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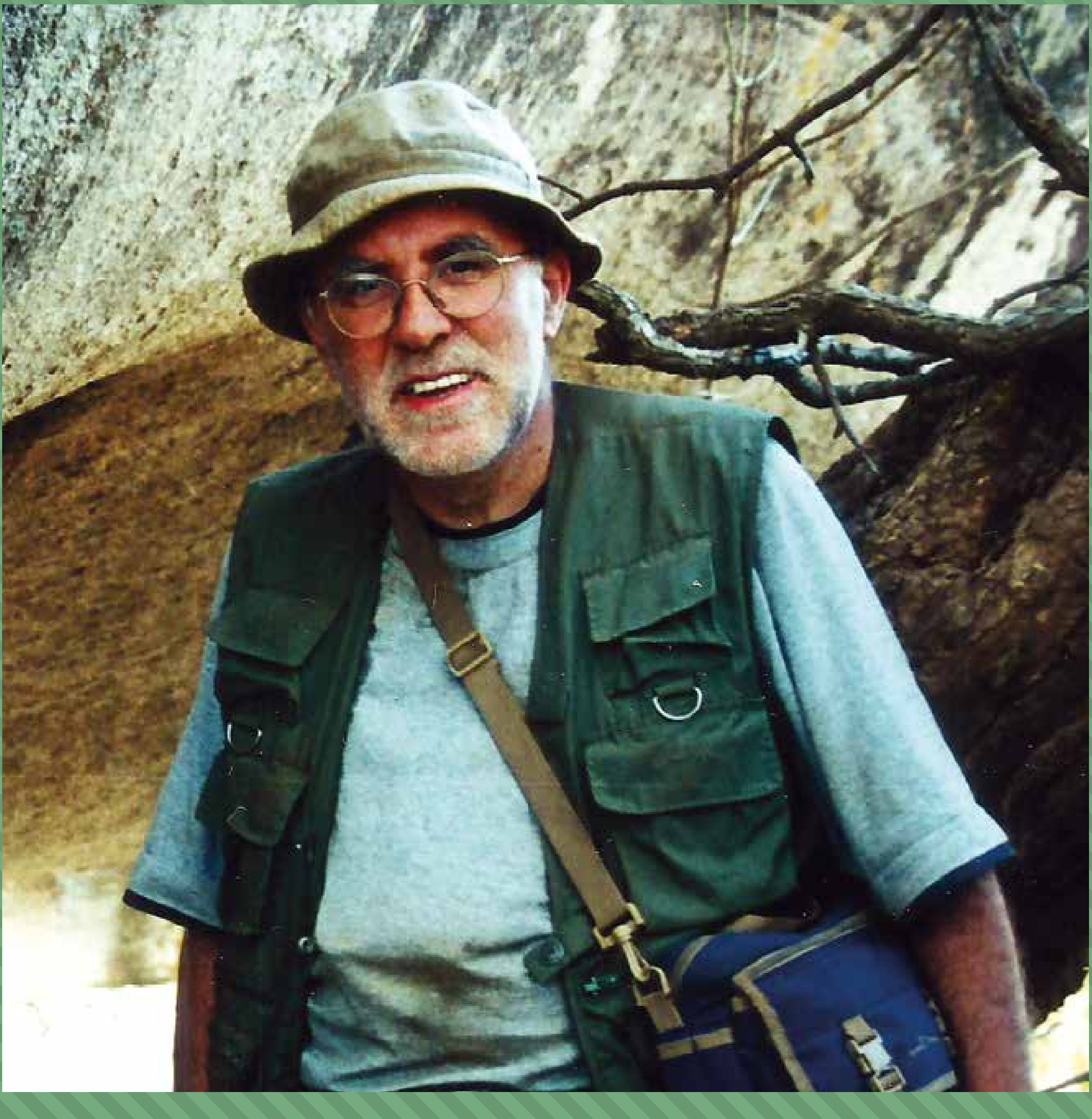

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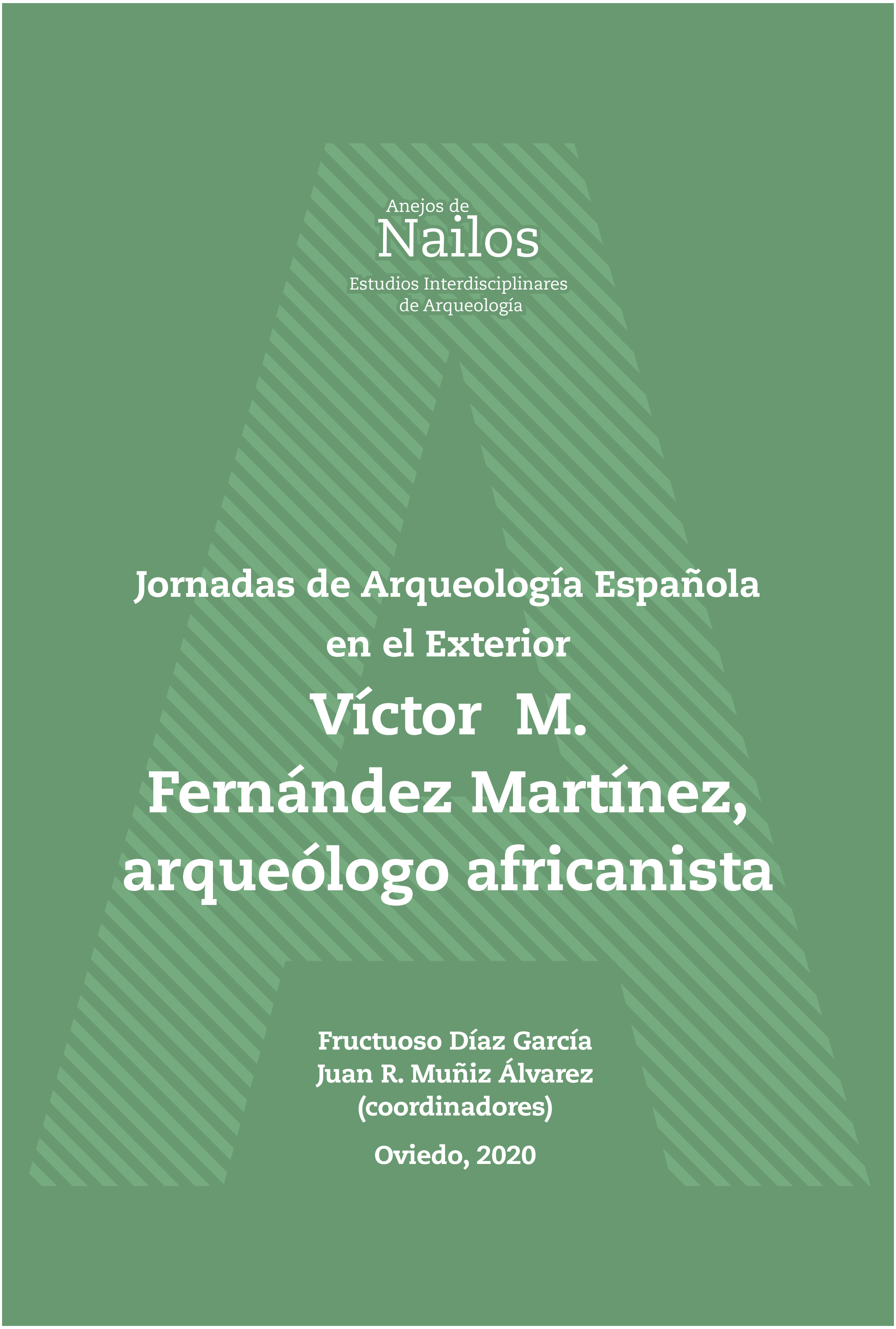

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Jornadas de Arqueología Española en el Exterior

Víctor M. Fernández Martínez, arqueólogo africanista

Fructuoso Díaz García
Juan R. Muñiz Álvarez
(coordinadores)

Oviedo, 2020

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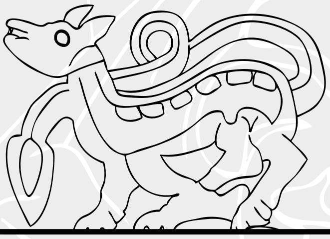

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En recuerdo de
Juan Antonio Fernández-Tresguerres Velasco
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Sumario

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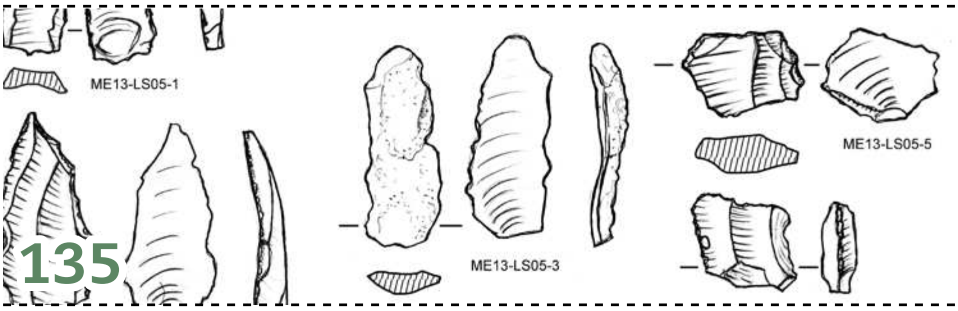
Summary



Summary

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Archaeological surveys in Tendaho (Lower Awash, Afar Regional State, Ethiopia)

Ignacio de la Torre, Alfonso Benito-Calvo y Rafael Mora

Resumen

Este trabajo presenta las prospecciones arqueológicas en la zona de Tendaho (Lower Awash, Triángulo de Afar en Etiopía), destinadas a la documentación de yacimientos plio-pleistocenos en peligro de desaparecer por la construcción de una presa. Presentamos también una modelización en SIG de la extensión de la presa y el área potencial afectada, y valoramos la importancia de los materiales documentados durante las prospecciones.

Palabras clave: África oriental, Etiopía, Afar, Tendaho, Pleistoceno medio

Abstract

This paper presents the archaeological surveys conducted in the Tendaho area (Lower Awash, Afar Triangle in Ethiopia), aimed at documenting Plio-Pleistocene sites endangered by the construction of a dam. We also introduce a GIS model of the area affected by the dam, and evaluate the relevance of materials documented during our surveys.

Key words: East Africa, Ethiopia, Afar, Tendaho, Middle Pleistocene

1. Introduction

The Afar Triangle in Ethiopia is one of the World´s most important regions for the study of human evolution, from earliest hominins (White *et al.*, 2009) to the first Oldowan (Semaw *et al.*, 1997) and the appearance of anatomically modern humans (White *et al.*, 2003). The abundance of paleoanthropological sites in the region is largely due to the geological features of the Ethiopian Rift System (Quade and Wynn, 2008), which have enabled an optimal preservation of Tertiary and Quaternary fossil and archaeological remains (WoldeGabriel *et al.*, 2000). Central Afar, in particular, contains a significant concentration of highly relevant paleoanthropological sites such as Hadar (Johanson and Taieb, 1976; Tiercelin, 1986), Gona (Quade *et al.*, 2008), Woranso-Mille (Deino *et al.*, 2010), Ledi-Geraru (DiMaggio *et al.*, 2015) and Dikika (Wynn *et al.*, 2006), among others.

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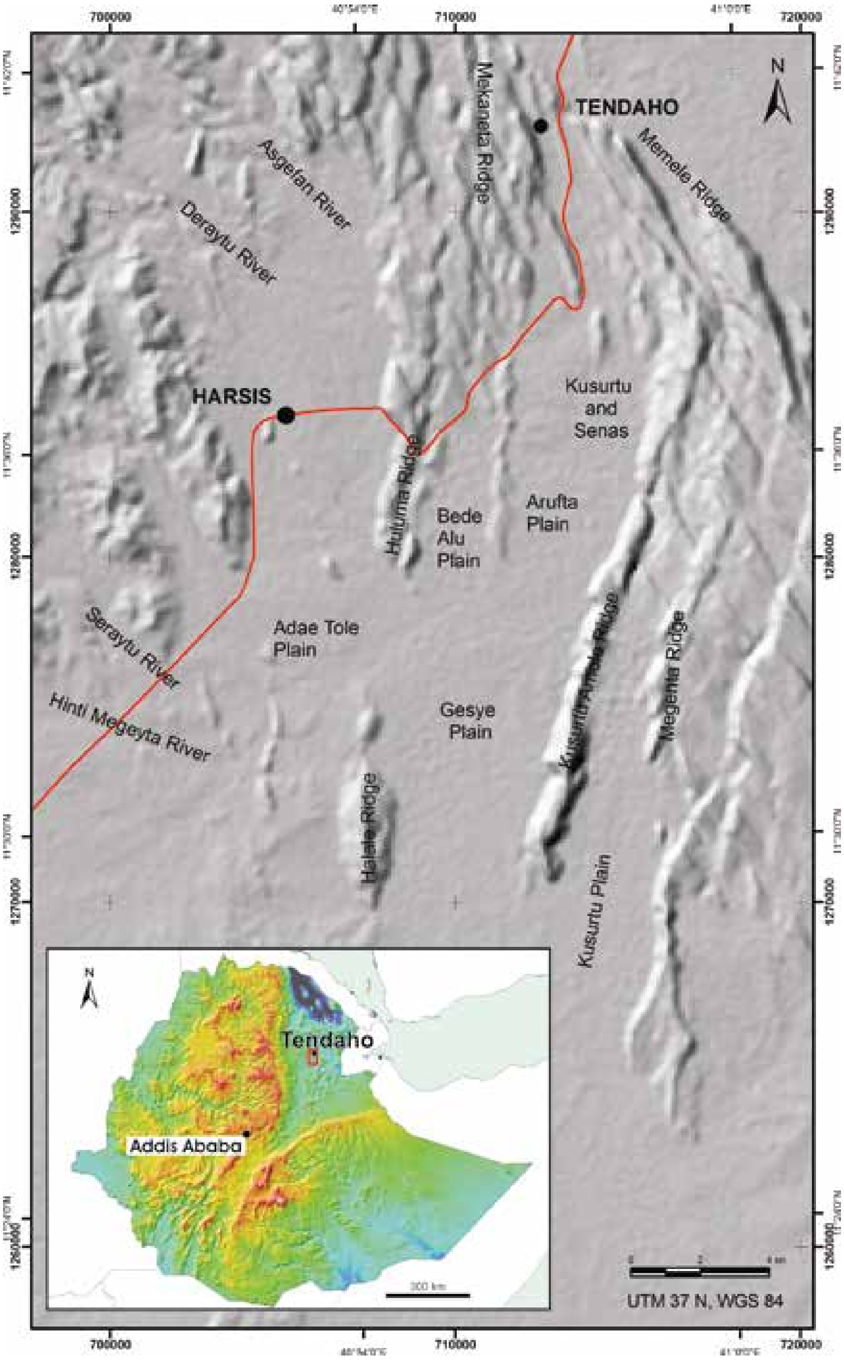

Tendaho is located in the lower course of the Awash River, in the central part of the Afar Regional State (Figure 1). The Tendaho Graben, surrounded by NW-SE trending faults, is the largest depression of Central Afar and contains a thick (over 1000 meters) volcanic and sedimentary sequence (Acocella *et al.*, 2008). Recently a dam has been constructed in the Tendaho Strait, in order to create a great water reservoir in this part of the Awash River. This dam was expected to flood nearby Plio-Pleistocene deposits, and given the relative proximity of relevant paleoanthropological localities like Woranso-Mille and Ledi-Geraru research areas, the importance of conducting field surveys in Tendaho to evaluate its archeological and paleontological potential became clear. The relevance of the Tendaho deposits was preliminarily established by the Paleoanthropological Inventory of Ethiopia in the 1980s- early1990s, but to the best of our knowledge no further fieldwork had been conducted since then. Hence, no detailed indicators were available to assess the impact that the Tendaho dam could have on local Plio-Pleistocene outcrops.

Figure 1. Location of Tendaho in the Afar Regional State, Ethiopia.

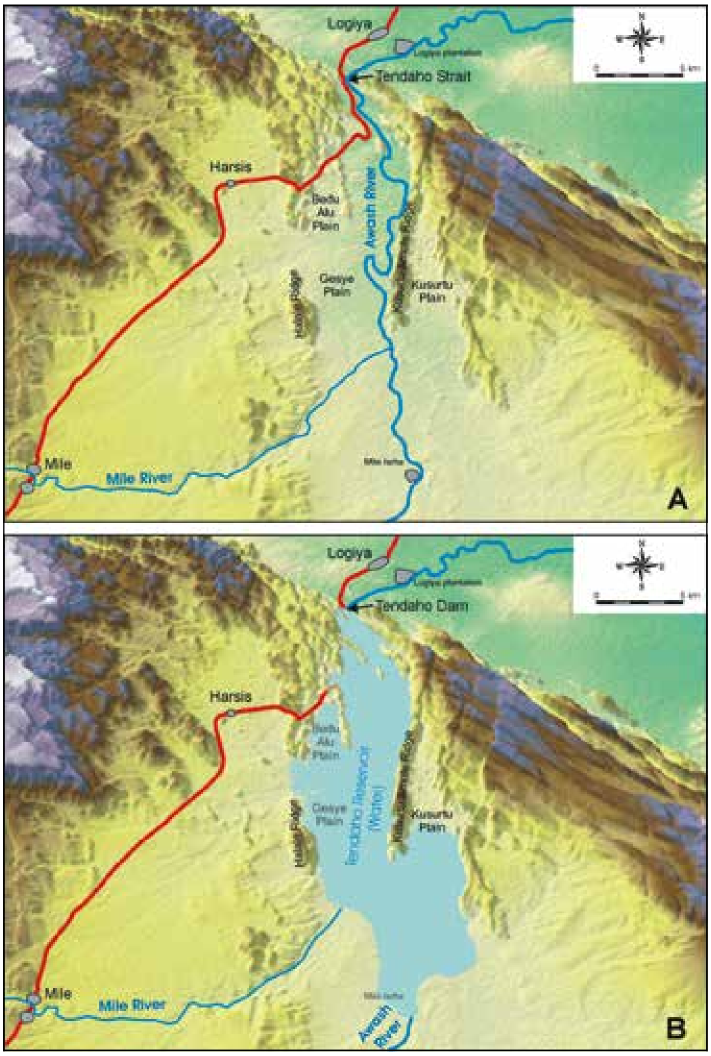

Figure 2. GIS model of the Tendaho valley. A) Topography of the area before the flooding of the dam. B). Estimation of the potential flooded area by the Tendaho reservoir. 3-D reconstruction based on the Tendaho dam technical characteristics, DEM SRTM3 (NASA), 1:50,000 Ethiopian Topographics Maps, and GIS software.

Surveys were planned to evaluate the impact of dam flooding in Tendaho. They included laboratory GIS analysis, aimed at assessing the extension of the area to be flooded, and fieldwork to evaluate the archeological and paleontological potential of the areas threatened by the dam. In the following pages a summary of the laboratory and field work conducted in 2007 in the Tendaho valley is presented, as well as an assessment of the potential of its Plio-Pleistocene deposits.

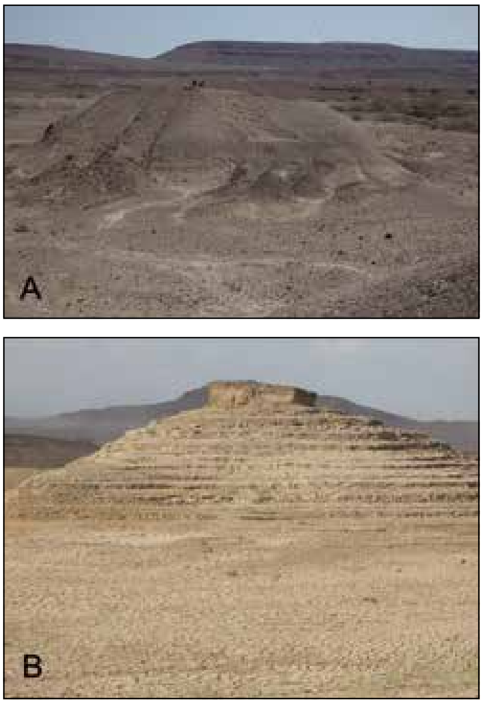

Figure 3. Artifact - bearing exposures in Mekaneta stream. A) Outcrops in February 2007, before the construction of the dam. B) Outcrops in February 2008, after the Mekaneta exposures were flooded by the dam and then uncovered again.

2. The Tendaho dam and modeling of the Awash plain flooding

All data concerning technical details of the Tendaho strait dam had to be gathered on site. According to the information assembled during field work, it is an embankment dam, made of a massive semi-plastic mound of earth and/or rock with a dense, waterproof core. The reservoir would have a relative height of 53 meters, with an absolute elevation of 412 m above sea level, and was calculated to flood over 17,000 hectares when coming into operation in July 2007.

These data were entered into a GIS in order to model zones of the Tendaho valley likely to be flooded. This modeling used topographic data provided by the DEM SRTM3 (source NASA, resolution: 3 arc-second; absolute error: 6 m for the 90% of the data in Africa); geographic data were also monitored with 1:50,000 Ethiopian topographic maps of the area.

Results of the GIS model are shown in Figure 2. Figure 2A is a 3-D modeling of the Tendaho valley landscape before any topographic modification caused by the dam. Figure 2B idealizes the maximum level of the Tendaho Reservoir, when the dam would flood all the Awash Valley between Tendaho Strait and Mile Ishra. As average heights do not exceed 407-410 m (1:250,000 Ethiopia Topographic Maps, Serdo sheet) from the Tendaho Strait down to Mile Ishra, the maximum flood capacity of the dam would affect the area below 412 m. From east to west, the reservoir was estimated to have a mean width of four kilometers (Figure 2B), which would affect the delineation of the road between Harsis and Logiya.

The estimates above were based upon the premise of full operation of the reservoir. Field surveys were designed to cover as much of the potential flooded area (Figure 2B) as possible before the dam was completed. In the intervening year between our 2007 surveys and 2008, however, we learnt that the Tendaho dam had only flooded the area for a

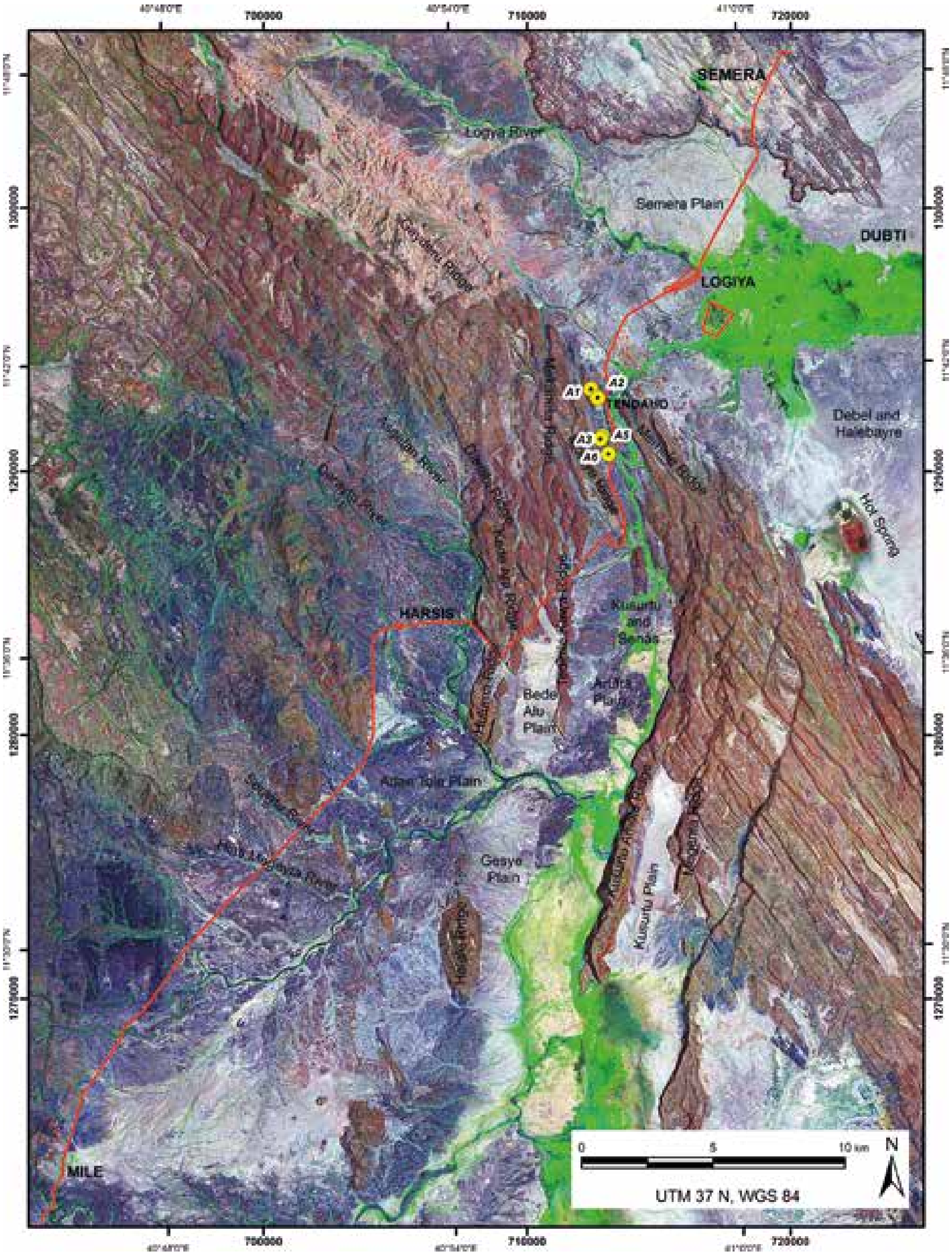

Figure 4. Location of the survey areas in the Tendaho valley and their archaeological occurrences (yellow dots).

limited period of time, although we do not know the exact causes of subsequent desiccation. When we visited the area in 2008, traces of flooding were visible in the outcrops, but the outcrops were once more above water (Figure 3).

Nevertheless, the salvage surveys conducted in 2007 enabled us to refine the geological and archaeological knowledge of the area within the influence of the reservoir and are presented in the following sections.

3. Geological and geomorphological description of the Tendaho valley

Surveys were conducted along the Awash Valley and its most important tributaries. Relief shows two main morphological units: ridges and plains. Ridges present elevations between 700-450 m and are composed of volcanic materials of Plio-Pleistocene age, i.e. Afar Stratoid Series and acid volcanic centers (Varet, 1978). Usually plains extend about 350-450 m, reaching 500 m in height in headwater valleys. Geological units outcropping in these plains contain Plio-Quaternary sediments and Pleistocene-Holocene volcanic materials (Thurmond *et al.*, 2006). Surveys were focused in those areas with sedimentary sequences.

This zone is located at the south of the Tendaho-Gobaad Discontinuity, which separates this area (South-Western Afar Region; Beyene and Abdelsalam, 2005) from the East-Central Afar Region. Geographically, the area is delimited in the north by the Tendaho Strait and in the south by the Halale Ridge. The area between these points covers a north-south band across the Awash River Valley, delimited at the east and the west by the Afar Stratoid Ridges. The surveyed areas (Figure 4), from the north to the south, are as follows:

Tendaho area

The Tendaho dam has been constructed in the northernmost area below the Tendaho-Gobaad Discontinuity. In this zone, there are Plio-Pleistocene sediments in the bottom of the Awash Valley and in the Mekaneta Stream (a west tributary of the Awash River). The top of the sedimentary sequence in the Mekaneta Valley is located at its headwater (410 m asl) and comprises marls and a bone breccia which lie on detritic sediments (sands, silts and gravels). Closer to the Afar Stratoid rocks, these materials contain slope deposits (basalt boulders and clays). At the base of this sequence there is a white layer of carbonates (locally with chert), silts and sands, which include gravel levels. Similar materials are also found in the lower valley of the Awash River, near the Tendaho dam. The sequence both in Mekaneta and the Awash valleys is occasionally covered by more recent sediments containing rounded gravels (affected by aeolian processes), and boulders from the Afar Stratoid slopes.

Figure 5. Thick sedimentary sections exposed in the Harsis area.

Kusurtu and Senas Plains

Kusurtu and Senas Plains are located at the south of the Tendaho area, bordering on the Megenta Ridge to the east and on the Tedihile Kawa Ridge to the west (Figure 4). In this area, there is the same Plio-Pleistocene white unit as in the Tendaho area. Although the Kusurtu and Sena Plains are widely incised by gullies, the white Plio-Pleistocene units are not well exposed due to an overlying layer of gravels, tentatively ascribed to the Upper Pleistocene. These gravel layers cover older deposits everywhere limiting Plio-Pleistocene outcrops to a few patches. More recent Quaternary sediments are also exposed in the Kusurtu and Senas Plains; they are assigned to the Upper Pleistocene and Holocene, and are associated to the Awash River floodplain, valley bottoms and alluvial fans.

Harsis area

This area is located near Harsis village and further north, around the Deraytu and Asgefan valleys (Figure 4). Although not expected to be affected by the flooding (Figure 2B), this area was surveyed in order to provide a wider perspective of the sedimentary dynamics in the Tendaho region. There are no exposures near Harsis village, an area characterized by a flat topography with alluvial sediments. Further north, the greater incision of the Deraytu and Asgefan rivers has led to the formation of gullies with older sediments, probably Pliocene to Middle Pleistocene (Figure 5); the incision of the Deraytu river exposes a fluvial aggradation series in the north margin, composed of sequences of gravels, sands and clays, the top of which is located 30-40 m over the Deraytu floodplain. The south margin of the Asgefan River contains similar alluvial sediments, comprising gravels and sands, and intercalated volcanic tuffs. These sediments rest on a red unit, composed of detritic sediments with silifications. Both units are affected by faults.

Arutfa Plain

The dynamics of Arutfa Plain are similar to those described for the Kusurtu and Senas Plains (Figure 4). Thus, in the Arutfa Plain there are recent alluvial sediments from the Awash and other valley bottoms. Upper Pleistocene gravels that prevent the exposure of Plio-Pleistocene deposits are also common. The latter emerge rarely and in scattered outcrops, in which Plio-Pleistocene sediments consist of white silts and clays.

Bede Alu Plain

In this plain, located between Huluma Ridge and Tedihite Kawa Plain (Figure 4), only recent sediments have been recorded (Gasse, 1978), probably of an Upper Pleistocene age. These are composed of proximal-distal alluvial fan sediments.

4. Geological synthesis

In the survey and mapping works the following geological units have been distinguished:

A) The Afar Stratoid series. This is a Plio-Pleistocene volcanic unit affected by numerous faults and fissures. It consists mainly of basalts, although there are also intercalated sediments. In some occurrences, basalts are affected by heavy weathering. The upper part of the series contains several acid centers (mainly rhyolitic).

B) Acid volcanic centers. These are usually intercalated in the upper part of the Afar Stratoid series (Varet, 1978), and consist of microcrystalline ryolithes, abundant obsidians, and rare piroclastites.

C) Red sedimentary series with silifications. These are located in the Harsis area and in the north-western part of Tendaho. The sediments seem to be older than the fluvio-lacustrine white series and are affected by faults.

D) Travertines, clays, marls and silts, located in the Hot Spring-Tendaho area.

E) Clays, muds, silts, sandstone, gravels, and tuffs associated with lacustrine, fluvial, alluvial and volcanic environments (Plio-Pleistocene white series). These sediments have been assigned broadly to the Plio-Pleistocene, although they have the same geological position and characteristics as the Upper Pliocene Lacustrine sediments described by Gasse (1978). In the surveyed areas such deposits are not too incised, except for some localities in the Mekaneta area. These sediments are affected by faults, and frequently contain fossils. In the rest of the surveyed zones, deposits are commonly carpeted with a thin layer of rounded gravels (tentatively ascribed to the Upper Pleistocene), which are affected by aeolian processes.

F) Detritic sediments of Upper Pleistocene age. In this unit sands, clays and gravels related to alluvial fans, alluvial plains and fluvial terraces, are grouped together. These deposits come from the erosion of the Afar stratoids and Plio-Pleistocene sediments.

G) Holocene fluvial, alluvial and aeolian deposits. These sediments consist of sands,

Note that faults affecting the Afar Stratoid and Plio-Pleistocene white series are not included in the map

Figure 6. Geological map of the Tendaho valley as from our surveys, with an estimation of floodable sedimentary areas by the water reservoir.

Figure 7. Large lava flakes in locality A-2.

clays and gravels corresponding to the floodplain and lower terraces related to the Awash River and tributaries.

Based on the GIS predictive model described in section 2 and on the geological information obtained during field surveys, a geological map of the Tendaho valley was designed (Figure 6). This map intended to assess which geological units would be affected by the Tendaho reservoir, and indicated that the dam would flood areas containing Plio-Pleistocene sediments. These deposits show similar sedimentary features to the Upper Pliocene deposits described further south (Gasse, 1978). However, in the Tendaho area such deposits are usually carpeted with a thin layer of Upper Pleistocene gravels that prevent the sighting of Plio-Pleistocene sediments. Only in the Mekaneta valley, where there are badlands lacking such gravel layers, was it possible to find lithic and bone remains, as described in the following section.

5. Archaeological occurrences in the Tendaho valley

As mentioned above, the presence of archaeological remains in Tendaho was first pointed out by the Paleoanthropological Inventory of Ethiopia, which mentioned the presence of fossils of large mammals and the abundance of Middle Stone Age artifacts.

Our survey focused on those areas likely to be affected by dam flooding, and paid special attention to zones where the layer of gravels carpeting Plio-Pleistocene deposits was absent. Nearly all archaeological occurrences found during our surveys were located in a restricted part of the Tendaho valley, that nearest the Tendaho dam at Mekaneta stream. In this area, artifacts and bones were scattered across the outcrops, and six patches of surface stone tools and bones were considered as assemblages (Figure 4).

In Locality A-1, microfauna was abundant in a level where several flakes and a basalt core were found on the surface, but no stone tools were located in situ. Locality A-2 is stratigraphically older than A-1 and yielded numerous basalt flakes. Although no handaxes were recorded, the technology and size of flakes, as well as the character of retouched pieces, resembled Acheulean technology (Figure 7). Artifacts in A-2 were in fresh condition and associated with a number of fossil bone remains.

The patterning in Locality A-3 was similar, with abundant fossil remains and stone tools. Flakes are usually on basalt and have fresh edges. Again, no handaxes were recorded, but sophisticated features of flake technology suggest that Locality A-3 is also an Acheulean occurrence. This assertion is supported by the A-4 outcrop, located less than 50 meters from locality A-3 (Figure 4); A-4 has the same stratigraphic sequence and probably is part of the same paleosurface as A-3, now eroded and preserved only in small promontories. At Point A-4

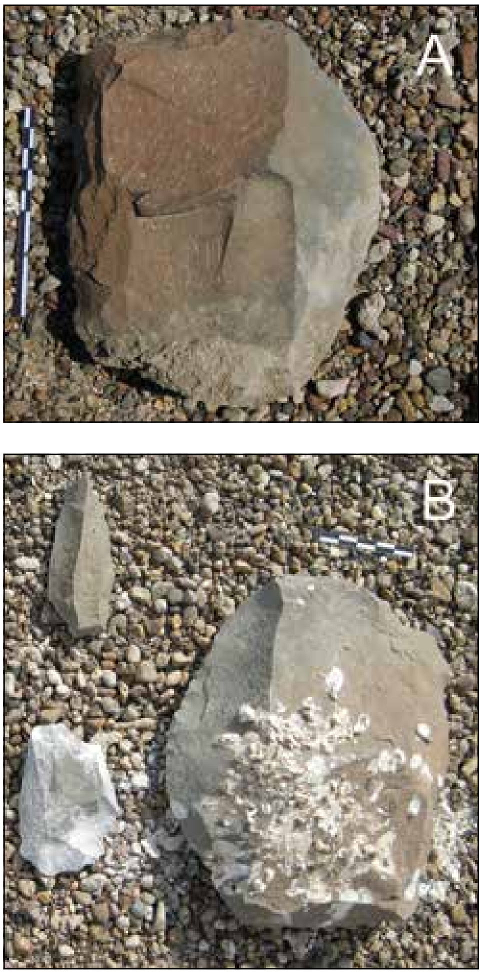

Figure 8. Surface artifacts at locality A-4. A) Handaxe from the 2007 surveys. B) Handaxes and flakes from the 2008 visit.

there are also abundant bone remains and their cortical surfaces are not as weathered as in Point A-3. Moreover, in A-4 many artifacts were found at the top of the sequence, including handaxes that confirm the Acheulean entity of assemblages from this area (Figure 8).

Locality A-5, a promontory located close to A-4, also has a high density of stone tools. As with Locality A-4, most artifacts are embedded in small-sized gravel layers. In Locality A-5 stone tools were found in situ in at least two different gravel layers. Among the artifacts, some Levallois-discoid cores were identified (Figure 9), along with large mammal fossils. Locality A-6 was entirely composed of fossil remains with no stone tools eroding out from the outcrop.

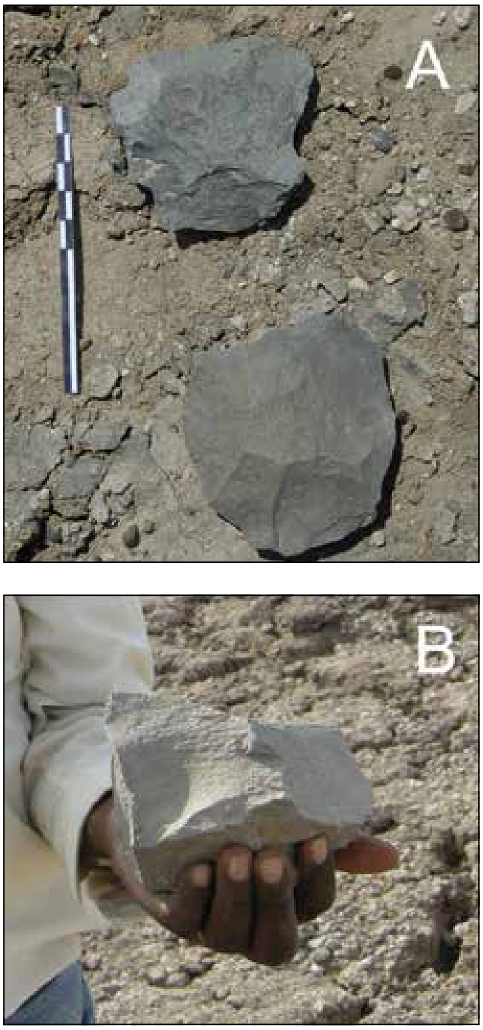

Figure 9. Artifacts in locality A-5. A) Centripetal cores from the 2007 surveys. B) Large discoid cores from the 2008 visit.

It is remarkable that, in spite of the relative extension of the Tendaho valley, all significant archeological and paleontological occurrences were restricted to the badlands located in Mekaneta Stream, an area of only 1.8 km^2. Fossils and basalt stone tools are relatively common in these outcrops and are widespread across the Mekaneta Stream. Bones are heavily mineralised but stone tools do not show particularly archaic features. Nonetheless, we should be cautious when asserting the chronology of these assemblages, since there are no radiometric dates or local geological maps that could help correlate with better known areas in the South. However, because of the presence of well-structured cores and some handaxes, we have tentatively ascribed the Mekaneta stream assemblages to the late Acheulean.

6. Conclusions

This paper has shown that in the Tendaho valley there are areas with Plio-Pleistocene deposits affected by the construction of a large reservoir. However, a considerable part of those Plio-Pleistocene sediments is carpeted with a thin layer of gravels that prevent visibility of older deposits. Therefore, it is difficult to assess the archeo-paleontological potential of a large part of the Tendaho valley due to the absence of appropriate exposures.

Our surveys indicated that the area in which Plio-Pleistocene deposits were best exposed, with no gravels covering older sediments, was the Mekaneta Stream. It may not be coincidence that, precisely in this part of the Tendaho valley in which deposits were satisfactorily uncovered, a number of archaeological and paleontological finds were recorded. In Mekaneta Stream, lithics and bones are abundant. These fossils, which include hippos, bovids and equids, are heavily mineralized, post-depositionally fractured and sometimes weathered. Their chronology is difficult to assess, since to the best of our knowledge no dating programs or detailed geological correlations are available for this area as yet. However, stone tools seem to belong to the late Acheulean, as suggested by the presence of Levallois technique and fine handaxes. For these reasons, we tentatively place these assemblages somewhere in the Middle Pleistocene.

The preliminary character of our conclusions should be considered within the frame of the rescue surveys conducted in 2007 only, just little earlier than the flooding of the Tendaho valley began. Our GIS predictive model indicated that Mekaneta sites would be flooded by the water reservoir by the second half of 2007, an event that subsequently happened. Unexpectedly however, assemblages have been uncovered again (Figure 3). New materials are eroding out from the exposures (Figures 8 and 9), which although affected by their having been under water, have not collapsed. Should the area remain above water for longer, perhaps excavations in these sites would complement the information obtained from the preliminary surveys.

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