Article

Pleistocene and Holocene peopling of Jerada province, eastern Morocco: introducing a research project

Le peuplement humain pendant le Pléistocène et l’Holocène dans la province de Jerada, Maroc oriental : introduction d’un projet de recherche

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Abstract

The Aïn Beni Mathar – Guefaït (ABM-GFT) region in Eastern Morocco is the object of an archaeological, palaeontological, geological and geochronological research project, led by an international team since 2006. The research in this former fluvio-lacustrine basin, roughly 2000 km\(^2\), has revealed a significant number of Pleistocene and Holocene sites. Here we introduce the research project, that we conduct in the region, the main issues it aims to address, and the results already obtained.

Keywords: Pleistocene, Holocene, Human peopling, Eastern Morocco, Green Sahara

Résumé

Depuis 2006, la région de Aïn Beni Mathar – Guefaït (ABM-GFT) au Maroc Oriental, fait l’objet d’un projet de recherche en archéologie, paléontologie, géologie et géochronologie, mené par une équipe internationale. Ces recherches ont permis la découverte d’un nombre significatif de gisements d’âge Pléistocène et Holocène, dans un ancien bassin fluvio-lacustre, qui s’étend sur une surface de 2000 km\(^2\). Notre objectif ici est de présenter le projet de recherche, que nous entamons dans la région, la problématique qu’il traite et les premiers résultats déjà obtenus.

Mots clés : Pléistocène, Holocène, Peuplement humain, Maroc Oriental, Sahara « vert »

1. Research proposal

The Aïn Beni Mathar – Guefaït (ABM-GFT, Jerada province, Eastern Morocco) area corresponds to the north-western border of a Plio-Pleistocene fluvio-lacustrine basin\textsuperscript{29} that was part of the Intraatlas High Plateaus region that extends through Eastern Morocco and Northern Algeria (Fig. 1). Since the Middle Pleistocene, this plain is dissected by the current Oued Haï within the Moulouya watershed. The remains of the former fluvio-lacustrine series are preserved as mesas along the ABM-GFT area. The palaeontological and archaeological remains described in ABM-GFT have been recovered from both the Plio-Pleistocene series and the Middle and Upper Pleistocene and Holocene fluvial series.

Here we introduce the project at ABM-GFT by presenting, first, the broad issues the project is facing and, second, the first results of the research.

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30
2. Broad issues and research framework

The project we introduce aims to fulfil some of the major gaps in the current research on the early human settlement of North Africa and its evolution through the Pleistocene and Holocene by developing the topics and issues that are driving the current research in Maghreb. We refer to issues such as the importance of the Saharan ecological cycles over the human adaptation in the surrounding regions, or the recently proposed Panafrican hypotheses to explain the human evolution through the continent and the extension of the early hominin settlement in Maghreb after the record of hominin technology in the Ain Boucherit site (Setif, Algeria). Such issues are addressed within two wide research topics. First, we aim at the reconstruction of the arrival and evolution of early humans in this region north of the Sahara, including the research on the development of the region’s geomorphology and ecosystems throughout the Pleistocene. Second, we address the introduction of the economy of production during the Holocene and its relationship with the last hunter-gatherers\textsuperscript{30}.

Fig. 1: map showing the location of the main sites discovered and excavated in the frame of this project by period and culture (© J. I. Morales).

\textsuperscript{30} Aouraghe H. \textit{et al.} 2013.
2. 1. The first hominin settlement in Maghreb

The Ain Boucherit – Ain Hanech – El Kherba Algerian site complex documents a well-dated record of the today earliest hominin settlement in the Maghreb\(^{31}\). Beyond that Early Pleistocene ensemble, we know little about hominin presence in the Maghreb and north of the Sahara until the late Early Pleistocene of Casablanca (Morocco), with its collection of Mode 2 lithic tools in the Thomas Quarry level L\(^{32,33,34}\). It is especially from the initial Middle Pleistocene onwards that the record of human settlement became more extended and continuous. In this context, the record that we introduce here of Mode 1 lithic tools within a geological horizon, well placed in a stratigraphic section that is the target of different geochronological studies in the ABM-GFT area, is of high interest, since it is an unprecedented finding in Morocco.

A second question regarding the early phases of the Pleistocene of the Maghreb is the lack of an extensive and well-dated record of fossil vertebrates. In addition to the abovementioned site cluster of Ain Hanech, only Ahl al Oughlam (Morocco)\(^{35,36}\) and few other sites, date to the Early Pleistocene. Among the ABM-GFT project results, that we introduce below, there is the discovery of a major new Early Pleistocene palaeontological site, which greatly improves our knowledge about the North African fauna during this timeframe and allows us to address the paucity of this kind of record in the Maghreb.

2. 2. Green Sahara and hominin settlement

A general topic about the interpretation of the settlement and adaptation of hominins in Maghreb is the role played by the Sahara during Plio-Pleistocene times. Recently, many authors are considering the importance of the “Green Sahara” model for understanding how hominins reached the Maghreb and evolved in and around the Sahara\(^{37,38}\). During “Green Sahara” phases of the Plio-Pleistocene, river basins and extensive lakes covered the area, currently occupied by the desert. To assess the presence of a wet environment in the ABM-GFT region for some periods and the cyclicity of wet and dry phases, beyond the geomorphological analysis, we are applying multiproxy study, involving geochemistry, palaeontological data and environmental magnetism. This aims to unravel palaeoenvironmental variations across the stratigraphic sections where archeological and paleontological findings are embedded.

The “Green Sahara” scenario drives our research towards gaining a better understanding of the peopling of the ABM-GFT region and its connection to the core of the Sahara, where research carried out in the 1950’s led to the discovery of numerous Mode 2 and Mode

\(^{33}\) Raynal et al. 2017.
\(^{34}\) Rhodes et al. 2006.
\(^{35}\) Geraads D. 2006.
\(^{38}\) Larrasoaña et al. 2013.
This allows us to propose reconstructions of the modes of human settlement and movements and to assess the correlation between hominin settlement in Maghreb and wet phases and with the occurrence of hominins elsewhere in Africa.

2. 3. Sahara ecology, Panafriican evolution or marginalisation

It will be of special interest to ascertain whether the transitions to wet or arid phases have driven human technological or behavioural evolution, as well as population dispersals and expansions or extinctions. We described the Pliocene and Early Pleistocene phases at ABM-GFT as corresponding to a fluvio-lacustrine landscape. Furthermore, recently a wet landscape related to a “Green Sahara” episode was described for the early Holocene at ABM. Thus, we can predict the same influences for the earliest phases of hominin evolution.

In addition, we propose to consider how such ecological shifts can be linked to Saharan - Maghrébian regional singularities (Tabelbala knapping method, Aterian, Iberomaurarian) allowing either enlarged or limited limited dispersals and marginalisation. We suggest that the alternation of the desert and “Green Sahara” is an important clue for Panafriican models of early hominin evolution in the Maghreb, similar to that recently published for the dispersal and evolution of Middle Pleistocene Homo sapiens. That is, considering the record of a very early hominin dispersal in Algeria, it can be envisaged a similar introduction into western Maghreb and even it can be proposed as hypothesis a Panafriican evolution of early hominins.

3. Interdisciplinarity and transdisciplinarity in the methodology

The project we introduce began in 2006 as an international cooperation between the Université Mohamed 1er of Oujda (UMP, Eastern Morocco) and the Catalan Institute for Human Palaeoecology and Social Evolution from Tarragona (IPHES-CERCA, Catalonia, Spain). The first team included paleontologists, geologists and archaeologists aiming at the surveying of a territory, ABM-GFT, not well known in the hominin evolution research. Specially, the open-air archaeological record was very meagerly known. The evolution of the project made it necessary to include other archaeologist, geologists, geochronologists and specialists on palaeoenvironmental proxies coming from other institutions, both national and international.

The international project is working to accomplish those referred objectives, strongly based on an accurate and extended surveying of the region. This allowed the discovery of several archaeological and paleontological sites showing a record corresponding to the whole
Quaternary and Holocene times. These sites have been charted and referred to a general stratigraphic series. This series was previously established but proved to need to be redrawn during our research, as we will show in the next section.

In parallel to the geological research, we performed a systematic chronological sampling for the geological, palaeontological and archaeological sites to be precisely dated. Techniques such as Palaeomagnetism, ESR, OSL and C14 are being applied to provide a precise dating to the sites and to geological units in the region.
The paleontological and archaeological sites have been systematically explored and sampled. And in the recent years, some of them have been excavated applying the archaeological method, using a 3D-grid system to chart every item recorded (Fig. 2). A drone was also used to help chart both the archaeological records in some sites and the geological units.

The analysis of the paleontological and archaeological record is allowing us to establish the biostratigraphic units and the hominin settlement phases in the region. Such a study in combination with the geochronology gives us a chronological framework for the region’s natural history.

4. First Results

In that section we will present the initial results that have been gained during the first years of this project.

4. 1. First phase of the series: Early Pleistocene fluvio-lacustrine environment

Fig. 3: Mode 1 and Mode 2 industries: a) and b) orthogonal cores from Gara Soultana and Ain Tabouda; c) and d) handaxes from Oued Rabt (© IPHES).
As we have previously stated, the first result of our project to be stressed is the research on the regional geology. In contrast with the previous reconstruction of the geological series and landscape formation, the current research has established that the current Charef-El Haï-Za fluvial system is dissecting and dismantling an ancient fluvio-lacustrine sequence. This one is composed by four stratigraphical units roughly covering the Plio-Pleistocene. This sequence persists as mesa morphologies showing different depths of erosion. Some of these mesa have been previously understood as terraces of the current fluvial system. Our research showed that, to the contrary, they all belong to the former fluvio-lacustrine-palustrine series. This series shows sediments of a mainly fluvial basin at the bottom, shifting to a basin dominated by lacustrine environments.

The first part of the sequence preserved three archaeological sites containing Mode 1 lithic tools, Aïn Tabouda, Gara Soultana and Charchara 1. The latter one being an in-situ ensemble recorded in a silt horizon. This is the first recovery of clear Mode 1 industry inside a geological sequence in Morocco. None of these sites records any faunal remains so far (Fig. 3).

Besides the archaeology, we discovered a palaeontological site: Guefaït-4. This is a rich and well-preserved horizon containing both macro and microvertebrates, recorded in a palustrine level constituted of clay and marls, at the base of Unit 2, within the Dhar Iroumyane stratigraphic section. This site will improve the Maghrebian faunal record because: i) it has delivered some species which, up to now, were unknown or poorly represented in North Africa and ii) by its precise dating thanks to the geochronological methods that are currently underway. This site has been excavated in an extension of 28 m² and has yielded 3269 fossils. Up to date, fossils in this site do not present any marks attesting anthropic intervention (Fig. 4). The abundance of hipparionine, along with the absence of Equus point to an Early Pleistocene chronology. Guefaït-4 has recorded a new species of murid, the latest Golunda species in Africa, Golunda aouraghei, sp. nov. This species also allows a preliminary attribution of the site to the Plio-Pleistocene boundary. The micromammal and herpetological record at Guefaït-4 point to an open woodland habitat with dry conditions, close to a rocky landscape with permanent water body in the vicinity. The latter is also suggested by the sedimentary traits of the stratigraphic unit containing the assemblage.

The fossil collection of Guefaït-4 has delivered remains that recently led to the description of two species not previously recorded in the assemblage. First, we described teeth of a cercopithecoid that has been ascribed to Macaca cf. sylvanus enlarging the meagre record of cercopithecoids in North Africa. And second, we introduced the recovering of a small-sized specimen of the genus Dinofelis, a saber-toothed cat mainly known from East and South Africa.

Fig. 4: large mammals from Guefaït 4: *Gazella* sp. 1) horn core sin. lateral view; 2) M$_3$ sin. buccal (a), occlusal (b) and lingual (c) views; *Tragelaphus* sp. 3) P$_4$ sin. buccal (a), occlusal (b) and lingual (c) views; 4) M$_3$ sin. buccal (a), occlusal (b) and lingual (c) views; cf. *Lupulella paralius*: 5) M$_3$ sin. buccal (a), occlusal (b) and lingual (c) views; *Hipparion* sp.: 6) M$^{1/2}$ dext. occlusal view; *Anancus*: 7) molar occlusal view. The upper scale bar corresponds to figure 5, while the lower scale bar corresponds to the remaining figures. (© J. V. D. Made).
4. 2. Second phase of the series: Middle Pleistocene - Holocene fluvial environment

In a second geomorphological phase, the formation of the current fluvial system cut into the former sequence, resulting in different environmental conditions. This incision likely began in the Middle Pleistocene. The oldest locality, recorded in that phase, is Oued Rabt, a site contained in an alluvial fan and which has yielded a Mode 2 lithic assemblage, without faunal remains. These lithic tools correspond to an advanced phase within the Mode 2 evolutionary sequence in Maghreb (Fig. 3).

The intensity of human occupation in the basin increased gradually at the end of the Middle Pleistocene, probably from the MIS-5 onwards, fitting well with the Panafrican emergence of archaic *Homo sapiens*. At this time, abundant and ubiquitous evidence of Middle Stone Age (MSA) industries, patchily distributed across the landscape, represent the Mode 3. Isolated MSA occurrences appear as lithic scatters unearthed by the erosion of ancient river-banks where they have been first deposited; mainly in the Oued Za area. These scatters often contain the debris of single knapping episodes including cores and flakes, but sometimes they also show the aggregation of temporally separated events displaying different types of raw materials and finished tools (Fig. 5).

In the El Haï – Charef area, MSA materials also appear stratified under several meters of alluvial river deposits, as in the Oued Charef site, where a discrete concentration of flaking products from the late MIS-5 was excavated and refitted. Locally, the Sahb el Ghar – Swiwina area displays the highest intensity of MSA settlements, related to the Neogene primary flint outcrops. Flaked flint is present in the entire area, with several significant concentrations representing homogeneous knapping episodes exposed by the erosion of the hills. Two sites were excavated in the Swiwina plains: Sahb el Ghar 1 and 2. They document stratified open-air layers with MSA materials. Of special interest is Sahb el Ghar 2, where three different MSA layers were documented, and ca. 3000 stone tools were recovered in a 9 m² test pit\(^52\).

To build up and to sort a regional MSA technological sequence is one of the main objectives of the late Middle - Late Pleistocene excavations. The alternation of Levallois, with tanged tools and non-Levallois assemblages, is a significant pattern observed for this period\(^53\). Advances in the dating programs will contribute to shedding light on the diachronic variation of the stone tool assemblages and their relation to the changes in human occupation patterns and the evolution of environmental conditions.

During the last two years, the latest occurrences of hunter–gatherers in the area, the Late Stone Age (Mode 4) industries, are being discovered by surveys and excavated, adding new and pivotal information about human evolution in the region. The project has so far documented open-air campsites within *in-situ* stratigraphic deposits for the first time in the region. The newly discovered sites seem to indicate a clear cultural and economic breakup occurring between the late MSA and the LSA. A high diversification in the exploited lithic raw

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\(^52\) Chacón M. G. *et al.* 2018.

\(^53\) Doerschner N. *et al.* 2016.
material is linked to the almost exclusive presence of blade and bladelet reduction sequences oriented to the production of backed microliths (Fig. 5).

The landscape occupation patterns in these new sites reveal preferences for elevated prominent positions close to the main river courses, where concentrations of thousands of stone tools and structured fireplaces are being documented, such as in the cases of Tahya 4 and Ain Tifirassine. Besides these open-air camp sites, LSA remains are also present in caves, located in the upper basin and in the shelters formed by the erosion of the Plio-Pleistocene conglomerate relics in the Gara Soultana area.

Our archaeological surveys have also attested human settlements linked to the Early Holocene. The study of these localities provides new information about the introduction of a consolidated economy of production in the region. The new settlements documented are all close to the main river streams, including open-air sites with recurrent occupation phases, as well as rock-shelters and small caves. In the open-air site of Tahya 2, archaeological levels
yield hearths and high-density bioarchaeological deposits, dating back to at least the Early Holocene.

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ملخص
منطقة عين بني مطهر - ڭافايت بإقليم جرادة بالمغرب الشرقي بكونها موضوع مشروع دولي للبحث في علم الآثار، وعلم الآثار والتاريخ والتحقيب الجيولوجي، منذ 2006، تنجه مجموعة من الباحثين من تعدد الاختصاص، وقد سمح هذا البحث الميداني من اكتشاف عدد من المواقع الأثرية التي تنتمي إلى حقب البلايستوسين والهولوسين في الحوض القديم النهري - بحري في عين بني مطهر، والملتحد على مساحة 2000 كلم مربع. هدفنا هنا هو تقديم مشروع البحث الذي بدأناه في المنطقة والاشكالية التي تواجهه والنتائج الأولية التي حصلنا عليها بالفعل.

منذ سنة 2006 ، كانت منطقة عين بني مطهر - ڭافايت، إقليم جرادة بالمغرب الشرقي، موضوع مشروع بحثي، في علم الآثار وعلم الآثار والتاريخ والتحقيب الجيولوجي، ينفذ فريق دولي متعدد الاختصاصات. أدى هذا البحث إلى اكتشاف عدد كبير من المواقع الأثرية التي تنتمي إلى حقب البلايستوسين والهولوسين في الحوض القديم، في حوض نهر - بحري قديم، يمتد على مساحة 2000 كيلومتر مربع. نهدف هنا تقديم مشروع البحث الذي شرعنا في إنجازه بالمنطقة والمشكلة التي تتوخى معالجتها والنتائج الأولية التي تم التوصل إليها.

الكلمات مفتاحية : البلايستوسين، الهولوسين، تواجد الإنسان، إقليم جرادة بجهة الشرق، الصحراء «الخضراء».