Introduction

The paleoanthropological potential of the Awash basin was recognized following the discovery of rich archaeological occurrences at Melka Kunture in the 1960s (Chavaillon, 1967). Surveys were soon extended to the middle and lower reaches of the Awash basin, leading to the discovery of many of the now-renowned paleoanthropological areas in the Afar Rift (Taieb, 1974; Figure 1). Today, Afar resources support more than a dozen separate paleoanthropological research projects, with significant discoveries made in the Chorora, Middle Awash, Gona, Hadar, Woranso-Mille, and Dikika study areas (Figure 1).

Unlike earlier geologists and explorers, Maurice Taieb appreciated and quickly began to share the paleoanthropological potential of the Afar Rift (Taieb, 1974). His initial surveys took him to all of the study areas noted above (Taieb et al., 1972; Figure 1). In late 1971, Taieb conceptualized what would become the International Afar Research Expedition (IARE), and conducted further surveys of this multinational scientific research project with Kalb (2001), Coppens, and Johanson as collaborators. In March of 1972, as part of the broad initial exploration of the Afar Rift, Kalb would conduct a traverse across the eastern region of the modern Awash River and west of the Megenta mountain ridge. The traverse included transsects across the large, fairly featureless plain dominating the NNE-trending Karrayu Graben (Figure 1).

Kalb’s (2001) memoir—Adventures in the Bone Trade—constitutes the only published account of the three-day transsect across the Karrayu Graben and beyond. It mentions photographing, collecting, and sketch-mapping vertebrate fossils and Middle Stone Age tools along the Abaco stream, an eastern Awash tributary ~25 aerial km downstream and due east of Hadar (Figure 1). Kalb (2001) guessed that the Abaco occurrences were Late Pleistocene in age, and continued his transect first south, then along the western edge of the Megenta, noting ‘Late Stone Age’ artifacts just south of an abrupt E–W-aligned gap that bisects the mountain ridge (Figure 1). Kalb’s (2001: p. 64) vehicle traverse continued up to the northern end of the basin, where, despite reports by the local Afar inhabitants about rich fossil occurrences nearby, he ended his survey as ‘time and gas were short.’ The superficiality of this and subsequent early paleoanthropolog-
Figure 1. (a) Map showing hominid-bearing research areas in the Awash basin (left), and sampled localities in the northern part of the Megenta study area (right; white circles represent archaeology and vertebrate paleontology localities; white star represents the hominid-bearing locality). (b) Sedimentary exposure in the northern part of the Megenta study area, with the Megenta mountain ridge seen in the background (view NE).
ical surveys of the Lower Awash basin suggested to one of the coauthors (Y.S.) that additional survey was warranted, particularly north of Deneba River (Figure 1). Despite proximity to hominid-bearing sites west of the modern Awash River (e.g. Haile-Selassie et al., 2007), the localities described here had remained paleoanthropologically little explored due to their inaccessibility. Relocation of Kalb’s (2001) Abaco occurrences and identification of new ones farther north were carried out as part of exploratory surveys initiated in 2016 by one of us (Y.S.) (Sahle and Beyin, 2017). Successive surveys on both sides of the Megenta in 2017 and 2018 eventually led to the discovery of extensive sedimentary outcrops west of the mountain ridge. The presence of well-preserved and more complete fossils, as well as finely shaped large cutting tools eroding from a conspicuous sandstone unit was established for the first time in September 2018.

Additional fieldwork conducted by the authors and their local collaborators in December 2018 focused on the documentation and sampling of archaeological and fossil occurrences in the northern part of what is now designated as a new study area, with a research permit issued to Y.S. by the Ethiopian Authority for Research and Conservation of Cultural Heritage (ARCCH).

### Survey and Collection Methods

A broader survey of the study area was conducted both along vehicle and foot transects, with the intention of identifying the distribution, type, and density of archaeological and fossiliferous occurrences. A subsequent remote sensing approach enabled a more detailed mapping and documentation of prioritized localities. A spectral signature model was derived from Landsat 8 satellite images (Conroy et al., 2012). Survey was assisted by a false color composite image imported on to a widescreen Toughpad with a built-in GPS receiver to allow for the identification, and real-time spatial tracking of fossiliferous and artifact-bearing deposits. Sedimentary markers of interest were documented with a separate handheld GPS and across large areas in order to understand their spatial patterns.

Stratigraphic sections were made along transects trending E–W, and NE–SW to document temporal and lateral variations. Detailed descriptions, section measurements, drawings, and bulk sampling of sediments were made at different loci. Marker beds, such as the main fossiliferous and artifact-rich sandstone layer, were traced across large distances and mapped using GPS. Tephra and other deposits were sampled from multiple localities for geochemical fingerprinting as well as radiometric and other dating analyses.

Once a general understanding of the stratigraphic succession was established, collection of specimens from prioritized localities was conducted. Per ARCCH directives, only freshly eroded, identifiable, and rare vertebrate faunal and archaeological specimens were collected during this exploratory phase. The spatial provenience of all collected specimens was documented using handheld GPS, before being individually numbered and bagged. Fragile specimens were wrapped in aluminum foil or plaster jacketed to prevent further disintegration during extractions and/or transportation. All collected fossil remains were transported to and are permanently housed at the National Museum of Ethiopia, Addis Ababa.

Archaeological test excavation was conducted in order to assess the contextual integrity and nature of in situ occurrences. The test excavation followed standard archaeological methods where a 1 m² trench was excavated to a depth of ~1 m in 10 cm artificial excavation units. In situ artifacts were plotted and photographed before extraction. Sediments were sieved through a 6 mm wire mesh screen to capture small finds. Excavation wall profiles were illustrated and photographed before the excavated squares were backfilled. All recovered archaeological finds were separately labeled and are housed in the National Museum of Ethiopia, Addis Ababa.

### Results

Fossiliferous and artifact-bearing sedimentary deposits crop out in several localities between the Awash River and the Megenta mountain ridge, hereinafter referred to as the Megenta study area. In the following subsections, we summarize major aspects of the geology, paleontology, and archaeology of the Megenta study area.

### Geology

Sediments to the northwest of the Deneba River are less deeply incised than they are in the eastern half of the Megenta study area (Figure 1). Consequently, a main fossil- and archaeology-rich sandstone unit survives in the former section in widespread remnant patches marking the top of several hundred isolated but closely clustered knolls and associated bluffs, or as more extensive deflated blocks. The low-lying, deflated outcrops often yield more fragmentary fossils and patinated artifacts, whereas those found in situ or recently eroded from the sandstone exhibit excellent preservation.

Several tephra beds have been identified across the broad surveyed areas. One of the vitric tephra beds is associated with the Middle Stone Age fossiliferous occurrences near Abaco; two others are in the Sen’as and Hillu catchments north of the Deneba River (Figure 1). Based on our preliminary field observations, it appears that one of these volcanic units predates the deposition of the main fossiliferous and artifact-bearing sandstone unit (Figure 2). Ongoing tephrochemical fingerprinting and potential lithostratigraphic correlation are expected to provide direct age estimates as well as clarify the relationships between occurrences within and beyond the study area.

Samples from a loosely consolidated sand layer immediately overlying the main sandstone unit have similarly been collected for potential minimum age estimates using various methods, such as surface exposure dating. At this stage, the regional geology, as well as the sampled faunal (Table 1) and artifact assemblages (Figure 3) strongly suggest that the main fossiliferous and archaeological unit north of Deneba could be from the Middle Pleistocene. Younger deposits occur along the southwestern and eastern parts of the study area associated with Middle and Late Stone Age archaeology.
Vertebrate fauna

The presence of well-preserved fossils, including elements fossilized in original anatomical articulation, in the closely probed localities of Kada Dora, Ounda Dora, Angaliteli, and Mak’anitali—all within the Sen’as and Hillu catchments (Figure 1)—suggests that the widely exposed sandstone that has yet to be investigated thoroughly will yield similarly significant remains. Fossils collected from the initial reconnaissance include >100 identifiable vertebrate specimens, including Bovidae (several tribes), Equidae, Carnivora, Suidae, and Hominidae. Table 1 provides a complete list of the vertebrate fauna recovered from the sampled localities. Some of these taxa are represented by fairly complete specimens preserving the cranium, mandible, and/or maxilla. A Crocuta cranium and mandible, several well-preserved bovid crania, an Elephas mandible, and a Kolpochoerus maxilla represent some of the more complete discoveries from the study area.

Hominid finds comprise a well-preserved left proximal femur and asterionic parietal fragment from two adult individuals discovered by Y.S. from the Kada Dora locality. Given the inferred Middle Pleistocene age of the hominid-bearing sediments, the recovered remains promise important insights into critical questions in human evolution (Rightmire, 2009). Curatorial preparation and detailed investigation of the hominid and other relatively complete and uniquely informative specimens is currently in progress.

The abundant representation of Hippopotamus, Crocodylus, and other water-dependent and wetland adapted bovid

Table 1. Preliminary vertebrate faunal list (from the Kada Dora, Ounda Dora, Angaliteli, and Mak’anitali localities) of the Megenta study area

<table>
<thead>
<tr>
<th>Aves</th>
<th>Gen et sp. Indet.</th>
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<tbody>
<tr>
<td>Primates</td>
<td></td>
</tr>
<tr>
<td>Hominidae</td>
<td></td>
</tr>
<tr>
<td>Homo sp.</td>
<td></td>
</tr>
<tr>
<td>Carnivora</td>
<td></td>
</tr>
<tr>
<td>Hyaenidae</td>
<td>Crocuta sp.</td>
</tr>
<tr>
<td>Artiodactyla</td>
<td></td>
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<tr>
<td>Bovidae</td>
<td></td>
</tr>
<tr>
<td>Alcelaphini</td>
<td>Connochaetes taurinus</td>
</tr>
<tr>
<td>Antilopini</td>
<td>Gen et sp. Indet.</td>
</tr>
<tr>
<td>Reduncini</td>
<td>Koba kob</td>
</tr>
<tr>
<td>Tragelaphini</td>
<td>Tragelapetus cf. imberbis</td>
</tr>
<tr>
<td>Suidae</td>
<td>Kolpochoerus majus</td>
</tr>
<tr>
<td>Phaco./Metridiochoerus modestus</td>
<td></td>
</tr>
<tr>
<td>Hippopotamidae</td>
<td></td>
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<tr>
<td>Hippopotamus cf. gorgops</td>
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Figure 3. Fossils and artifacts from the Megenta study area: (a) bovid cranium and horn core partially exposed in the colluvium layer at Kada Dora; (b) bovid maxilla and artifact embedded in the colluvium layer at Kada Dora; (c) selected artifacts from the Dara Dora test excavation; (d) biface/core with evidence of platform preparation and preferential removal from Angaliteli; (e) unifacial cleaver made on a flake from prepared core from Kada Dora.
species (with Reduncini accounting for 60% of the collected bovid samples) indicates a near-water, relatively wooded habitat for the sampled localities. More open-country and savannah adapted faunas, such as Equus and Antilopini, are less abundant in the collected paleontological samples. However, a more exhaustive sampling of the Megenta fauna will enable better understanding of the paleoecology.

Archaeology

Artifacts from the northwestern parts of the study area (along the Sen’as, Hillu, Garsa, and Deneba rivers) would be traditionally described as late Acheulean. Bifaces are well shaped and standardized, often with shallow flake scars and straight edges (Figure 3). Such features are often considered suggestive of soft hammer percussion, although ascertaining this for the Megenta assemblage requires more sampling and closer examination. Hand axes are abundant, whereas bifacial and unifacial cleavers are present in smaller numbers. Some indications of the Levallois concept are inferred from surface-collected pieces (Figure 3), although these are rare and a confident understanding of the reduction patterns will come only with larger samples of excavated assemblages.

Artifact raw material in the Acheulean occurrences is overwhelmingly dominated by basalt, although bifaces on obsidian and siliceous rocks are also present in a smaller frequency. Both large side-flakes and flat cobbles were employed for biface production. Hundreds of freshly eroded and eroding artifacts with sharp edges and unpatinated surfaces attest to the integrity of the surface assemblages. Furthermore, the artifacts show diversity in tool type, size, and technology; less so in raw material type. A test excavation conducted at Dara Dora locality, a few hundred meters north of the Kada Dora hominid sites, further supports this observation and provides information on the concentration (34 in situ pieces recovered from within 1 m²), composition, and other aspects of these late Acheulean occurrences.

Other important occurrences of lithic artifacts appear along the Abaco stream in the southwestern parts of the study area, and the foothills near the Megenta gap in the east (Figure 1). The Abaco archaeological occurrences contain small flakes, diminutive bifaces, and pointed pieces made on various types of raw material. Prepared core technology is evidenced both by the presence of Levallois cores and products with faceted platforms. These are commonly collectively recognized as Middle Stone Age. On the other hand, the artifacts from the Magenta foothills near the gap contain reciprocally retouched scrapers and blades, mostly made on obsidian and reminiscent of the region’s Later Stone Age technological tradition. It is therefore certain that the Megenta deposits, as for several other Awash basin study areas, span considerable time depth and offer multiple time windows into the Middle, and Late, Pleistocene evolutionary records of the region.

Discussion

Paleoanthropologists still struggle to understand the details of evolutionary paths and processes leading to the emergence of Homo sapiens morphologies and the set of technologies and behaviors generally considered more advanced than the preceding, longest-lived archaeological tradition commonly called the Acheulean. The sparseness of fossil hominids from well-dated Middle Pleistocene contexts in eastern Africa and beyond further hinders clear insights into the evolutionary contexts of the period and region (cf. Guy et al., 2015). Controversies on the taxonomic attribution of the relatively few African hominid fossils from this period aside, a plethora of questions remains regarding the contextual backdrops against which human evolution proceeded (Rightmire, 2009). Testing of such outstanding hypotheses is particularly timely considering recent controversial claims for an older (Hublin et al., 2017), and possibly pan-African (Scerri et al., 2018) origin of our species. As efforts continue to appraise existing claims for the ‘earliest’ fossil representatives of our species (Sahle et al., 2019), an adequate understanding of the Middle Pleistocene record immediately before the appearance of H. sapiens anatomy must be obtained to draw meaningful contextual pictures.

The recent publication of a trio of papers on paleoanthropological work in the Olorgesailie basin further illustrates the complications currently associated with these topics (Brooks et al., 2018; Deino et al., 2018; Potts et al., 2018). The set of technologies and behaviors traditionally collectively termed as Middle Stone Age are argued to have arisen at Olorgesailie ~300 ka, and are suggested to be linked to environmental changes and major faunal turnover. However, the actual time period key to understanding the trajectory and dynamics of these aspects (i.e. 500–300 ka) is missing from that basin’s record due to non-deposition (Deino et al., 2018). Research on this unsampled time period will be crucial to resolving the theories and claims surrounding the evolutionary context of our species.

The unresolved questions we pose about processes leading to anatomical and behavioral changes in the Middle Pleistocene require investigation across wider geographic regions. With its late Acheulean and early Middle Stone Age archaeology, associated with tephra beds, diverse faunas, and hominin remains, the Megenta research area promises to contribute to strong tests of key hypotheses about the evolution of our unique biology and behavior.

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References