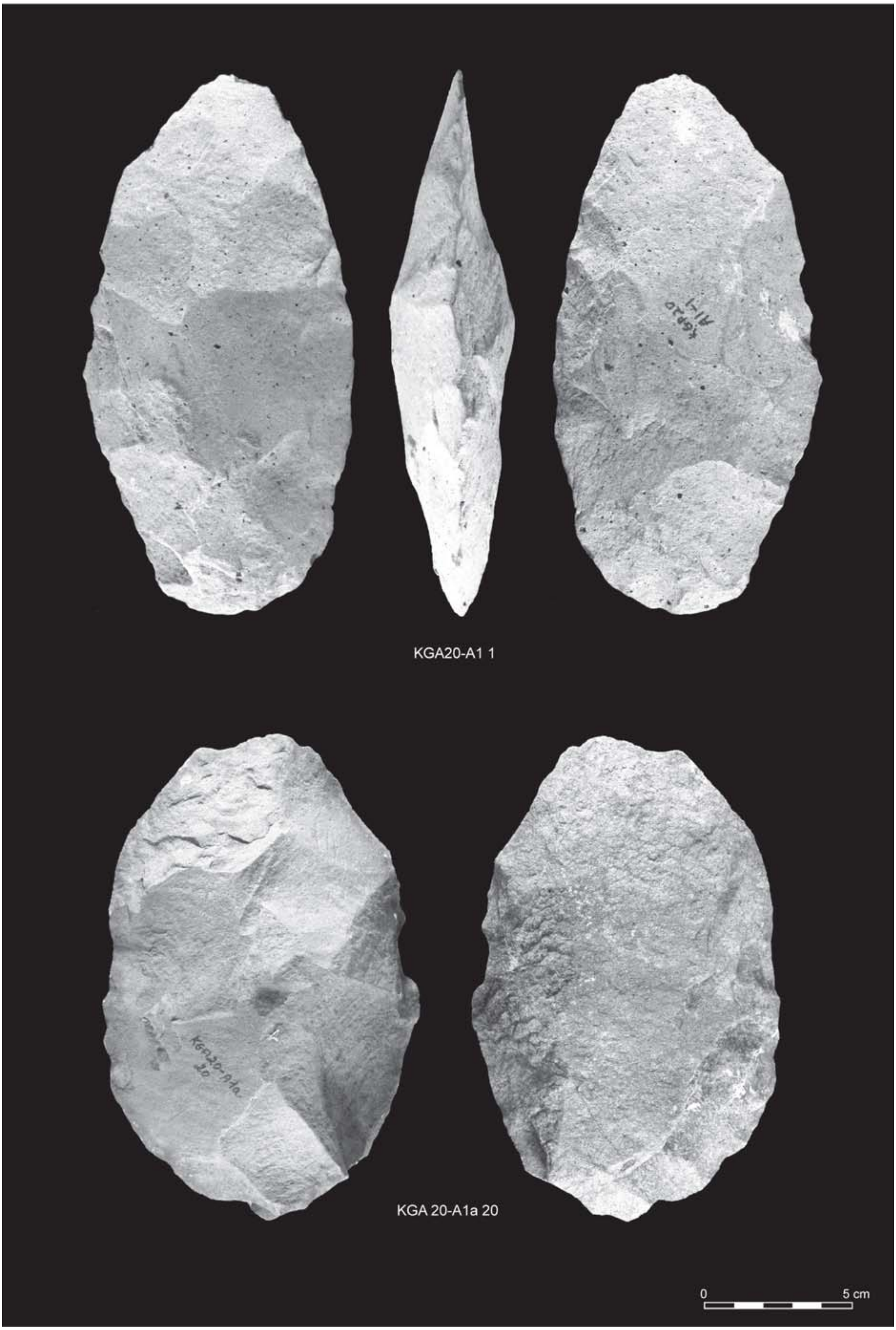


Plate 63



KGA20-A1 1

KGA 20-A1a 20

Plate 64

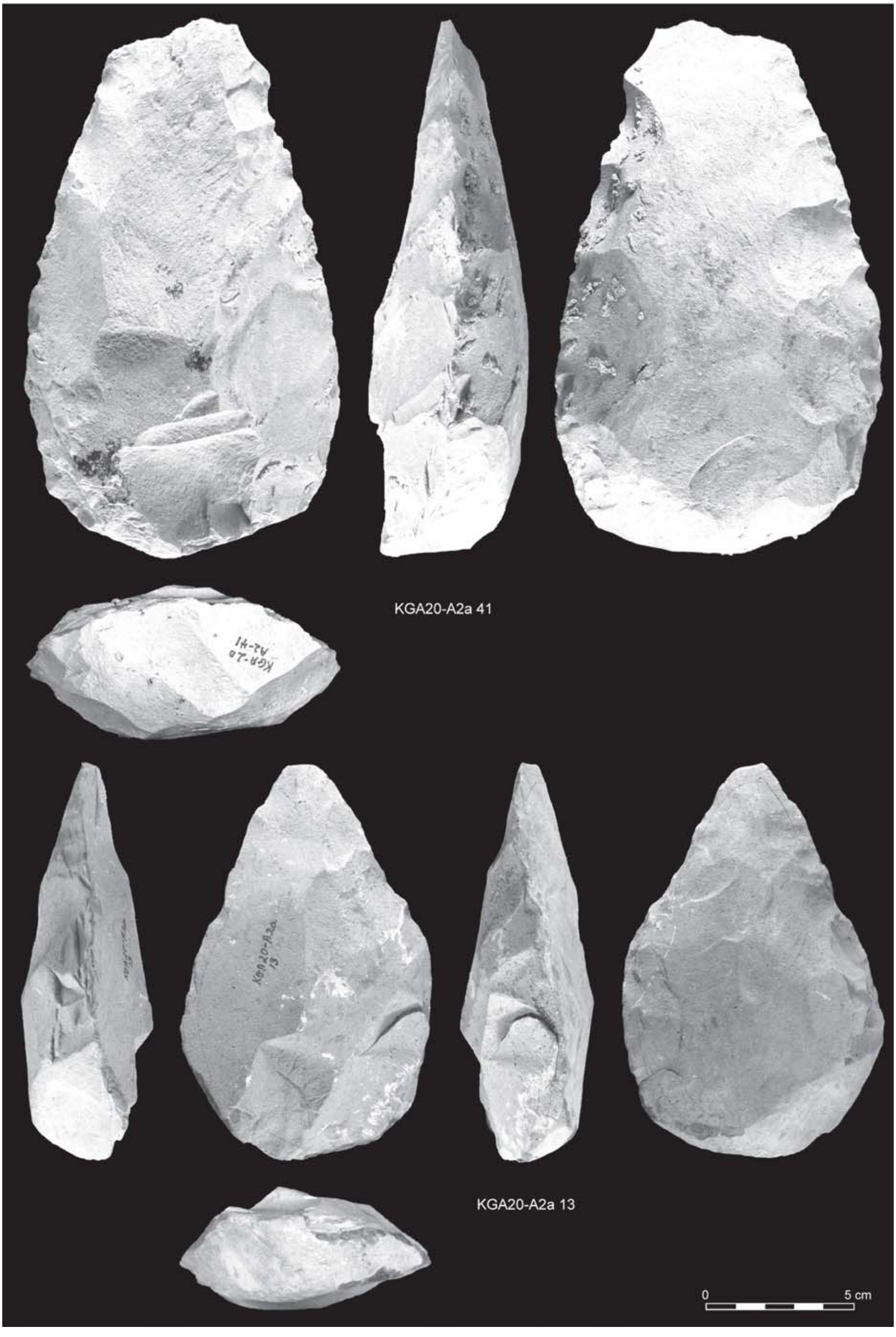


Plate 65

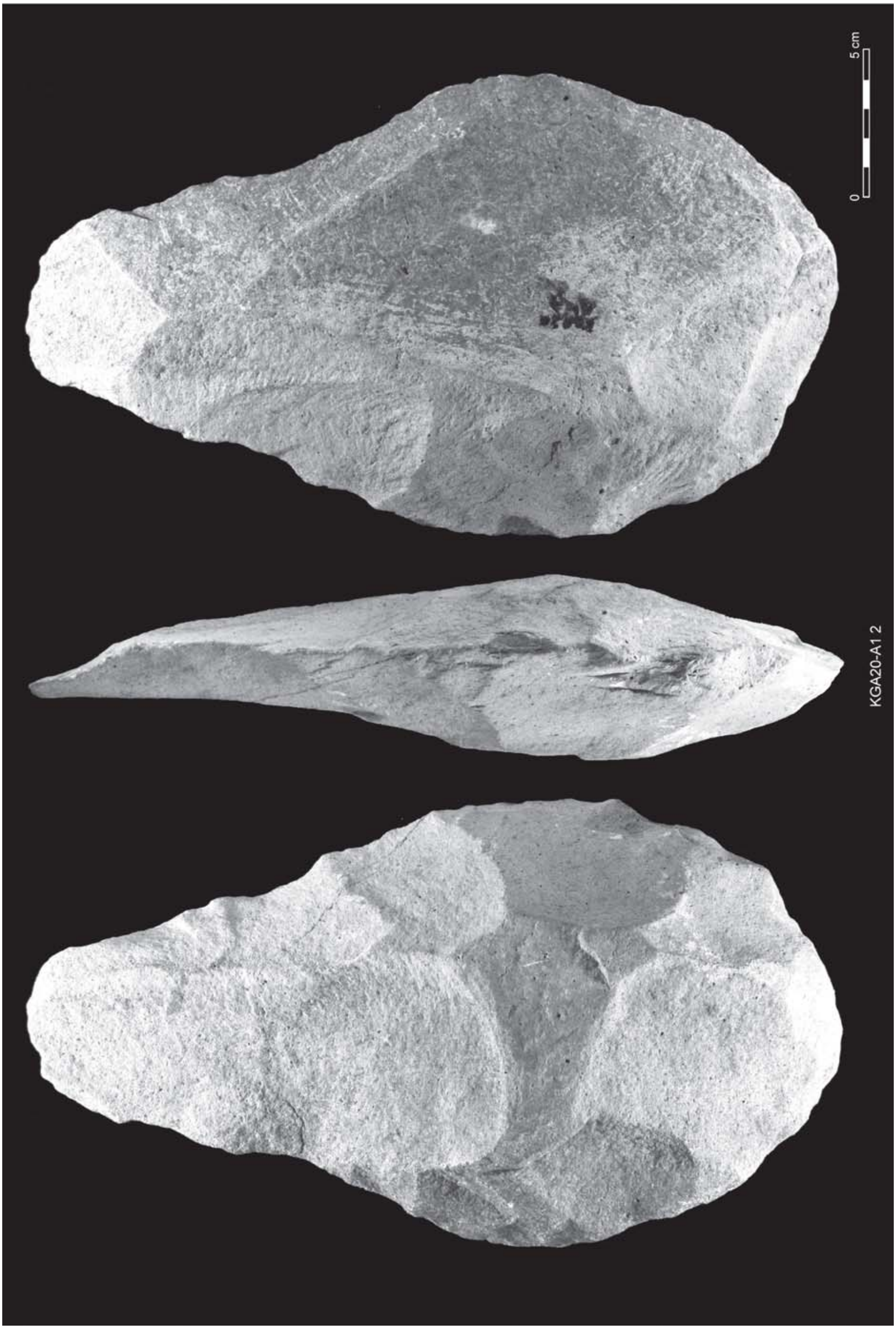


Plate 66

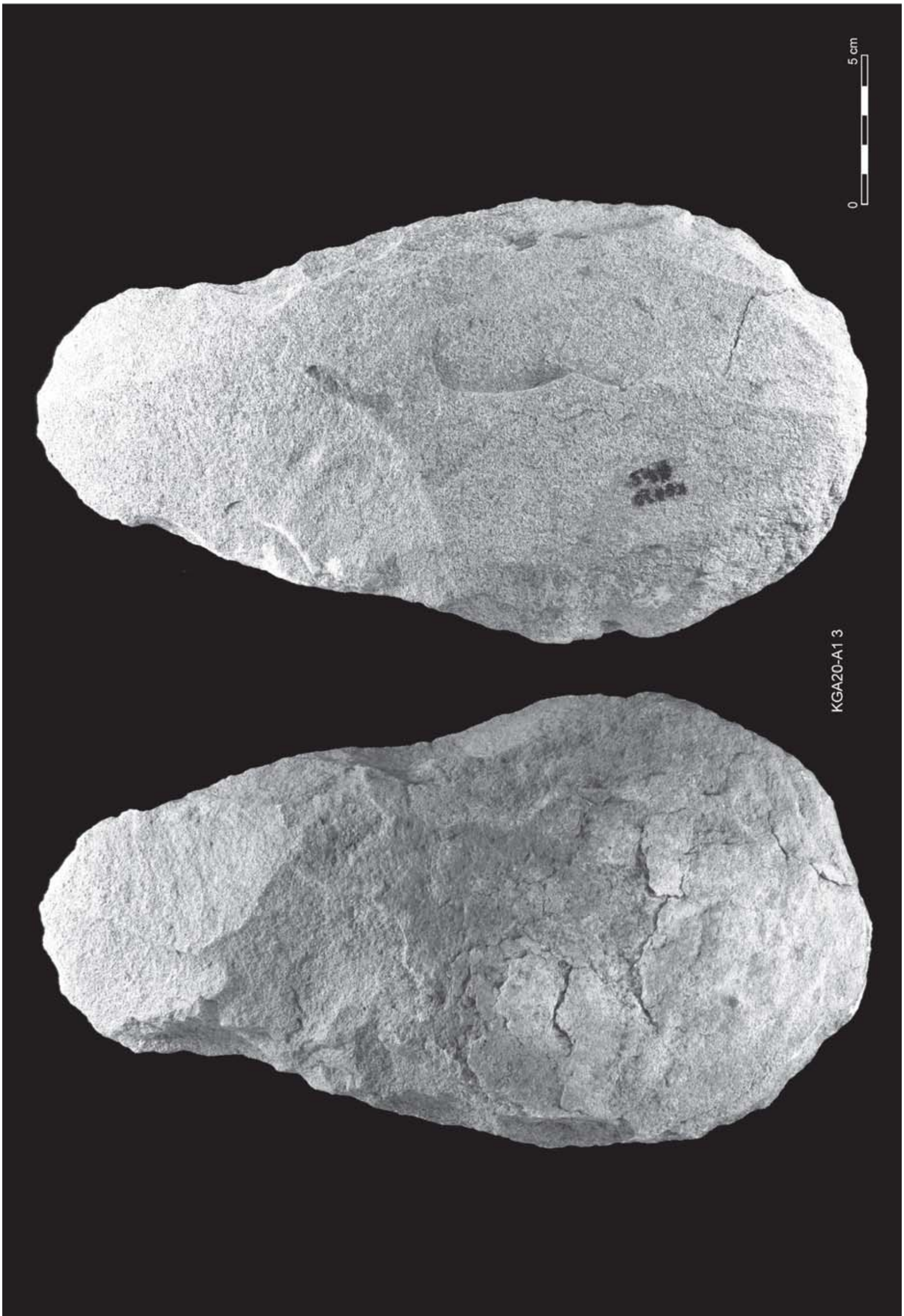


Plate 67

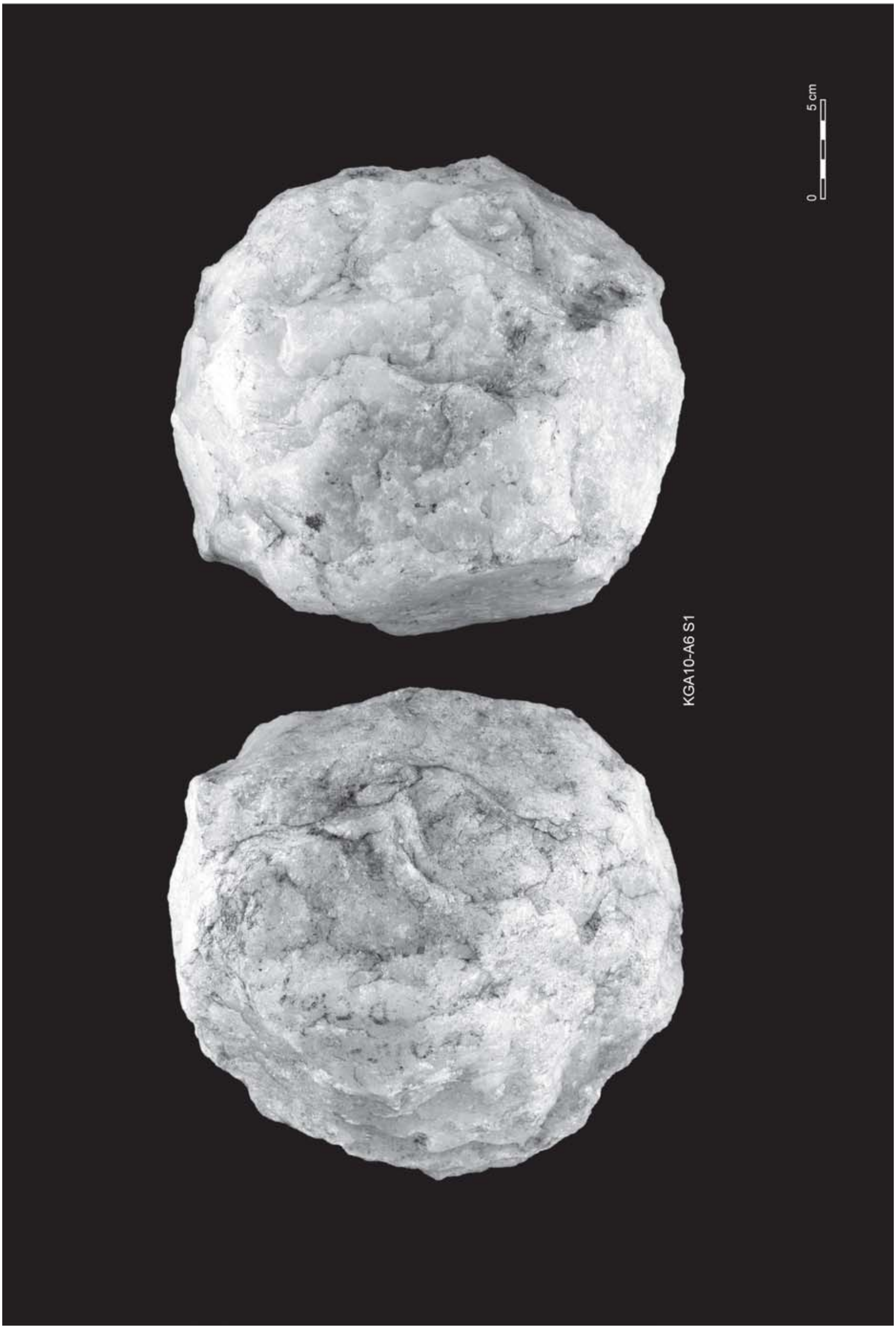
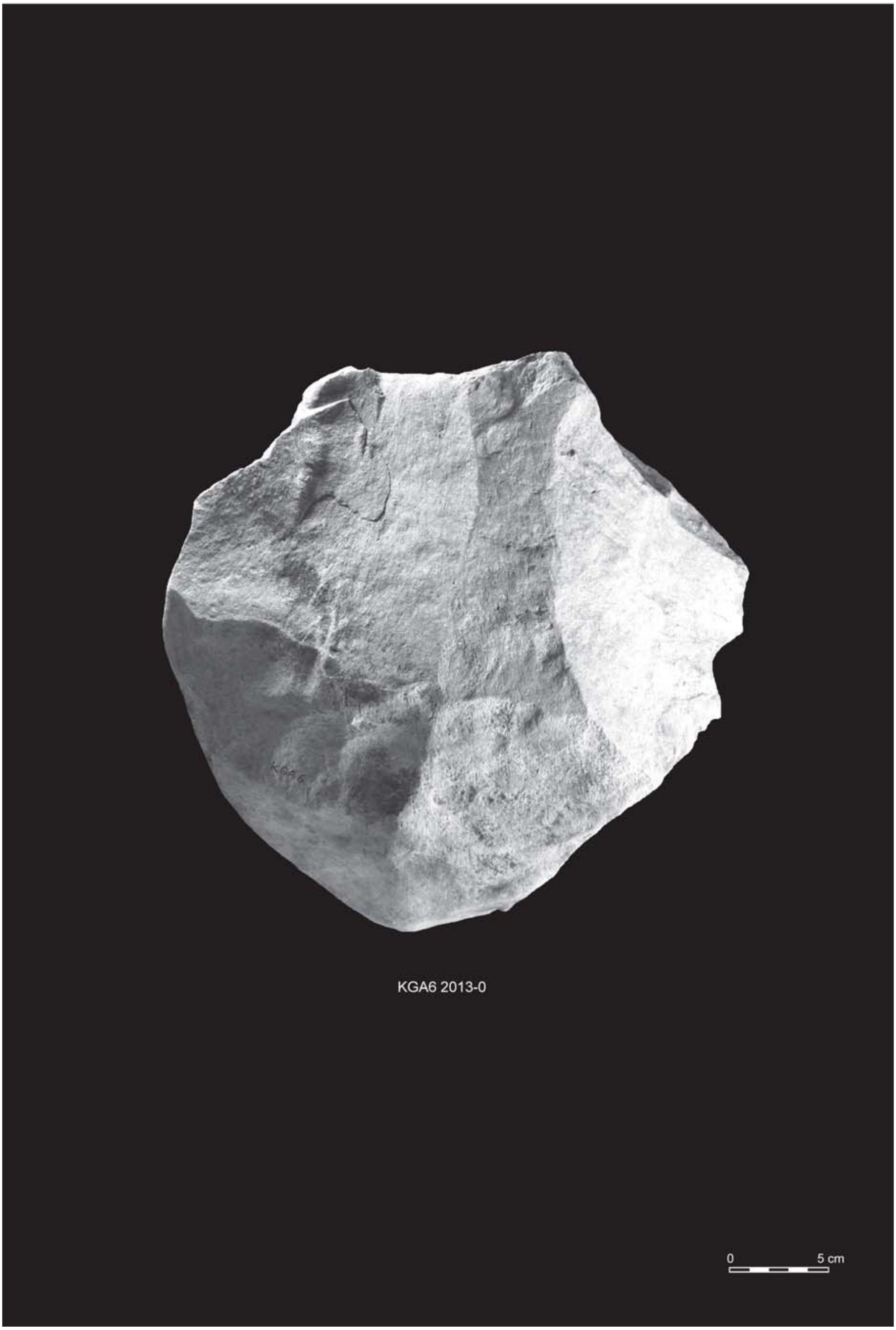


Plate 68



KGA6 2013-0

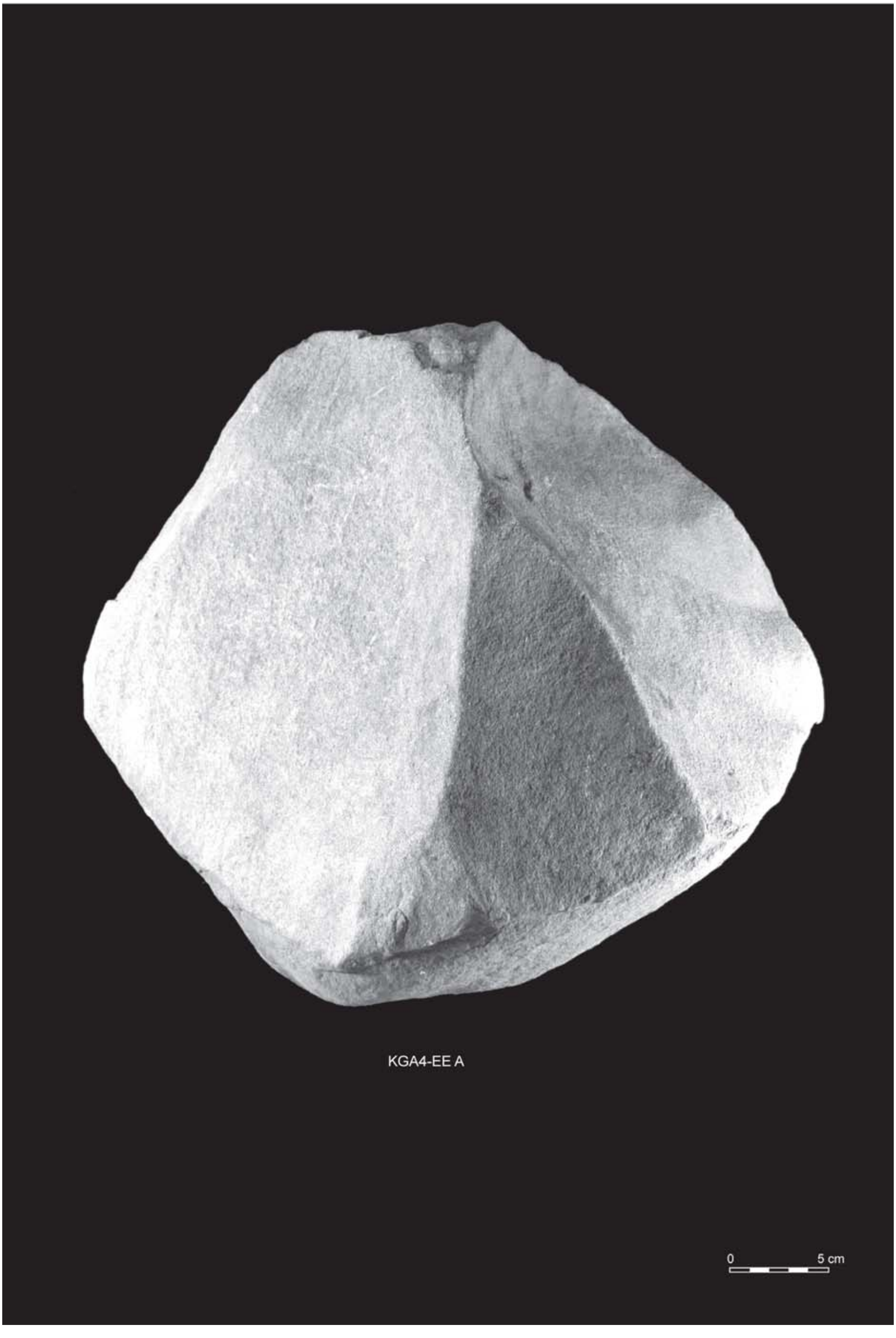

KGA4-EE A
0
5 cm

Plate 70

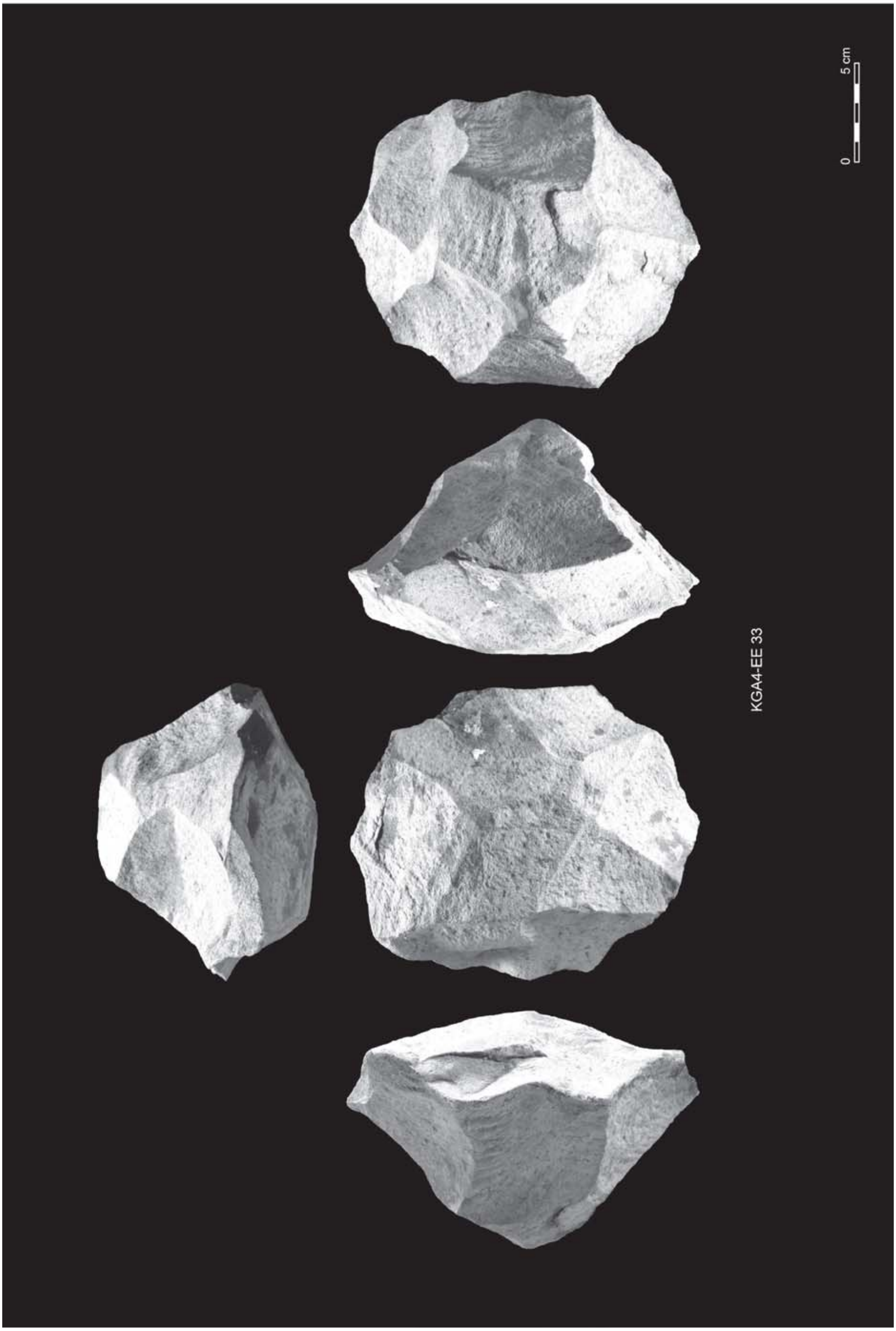


Plate 71

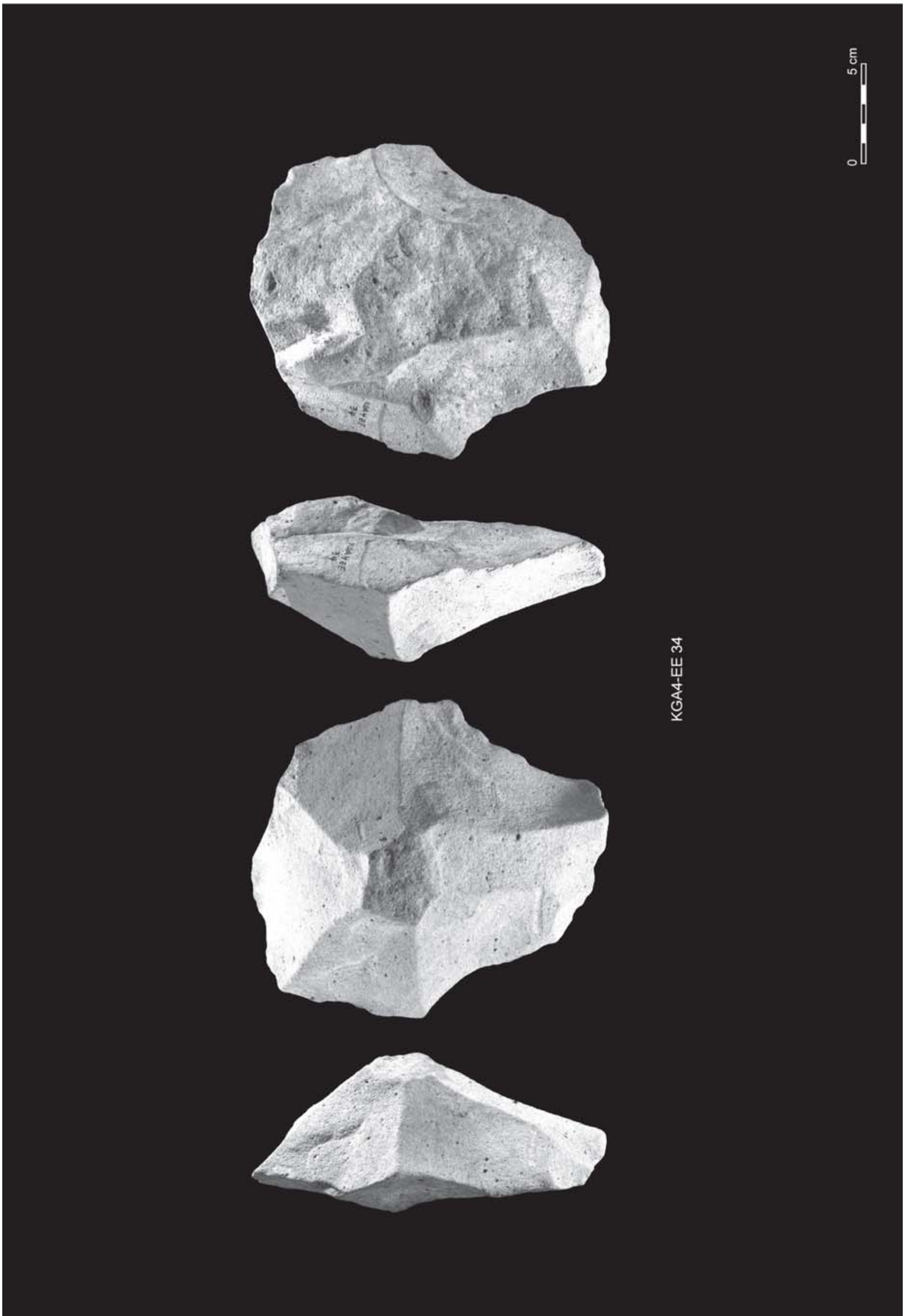


Plate 72