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Case report

A middle paleolithic and neolithic/chalcolithic flint extraction and reduction complex at Mt. Achbara, Eastern Galilee, Israel

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ABSTRACT

This paper reports on a recently discovered Middle Paleolithic and Neolithic/Chalcolithic open-air flint extraction and reduction complex at Mt. Achbara in Israel's Eastern Galilee. Lithic assemblages recovered from a few of the hundreds of tailing piles documented in a field survey indicate a combination of Middle Paleolithic finds including Levallois cores and Neolithic/Chalcolithic finds, mainly bifacial (axe/adze) tools. At present, the extraction and reduction complex at Achbara is one of four found on the flint-bearing Eocene Timrat formation of the Galilee. Together, they provide evidence of intensive Paleolithic and Neolithic/Chalcolithic flint extraction, in quantities that most probably exceeded local consumption. After describing the new complex, we discuss its possible relation to nearby occupation sites, with a focus on the Middle Paleolithic Amud Cave.

1. Introduction

In prehistoric times, flint was one of the main raw materials used for tool making. Consequently, lithic procurement strategies are central to research on human behaviour and adaptation (e.g. Adams and Blades, 2009; Delage, 2007a; Goren-Inbar and Sharon, 2006). A survey of past and current research on the topic reveals two distinct research approaches. The first focuses on procurement strategies and attempts to locate possible lithic sources used at occupation sites. This approach evolved mainly in Europe (Féblot-Augustins, 1993; Roth and Dibble, 1998; Fernandes et al., 2008; Wilson, 2007a, 2007b; Garcia-Anton et al., 2011; Browne and Wilson, 2011; Cauche, 2012; Wilson and Browne, 2014) and recently in Israel (Ekshtain et al., 2014, 2016; Wilson et al., 2016). The second approach focuses on the sources, i.e., the characteristics of the lithic extraction and quarrying, and attempts to track links and identify destinations to which products of the quarry/extraction and reduction (henceforth E&R) site were transported to. Examples of this approach are studies on Paleolithic quarries/E&R sites found in North Africa (Foley and Lahr, 2015); Egypt (Vermeersch et al., 1990, 1995, 1998; Vermeersch and Paulissen, 1997; Vermeersch, 2002); Arabian Peninsula (Jennings et al., 2015; Groucutt et al., 2017), Israel (Barkai et al., 2002; Barkai and Gopher, 2009; Gopher and Barkai, 2006, 2011, 2014; Ekshtain et al., 2012; Finkel et al., 2016), India (Petraglia et al., 1999; Paddayya et al., 2000, 2002, 2006; Shipton, 2013) and more. Neolithic/Chalcolithic flint quarries/E&R sites are well known from Neolithic England and Europe (Weiner, 1986; Field, 1997; Pétrequin et al., 1998; Barber et al., 1999; Topping and Lynott, 2005 and references therein), Israel (Taute, 1994; Barkai and Gopher, 2001; Sharon and Goring-Morris, 2004; Gopher and Barkai, 2006; Grosman and Goren-Inbar, 2007, 2016; Finkel et al., 2017b; and see more below) and Jordan (Quintero, 1996; Quintero et al., 2002).

Examination of these sites involves questions such as the sequence and scope of the quarrying and extraction operations, the use of tools, possible division of labour, the transmission of knowledge, development of familiarity with the landscape, and the significance of quarrying and extraction sites as prominent locales in the landscape (e.g. Bradley and Edmonds, 1993; Claris and Quartermaine, 1989; Edmonds, 1999; Field, 2005; LaPorta, 2005; Scott and Thiessen, 2005; Elston, 2013). The study presented here takes the second research approach: it contributes mainly to the understanding of the broad picture of E&R activity in prehistoric Israel, and attempts to cross-check information with the results of a study of the flint sources of the nearby Neanderthal Amud Cave (Ekshtain et al., 2016), which took the first approach.

1.1. Paleolithic and Neolithic/Chalcolithic extraction and reduction complexes in northern Israel

Lower and Middle Paleolithic flint E&R complexes (the term complex will be used here to describe the complete area/site where E&R activities took place; sub-areas will be termed E&R localities) were discovered until now in four locations in northern Israel (i.e., Upper Galilee, Lower Galilee, Hula Valley, Golan Heights, Mt. Carmel, Jezreel Valley and Menashe Hills): Sede Ilan in the Eastern Lower Galilee (Barkai et al., 2006; Barkai and Gopher, 2009); Giv'at Rabbi in the

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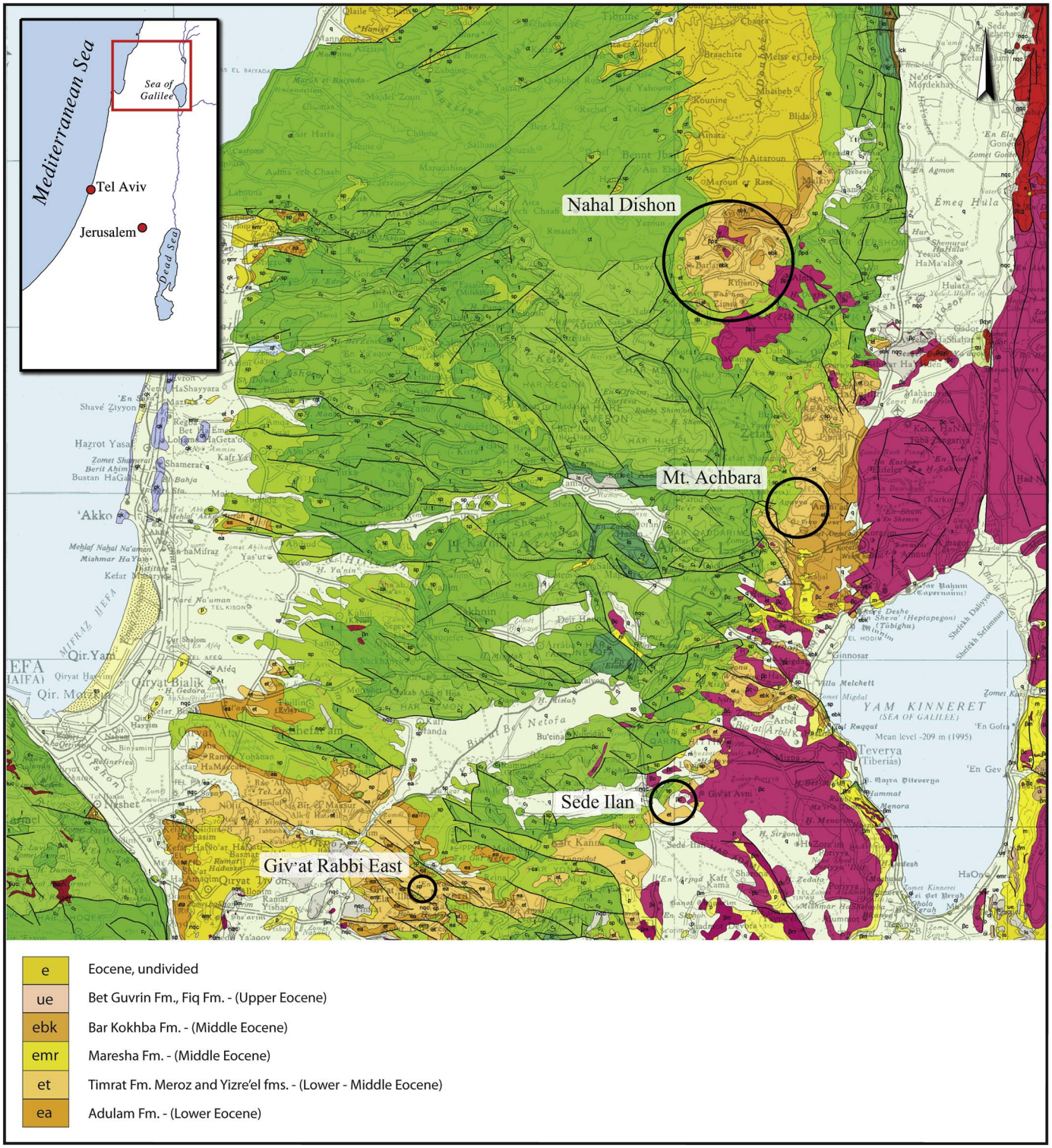


Fig. 1. The currently known Paleolithic Dishon, Sede Ilan and Giva't Rabbi East E&R Complexes, and the new complex at Mt. Achbara (Geological map of Israel, 1:200,000. Sneh et al., 1998).

Lower Galilee (Ekshtain et al., 2012; Yaroshevich et al., 2017); The Dishon extensive complex in the Upper Eastern Galilee (Finkel et al., 2016 and reference therein) (see those three and the new Mt. Achbara complex in Fig. 1) and Daliyat el-Carmel 3/Site 164 on Mt. Carmel (Olami, 1984: 147; Barkai et al., 2006; Rosenberg et al., 2009). It is significant to note that although northern Israel contains flint from other geologic formations, the three E&R complexes mentioned above, and the new complex reported on here, are located on the Eocene Timrat formation, which Delage (2007b) specified as the best flint type for knapping purposes. Although flint is found in many formations in the Galilee (Delage, 2007b; Ekshtain et al., 2016), the combination of Delage's observations and the location of the E&R complexes indicate that although it may seem that "flint is found everywhere" in the Galilee, Eocene flint was preferable.

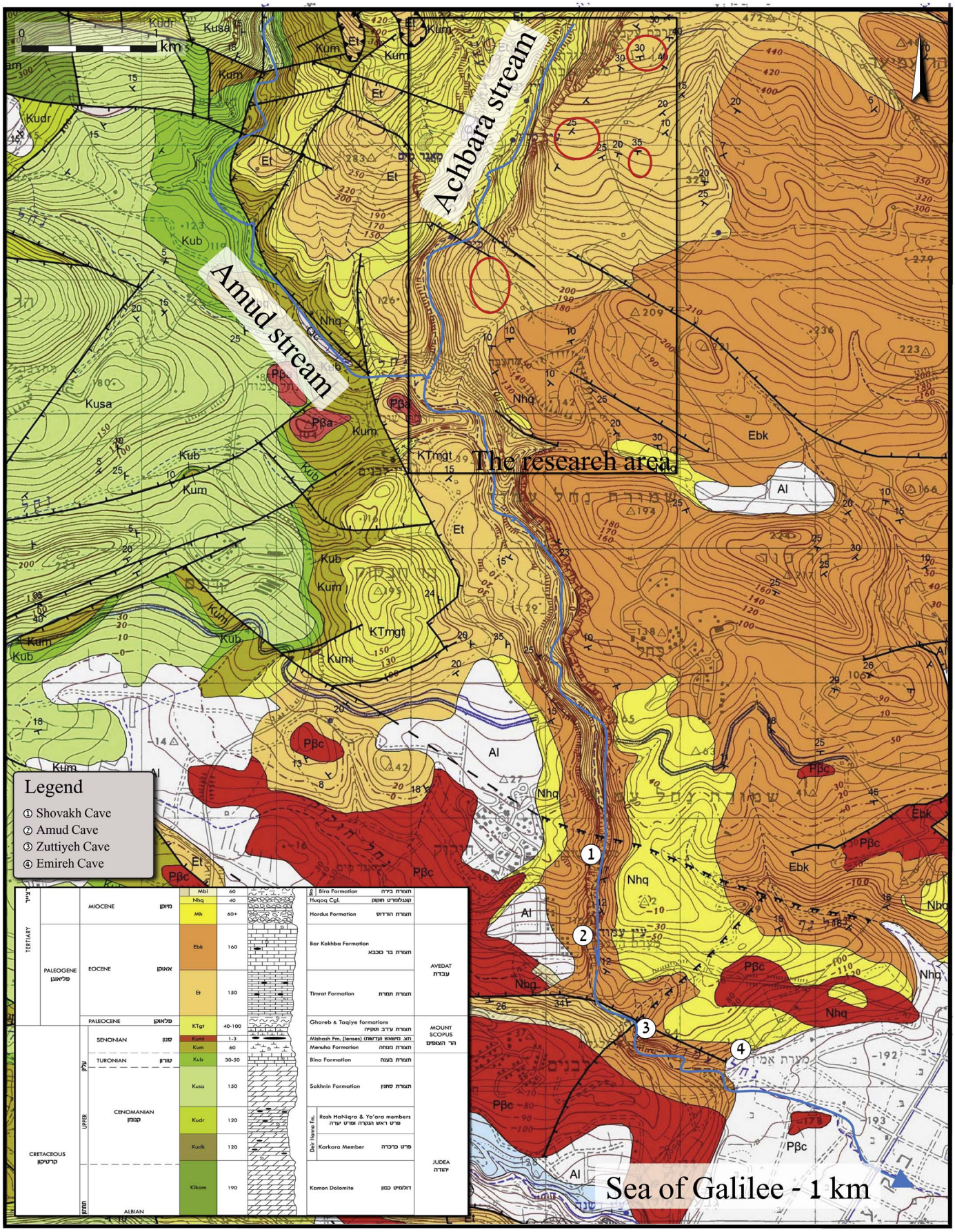


Fig. 2. Geography, geology, Paleolithic sites and E&R localities within the Achbara E&R complex (geological map: Bogosh and Sneh, 2014).

Fig. 3. Aerial photo of the research area.

All these complexes (including the one in the Carmel) are characterized by tailing piles that were purposely created in these industrial areas during long-term flint extraction and reduction, as part of the management of the extraction landscape (Gopher and Barkai, 2014). How were these complexes actually formed? Surveys of E&R localities in recent years, combined with the data from small scale excavations conducted in the tailing piles at Mt. Pua and Sede Ilan (Barkai et al., 2002, 2006; Barkai and Gopher, 2009; Gopher and Barkai, 2006, 2014), suggest the following chain of operation:

- Locating specific desired flint extraction front
- Extracting flint, sometimes employing limestone or basalt tools
- Creating stone waste piles (backfill piles) from the large amounts of broken limestone – during or immediately after flint extraction
- Aligning backfill piles on top of and between exhausted extraction fronts, leaving unexploited flint extraction fronts free for further use
- Flint knapping – core shaping for later use; blank production and/or tool making conducted on top of backfill piles that form tailing piles known today

The tailing piles at those sites vary in size from small (1–2 m in diameter and up to 1 m in height) to large (tens of m in diameter and 3–5 m in height). The piles are concentrated within relatively restricted areas, which create a highly visible extraction landscape that appears as an artificial mark on the landscape. One of the most common features is the flint-knapping waste, with flint artefacts found on the surface of and within the piles. Basalt wedges, probably used to enlarge the natural fissures in the limestone karrens, are also found on and within the tailing piles, sometimes in considerable numbers (e.g. at Sede Ilan, Lower Galilee: Barkai et al., 2006). Caching of flint artefacts underneath one of the piles has been reported at Mt. Pua (Barkai and Gopher, 2011).

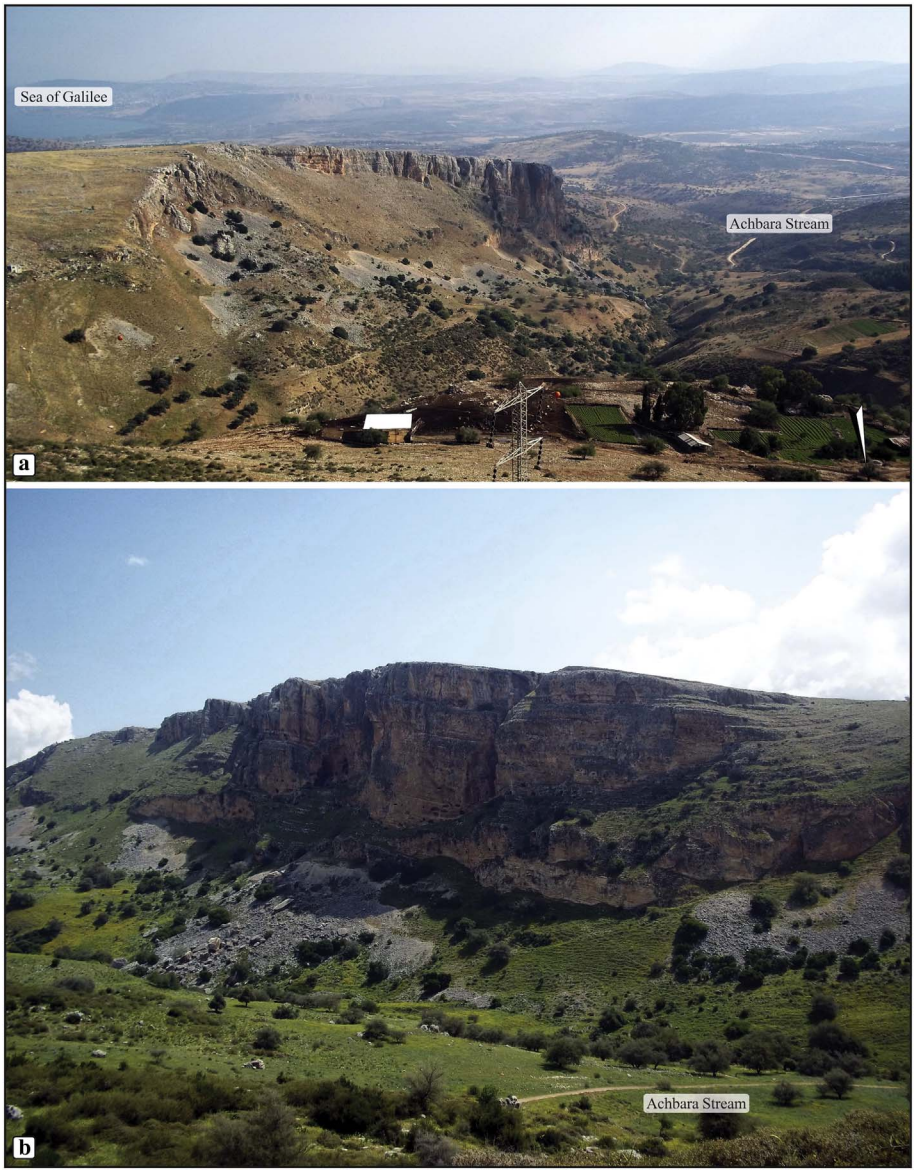


Fig. 4. (a) Achbara Cliffs. Photo taken from the north; (b) Achbara Cliffs. Photo taken from the Achbara Stream in the west.

As to whether the phenomenon described here is the result of embedded or direct procurement (Binford, 1979, 1980; or 'special purpose': Frahm et al., 2015), we would like to note that Achbara represents an extensive area used for flint extraction from a single geological formation that was repeatedly visited in the Middle Paleolithic and much later, in the Neolithic/Chalcolithic periods, in order to procure high quality stone from primary geological sources. This suggests direct rather than embedded procurement. It is important to note that although direct procurement is not intuitively correlated to Paleolithic hunters-gatherers, accumulating evidence from North Africa (Foley and Lahr, 2015); Arabian Peninsula (Jennings et al., 2015; Groucutt et al., 2017), Israel (Barkai et al., 2002; Barkai and Gopher, 2009; Gopher and Barkai, 2006, 2011, 2014; Finkel et al., 2016) India (Petraglia et al., 1999; Paddayya et al., 2000, 2002, 2006; Shipton, 2013) and more, suggest that this was the case.

As part of the first group of studies mentioned above, Ekshtain's work on flint provenance in northern Israel focused on possible flint raw material sources exploited by the Middle Paleolithic inhabitants of Ein Qashish (Jezreel Valley – Ekshtain et al., 2014) and Amud Cave (Eastern Galilee – Ekshtain et al., 2016). This was based on a survey that covered a considerable area of northern Israel, including the Dishon and Sede Ilan E&R complexes (Ekshtain et al., 2016; Fig. 1) but the study refers to natural flint sources only and did not discuss the relationship between those E&R complexes and the Amud Cave. Ekshtain et al.'s conclusion, based on the similarity between geochemical properties of the Eocene flint sources in the vicinity of Amud Cave and flint artefacts from the cave, characterized visually as Eocene, was that the inhabitants of the cave procured flint from daily exploitation territory (DET) within a radius of ~5–6 km of the cave. We accept Ekshtain's observation concerning the Eocene origin of the Amud Cave artefacts, and acknowledge the fact that Eastern Galilee Eocene flint properties are similar in the entire area (Ekshtain et al., 2016 and our initial results – Finkel et al., 2017a, 2017b). To this we wish to add the new data on the Mt. Achbara E&R complex and suggest that the Mt. Achbara E&R Complex may also have been one of Amud Cave's flint sources. We note that the Mt. Achbara E&R complex was not mentioned by Ekshtain et al. (2016) as a source for the Amud Cave dwellers although they mention a source some 500 m to the west of Achbara South, in the Achbara Stream (Ekshtain et al., 2016: Fig. 2b and Table 1 – potential source 31 [inside the DET]).

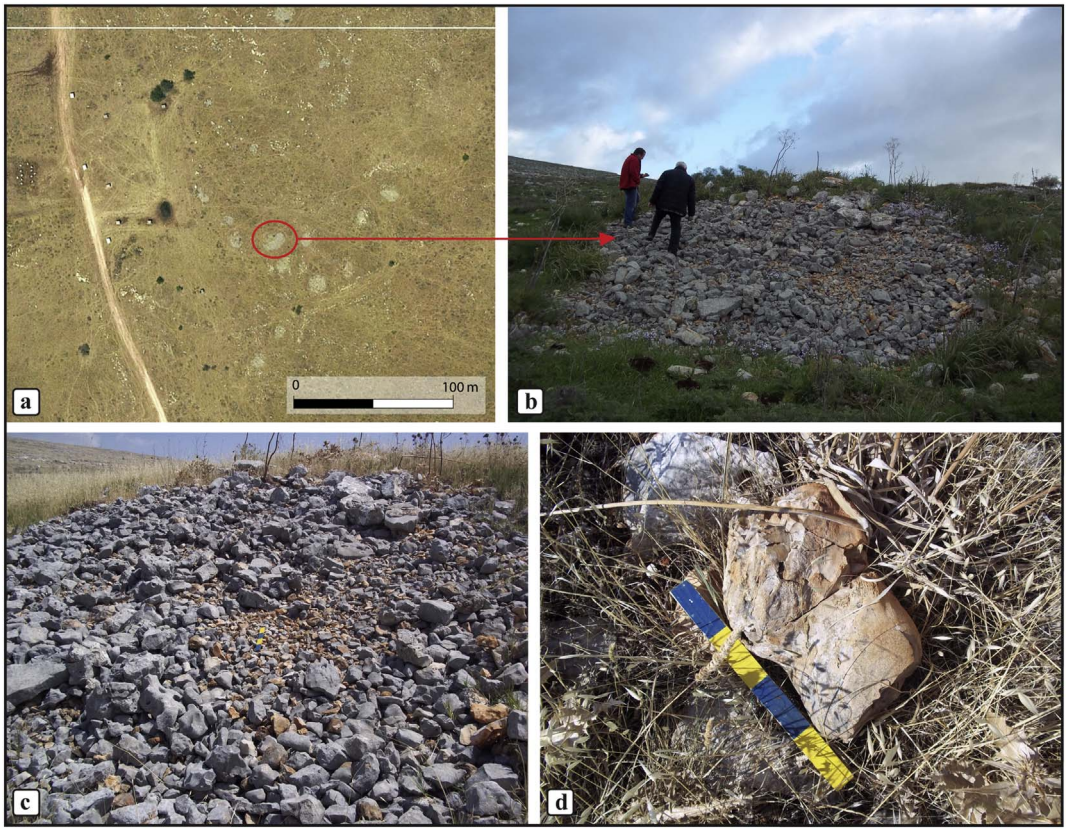
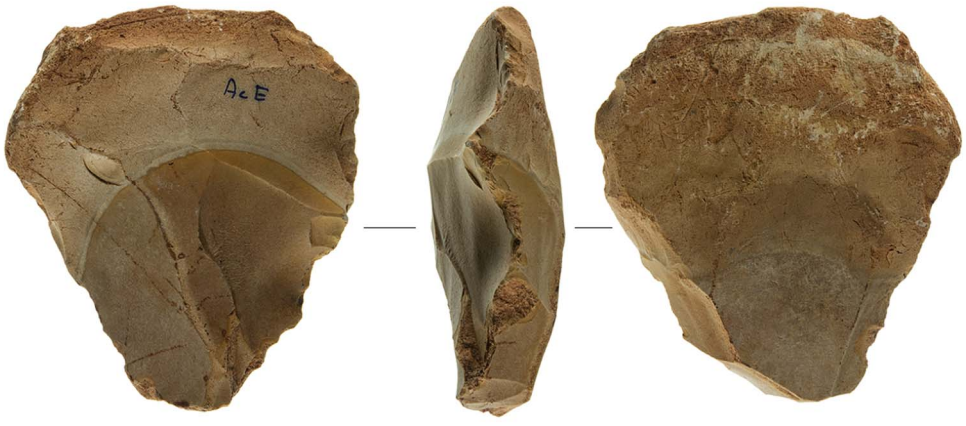


Fig. 5. (a) Aerial photo of extraction and reduction locality Achbara East (circle marks the surveyed pile); (b) ground photo of the surveyed pile taken from the south; (c) flint (all over) and limestone on the surveyed pile – scale (in the centre) = 40 cm; (d) flint nodules near the pile.

Fig. 6. Artefacts from the surveyed pile at Achbara East. (1) core (most probably Levallois); (2) core (most probably Levallois); (3) Levallois core; (4) core (bifacially shaped, most probably initial stages of preparing Levallois core).



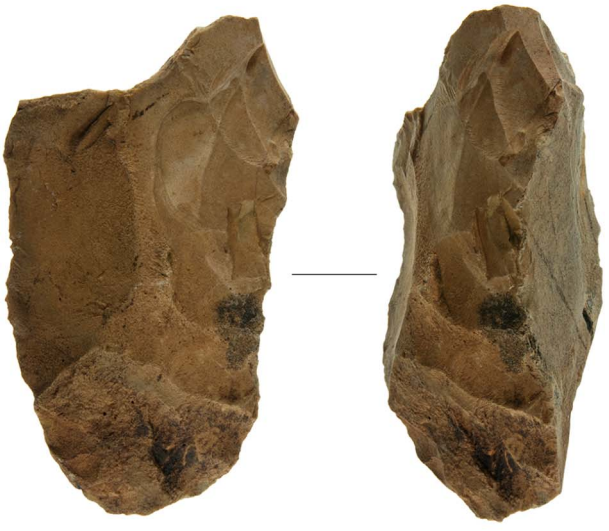


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Fig. 7. Artefacts from the surveyed pile at Achbara East. (1) adze roughout (possibly Chalcolithic); (2) core (most probably Levallois); (3) chisel roughout (Neolithic or Chalcolithic); (4) bifacial roughout.

Table 1
Assemblage composition and weight of items in 4 m^2 of surface collection at Mt. Achbara East and West E&R localities and three E&R localities in the Dishon complex (see also Fig. 18).

Category of items	Ac West		Ac East		Dishon - Baram South (Bs). (Finkel et al., 2016)		Dishon - Baram North (Bn) (Finkel et al., 2016)		Dishon Reihan plateau (R) – RAW 100 pile (Finkel et al., 2017b)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Core	14	9.2	30	19.3	7	3.6	14	11	12	3.7
Large flake (> 10 cm)	4	2.6	4	2.6	2	1	6	4.7	48	14.8
Retouched large flake	3	2			7	3.6	2	1.6	5	1.5
Flake	37	24.4	28	18.1	50	25.6	22	17.2	182	56.2
Retouched flake	49	32.2	38	24.5	58	29.7	17	13.3	39	12
Bifacial roughout	2 (late)	1.3			1	0.5	1	0.7	9 (late)	2.7
Chunk	43	28.3	55	35.5	66	33.8	61	47.7	13	4.1
Levallois core							1	0.7		
Blade					4	2	4	3.1	16	4.9
Total	152	100	155	100	195	100	128	100	324	100
Weight (kg)	21.75		27.35		23.75		24		32.1	
Levallois cores in entire pile	3		5		2		2		7	

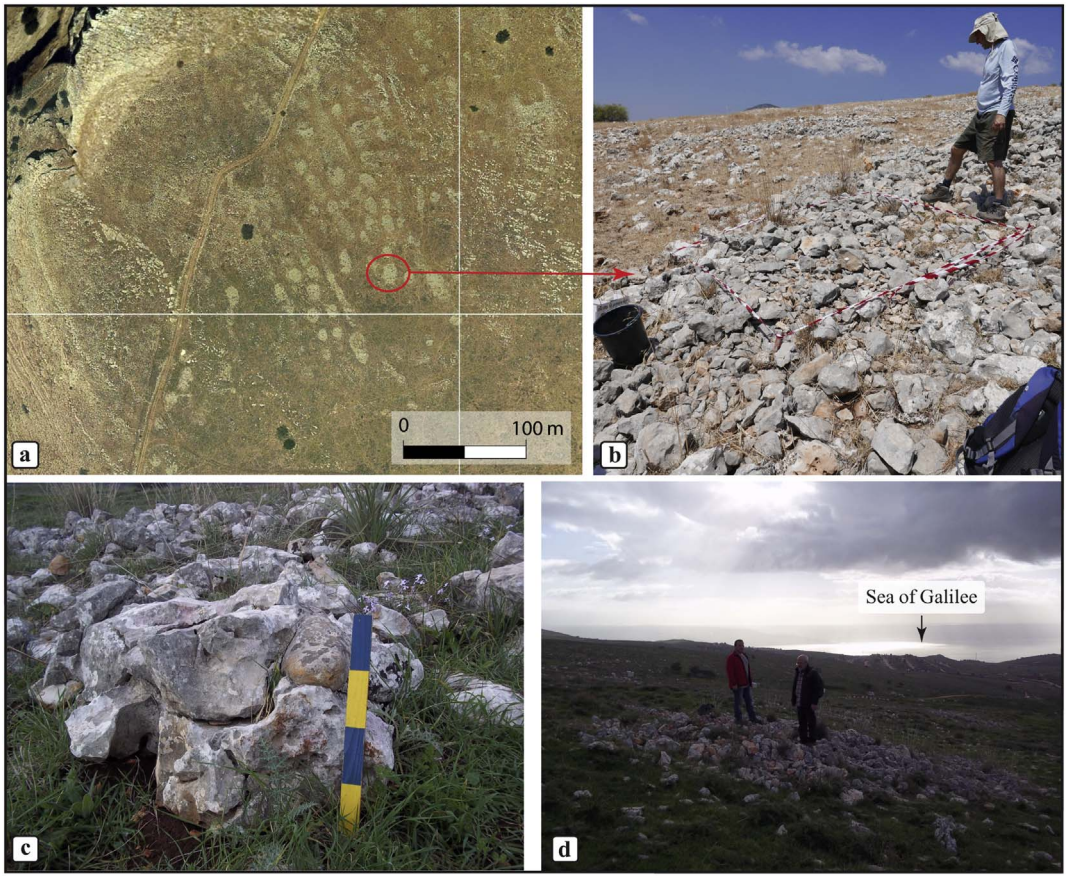

Fig. 8. (a) Aerial photo of extraction and reduction locality Achbara West (circle marks the surveyed pile); (b) ground photo of the surveyed pile taken from south-east (for scale - the red-white tape marks the 2 × 2 m square at the centre of the pile); (c) flint nodule in limestone karren near the pile; (d) ground photo from north-west, Sea of Galilee in the background. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Achbara E&R complex also includes Neolithic/Chalcolithic finds. The intensive use of bifacial tools during the Neolithic/Chalcolithic periods required systematic flint procurement, primarily by quarrying (e.g., Barkai et al., 2006; Schyle, 2007; Taute, 1994) and specialized workshops for the production and maintenance of bifacial tools. Neolithic/Chalcolithic bifacial extraction and workshop sites in northern Israel include the newly discovered Neolithic/Chalcolithic site of RAW at Mt. Reihan, in the Dishon E&R complex, Upper Galilee (Finkel et al., 2017b); Giv'at Kipod Late Neolithic/Chalcolithic basanite quarry and axe workshop in the Menashe Hills (Rosenberg et al., 2008;

Fig. 9. Artefacts from the surveyed pile at Achbara West. (1) core (bifacially shaped, most probably initial stages of preparing Levallois core); (2) Levallois core.

Rosenberg and Gluhak, 2016; Shimelmitz and Rosenberg, 2016); Giv'at Rabbi East, where Neolithic flint workshops and refuse pits were discovered on top of flint outcrops (Barzilai and Milevski, 2015); Mt. Carmel with Neolithic workshops found within flint procurement locations at Point 355 Z (Ronen and Davis, 1970); Giv'at Mikhal (Wreschner, 1963); and Daliyat el-Carmel 3 (Olami, 1984: 147; Barkai et al., 2006; Rosenberg et al., 2009); and finally, a Chalcolithic bifacial workshop was detected at Khirbet Yoah, Menashe Hills (Shimelmitz and Mendel, 2008).

The Neolithic/Chalcolithic finds in the Mt. Achbara E&R complex are of much lesser intensity than in RAW (Dishon). This find combined with our limited knowledge of Neolithic/Chalcolithic occupation sites around the Mt. Achbara E&R complex (see below), and the fact that geochemical characterization of flint items from Neolithic/Chalcolithic sites are currently lacking, makes it difficult to propose to which occupation sites flint items from Mt. Achbara E&R complex were exported.

The objectives of this paper are to present the results of a survey of the flint extraction and reduction complex at Mt. Achbara in the Upper Galilee, Israel; to present selected lithic items from a single tailing pile in each E&R locality in an attempt to assign it chrono-culturally; to estimate the scale, quantity and scope of the E&R complex described; and to reconstruct plausible relationships between the Achbara E&R complex and occupation sites in the region.

Fig. 10. Artefacts from the surveyed pile at Achbara West. (1) bifacial roughout; (2) Levallois core; (3) core (for the production of large flakes, probably later use of former Levallois core).

Fig. 11. Artefacts from the surveyed pile at Achbara West. (1 + 2) adze roughouts (possibly Chalcolithic); (3) core (for the production of flakes); (4) core (for the production of blades. Single platform).

2. The research area

2.1. Geography and geology

The Mt. Achbara E&R complex, at 160–460 masl, is located 8 km north-west of the northern shore of the Sea of Galilee (Fig. 1) on the moderate slope of Mt. Achbara. The complex (Figs. 2, 3) is situated near the Achbara Cliffs above the perennial Achbara Stream, which is the largest tributary of the Amud Stream (Fig. 4). The Sea of Galilee and Amud Stream are visible from the E&R complex (Figs. 4a, 8d). An important factor that contributed to the minimal post-depositional processes is the moderate slope topography, similar to that in the Dishon and Sede Ilan E&R complexes.

Geologically, the study area consists of Eocene limestone and chalk. The E&R complex is situated within the Lower Eocene limestone Timrat formation characterized by limestone and chalk karrens containing

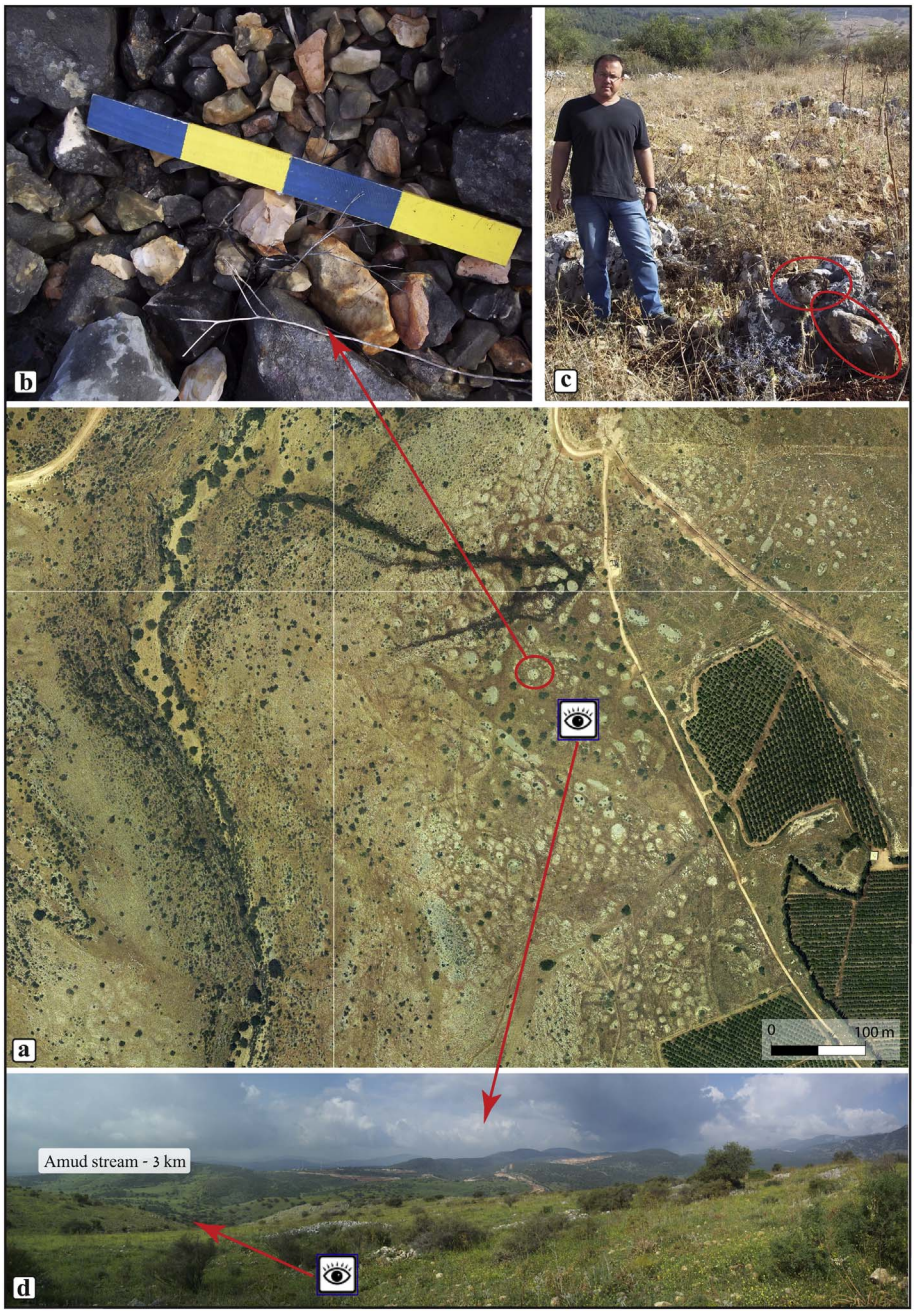

Fig. 12. (a) Aerial photo of extraction and reduction locality Achbara South (circle marks the surveyed pile; eye marks the look-out point for d); (b) close-up of the surveyed pile; (c) flint nodule in limestone; (d) view from locality of Achbara South, looking south-west – Amud Stream.

large amounts of flint nodules (Delage, 2007b; geological maps: Levitte and Sneh, 2013; Bogosh and Sneh, 2014). It should be noted that the nearby Bar Kochba formation contains much less flint than the Timrat (see also geological maps: Bogosh and Sneh, 2014 [less flint than Timrat]; Levitte and Sneh, 2013[no flint]). The Mt. Achbara Eocene outcrop is part of a 30-km-long 'strip' of Timrat and Bar Kochba formations that runs along the Eastern Galilee (Sneh et al., 1998, see Fig. 1). The rugged karstic landscape combined with the grassland vegetation of the area, termed by botanists the 'Arid Galilee' (rather than the common oak forests of the broader region), due to the local soil's limited water carrying capability (Rabinovitch-Vin, 1986), explains why the area was used in history mainly for pastoral agriculture and not for plant cultivation, which would heavily damage the E&R complexes.

2.2. Prehistory and history of the area

We limited the description of occupation sites to a radius of 10 km from the Achbara E&R complex in accordance with our supposition that the Dishon E&R complex 15 km to the north (Finkel et al., 2016 and reference within) and the Sede Ilan E&R complex 15 km to the south (Barkai et al., 2006; Barkai and Gopher, 2009), both of which contain similar Eocene flint, were more likely the sources of Eocene flint for their neighbouring ~10 km range occupation sites.

The activity of Paleolithic human groups is well documented in the area. Several known caves are situated 5–7 km south of the Mt. Achbara E&R complex. Zuttiyeh Cave contains Middle Paleolithic finds (Turville-Petre et al., 1927; Gisis and Bar-Yosef, 1974). Amud Cave was

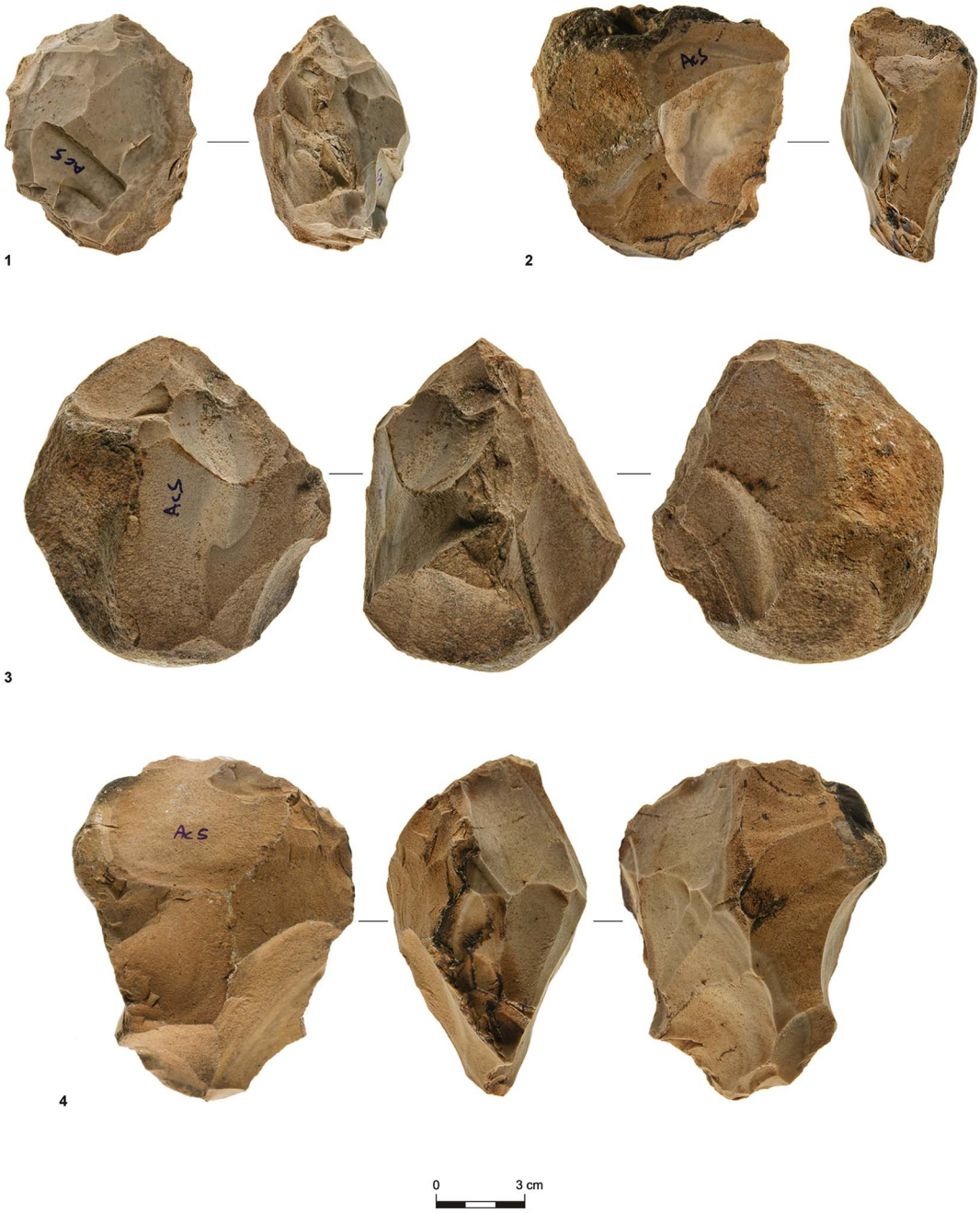

Fig. 13. Artefacts from the surveyed pile at Achbara South. (1) Levallois core; (2–3) cores; (4) Levallois core.

extensively excavated, first by Suzuki and Takai (1970) and later by Hovers et al. (1995). The Amud Cave research includes the study of faunal composition and exploitation (Rabinovich and Hovers, 2004), the flora and its exploitation (Madella et al., 2002), the local Middle Paleolithic climate (Hallin et al., 2012), exploitation of lithic sources (Ekshtain et al., 2016) and human population dynamics (Hovers, 1998, 2001; Belmaker and Hovers, 2011) and more. Shovakh Cave was excavated in the 1960s (Binford, 1966). Emireh cave contained Middle and Upper Paleolithic finds (Turville-Petre et al., 1927) and Upper and Epi Paleolithic finds were discovered on the terrace in front of it (Gisis and Bar-Yosef, 1973). Ullman recently found Paleolithic finds in a small cave (Ullman, 2014: 75 [AmE_15]) 1 km south of Mt. Achbara's most southern E&R location.

Neolithic and Chalcolithic sites in the area seem to be limited to the Achbara and Amud Streams. Surveys identified the Neolithic site of Ein Hadas in the Achbara Stream bed (Frankel et al., 2001) and three Neolithic and Chalcolithic sites in the Amud Stream (Tepper et al., 2000, citing an unpublished survey by Rabani in the 50s). None of these sites was excavated.

The Chalcolithic sites in the southern Golan Heights are located 15 km east of the Achbara E&R complex (Eocene flint adzes were found mainly in Rasem Harbush, Noy, 1998: 270–271). We mention them

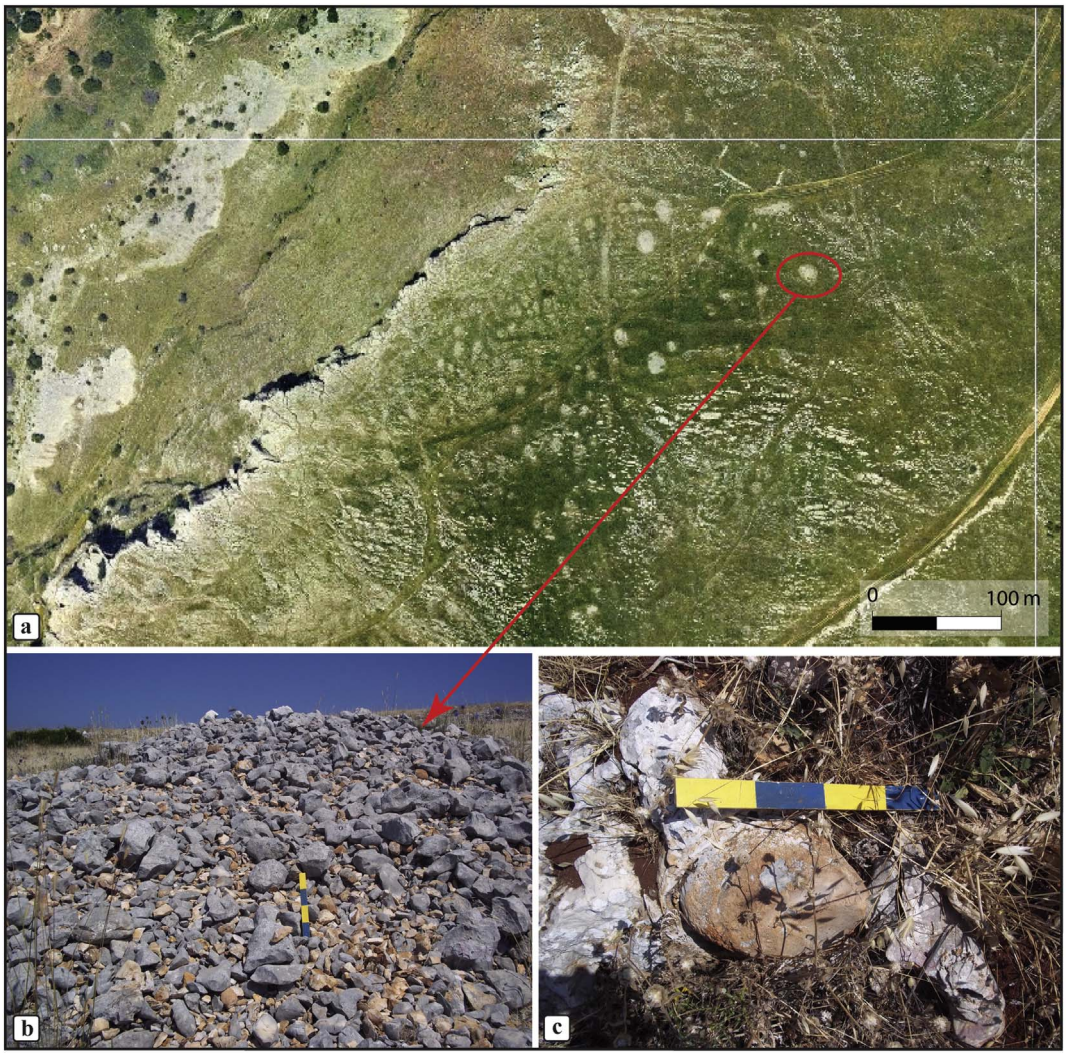

Fig. 14. (a) Aerial photo of extraction and reduction locality Achbara North (circle marks the surveyed pile), note the Achbara cliffs; (b) surface photo of the surveyed pile taken from the east; (c) flint nodule in limestone.

because the Achbara E&R complex is their closest Eocene source.

The discovery of new extensive flint E&R complex in Mt. Achbara enables us to further examine the relationship between the raw material, E&R complexes and these occupation sites.

It is worth noting that the Achbara area was occupied in historical periods, including the Iron Age (it is mentioned in Tiglath-pileser III's conquest list and the Roman period (notably the rock shelters in the Achbara cliffs used during the Jewish rebellion; see overview in Shavti'el, 2014)).

3. Methods

The field survey was conducted in 2014–5. The research area was divided into four E&R localities (Fig. 3: W-West. E-East, N-North, S-South), spread over the Mt. Achbara slope. Each locality is described by size, elevation (masl), and the number of tailing piles. Aerial photographs were used to assess the overall size of the extraction localities. Each extraction locality is represented by an aerial photograph and a land photograph of the locality. At each extraction locality a single tailing pile (four in total) was thoroughly surface surveyed. Each pile is described topographically and illustrated by a photograph with a standing human used as a scale. A few lithic finds at each pile (bifacial tools or roughouts, Levallois cores, cores, large flakes, blades, and so forth) are shown in photographs and briefly described for chrono-cultural assessment. Natural flint nodules embedded in the limestone in the vicinity (within 50 m) of some of the piles are also shown in the photographs. More comprehensive lithic studies of selected contexts are planned.

To assess the number of flint items on the tailing piles a systematic surface collection of a 2 × 2 m square at the centre of the pile was conducted at two of the four selected piles (Figs. 5c, 8b, 18a–b) for 20 min by six experienced graduate students and archaeologists with a specialization in prehistory. Only relatively large items (> 2 cm) that were visible on the surface were collected. We note that Neolithic/Chalcolithic finds (mainly bifacials) are over-represented in the figures shown in the results section. This bias is a result of their higher visibility during the field survey due to their regular morphology and standardization. However, it should be noted that the greater bulk of the knapping waste covering the tailing piles is composed of cores, large and small flakes which, from a technological point of view, reflect mostly Paleolithic knapping traditions. The total flint assemblages recovered were weighed and the items were classified according to accepted standards (see Finkel et al., 2017b for details).The results were later compared to similar collections from the Dishon E&R complex.

Fig. 15. Artefacts from the surveyed pile at Achbara North. (1–2) Levallois core; (3) large retouched flake.

Fig. 16. Artefacts from the surveyed pile at Achbara North. (1) Bifacial roughout on a flake; (2) Levallois core; (3) core (for blades, single platform); (4); adze roughout (possibly Chalcolithic).

4. Results

The following is a description of the four E&R localities found in the survey:

4.1. Achbara East

Achbara East contains 12 tailing piles located about 330 masl (Fig. 5a). Flint nodules are found within the limestone near the piles (Fig. 5d). Artefacts from the surveyed pile include probable Levallois cores (Figs. 6, 7) and Neolithic/Chalcolithic bifacial roughouts (Fig. 7) indicating human activity during the Middle Paleolithic and the Neolithic/Chalcolithic periods (see also Table 1).

4.2. Achbara West

Achbara West contains ~40 large and many smaller tailing piles (Fig. 8a) located about 330–360 masl. Flint nodules are found within the limestone near the piles (Fig. 8c). Artefacts from the surveyed pile include cores, flakes, probable Levallois cores (Figs. 9, 10) and bifacial roughouts – possibly Chalcolithic (Fig. 11) – indicating human activity during the Middle Paleolithic and the Neolithic/Chalcolithic (see also Table 1).

4.3. Achbara South

Achbara South contains hundreds of tailing piles of all sizes (Fig. 12a) located about 160–200 masl. Flint nodules are found within the limestone near the piles (Fig. 12c). Artefacts from the surveyed pile include cores and Levallois cores (Fig. 13) attesting mostly to human activity during the Middle Paleolithic.

4.4. Achbara North

Achbara North contains a few relatively large tailing piles (Fig. 14a) located about 440–460 masl. Flint nodules are found within the limestone near the piles (Fig. 14c). Artefacts from the surveyed pile include Levallois cores (Figs. 15, 16), Neolithic/Chalcolithic bifacial roughout and a single platform blade core (Fig. 16) attesting to human activity during the Middle Paleolithic and to some extent during the Neolithic/Chalcolithic. Achbara North yielded a few basalt pieces on the tailing piles (Fig. 17) and beside the piles, which according to previous finds from the Dishon and Sede Ilan E&R complexes, are assumed to be wedges, used to enlarge fissures within the limestone karrens. Transporting those pieces required a substantial effort, since the nearest basalt outcrops are the large 'Cover Basalt' flow ~4 km to the east, or the small patches of 'Amud Basalt' ~3 km to the south west.

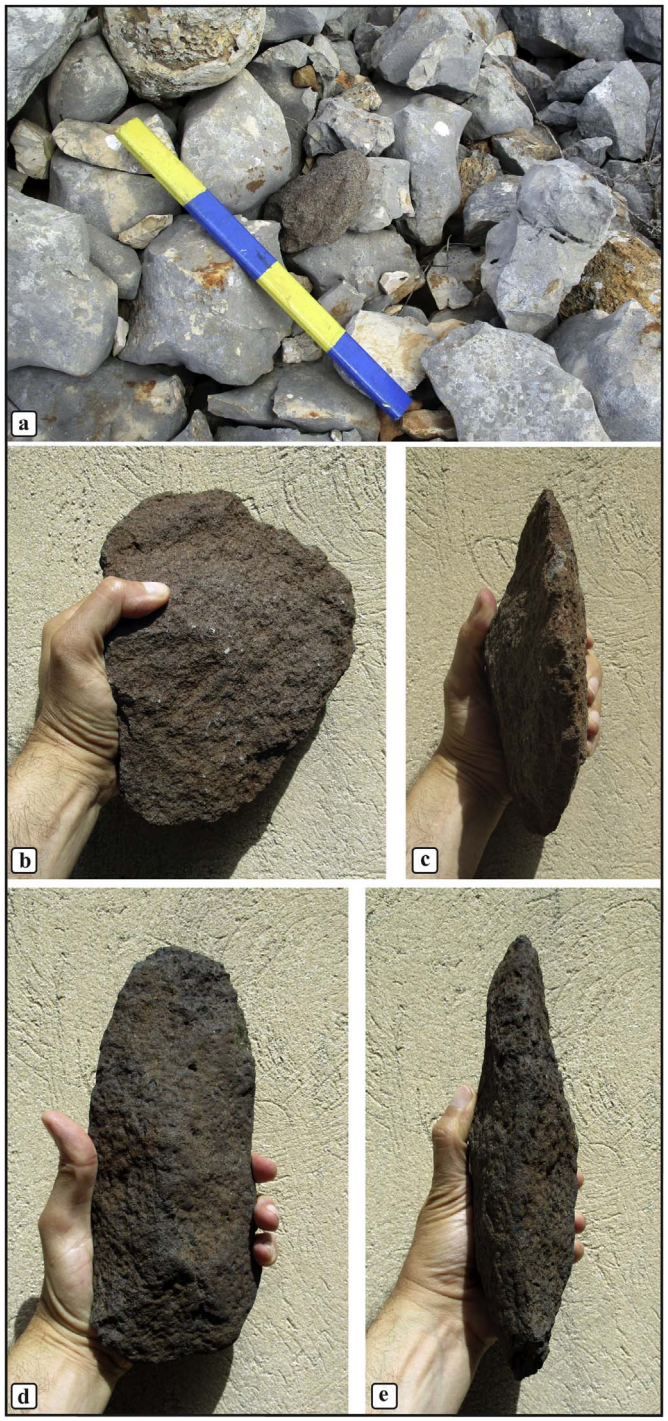

Fig. 17. Basalt pieces from Achbara North E&R locality, used most probably as wedges. (a) On the tailing pile shown at Fig. 14b; (b–c) found 100 m north-east of the pile and 20 m from another tailing pile; (d–e) found 100 m north-east of the pile and 20 m from another tailing pile.

4.5. Lithic debitage density assessment

In an attempt to establish a general level of density in piles, we compared the results of surface collection of two piles (one from Achbara West and one from Achbara East) to results from three localities of the Dishon complex (Table 1, Fig. 18). The values of the weight of flint assemblages and the total number of flint items collected from 2 × 2 m squares from four of the piles – two in the Achbara E&R complex and two of the three from the Dishon E&R complex – look surprisingly similar, and may attest to a similar intensity of Paleolithic E&R activities. The Reihan Plateau (R) – RAW 100 pile in the Dishon complex, which is different from the other two at that complex and the two from the Achbara complex, is part of a Neolithic/Chalcolithic workshop found at that specific location (see Finkel et al., 2017b – pile RAW 100).

5. Discussion and conclusions

The data presented here describe a new Middle Paleolithic and Neolithic/Chalcolithic flint E&R complex at Mt. Achbara that was systematically exploited by early humans, probably over long periods of time. Concerning the E&R Paleolithic activities, the phenomenon described at Mt. Achbara is similar to what was found in the Dishon and Sede Ilan complexes and described as “changing the face of earth” (Barkai and Gopher, 2009). The size of the entire area and the hundreds of tailing piles place Mt. Achbara between the smaller Sede Ilan (and Giva't Rabbi East) and the larger Dishon complexes (Barkai et al., 2006 and Finkel et al., 2016 respectively). The artefacts found attest to human activity during the Middle Paleolithic period and later use during the Neolithic/Chalcolithic period. These attestations closely correlate with observations at the Dishon complex (Barkai et al., 2002, 2006; Finkel et al., 2016), where remnants of natural outcrops still containing flint nodules were found in the vicinity of the surveyed piles, possibly indicating the original, pre-tailing-pile extraction landscape.

Thus, we suggest that the tailing piles at Achbara are the result of a well-planned, organized, structurally sequenced, and knowledge-based exploitation system that enabled the efficient and long-term use of the flint sources in the Mt. Achbara complex.

The nearest known Middle Paleolithic sites to Mt. Achbara E&R complex are located 5–7 km to the south in the Amud stream – the Amud, Zuttiyeh, Shovakh and Emireh Caves. These sites and others could have been the target of flint items transported from Achbara E&R complex.

Ekshtain et al. (2016) compared archaeological flint items from Neanderthal site of Amud Cave, characterized visually as Eocene from subunits B4 and B1 (dated ~68 and ~55 ka respectively), to possible Eocene natural outcrops around the cave site. Ekshtain et al.'s research focused on identifying flint raw material sources within daily exploitation territories (DET – in a radius of ~5–6 km around the cave), did not identified the E&R complex described here. Based on geochemical analysis they concluded that local material (within DET) was abundant in both subunits.

Based on the Eocene origin of the archaeological flint from Amud Cave and the new evidence for Middle Paleolithic E&R activity at Mt. Achbara within the Amud Cave DET, we suggest that the Mt. Achbara E&R complex may be a possible flint source of the Amud Neanderthals. Preliminary results of a geochemical study of flint debitage from three locations in the Achbara complex (AE, AW, AS) show that the Timrat Eocene flint of Achbara is very similar to the flint of the Dishon in the north and Sede Ilan in the south (both of the same formation). Thus, a geochemical differentiation between the Eastern Galilee E&R complexes is difficult, and the plausible association of Achbara with the Amud Stream sites is presently based on their geographical proximity.

We claim that the major effort invested in extracting flint nodules from the limestone karrens and the repeated exploitation of the Mt. Achbara E&R complex, attest to direct rather than embedded procurement. We do not suggest that embedded procurement was not at work within the Amud Cave's DET; rather, we suggest that direct

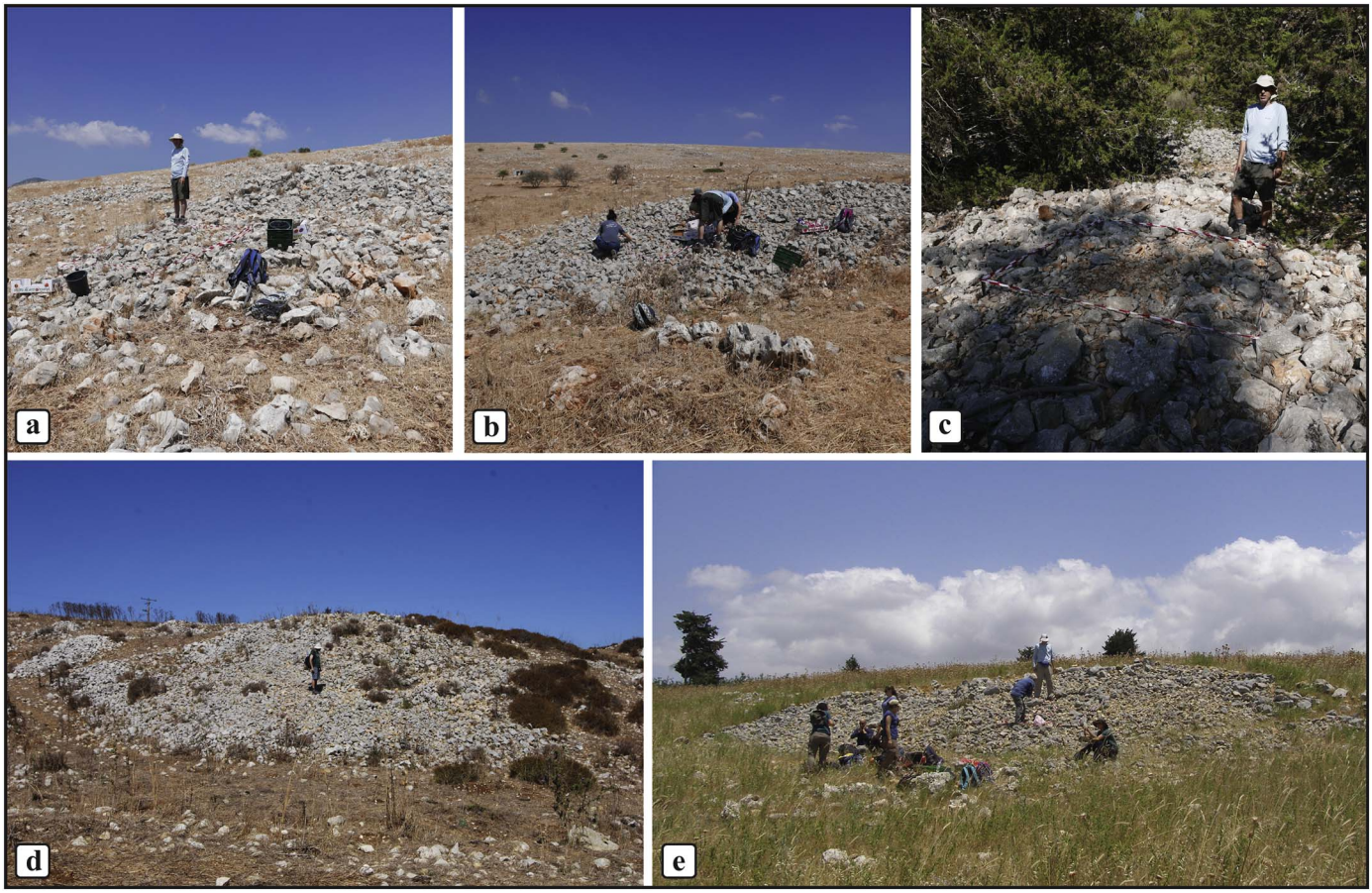

Fig. 18. E&R tailing piles: (a) Achbara West; (b) Achbara East; (c) Dishon Bs; (d) Dishon Bn; (e) Dishon RAW 100.

procurement was a significant strategy in stone procurement during Paleolithic and Neolithic/Chalcolithic times.

Conflict of interests

We hereby declare that we have no conflict of interests.

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