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A reassessment of the Middle and Later Stone Age lithic assemblages from Aladi Springs, Southern Afar Rift, Ethiopia

Tegenu Gossa^a, Yonatan Sahle^{b*} and Agazi Negash^c

^a*Department of History and Heritage Management, Arba Minch University, P.O. Box 21, Ethiopia;* ^b*Department of Archaeology, University of Cape Town, Rondebosch 7701, South Africa;* ^c*Paleoanthropology and Paleoenvironment Program, Addis Ababa University, P.O. Box 1176, Ethiopia*

The site of Aladi Springs was discovered and excavated in the 1970s. However, the assemblages from this site did not subsequently receive full investigation. Here, we present results of the first exhaustive analysis of the lithic collections from both the Middle and the Later Stone Age (MSA/LSA) occupation horizons at this site. Detailed analysis of metric and non-metric attributes reveals a marked variability in production techniques and overall size of major tool classes, with dimensional diminution evident across these occupations. However, tool utilisation patterns exhibit an overall similarity where marginally retouched tools and inverse retouch techniques appear to be the characteristic features of both industries. Whereas the presence in the MSA occupation of tool forms with LSA affinities suggests that the site may actually represent a transitional context, additional excavations and/or detailed microstratigraphic studies are needed in order to establish unequivocally the actual cultural trajectories at Aladi Springs.

Keywords: Middle Stone Age; Later Stone Age; stone tools; Aladi Springs; Ethiopia

Le site d'Aladi Springs a été découvert et fouillé dans les années 1970. Cependant, les artefacts issus du site ne firent pas par la suite l'objet d'une analyse complète. Nous présentons ici les résultats de la première analyse exhaustive des collections lithiques des horizons d'occupation du Middle et du Later Stone Age (MSA/LSA) de ce site. L'analyse détaillée des attributs métriques et non-métriques révèle une variabilité marquée dans les techniques de production et dans la taille d'ensemble des classes d'outils majeures, avec une nette diminution dans les dimensions sur la durée des occupations. Cependant, les modes d'utilisation des outils semblent globalement similaires, les outils maginalement retouchés et les techniques de retouche inversée paraissant caractériser les deux industries. Si la présence dans les niveaux MSA de formes ayant des affinités LSA suggère que le site représente peut-être un contexte transitionnel, des fouilles supplémentaires et/ou des analyses microstratigraphiques détaillées seront nécessaires avant de pouvoir établir sans équivoque les véritables trajectoires culturelles à Aladi Springs.

Introduction

Located halfway between the famous Porc Epic Cave and Lake Beseka Stone Age sites, Aladi Springs represents one of the many sites in Ethiopia that were excavated decades back but have received little investigation since (Figure 1). This open-air site

*Email: yonatan.chemere@uct.ac.za

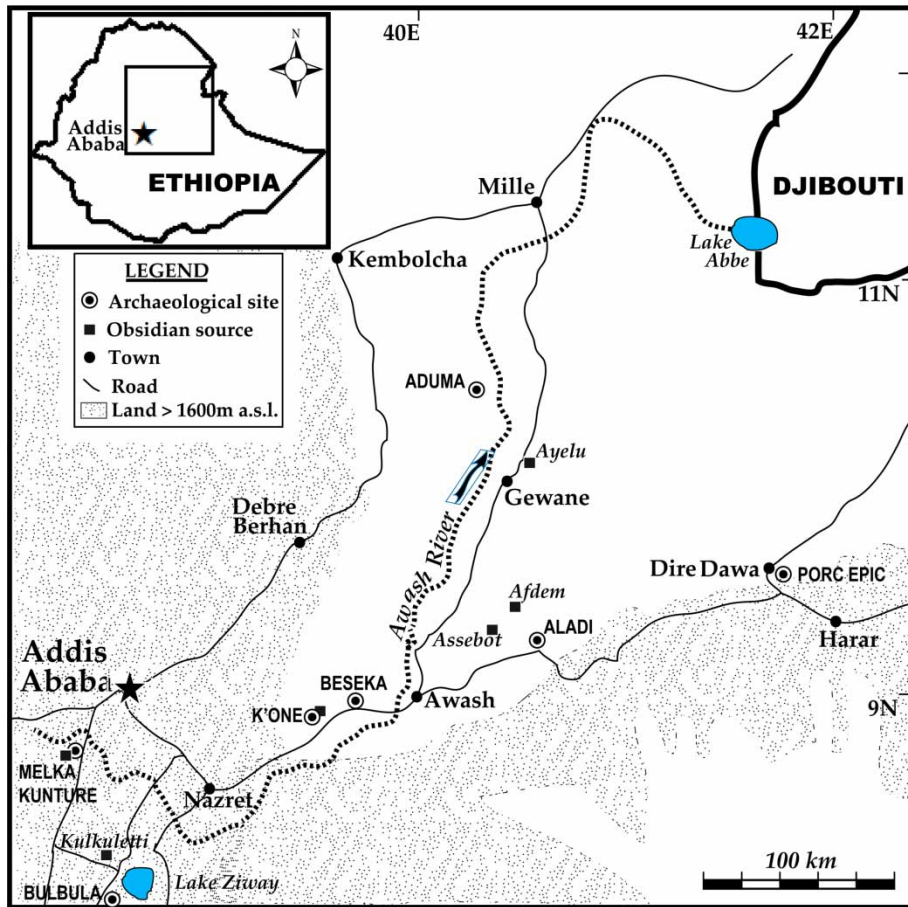


Figure 1. A map of the study area and other Stone Age sites mentioned in the text (after Negash *et al.* 2011).

rests near the base of a gentle slope, commonly called the Eastern Escarpment, running into the centre of the Southern Afar Rift (Williams *et al.* 1977). Aladi Springs was discovered and excavated for the first time in 1974 by a research expedition led by the late Desmond Clark (Clark and Williams 1978). This expedition also surveyed much of the rest of the Southern Afar Rift and discovered a number of other new sites (e.g. K'one and Lake Beseka) (Clark and Williams 1978; Brandt 1986; Figure 1). Among its main objectives was the investigation of the ways in which Later Stone Age (LSA) micro-blade industries evolved from the antecedent Middle Stone Age (MSA) traditions. Accordingly, analyses were made on assemblages from the sites of both K'one (LSA and MSA) and Laga Oda (LSA) (Clark and Prince 1978; Kurashina 1978, 7–9; Figure 1). The MSA sites of Porc Epic Cave (Clark and Williamson 1984; Figure 1) and Lake Beseka (Brandt 1982, 1986) also received detailed investigations soon after. However, except for the study of 36 sample artefacts (less than 15% of the total excavated assemblages) (Clark and Williams 1978), the larger part of the lithic materials from Aladi Springs was never fully analysed.

The 1974 excavation at Aladi Springs noted ‘an almost perfect stratigraphy, layer cake stratigraphy . . .’ (Williams *quoted in* Clark 2002, 452). However, the subsequent analysis of the small sample of artefacts identified LSA-type tools within the MSA assemblage (Clark and Williams 1978). This led to a suspicion that there may have been a mixing of artefacts from the LSA horizon into the MSA (Brandt 1986, 62). Consequently, the Aladi Springs materials never attracted research attention over the decades that followed. Whereas a reinvestigation of the site’s actual microstratigraphy and/or renewed archaeological excavations are currently virtually impossible due to extant security problems around the locality of interest, a full-scale analysis of the 1974 collections provides a good starting point for bringing the site back into discussions surrounding Late Pleistocene adaptive behavior in the wider region.

Archaeological and Stratigraphic Background

Excavations at Aladi Springs were accompanied by geological investigations in the wider Southern Afar Rift (Williams *et al.* 1977). More specifically, these studies showed that the lithostratigraphic successions at Aladi Springs (Figure 2) are in

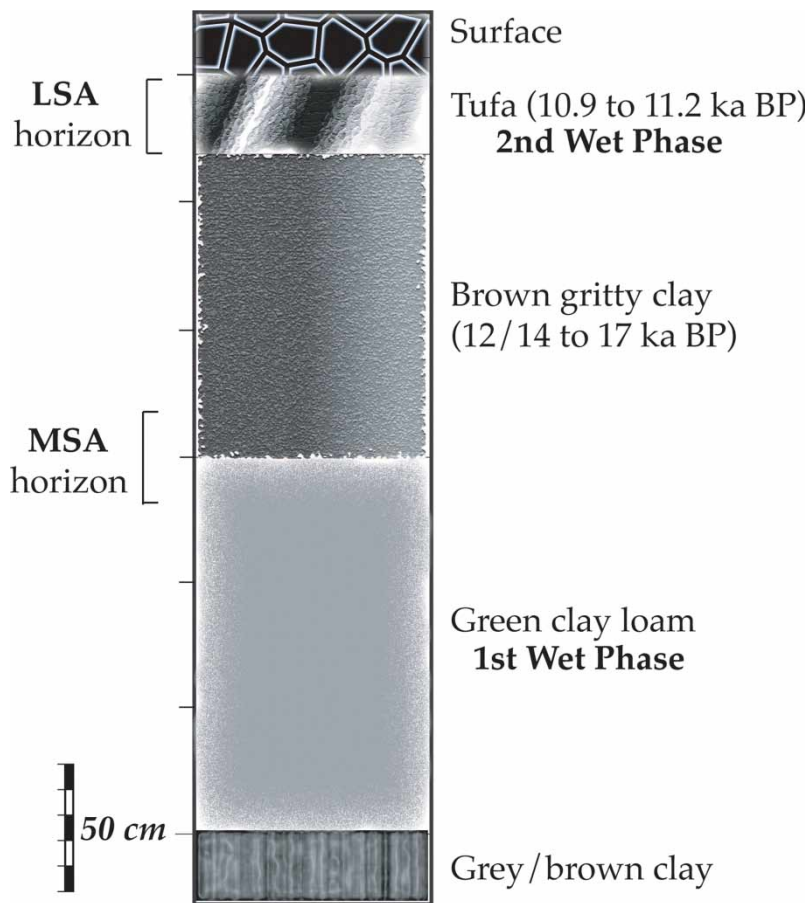


Figure 2. A schematic representation of the cultural stratigraphic succession at Aladi Springs.

conformity with those of Lake Beseka and other sites in the region that have well-developed chronological frameworks (Williams *et al.* 1977; Clark and Williams 1978). On the basis of these data and of an analysis of a sample of artefacts, Clark and Williams (1978) suggested that the assemblage from the 'first wet phase' at Aladi represents 'late' MSA technologies and that the assemblage from the 'second wet phase' is a purely LSA industry. However, dates for the MSA occupations have not been established, despite the sampling of datable charcoals from this horizon (Williamson 1976). For the LSA occupation available dates come from the abundant gastropod shells in the tufa layer that are estimated at $11,070 \pm 160$ BP. In between the two occupation horizons is a brown gritty clay horizon believed to represent a dry phase that lasted from roughly 17 kya to about 12/14 kya (Clark and Williams 1978, 33). The 'late' MSA affinities of part of the Aladi Springs assemblages, together with the site's location almost equidistance between the purely MSA and LSA sites of Porc Epic and Lake Beseka respectively (Figure 1), has further increased interest in the site's potential for establishing the cultural chronology of the region.

In 1976 K. Williamson, then a graduate student of Desmond Clark's, conducted another excavation at Aladi Springs. Unfortunately, except for a field report (Williamson 1976) submitted to the then Antiquities Department of Ethiopia, the 1976 materials Williamson took abroad were never analysed. In his report Williamson (1976) indicated that the LSA materials previously noted to have appeared in association with the MSA ones might have resulted from mixing by way of down slope wash. Comparisons of the materials from the two excavations still remain impossible because we could not confirm where these materials are now located. In a later review dealing with the Upper Pleistocene archaeology of the Horn of Africa Brandt (1986, 62) concluded, from a personal communication with Desmond Clark and Williamson, that the 'late' MSA layer at Aladi Springs contains 'disturbed and mixed' deposits. While the aim of this paper is not to contest Williamson's impressions about the site's stratigraphic integrity, the fact that the 1976 excavation was never studied in detail nor published anywhere justifies the need for a reinvestigation, from all possible angles, of the actual behavioural context represented at Aladi Springs.

As a result of the limitations already noted, the current analysis of assemblages from this potentially informative site has had to depend on the only collection available at the National Museum of Ethiopia – that of the 1974 season. Our present study describes the entirety of this collection (including the samples described earlier by Clark and Williams [1978, 33–34]). We document patterns that are evident in the MSA and LSA assemblages and present inferences that can be made about key attributes of the assemblages from both cultural stratigraphic units, in spite of the lack of absolute confidence on the *transitional* status of the older occupation horizon.

The terminal MSA and early LSA archaeology of Ethiopia has long remained much less clear than that of earlier periods. A large majority of these late Pleistocene sites suffer from the lack of a secure geochronology and/or sufficient stratigraphic contexts. This has limited their potential for contributing to our understanding of foraging behaviours and cultural chronologies in this period. Detailed reviews of Upper Pleistocene sites in Ethiopia and the Horn have been presented elsewhere (Brandt 1986; Bachechi 2004). In addition, only the site of K'one (besides Aladi) has been identified as containing assemblages with transitional features. Dated to

14,670 ± 200 BP (Williams *et al.* 1977), K'one's location near an obsidian source and its proximity to Aladi Springs ought to present an excellent opportunity for inter-assemblage comparisons. However, doubts about the integrity of the stratigraphy of the excavated trench, together with the extreme rarity of shaped tools among the materials recovered, discouraged ensuing research on the K'one material (Kurashina 1978, 350–353). Sites with secure radiocarbon dates and better stratigraphic settings such as Bulbula (Gasse and Street 1978; Figure 1) or Harurona, in southwestern Ethiopia (Bachechi 2004) unfortunately provide assemblages that contain only exclusively LSA features. An ongoing research project at Moche Borago, near Harurona, does document continuous occupations with MSA and LSA assemblages and well-established dates (Brandt *et al.* 2010, A5), but these assemblages do not contain features that can be associated with the MSA/LSA transition (Brandt 2008, 22).

Methods

Different scholars use different approaches to test the variability of tools/assemblages within and across occupation horizons (e.g. Ambrose 2002; Villa *et al.* 2005; McCall and Thomas 2009). In our case, since we do not have fine-grained information on the stratigraphic details of the 1974 excavation, such as on the excavation levels, we conduct only inter-assemblage comparisons of the two occupations.

A major focus in our analysis has been the identification of techno-typological attributes and patterns that stand out as typical/common to the LSA versus MSA occupations. Measurements of artefact dimensions were collected using an electronic digital caliper. Considering the major reason for the long exclusion of the Aladi Springs materials from full-scale analysis, i.e. the suspicion of stratigraphic mixing (Brandt 1986), a more elaborate comparison of tool class attributes has been employed in order to infer trends of change and/or continuity across the occupations.

The Aladi Springs assemblages were originally classified into two culture-stratigraphic units, namely the 'late' MSA and the LSA (Clark and Williams 1978). The 'evolved/late' MSA assemblages show a blend of MSA elements with blade-based industries. On the other hand, the LSA occupation horizon witnessed an increased emphasis on the diminution of similar tool forms as compared to the underlying unit. For convenience, our analysis retains the contextual categories and adopts most of the technological-typological systematics used by previous researchers in their initial analysis of the selected sample artefacts. This allows a study of the assemblages with similar methods of analysis in order to see if different inferences can be drawn. Accordingly, we compare shaped tool compositions, striking platforms and core types between the two occupations. Furthermore, we analyse the modification categories and raw material compositions witnessed in the assemblages. Artefacts from surface collections display a unique feature in which materials ranging from big unmodified cobbles to bladelets are represented. However, both these artefacts and débitage classes are excluded from detailed analysis here since they are deemed to be susceptible to mixing and have not therefore been attributed to either of the occupations.

Results

Analysis of assemblages from both occupation horizons has enabled the identification of formal tool classes, striking platform types and a variety of core forms. In general, scrapers appear to be the dominant formal tool types in both the MSA and the LSA assemblages (Table 1). These include both scrapers made on blades and non-blade-based forms. Blade-based scrapers account for more than half of the total tool classes in the MSA, while non-blade-based scrapers form the second and third largest tool forms in the MSA and LSA layers respectively. In the LSA horizon, bladelet tools make up the second largest tool class. An increase in the proportion of tools on bladelets in the LSA assemblages suggests that more emphasis was given by the knappers to the production of micro-blade tools. It is also noteworthy that some of the characteristic MSA tools, such as core scrapers, utilised sub-triangular flakes and long blades with faceted platforms, are absent in the LSA levels.

Except for the absence of denticulated blades in the LSA levels, the relative share of other blade types (Figure 3; Table 2) is largely similar across the two horizons. The majority, 53 out of 62 artefacts, of the retouched tools (i.e. scraper blades) in the MSA level are inversely retouched. Of the remainder, seven are obversely retouched, while two bear Ouchtata retouch where semi-abrupt to fine retouches are continuously, but irregularly, applied to the lateral edge of a blade/bladelet. Retouch on these MSA scraper blades is dominantly of marginal type. Only three scraper

Table 1. A summary of formal artefact classes from the MSA and LSA occupations at Aladi Springs (typology mostly adopted from Clark and Williams (1978)).

Artefact category	MSA		LSA	
	N	%	N	%
SHAPED TOOLS	176	100.0	70	100.0
Scrapers (blade and non-blade)	100	57.0	31	44.0
Points	5	3.0	2	3.0
Bladelet tools	20	11.0	16	23.0
Burins	5	3.0	7	10.0
Drills/borers	2	1.0	1	1.4
Sub-triangular flakes (utilised)	2	1.0	—	—
Notched pieces	21	12.0	8	11.4
Indeterminate tools	5	3.0	—	—
Denticulated pieces	6	3.4	1	1.4
Backed pieces	10	5.6	4	6.0
CORES	69	100	34	100
Radially prepared discoids	7	10.0	—	—
Multi-platform	10	14.4	6	17.6
Single platform blade	15	21.7	9	26.5
Single platform prismatic	1	1.4	1	3.0
Single platform bladelet	3	4.4	8	23.5
Opposed platform	7	10.0	3	8.8
Pyramidal	2	3.0	1	3.0
Bipolar	3	4.4	2	5.8
Core on flakes	6	9.0	1	3.0
Core fragments	15	21.7	3	8.8
DEBITAGE (chips and chunks)	308	100	824	100
ORDINARY FLAKES	1051	100	815	100

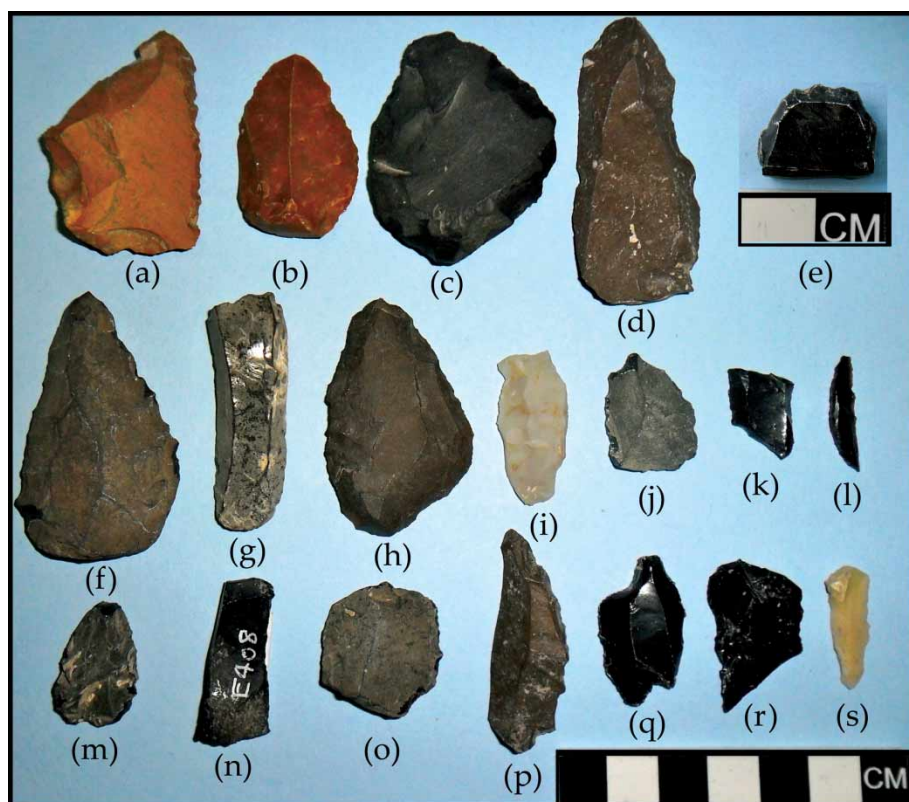


Figure 3. Selected formal tools from Aladi Springs: a) denticulate; b) utilised sub-triangular flake; c) core scraper; d) long blade; e) thumbnail scraper; f) Levallois point; g) prismatic blade; h) sidescraper; i) backed blade; j) drill/borer; k) burin; l) backed bladelet; m) point on flake; n) prismatic blade; o) sidescraper; p) backed blade; q) drill/borer; r) burin; s) backed bladelet. (Artefact types represented by 'a' through 'd' are exclusive to the MSA, while 'e' is only found in the LSA assemblages. All artefacts in the second row ['f' to 'l'] are thought to be the MSA functional equivalents of the artefacts in the last row ['m' to 's'] that come from the LSA horizon).

blades bear retouch that ranges from marginal to semi-invasive. Likewise, 17 out of 21 scraper blades in the LSA levels are inversely and marginally retouched, while the remainder are obversely and marginally retouched.

Backing of edges was applied on 11 MSA blades. Of these, seven were inversely backed, three bidirectionally and only one obversely. All of the bidirectionally backed blades bear backing all along their lateral sides. Considering now the location of backing, we note that four of the MSA blades were backed only proximally, while three blades bear backing on their medial, medial and proximal and whole sides; one further blade was backed along the entirety of its left side. Among the LSA assemblages too backing is one of the least applied edge-trimming techniques. All of the LSA backed blades are inversely backed; three bear backing on their whole sides, while one has backing on its medial side only.

Among bladelets in the MSA assemblages, normal retouching (rather than notching, denticulation or the use of the Ouchtata technique) appears to be

Table 2. Summary statistics and dimensions (mm) of blade, scraper and core types in the MSA versus LSA assemblages at Aladi Springs.

	MSA	LSA
BLADE	(N = 92)	(N = 31)
Scrapers	62	21
Double side	34	12
Single side	27	9
Double side-and-end	1	–
Backed	10	4
Notched	13	5
Denticulated	6	0
Notched-and-backed	1	1
Dimensions	Mean $\pm$ standard deviation	Mean $\pm$ standard deviation
Length	30.83 $\pm$ 14.67	22 $\pm$ 7.36
Width	17.15 $\pm$ 5.69	13.92 $\pm$ 2.16
Thickness	6.51 $\pm$ 3.03	4.57 $\pm$ 1.31
NON-BLADE	(N = 38)	(N = 10)
Scrapers		
Double side	8	2
Double side-and-end	17	1
Single side	3	1
Core scraper	5	0
End	5	2
Thumbnail	0	4
Dimensions	Mean $\pm$ standard deviation	Mean $\pm$ standard deviation
Length	34.17 $\pm$ 9.26	26.96 $\pm$ 3.91
Width	25.29 $\pm$ 7.14	19.07 $\pm$ 4.30
Thickness	8.34 $\pm$ 2.87	7.95 $\pm$ 1.04

the dominantly applied edge-trimming technique. Most of these retouches are inverse and marginal, as in most other tool classes within this assemblage. Only two of the bladelets are obversely retouched, while another one bears Ouchtata retouch. Similarly, bidirectional and inverse backing along a part or an entire lateral edge are the dominant backing techniques employed by the MSA occupants. In contrast to the trends among the MSA assemblages, obversely and marginally retouched bladelets dominate among the LSA assemblages. However, as in the MSA, the prominently applied retouching technique among backed pieces in the LSA remains inverse and marginal backing.

Non-blade scrapers make up the second largest tool class in the MSA, but stand third in the LSA (Table 1). Seven scraper types have been identified from both occupation horizons (Table 2). Double side-and-end scrapers constitute the largest number in the MSA levels (17 artefacts; 41.5%) in contrast with only one scraper of this type found in the LSA assemblage. In addition, core scrapers are observed in the MSA layers, but are totally absent in the LSA. Likewise, thumbnail scrapers are only represented in the LSA assemblages (Figure 3; Table 2).

Thirty-five (90%) of the non-blade scrapers in the MSA assemblages are inversely retouched while the remaining four are retouched obversely. The trend in retouch class is similar to that of the blade-based scrapers in that the typical retouching pattern is one made from the ventral onto the dorsal surface of the scrapers. In terms of the invasiveness of retouch, however, the pattern among non-blade scrapers

appears to be different from that among scraper blades. There are 16 scrapers (about 41%) in the non-blade tool category with retouch ranging from marginal to semi-invasive in contrast to only three scraper blades with such a degree of retouch. Three more non-blade scrapers possess semi-invasive retouch and the remaining ten specimens bear marginal retouch. That more non-blade scrapers are invasively retouched than blade-based ones is plausibly attributable to them having been used more intensively than the latter. More conclusive results would require the running of statistical tests that need more samples of both tool forms.

A prominent feature of the Aladi Springs assemblages is the difference across the occupation horizons in the relative share of faceted platforms. Nearly half of the blade-based tools in the MSA assemblages retain faceted platforms compared to only about a quarter in the LSA. A third of the scrapers in the MSA layer were also produced using faceted platforms. In addition to this, radially prepared discoids (Figure 3) are only represented in the MSA horizon. In general, the presence of these patterns in this horizon comes as no surprise since platform preparation and radial core reduction techniques are among the salient features of tool production in the MSA (e.g. Ambrose 2002). By contrast, the proportion of blade-based tools with pointed platforms rises from 24% in the MSA to 38% in the LSA (Gossa 2011).

Regarding raw material composition, obsidian is the most widely exploited rock, accounting for about 70-90% of all the artefacts in both occupations (Table 3; Gossa 2011). In order of relative abundance, chert, ignimbrite/rhyolite and basalt make up the rest of the raw material types exploited by both MSA and LSA people at Aladi Springs. Locally, basalt and ignimbrite/rhyolite are the most abundant of the raw materials represented in the Aladi Springs assemblages (Pleurdeau 2005, Figure 4). The dominance of obsidian in the assemblages can be attributed to the preference of such a high-quality silicate quarried from sources still within close proximity to the site, such as Afdem and Assebot (Figure 1). A recent geochemical analysis (Negash *et al.* 2011) has positively characterised some of the Aladi artefacts, confirming their extraction from the Assebot source approximately 30 km away.

Finally, we consider core types, which exhibit profound similarities across the two horizons. The only exception is the presence of radially prepared discoid cores, which are exclusively found in the MSA occupation (Figure 4; Table 1). A notable similarity that may attest to its transitional nature is the presence of small pyramidal and single

Table 3. Cores and major shaped tool categories from the MSA and LSA horizons at Aladi Springs by raw material type.

	Obsidian	Chert	Ignimbrite/ Rhyolite	Basalt	Quartz
SHAPED TOOLS					
MSA	140 (79.7%)	22 (12.5%)	11 (6.0%)	2 (1.1%)	1(6.0%)
Blade-based	101	16	11	—	—
Non-blade based	39	6	—	—	1
LSA	61 (87.0%)	7 (10.0%)	—	—	2 (2.8%)
Blade-based	37	5	—	—	2
Non-blade based	24	2	—	—	—
CORES					
MSA	47 (68.1%)	14 (20.3%)	4 (5.8%)	4 (5.8%)	—
LSA	27 (79.4%)	3 (8.8%)	3 (8.8%)	1 (3.0%)	—

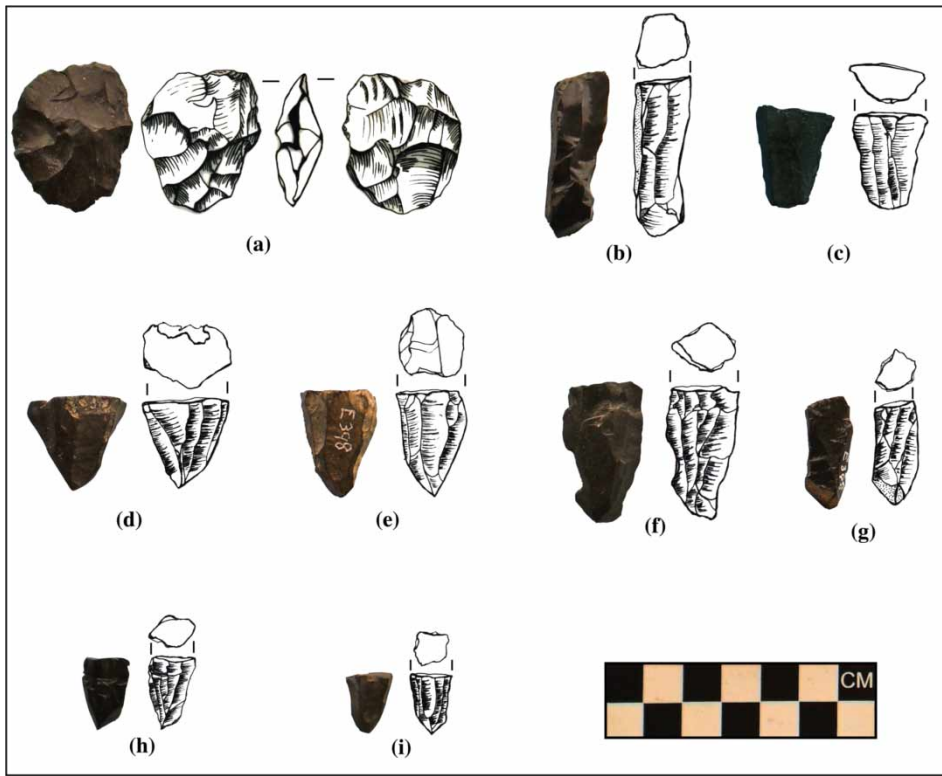


Figure 4. Illustrations of selected core types from Aladi Springs: a) radially prepared discoid; b) prismatic blade core [MSA]; c) prismatic blade core [LSA]; d) pyramidal core [MSA]; e) pyramidal core [LSA]; f) single platform blade core [MSA]; g) single platform blade core [LSA]; h) single platform bladelet core [MSA]; i) single platform bladelet core [LSA].

platform blade/bladelet cores in the MSA assemblage (Figure 4). In terms of dimensions, cores from the two horizons do, however, show some difference, as the mean length of those from the MSA is 36.5 mm compared to 30.1 mm in the LSA. Corresponding figures for mean width are 26.2 mm and 21.2 mm respectively, while mean thickness is 14 mm for both assemblages. While the differences may not appear to be very big, for both length and width Mann-Whitney U -tests show that they do rise to the level of statistical significance ($U=870$; $p=0.03$ for length; $U=783$; $p=0.006$ for width).

Discussion

Notable differences exist between the MSA and LSA lithic assemblages from Aladi Springs in some of the key attributes. Techno-morphologically, there is a clearly observable shift of emphasis from bigger blades and non-blade scrapers produced from prepared cores in the MSA horizon to the production of smaller blade and micro-blade tools in the LSA. Such diminution observed in the dimensions of dominant tool types across the occupation horizons is evident from the summary statistics provided in Table 2. A test of the levels of statistical

significance of such dimensional variability could not, however, be carried out due to the smallness of sample numbers for each specific tool type within the major tool classes.

The marked increase in the share of bladelet cores in the LSA (Table 2; Figure 4) is another noteworthy pattern, which is also synchronous with the increase in the share of such tool forms. This picture is also compatible with the relative trend of diminution in the dimension of cores from the MSA to LSA horizons, as is the case with shaped tools. Such core variations are attributable to knappers' preferences for high quality raw material. Except for a basalt blade core and seven multifaceted big cores and cores on flakes, all the other core types (over 90%) in both the MSA and LSA assemblages are made on obsidian and chert.

Variability is also observed in the raw material choices made by MSA versus LSA knappers. The increase in preference for cryptocrystalline silicates on the part of the LSA knappers is evident from the raw material composition of the retouched tools, which are made almost entirely from obsidian and chert (with the exception of just two bladelets made on quartz). In the MSA, by contrast, tools made on ignimbrite/rhyolite and basalt account for over 11% of the total. The small representation of low quality raw materials (Table 3) even among ordinary flakes (where ignimbrite/rhyolite and basalt account for 4% and 5% of these artefacts in the LSA and 8% and 7% in the MSA, respectively) may suggest an increase in the tradition of selecting high quality raw materials. The presence of such high quality raw materials as obsidian close to the site seems to have given knappers the freedom to engage in the experimentation and eventual production of all kinds of tools.

Despite these differences, there is an overall similarity in edge modification techniques employed in the resharpening of tools. Tools in both assemblages are dominantly marginally retouched, which is informative of the dynamics of the raw material economy. The availability of obsidian sources not very far from the site (Negash *et al.* 2011; Figure 1) may have relieved occupants of the site during both the MSA and LSA of the need for higher curation (*sensu* Shott 1996). This is compatible with the notion that raw material availability affects the intensity of utilisation of tools (Bousman 2005; Sahle and Negash 2010, 40). However, that the overall dimensions of the Aladi Springs assemblages are smaller than what is observed in most sites of similar period remains intriguing taking into account the ready availability of obsidian (cf. Clark 1988, 263). As another point of similarity, inverse retouching appears to be the dominantly applied retouch type, and hence a characteristic feature, in both of the industries from this site.

The present analysis cannot resolve the issue of whether Aladi Springs represents a 'late' MSA phase with transitional elements overlain by a clearly LSA occupation. However, it has shown that we can extract a better understanding from such an analysis of the entire collection at hand. More conclusive results on this issue require renewed field investigations on the actual stratigraphic and archaeological contexts of this promising site.

Conclusions

The analysis of the Aladi Springs materials presented here provides a better picture about what we can actually learn from these assemblages. As discussed above, the site

represents occupations with certain shared technological and typological traits, which can be used to infer continuities in adaptive strategy. However, it also exhibits marked differences in certain technological aspects evident in the comparison of the MSA and LSA occupations. While the main aim of this paper has been to provide a detailed description of the Aladi Springs assemblages for the first time, it has also tried to bring to readers' attention the promise that a fine-grained re-investigation of the site holds for delivering results on technological strategies across the MSA/LSA boundary, which is as yet poorly understood (Wadley 2005). While it is true that the transitional nature of the 'late' MSA assemblages at Aladi Springs is still equivocal, the present analysis nevertheless shows that this is not a *fait accompli*. Doubts over the stratigraphic integrity of the site rely on analysis of a small sample of artefacts, while plans to investigate these doubts more closely were never realised. A more confident conclusion about the context of the 'late' MSA layer must still await results from renewed field investigations.

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Notes on contributors

Tegenu Gossa holds an MA in archaeology from Addis Ababa University. He currently lectures at Arba Minch University in southern Ethiopia. His research interests include lithic analysis and Middle and Later Stone Age foraging strategies and he has participated in fieldwork in the Blue Nile basin of northwestern Ethiopia and in the Main Ethiopian Rift.

Yonatan Sahle holds an MA in archaeology and is currently a doctoral candidate at the Department of Archaeology, University of Cape Town. His research interests revolve around lithic analysis, ethnoarchaeology and social archaeology. He has carried out research on the contemporary use of obsidian scrapers among the Hadiya people of Ethiopia and leads a project at Gademotta in the Ethiopian Central Rift.

Agazi Negash is a senior lecturer at Addis Ababa University, Ethiopia. He received his PhD from the University of Florida in 2001 and has been a post-doctoral fellow at the University of California at Berkeley and the Max-Planck Institute. His research interests include prehistoric archaeology and the geochemical sourcing of raw materials and he has characterised over two dozens of obsidian sources in the Main Ethiopian and Afar Rifts.

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