



Dûma 4. The 2013 Report of the Saudi–Italian–French Archaeological Project at Dûmat al-Jandal, Saudi Arabia

Guillaume Charloux, Romolo Loreto

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Dûma 4

The 2013 Report of the Saudi–Italian–French Archaeological Project at Dûmat al-Jandal, Saudi Arabia

Guillaume CHARLOUX & Romolo LORETO

With the participation of Roberto Bottiglieri, Marianne Cotty,
Paul Courbon, Rémy Crassard, Yann Gayet, Yamandú Hilbert,
Frédéric Imbert, Martin Makinson, Thamer A. al-Malki, Andrea Marcolongo,
Bruno Marcolongo, Céline Marquaire, Abdul M.N. al-Marshd,
Charly Poliakoff, Ahmed A. al-Qaeed, Dara'an al-Qahtani, Christian Robin,
Thomas Sagory, Saverio Bruno Scigliano, Olivier Testa, Ariane Thomas
& Matthieu Thomas

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الحروف الصوتية	Long vowels ā, ū, ī
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Arabic Alphabet & Transliteration
(contemporary personal names excluded)

الحروف العربية ومقابلها باللاتينية

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- University of Naples “*L’Orientale*”, *Dipartimento di Studi Asiatici*.

The 2013 Season at Dûmat al-Jandal

Affiliations and Partnerships

The project works under the aegis of the following institutions:

- The Saudi Commission for Tourism and Antiquities
- The French National Centre for Scientific Research (UMR 8167, *Orient et Méditerranée*)
- The University of Naples “L’Orientale”, *Dipartimento Asia, Africa e Mediterraneo*

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- The French Embassy in Riyâdh, *Service de coopération et d’action culturelle (SCAC)*
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- CISA, *Centro Interdipartimentale di Servizi di Archeologia*
- The National Research Council of Italy, Inst. of Applied Geology [I.R.P.I.], Padova

Participants

The project is directed by Dr. Guillaume Charloux and Dr. Romolo Loreto. The following specialists took part in the project in 2013:

Saudi component

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Abdul M.N. Al-Marshd (vice-director of the al-Jawf Museum, SCTA)

Thamer A. Al-Malki (historian-archaeologist, SCTA)

Dara'an al-Qahtani (archaeologist, SCTA)

Italian component

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Roberto Bottiglieri (student, University of Naples *L'Orientale*)

Dr. Andrea Marcolongo (architect, CNR)

Prof. Bruno Marcolongo (geologist, CNR, Inst. of Applied Geology [I.R.P.I.])

Saverio Bruno Scigliano (restorer)

French component

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Yamandú Hilbert (prehistorian, CNRS/UMR5133)

Frédéric Imbert (epigraphist, University of Aix-Marseille)

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Thomas Sagory (photograph, freelance)

Olivier Testa (speleologist, French Federation of Speleology)

Dr. Ariane Thomas (archaeologist, Louvre Museum, Department of Oriental Antiquities)

Matthieu Thomas (speleologist, French Federation of Speleology)

Activities carried out during the season

The 2013 field campaign at Dûmat al-Jandal has taken place in two stages. A first phase, involving excavations, geomorphological surveys in the region and systematic inventory of the archaeological remains of the oasis, was conducted from the 21st of October 2013 to the 30th of November 2013, while the second phase, corresponding essentially to archaeological and epigraphic surveys was held from the 21st to the 25th of January 2014.

The 2013 campaign has been punctuated by several contingencies. As a result of the redevelopment of the museum, storage areas were destroyed, while our material (archaeological objects and working tools) has been moved to Riyâd. Furthermore, a change in legislation for workers involved long periods in which excavations had to stop. Archaeologists have therefore been obliged to perform work by themselves in their respective fields, but also to vary the activities: surveys in remote locations in the north of Jawf for the Italian component, inventory of the western part of the oasis and topography of the western sector for the French component. Despite these somewhat difficult conditions this year, research has not been in vain, and good results have emerged.

1. Surveys

Prehistoric surveys (**report Crassard & Hilbert**) have, in particular, revealed an unsuspected amount of 28 Palaeolithic sites in the region, of all periods, Lower, Middle and Upper Palaeolithic, but also some sites from the ancient/mid Holocene epoch (Neolithic & Chalcolithic). The concentration of lithic remains certainly reveals a densely populated region in all these periods, in radically different environmental conditions. The short campaign of archaeological and epigraphic surveys (see **Charloux et al. GIS**), has identified eight new rock carving sites. At this stage, no less than 87 sites, mainly engravings, have been listed around Dûmat al-Jandal.

Geomorphological surveys conducted by Romolo Loreto, Bruno Marcolongo, Andrea Marcolongo and Roberto Bottiglieri (**report Loreto et al. Geomorphological survey**) have tried to identify the caravan trails north of Sakaka. In addition to the lab work, nine new necropolises have been identified in the field. The necropolises show three different kinds of tombs: turret tomb, tumuli and mausoleum. According to the building techniques the tombs could be dated to the end of the Neolithic Era (tumuli), the whole Bronze Age (tumuli and turret tomb) and the beginning of the Iron Age (mausoleum tomb).

At the same time we have also intensified systematic surveys in the west of the oasis (see **report Charloux et al. GIS**), which is now almost entirely surveyed with the exception of a few squares and neighbouring plateaus. A work of geolocation and identification of structures was undertaken which was very useful in further analysis of the qanât system led by the French Federation of Speleology (see **report Courbon, Testa & Thomas, Wells**).

2. Excavations

Archaeological research continued in 2013 despite the difficulties mentioned above.

This year we have benefited from the arrival of Thomas Sagory, who achieved a complete photographic survey of Area C and part of area A, using a kite.

Sector A

The excavation in Sector A - report to be included in the next 2014-2015 report - continued towards the south limit of Trench 1, south of Building A, in order to carry on with an extensive excavation focused on defining the Nabataean urban area and more ancient levels.

Year 2013 archaeological campaign started by the excavation of a new square of 15 x 6 m has been delimited. In this first part of the excavation survey, beside the ordinary and daily record of all remains through photogrammetry, in order to draw plans and collect the elevation data of the archeological stratigraphic levels or the wall sections of sector A, after an assessment period, a 3D reconstruction of all wall remains has been started. A standard for the photo capture and point cloud generation has been defined. A digital reflex camera Canon D 500 with an 18 mm calibrated lens has been used with a fixed diaphragm of 8.0f and ISO 200 so to obtain the widest depth of field. Ground control points at a fixed distance of 1 m have been placed on the soil in order to be able to geo-reference all the single point clouds on the general model. Brand new technology Zscan Menci software, beside Photoscan and Rapidform XOR has been chosen.

Sector C

Studies carried out in Area C in 2013 (**report Charloux et al. Sector C**) had a twofold objective: to continue the analysis of the ancient enclosure and better understand the rhythms of occupation and the internal organization of the western sector through extensive excavations. In parallel, a digital terrain model (DTM and contour lines) sector was created from taking topographical points using a differential GPS on the whole area, allowing to reconsider

the entire relief and perspective on the findings structures. This work was coupled with the 3D reconstruction of the sector in photogrammetry by dense correlation of photographs taken with a kite by Th. Sagory.

A first sounding (SD10) was opened on the western side of the enclosure (unit 2) with the objective of testing the hypothesis of the main door of the sector (**report Thomas & Marquaire, SD10**). A hypothesis which has proved to be incorrect. Further details of the masonry have nevertheless appeared, in particular the presence of a triple wall, and not two as previously hypothesised (*Dûma 1*). This observation was confirmed by sounding 11 (**report Charloux & Marquaire, SD11**), which targeted an opening (postern) in the masonry of unit 8, at the base of the enclosure. Several construction stages have emerged during excavations. It is not impossible that the original enclosure is therefore formed by the units located in the valley, so that high units were built at a later time.

Sounding 6 (**report Makinson, SD6**) has targeted the excavation of a large basin, as identified by the excavator, discovered last year in an ancient building in mud brick and stone, and the adjacent rooms. The function of this vast building and the pit in its centre remains uncertain for now.

Sounding 12 (**report Cotty, SD12**), located against a large archaeological section created as a result of the destruction of an archaeological area by bulldozers, has uncovered a massive square structure, probably a tower.

3. Activities of protection

Some of the bad news in 2013 was the discovery of looting holes and acts of vandalism in the structures excavated in 2011-2012, particularly the *triclinium* (SD4) and tower (SD5). A notification was made to the service of Saudi Arabian Antiquities. Consequently, we decided to fill the *triclinium* in completely, and to entirely cover the sides of the tower (SD5) by building new protective stone walls.

The protection of the whole sector still remains one of our major concerns. A formal request for construction of a metal enclosure over the entire endangered area was addressed to the President of SCTA during an interview in Riyadh in early December 2013. For the same purpose, we also met the Wakil of the Jawf province on Wednesday 27th January.

Finally, a project of restoration-consolidation of the mud brick enclosure, the iconic building in Dûmat al-Jandal, was handed to the vice-president of the SCTA. This work requires the establishment of an adequate metal protection.

4. Lectures

1. Loreto R. “Dûmat al-Jandal: un centro carovaniero nel nord della Penisola Arabica”, II Ciclo di Conferenze Archeologia delle Vie della Seta, Percorsi, immagini e cultura materiale, B. Genito e L. Caterina. Università degli Studi di Napoli L’orientale, Napoli (April 10th, 2013).
2. G. Charloux & J. Schiettecatte, “Oasis de l’Arabie déserte”, Séminaire de M1-M2 Actualité de la recherche en Histoire de l’Art et Archéologie des pays d’Islam de l’université Paris IV (March 4th, 2013).
3. G. Charloux, “Dûmat/Dûmata, oasis antique du nord de l’Arabie, Etat de la recherche”, séminaire de M1-M2 Archéologie et histoire de l’Orient hellénistique et romain, Paris 1, F. Villeneuve (April 2nd, 2013).
4. G. Charloux, M. Cotty, E. Lanoë & M. Makinson, “Questions autour de la découverte d’un établissement fortifié à Dûmat al-Jandal (Arabie Saoudite)”, *Rencontres Sabéennes* 18, Fondation del Duca, Paris (June 6th, 2013).
5. G. Charloux, M. Cotty, E. Lanoë & M. Makinson, “The Wâdî Sirhân in antiquity: questions regarding the (re-)discovery of a fortified settlement at Dûmat al-Jandal, Saudi Arabia”, 46th Seminar for Arabian Studies, London, British Museum (July, 28th, 2013).
6. G. Charloux, “Ancient Water Management in Northern Saudi Arabia: The Case of Dûmat al-Jandal Oasis”. National Museum, Riyâdh (November 27th, 2013).
7. G. Charloux, “Managing the Water Supply in the Dûmat al-Jandal Oasis (Northern Saudi Arabia). An Exploration of the Ancient Hydraulic System”. International congress on the archaeology of North Arabia, University of Vienna (December 6th-7th, 2013).

4. Publications

1. G. Charloux & R. Loreto 2013, *Dûmat al-Jandal. 2,800 years of History in Saudi Arabia*. Bilingual text in English and Arabic, EADS-SCTA.
2. G. Charloux & R. Loreto 2013, “Oasis rediscovered. Dûmat al-Jandal”, *Saudi Voyager* (Winter 2013), p. 16-18.
3. R. Loreto & G. Charloux 2013, “The Saudi-Italian-French Archaeological Project at Dûmat al-Jandal (Preliminary Report of the 2012 Season)”, *La Newsletter di Archeologia CISA* 4 : 211–251. <http://www.unior.it/ateneo/8917/1/v...>
4. R. Loreto, Charloux G. & M. Makinson 2013, “Dûmat al-Jandal, oasis de l’Arabie déserte”, *Qantara* 87, p. 12-15.

Prehistoric Survey of the Al-Jawf Quadrangle, Northern Saudi Arabia

Yamandú H. Hilbert (CNRS, UMR 5133 Archéorient, MOM, Lyon) &
Rémy Crassard (CNRS, UMR 5133 Archéorient, MOM, Lyon)

The Al-Jawf Quadrangle in northern Saudi Arabia has thus far been the subject only of sporadic archaeological investigation (e.g. Adams *et al.*, 1977; Parr *et al.*, 1978). Here we present the preliminary result of the prehistoric survey campaign undertaken in mid-November 2013. During the survey 30 prehistoric sites have been located, mapped and sampled. Special consideration was given to the identification of Palaeolithic sites, although Neolithic, rock art and Chalcolithic localities have also been found and recorded. Following a brief introduction of the geographical settings of the surveyed area where both extent and configurations are examined, the geological and environmental frame is laid. Specific *loci* within the Al-Jawf Quadrangle were sampled based on raw material availability and general topographic location. The archaeological evidence from the recorded sites will be described. In order to provide a general overview of the different time periods, sites were divided into chronological categories (Lower, Middle and Upper Palaeolithic, Epipalaeolithic, Neolithic, Chalcolithic). A brief typo-technological assessment of the collected artifacts will follow.

Given the growing complexity of the Arabian Prehistoric record the sites from the Al-Jawf Quadrangle will be discussed, first in a regional frame and then in an extended intra-regional context. Given the geographical location of the Quadrangle, close to the desert areas of the southern Levant, Sinai, and Nafûd, the archaeological record described here may greatly add to the growing body of data on Arabian Prehistory.

Geographical and geological setting

The study area is located in the centre of the Al-Jawf Province in northern Saudi Arabia, the Jordanian border being only 200 km to the north. The province comprises approximately 100.212 km². Due to the short duration of the survey archaeological and geomorphological investigation focused around the modern city and oasis of Dûmat al-Jandal (known in Antiquity as Adummatu), located in the central northern part of the Province (**Fig. 1**).

The landscape of the Al-Jawf Quadrangle, which sits between latitude 29° 00' and 30° 00' N., and longitude 39° 00' and 40° 30' E, is marked by a turbulent topography with many grabens, faults, and folds. This is in great part a result of the rifting activities of the Arabian Shelf and its orientation a function of the axis of the Hail arch (northern section of the Central Arabian Graben System). Of the countless faults and graben systems within the quadrangle the wâdî al-Sirhân fault, which trends west-northwest across the quadrangle, is the most defining of these formations. Its fold orientation and the age of faulted lithologies suggest that this fault moved in a left-slip sense during the Late Cretaceous. The At-Tawil fault zone, located to the south of the area studied, is also a left-slip structure, based in orientation of folds adjacent to a fault segment in the zone. The Al-Jayb fault zone, located to the west of the At-Tawil fault zone, consists of a north-south trending set of faults (**Fig. 2**). With the exception of the plateaus and escarpments created by the tectonic activities in the area, aeolian sediments cover a great part of the Al-Jawf province. In the northeastern part of the area barchanoid ridge-type dunes belonging to the Nafûd desert run transverse to the prevailing westerly wind. These dunes are mostly stabilized and are covered in vegetation such as grasses, bushes, and small trees. Westward the dunes become thin and spread out with bare patches between them. In the southern and southeastern parts of the province, the dunes are a combination of barchanoid ridge type and linear (sief) dunes¹ trending in an east to southeast direction, and are the result of two dominant wind directions, probably northwesterly and southwesterly. The majority of these dunes are stabilized as the Nafûd contains more perennial vegetation than the surrounding rocky desert.

¹. Meissner *et al.* 1989; Wallace *et al.* 1997.



Fig. 1. Google map® image showing the location of Dumat al-Jandal and the Jawf Province

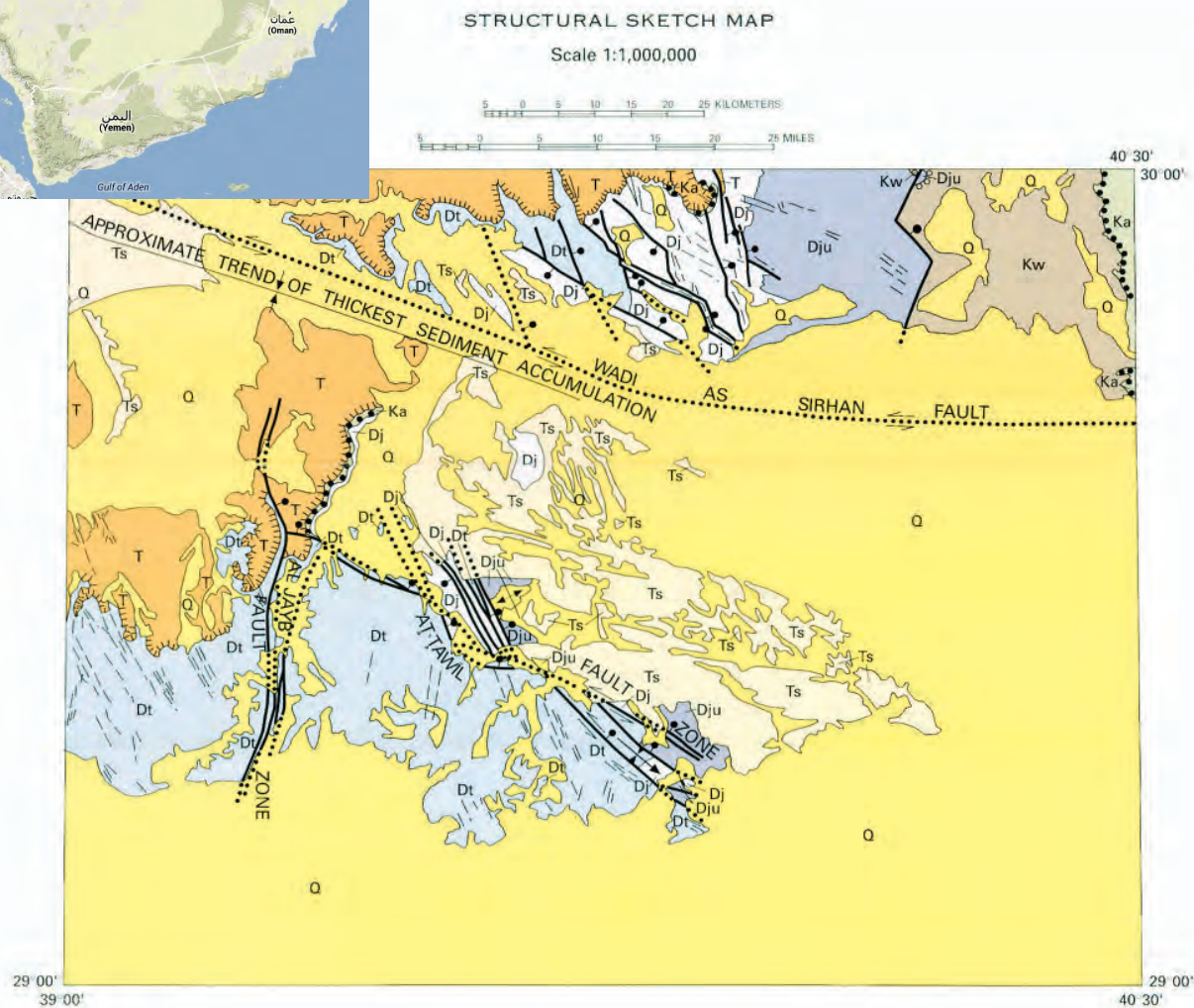


Fig. 2. Structural map of the Al-Jawf Quadrangle showing the position of the major graben and fault systems in the area (modified after Wallace et al., 1997)

As noted above, survey activities were concentrated north of the Wâdî al-Sirhân graben. In this area a set of semi-parallel trending faults and minor graben systems oriented slightly perpendicular to the Wâdî al-Sirhân graben have greatly influenced local topography and exposed lithologies. The block faulting's segregated the study area into a set of micro regions that ultimately display a high level of variability in terms of terrain roughness (**Fig. 3**). In this area, the rocks consist of continental or marine clastics, fine to medium-grained sandstone, with thin shaly interbedded layers. In addition, stromatolitic, creamy limestone and yellowish semi-consolidated limestone strata with interbedded layers of shale, silt or gypsum are observed.²

In terms of sedimentary history the local lithologies are the result of marine transgressions and regressions, the majority of the lithologies in the area being associated with deep sea sedimentary rock units.³ Due to the nature of the sedimentary rock deposits, mostly marine and to some extent brackish, shallow water bodies and even reefs, a great range of siliciferous minerals have been encountered. These, the majority being high quality chert and flint, were greatly prized as raw materials for the production of stone tools by prehistoric populations inhabiting the area across the millennia. Given the special interest in the prehistoric occupation of the Al-Jawf area, the location and configuration of the chert bearing lithologies will be quickly summarized. During the survey activities these areas were targeted and in the majority of cases proven to be rich in archaeological sites.

Within the Tertiary rock units four lithologies have proven to bear adequate raw materials for prehistoric lithic production. These occur either as scattered chert nodules or continuous chert bands within the mostly Palaeocene to Eocene rock strata. Dispersed brown chert nodules were found at the bottom of the *Sirhân Formation* (Ts), a laminated beige sandy limestone member with animal burrows. The *Sib member* (Ttms) of the *Miras Formation*, which presents itself as a finely crystalized limestone layer with interbedded gray chert was also identified as a raw material source. Three distinct types of raw material have been found within the *Sib member*; gray chert, brown phosphatic chert and silicified coquinoïd beds of light brown colour. The *Jalamid Formation*, another chert bearing stratum, is divided into an upper and a lower member, both chert bearing. The upper *Kuwaykabah member* (Ttjk) is composed of bioclastic argillous limestone and dolomite, which bear gray and grayish-brown chert near its base. The lower *Thaniyat member* (Ttjt) is composed of interbedded argillous sandy bioclastic limestone with phosphatic chert nodules.

2. Wallace *et al.* 1997; Ajmi (Al-) 2005.

3. Powers *et al.* 1966; Meissner *et al.* 1989.



Fig. 3. Photographs of the area studied

Additional chert bearing strata are found within the terminal Palaeozoic *Jouf Formation*, which consists of varicoloured silty shale with numerous thin beds of limestone and dolomite in the upper part and sandstone at several levels. Noteworthy here are the lower *Sha'iba member* (Djs), which contains some gray chert located above animal burrows and the upper *Hammamiyat member* (Djh) that contains various chert beds.⁴

Site	Period
DAJ-5	Holocene
DAJ-4	Middle Palaeolithic
DAJ-48	Middle Palaeolithic
DAJ-49	Middle Palaeolithic
DAJ-50	Middle Palaeolithic
DAJ-51	Middle Palaeolithic
DAJ-52	Middle Palaeolithic
DAJ-53	Middle Palaeolithic
DAJ-54	Middle Palaeolithic
DAJ-55	Middle Palaeolithic
DAJ-56	Holocene
DAJ-57	Neolithic
DAJ-58	Neolithic
DAJ-59	Middle Palaeolithic
DAJ-60	Holocene
DAJ-61	Holocene/Neolithic
DAJ-62	Chalcolithic/Neolithic
DAJ-63	Middle Palaeolithic
DAJ-64	Upper Palaeolithic
DAJ-65	Upper Palaeolithic
DAJ-66	Upper Palaeolithic /Holocene
DAJ-67	Middle Palaeolithic
DAJ-68	Holocene
DAJ-69	Lower Palaeolithic
DAJ-70	Middle Palaeolithic
DAJ-71	Middle Palaeolithic
DAJ-72	Middle Palaeolithic
DAJ-73	Middle Palaeolithic
DAJ-74	Holocene
DAJ-75	Holocene

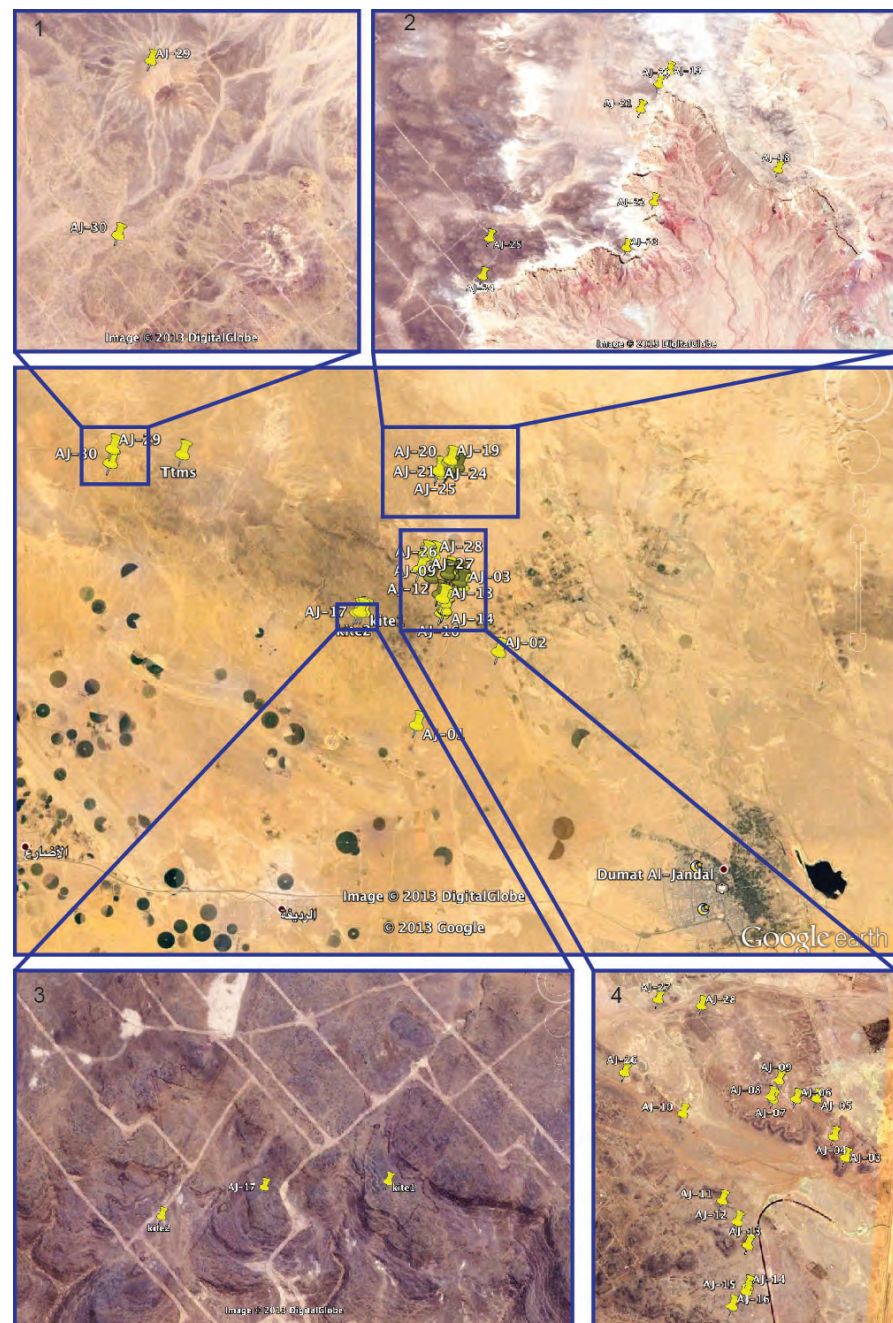
Table 1. Prehistoric sites

⁴. Meissner et al. 1989; Wallace *et al.* 1997.

Prehistoric evidence

Archaeological investigations have focused on three areas across the Al-Jawf Quadrangle. Areas for survey were selected based on proximity to chert beds or raw material outcrops. In addition to the ground truthing of the desk based analysis survey of remote sensed desert kite structures was undertaken, proving successful. The 30 sites discovered during the survey (**Table 1**) and their location is presented in **Fig. 4**.

Fig. 4. Location of sites:
1. Ar Rummantayn area;
2. Jal Ajrubah area;
3. Desert Kites;
4. Jebal al Himdi and al Wādī graben area



Of the surveyed areas the Jebal al-Himdi and al-wâdî graben zones have proven to be extremely rich in sites and raw material, here chert nodules found within the *Jouf Formation* have been detected. Sites were found on top of the limestone plateaus, inside the debris filled wâdî systems and at the foot of remnant sandstone hills. The Ar-Rummantayn (**Fig. 4.1**), although rich in chert due to the Tertiary limestone formations, has only produced two sites of undetermined age. This area was rich in raw material and a great part of the chert nodules and blocks show signs of early stage reduction or simple raw material “testing” (one to three removals to tryout the quality of the raw material). Sites were found on top and at the base of inselberg remnants located within the fluvial depression below the escarpments. The Jal Ajruh area (**Fig. 4.2**) is characterized by a flat Tertiary limestone plateau that extends for several kilometres. Across this plateau, brown phosphatic chert beads and gray brown chert nodules were found strewn about. Sites have been found along the edges of the plateau, overlooking the erosional plain some 40 to 60 m below.

Although absolute chronological attribution of the sites is problematic due to the absence of both datable organic materials and lack of stratified artifacts, an age estimate for these assemblages is made using relative chronology. This is possible by analyzing the technological and typological patterns displayed by the artifacts and their absolute age in areas adjacent to the Al-Jawf Quadrangle. Fortunately, archaeological research across Arabia has benefitted from many discoveries over the past years owing to the location of dated Palaeolithic sites.⁵ Additionally, in-depth lithic analysis on the associated artifact assemblages⁶ provide a frame of reference for the different lithic cultures of Arabia. In order to make such relative chronological statements artifacts were sampled from the majority of the mapped localities. The analytical process of the samples includes metrical as well as morphological parameters, which aid the description of each artifact. In addition complete technological descriptions for the collected cores were undertaken; the parameters for these studies are based on previous research.⁷

Descriptions of the mapped localities will now be given; these have been summarized under chrono-cultural sections following the interpretation of the lithic assemblages.

5. Armitage *et al.* 2011; Rose *et al.* 2011; Petraglia *et al.* 2012; Crassard *et al.* 2013; Delagnes *et al.* 2013.

6. Crassard 2009; Crassard & Thiébaud 2011; Hilbert *et al.* 2012; Delagnes *et al.* 2012; Usik *et al.* 2013; Crassard & Hilbert 2013; Hilbert 2014.

7. Bordes 1961; Marks 1976; Boëda 1995; Meignen 1995; Monigal 2002.

The Lower Palaeolithic

Survey activities have produced two localities that, based on the lithic evidence, may be ascribed to the Lower Palaeolithic. The term locality is here chosen deliberately given the configuration of the two sites. Both isolated artifacts were identified as bifacial hand axes. Sites DAJ-63 and DAJ-69 are situated on the same limestone plateau approximately 20 km to the north-northwest of Dûmat al-Jandal in an area known as Jal Ajrubah. The artifacts found at locality DAJ-69 were found close to the edge of the flat plateau with no other clearly associated artifact. Site DAJ-63, on the other hand, was found in the proximity of a chert outcrop, which also produced a moderately dense scatter of less patinated Levallois associated debitage. The isolated hand axe was the only evident Lower Palaeolithic artifact at that site and could easily be differentiated from the Middle Palaeolithic ones due to the obvious difference in patination and typology of the bifacial tool.

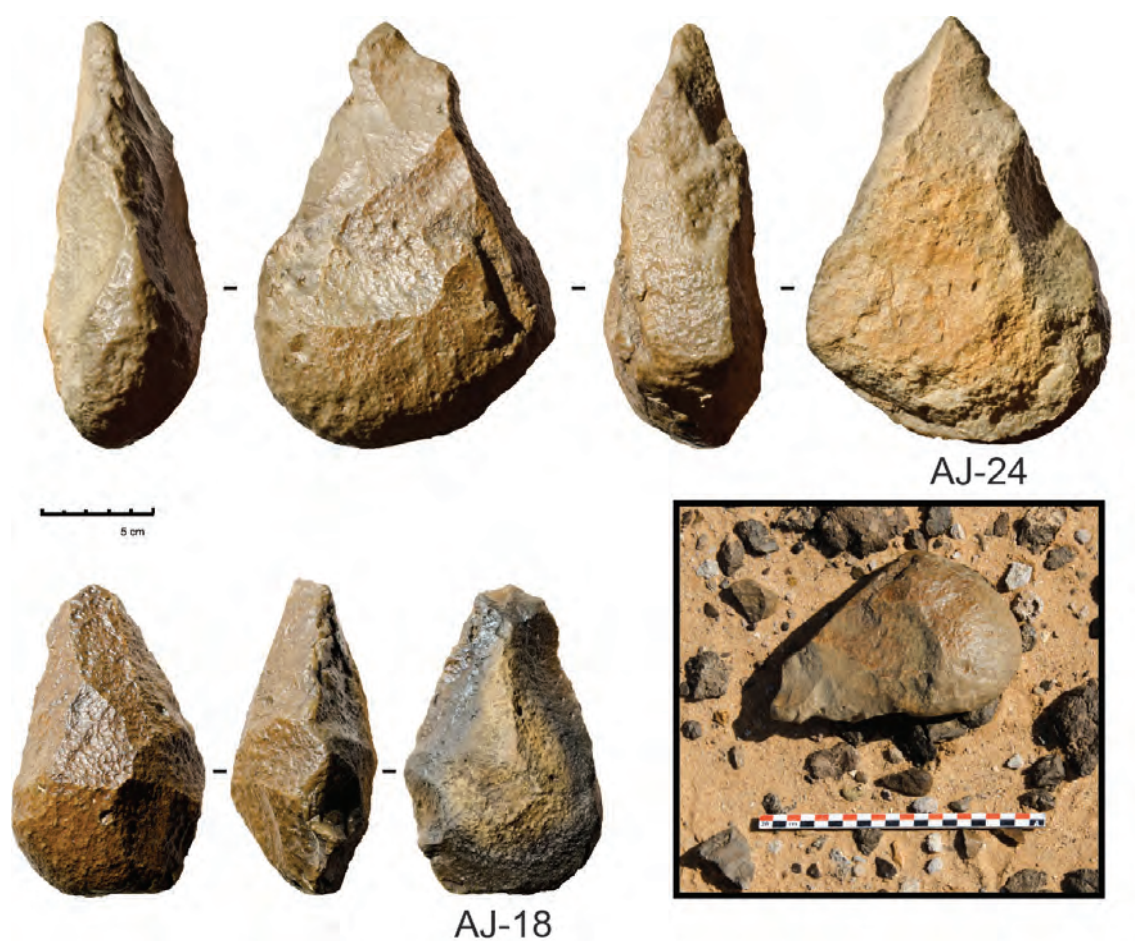


Fig. 5. Lower Palaeolithic Tools from DAJ-63 and DAJ-69

Both hand axes share certain morphological aspects while other features are quite disparate: the first thing that comes to mind is the obvious divergence in size. While the specimen from site DAJ-69 measures 180.55 mm in length 126.94 mm in maximum width and 67.75 mm in maximum thickness the dimensions of the specimen from site DAJ-63 are 126.79 mm in length, 68.51 mm in width and 48.92 mm in thickness. Also noteworthy are the differing cross-sections spotted on both pieces, while site DAJ-63 has a moderately symmetrical biconvex cross-section, the specimen from site DAJ-69 has a rather rhomboidal cross-section due in part to the unilateral retouch on the right edge of the tip of the piece. These features notwithstanding, general typological attribution allows us to categorize both pieces as almond shaped hand axes with untrimmed butts (**Fig. 5**).

The Middle Palaeolithic

Middle Palaeolithic sites in Arabia are generally associated with Levallois core technology⁸. Sites attributed to the Middle Palaeolithic period have been known since the early explorations of the Peninsulas wide landscapes.⁹ The Al-Jawf Province was no exception; of the 30 sites mapped in late 2013, 17 have been attributed to the Middle Palaeolithic based on the presence of Levallois technology. Middle Palaeolithic sites have been identified across all surveyed areas of the Al-Jawf quadrangle. One area in particular, however, has shown the highest density of Middle Palaeolithic sites – the Jabal al-Himdi area.

The Jabal al-Himdi and al-Wâdî graben area have in total produced 12 Middle Palaeolithic sites. Localities 48 to 54 are found on top of the Jabal al-Himdi plateau, while sites DAJ-55, DAJ-59, DAJ-71, DAJ-72 and DAJ-73 are located in the plains surrounding the plateau. Some of the localities where found within fluvial systems. In general, surface sites in this area show a low to moderate artifact density. Due to the presence of high-quality raw material it is assumed that little effort was invested in the acquisition of suitable chert for the production of tools and blanks. Artifact patination shows little variability, surfaces are in general brown with heavily worn edges (due to either wind abrasion or chemical dissolution). Artifacts found within fluvial systems, on the other hand, show white patination and less weathered edges (as was the case with the artifacts collected at DAJ-71).

⁸. Crassard 2009; Rose *et al.* 2011; Crassard & Hilbert 2013.

⁹. For overviews on Arabian history of Palaeolithic research see Rose 2006.

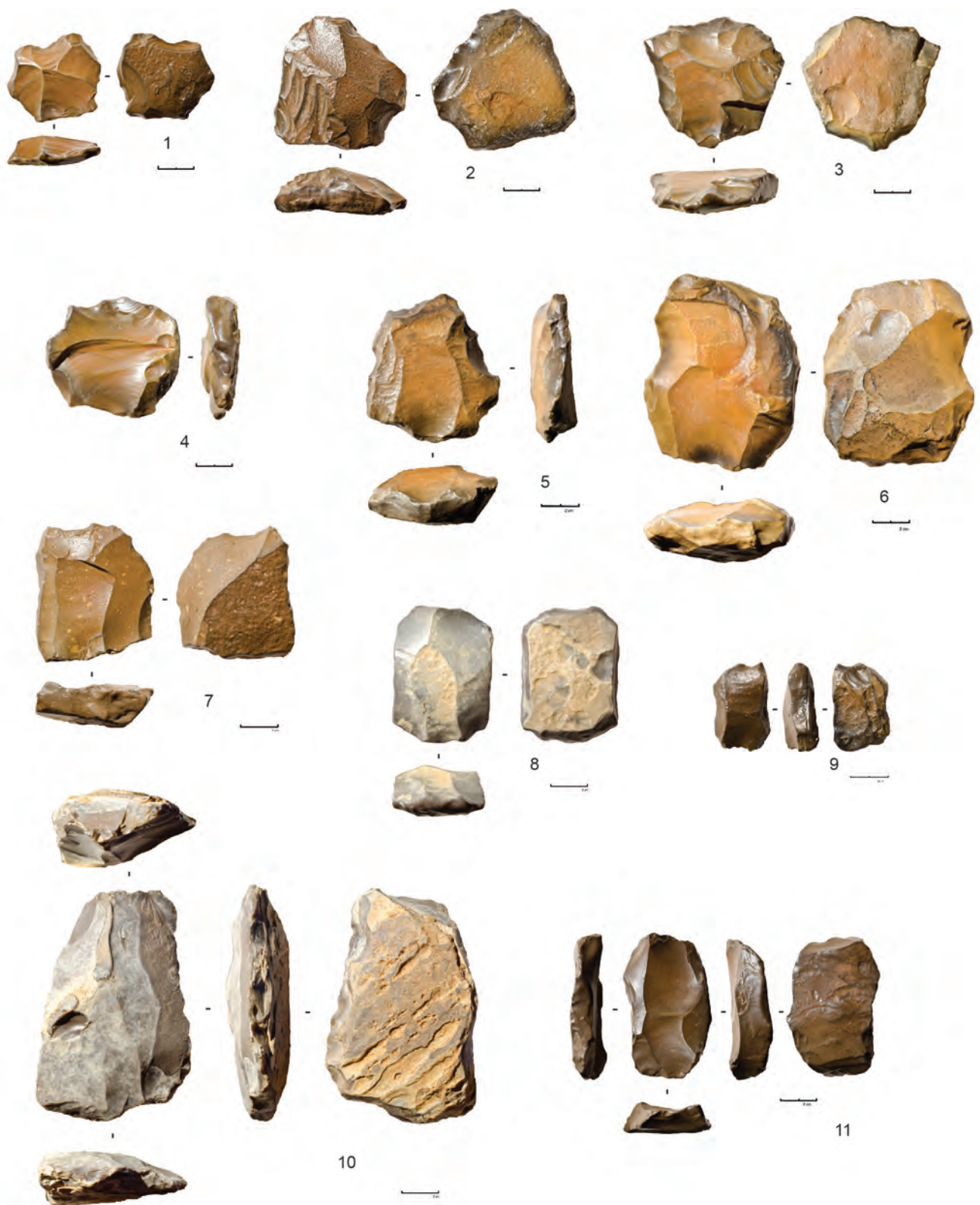


Fig. 6. Preferential Levallois cores with centripetal, bidirectional crossed (1 to 6), and bidirectional (7 to 11) preparation. 1 and 2 DAJ-49; 3 and 4 DAJ-51; 5 and 11 DAJ-73; 6 DAJ-70; 7 DAJ-52; 8 DAJ-55; 9 DAJ-63; 10 DAJ-71

Four sites have been found on the Jal Ajrubah area, sites DAJ-63, DAJ-64, DAJ-67 and DAJ-70. Similar to the Jabal al-Himdi area, Middle Palaeolithic sites were found on top of the plateau generally overlooking the valley. Unlike the Jabal al-Himdi sites, however, some of the Jal Ajrubah sites show multiple phases of occupation. For instance, site DAJ-63, which was located on the edge of the plateau on a raw material outcrop, has not only produced Levallois centripetal preferential, bidirectional flake cores and Nubian Levallois cores but also a hand axe attributed to the Lower Palaeolithic. The same can be said for the DAJ-64 site, which as such has delivered a high number of Upper Palaeolithic artifacts but also a small number of Middle Palaeolithic Levallois recurrent cores. That these artifacts do not belong to the same time period is enforced by the patination discrepancies observed on the specimens. The remaining sites in the area are attributed to the Middle Palaeolithic based on the archaeological evidence. At DAJ-67 a small surface site yielded a core and its associated debitage was found. A low density scatter was identified at DAJ-70 and yielded preferential Levallois and Nubian cores.

In terms of technological variability a high diversity of reduction patterns was identified. Middle Palaeolithic sites have presented a great range of Levallois cores, the major technological dialect being the preferential Levallois methods. Manipulation of the dorsal convexity was achieved by a variety of reduction patterns: bidirectional, bidirectional crossed, unidirectional crossed, unidirectional convergent and centripetal (**Fig. 6**). At seven different localities, sites DAJ-49 to DAJ-53, DAJ-63 and DAJ-70, Nubian cores were found (**Fig. 7**). These have so far identified in Southern Arabia (Yemen and Southern Oman) and at Al-Kharj,¹⁰ and represent an expansion of MSA technology from Northern Africa¹¹ into Arabia. Core technology and typology are consistent with the patterns identified across the southern Arabian territories and the North African sites.¹² In the majority of the identified cases the preparation method corresponds to Type 2 and Type 1/2. Cores show some variability in terms of size, although the majority of recovered specimens are small (below 80 mm).

Regional parallels for the use of bidirectional Levallois point production technology have also been noted across the Negev¹³ and desert regions of Jordan.¹⁴ Further research and analysis on the al-Jawf Levallois samples is needed to fully articulate regional trends. Additional sites and stratified occurrences would also help clarify matters.

10. Crassard & Hilbert 2013.

11. Van Peer & Vermeersch 2007; van Peer *et al.* 2010.

12. Rose *et al.* 2011; Usik *et al.* 2013; Crassard & Hilbert 2013.

13. Volkman 1983; Marks 1993.

14. Clark *et al.* 1997; Monigal 2002.



Fig. 7. Nubian Levallois cores. 1, DAJ-49; 2 to 4 DAJ-50; 5 and 6 DAJ-51; 7 and 8 DAJ-52; 9 and 10 DAJ-63

2.3 The Upper Palaeolithic

Upper Palaeolithic/Epipalaeolithic sites in Arabia have thus far remained elusive to archaeologists. In al-Jawf Quadrangle three sites have been mapped during the survey activities conducted along the Jal Ajrubah area north northwest of Dûmat al-Jandal. These are unlike the Late Palaeolithic sites of southern Arabia.¹⁵ Due to the problems of fully grasping the subtle divergences between Upper Palaeolithic and Epipalaeolithic technology¹⁶ the surface sites described here will be placed into this broad temporal frame. Sites DAJ-64 to DAJ-66 have all been recorded along the edge of the limestone plateau. These sites were found directly overlooking a box canyon situation that has formed due to erosion of the softer sandy limestone layers of the *Jalamid formation*. DAJ-64 was submitted to a selective intensive collection of both blanks and cores. Artifacts are made of fine grained yellow and brown chert of exquisite quality. The site is situated within what seems to be an erosional feature at the edge of the plateau and although a conjoin was made the surface scatter did not seem to be in primary position. The site is found across an approximately 30 by 50 m area, some artifacts have been found on a slight slope; artifacts show a high degree of fragmentation.

Artifacts collected include, as mentioned above, cores tools and blanks. Patination is very homogenous; little discolouration of the actual artifacts could be detected while edges show some degree of rounding possibly the cause of wind abrasion or chemical dissolution. Cores are strictly unidirectional parallel blade/bladelet cores showing intensive reduction. In general, specimens have a clearly discernible hierarchy between working surface, striking platform and back. At the intersection of the striking platforms and the work surface the discarded specimens show abrasive treatment, a technical feature that enhances the control over the detachment process. Striking platforms are prepared by the removal of core tables and in a few cases short hinged removals (**Figs. 8-9**). Altogether these traits are held indicative of complex blade and bladelet production. Tools collected are largely undiagnostic and consist of retouched core tablets, large flakes and some laterally retouched blades.

¹⁵. Rose & Usik 2009; Hilbert *et al.* 2012; Hilbert 2012.

¹⁶. Gilead 1988; 1991.



Fig. 8. Upper Palaeolithic bladelet cores from DAJ-64

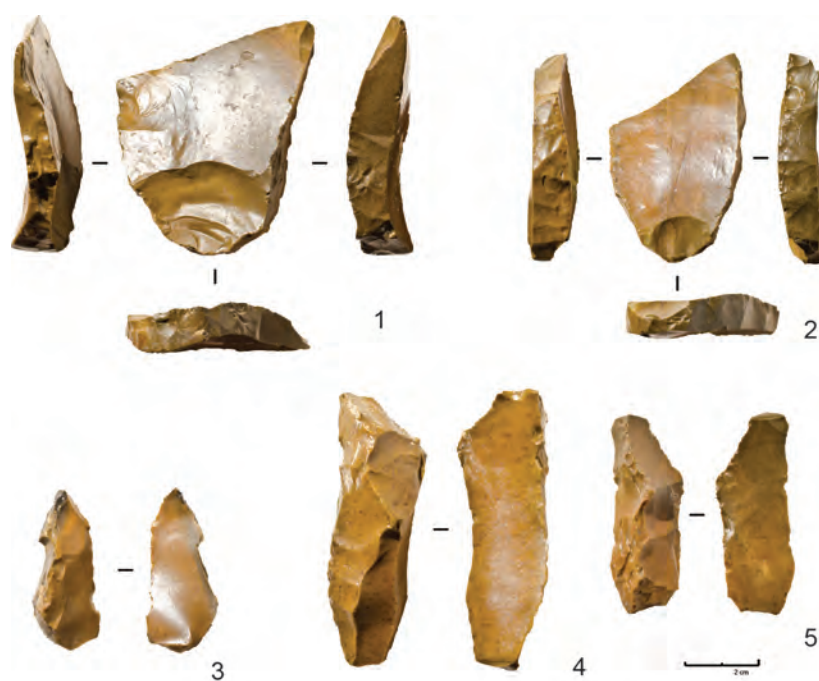


Fig. 9. Upper Palaeolithic core trimming elements, 1 and 2 core tablets; 3 to 5 crested blades

AJ-20 is located some 50 m south of DAJ-64 and consists of several clearly delimited, high density lithic scatters showing blades, bladelets, cores and other debitage (**Fig. 10**). DAJ-66 is similar to DAJ-65, only that the site has been disturbed by both modern activities (mainly looting and tracks) and by an ancient burial complex consisting of several tombs and large (8 m in diameter) circular structures.



Fig. 10. One of the pristine Upper Palaeolithic/Epipalaeolithic knapping events identified at the DAJ-65 locality

The Neolithic

Ten sites have been identified as Holocene; of these only a few could securely be identified as Neolithic through technological or typological patterns. Under these localities DAJ-57, DAJ-58 and DAJ-61 are noteworthy given the presence of bidirectional naviform core technology, a hallmark of the PPN period in the Levant¹⁷ (Fig. 11). Bidirectional naviform core technology is used to serially produce elongated blanks to serve as supports for different tools. Core maintenance and initial reduction start with the preparation of a crested edge and two opposite platforms. At DAJ-57 a series of these cores, and associated crested blades, were found in association with blades and bladelets. Tools found at the site are few and undiagnostic, mainly retouched blades and one end scraper. At DAJ-58 and DAJ-61 similar cores and blanks have been found



Fig. 11. Neolithic cores from DAJ-57, 1 and 2 exhausted bidirectional naviform cores, 3 single platform unidirectional bladelet core

¹⁷ Abbès 2003; Barzilai 2010; Barzilai & Goring-Morris 2010.

The Desert Kites

West of the Jabal al-Himdi and the al-Wâdî graben area, using satellite imagery remote sensing, the prehistoric unit identified two mega structures at the edge of a sandstone plateau. These star shaped structures appeared to be made of a series of stone walls with a large circular feature at the “point” of each convergent stone wall. Upon close inspection these could securely be identified as desert kites. Two large desert kites have been identified. Located between these sites was a high density lithic scatter (site DAJ-62). Artifacts are predominantly bifacial pieces, greatly ranging in morphology. Tools encompassed leaf-shaped bifacial foliates, knives, end scrapers, circular scrapers, barbed arrowheads, burins on truncation and retouched blanks (**Figs. 12-13**). Artifacts are heavily fragmented and only lightly patinated. Burnt animal bones, gazelle, have also been found and collected for dating purposes.

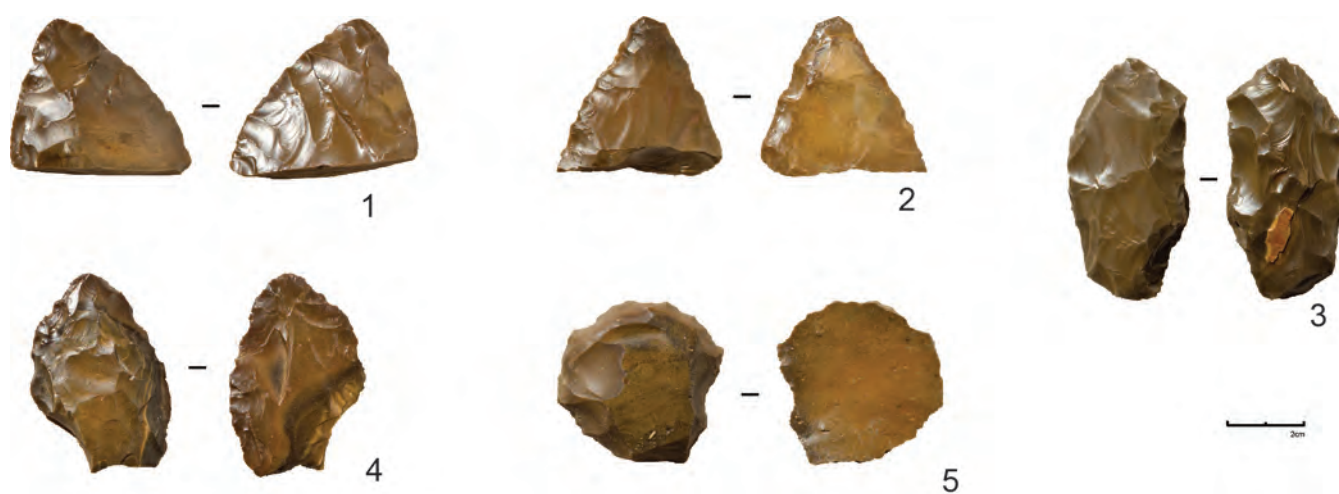


Fig. 12. Tools from DAJ-62, 1 to 4 bifacial artifacts, 5 circular endscrapers



Fig. 13. Barbed Arrowhead from DAJ-62

Outlook and Conclusions

The Al-Jawf Quadrangle presents a very interesting mixture of landscapes and archaeological sites. The archaeological occupation of this area, ranging from the Lower Palaeolithic to the present, may be linked to environmentally favourable conditions. Unfortunately the Lower Palaeolithic record for the quadrangle remains fragmentary and, beyond the fact that there are traces of occupation during what may likely be the lower Acheulean, little may be said.

Middle Palaeolithic sites were the most numerous found and presented a high level of variability in terms of reduction patterns. Some of which hints at connections across the Arabian Peninsula and beyond to possibly North Africa, as was the case with the Nubian cores found. The use of the term Nubian is here deliberately chosen and carefully reflected. The bidirectional Levallois point producing groups at al-Jawf represent the northernmost Nubian occurrence in Saudi Arabia. The technological patterns are clear and suggest a link either to the south, the west and possibly the northwest. The temporal range of these occurrences, however, remains loosely constrained to the time period between ~100 ka BP (MIS 5c) and 60 ka BP (MIS 3).

The identification of Upper Palaeolithic/Epipalaeolithic sites represents a novelty and hints at connections with the north, namely the Levant. No similarities with the Late Palaeolithic of Southern Arabia are evident. The absence of carinated pieces and Dufour bladelets, coupled with the primarily bladelet oriented reduction and use of core tables and crested blades as core trimming elements rather suggests a possible affiliation of the sites DAJ-64 to DAJ-66 with the Ahmarian. The lack of El-Wad points, however, is problematic; this may on the other hand simply be a result of the site function as a production location for bladelets. Further work is needed in order to enlighten this particular phase of Arabian Prehistory.

The Early Holocene occupation of this area, as marked by the PPN sites DAJ-57 and DAJ-58 and others, represents a period of intrinsic subsistence related change. Again a strong link with the Near Eastern archaeological record may be made based on the technological affinities visible on the lithic evidence.

In sum, the Al-Jawf Quadrangle shows a rich and diverse Prehistoric record owing to climate oscillations over the Pleistocene and its geographical position amidst prehistoric demographic centres (i.e. Near East and North East Africa). It is expected that further research in the area will bring additional invaluable data for the reconstruction of human prehistory in Arabia.

Geomorphological & Geoarchaeological Survey in Dûmat al-Jandal and al-Jawf Area

Romolo Loreto (University of Naples “L’Orientale”) &
Bruno Marcolongo (National Research Council of Italy,
Inst. of Applied Geology [I.R.P.I.], Padova)

The third geomorphological and geoarchaeological campaign in Dûmat al-Jandal and surrounding areas, performed between Oct. 22nd and Nov. 26th 2013 as part of the field activities of the Joint Saudi-Italian-French Archeological Project, was essentially devoted to the following main objectives:

1) survey and ground control along the ancient road network (“caravan routes”), identified and described during the previous (2012) geo-archaeological campaign. In particular, we have chosen the direction branching off the Dûmat al-Jandal oasis towards the main Euphrates archaeological sites of Mari-Abû Kemal to the north and Babylon to the northeast, leaving the other direction along wâdî al-Sirhân valley (Jawa-Azraq oasis-Zarqa to the northwest) to the Mediterranean sea for a future investigation (**Fig. 1**);

2) analysis on high resolution satellite images (Ikonos and Spot 5 multispectral data with 2.5 m ground resolution) of Google Earth of the Neolithic settlement model and kites of Harrat al-Harrah volcanic field.¹

¹. Harrat al-Harrah is the southern part of the wide volcanic field of Harrat ash-Shâm. It is extended in the northwest province of Saudi Arabia to the East of wâdî as-Sirhân upstream of Dûmat al-Jandal and is composed mainly of basalts flows from Oligocene to Recent Quaternary, with a gap of volcanic activity in the ages between 22 and 13 Ma.



Fig. 1. In red are depicted the suggested “caravan routes” after geomorphological interpretation of high resolution satellite images (© Google Earth)

Survey along ancient roads: Tamriyat area (Bruno Marcolongo)

Two are the main “caravan routes” we are suggesting here, which connect our site of Dûmat al-Jandal with the Mesopotamian depression and, in particular, with Abu Kamal (ancient Mari) to the north and Babylon to the northeast.

As underlined previously in the 2012 report, we have taken as geomorphological assumption that caravans, carrying goods through arid and semiarid environment, generally follow wâdî floors, that are more sheltered, richer in shallow groundwater resources also during dry season and generally easier to be crossed than rocky and bare terrain.

So, the entire “dissection pattern”, that is the whole system of landscape incisions formed by runoff water over extended periods and today dry in most cases, has been reconstructed until the smallest 1st order tributaries (after Horton-Strahler’s geomorphic classification).²

². Horton 1945: 275–370; Strahler 1957: 913–920.

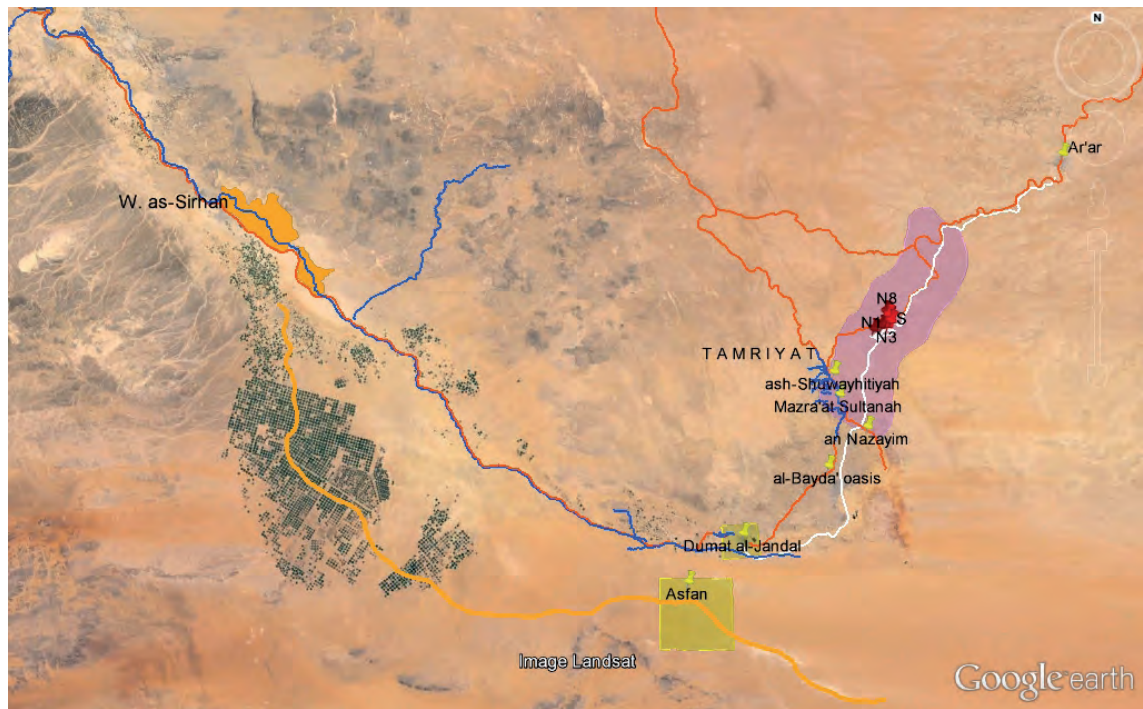


Fig. 2. Enlargements of the Tamriyat area showing the location of the tombs discovered (“turret”, circular and tumulus shape)

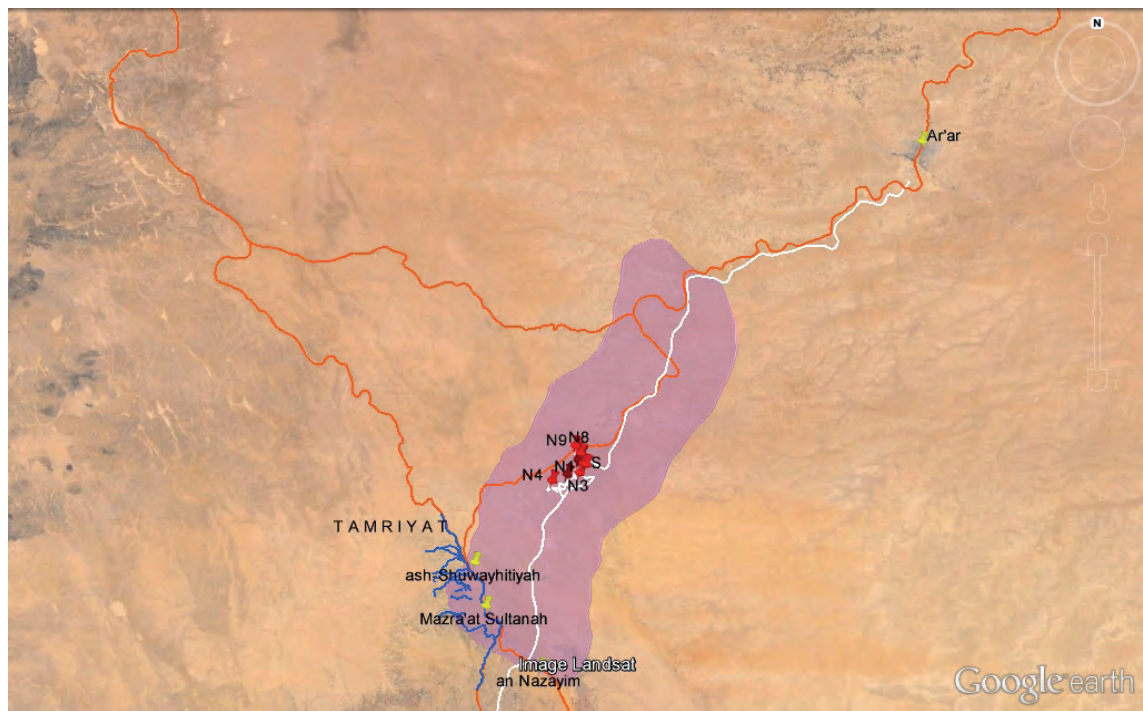


Fig. 3. Detail of the Tamriyat area showing the location of the tombs discovered (“turret”, circular and tumulus shape)

During a week of field survey we concentrated our attention on the Tamriyat area, where we have found at least 9 clusters of tombs (“necropolis”) just along the suggested ancient road (**Figs. 2-4**).

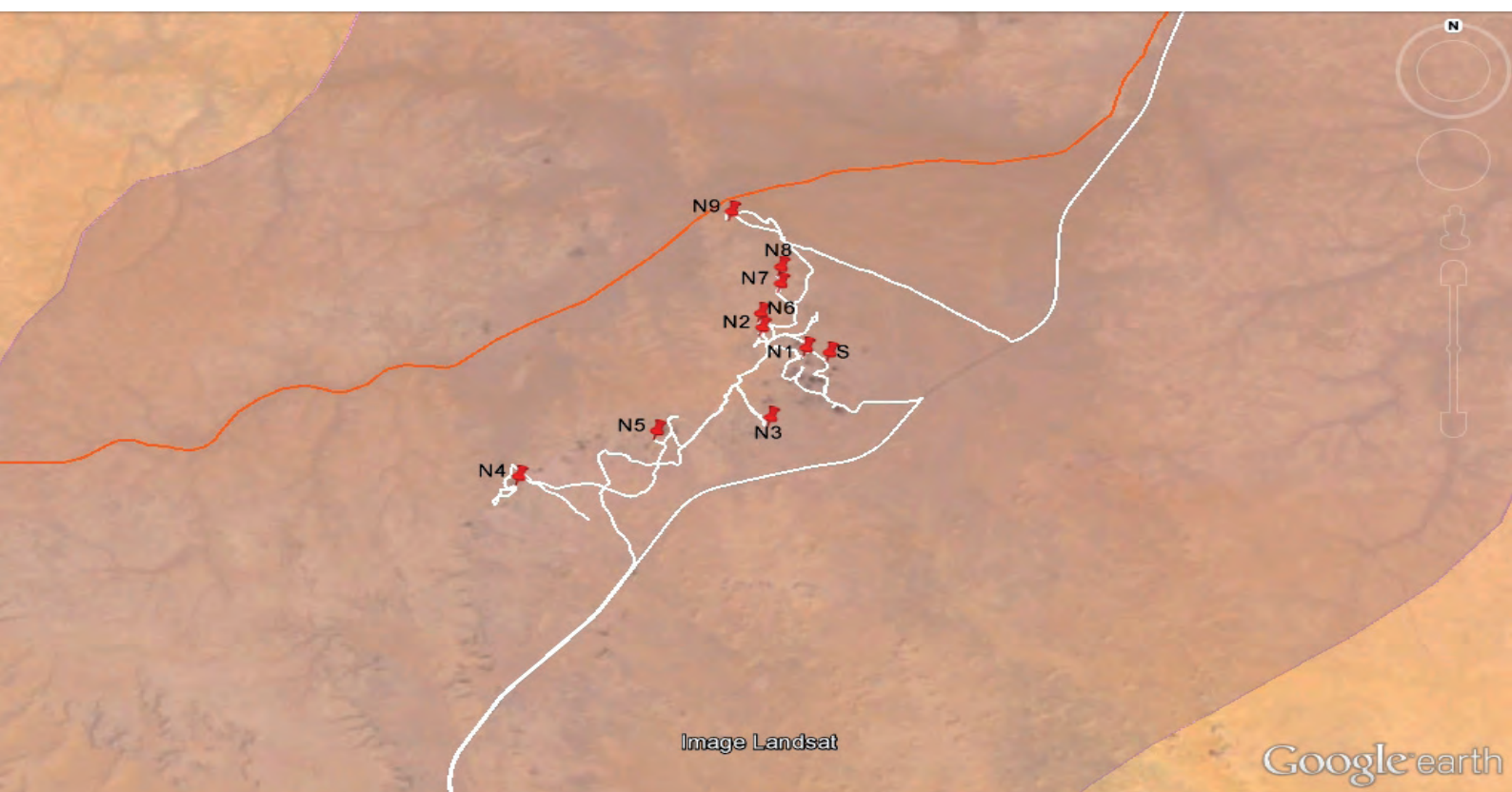


Fig. 4. Suggested “caravan route” (red), survey tracks (white) and necropolis clusters (numbered red spots from 1 to 9)

In Figure 4 the suggested ancient “caravan route” is depicted with a red line, following the main wâdî system here oriented SW-NE. The 9 tomb clusters (“necropolis”) identified on the ground are marked with red spots along the survey track which is in white. The darker band, about 4 km in width, is the surveyed terrain around the proposed old route.

It is important to note that the tomb clusters were discovered using a theoretical predictive model in close proximity to our proposed ancient route, lying on top of a step escarpment flanking the route itself. Therefore the tombs look like conspicuous elements in the landscape, visible from far away and indicating to some extent the right direction of travel (**Figs. 5-6**). In fact, the relation between these “anthropic landforms” and the traces of past routes is very tight and consistent.



Fig. 5. Tomb clusters flanking the ancient “caravan route” along wādi floor, on top of the valley escarpment (Necropolis 3)

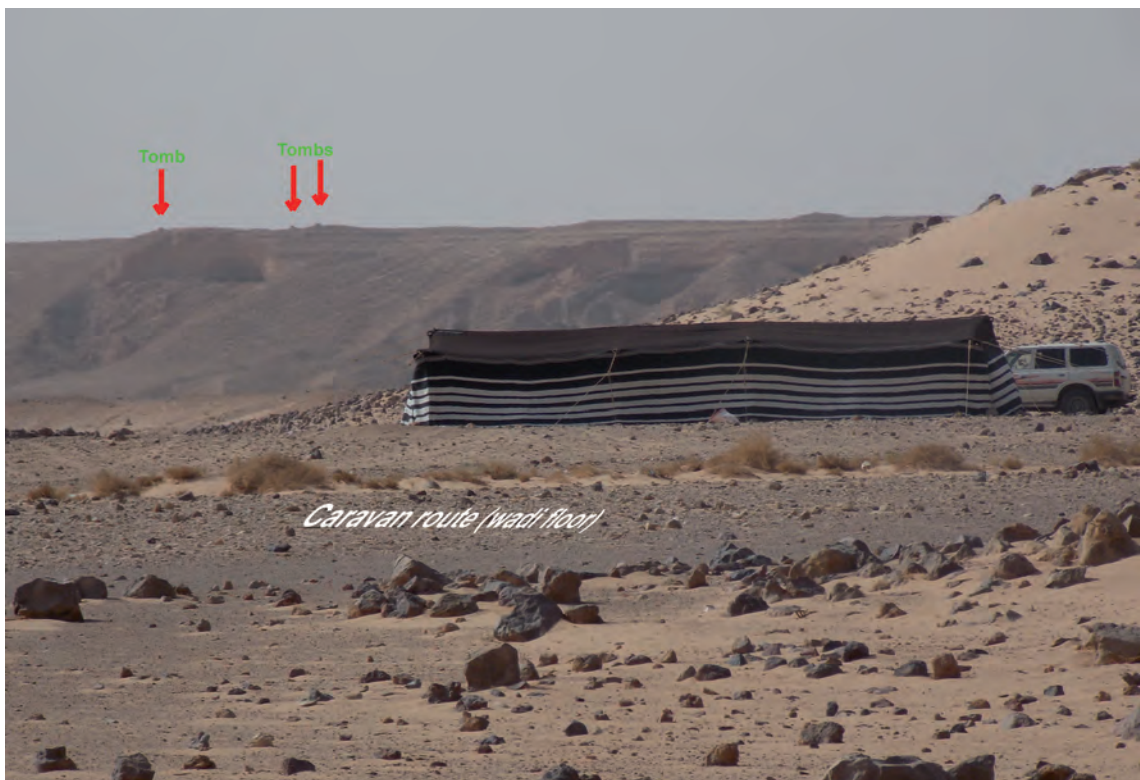


Fig. 6. Tomb clusters flanking the ancient “caravan route” along wādi floor, on top of the valley escarpment (Necropolis 4)

Here are presented some outstanding pictures (**Figs. 7-15**) of the tombs in their environmental setting.



Fig. 7. Necropolis 1



Fig. 8. Necropolis 2



Fig. 9. Necropolis 3



Fig. 10. Necropolis 4



Fig. 11. Necropolis 5



Fig. 12. Necropolis 6



Fig. 13. Necropolis 7



Fig. 14. Necropolis 8



Fig. 15. Necropolis 9

To fully investigate the location of these so far unknown clusters of ancient tombs in the Tamriyat area and to better understand their relations to natural landforms and environment, a high resolution image of 50x50 cm² from Digital Globe, taken on August the 8th 2009 by WorldView-1 satellite in B&W Panchromatic range 0.397-0.905 μ was used. In particular our attention focused on the so-called “Queen Tomb” (Site 3, the main tomb recorded. **Figs. 16-17**) and on the tombs of Site 4 (**Figs. 18-19**).

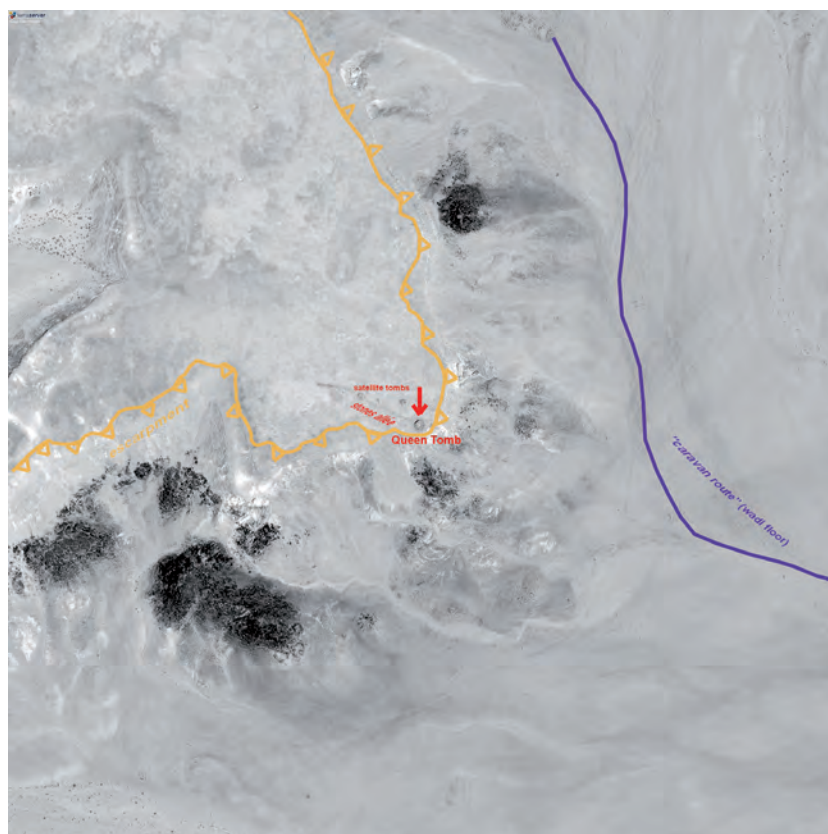


Fig. 16. “Queen Tomb” on Terra/WV01 Pan image (0.5 m of resolution)

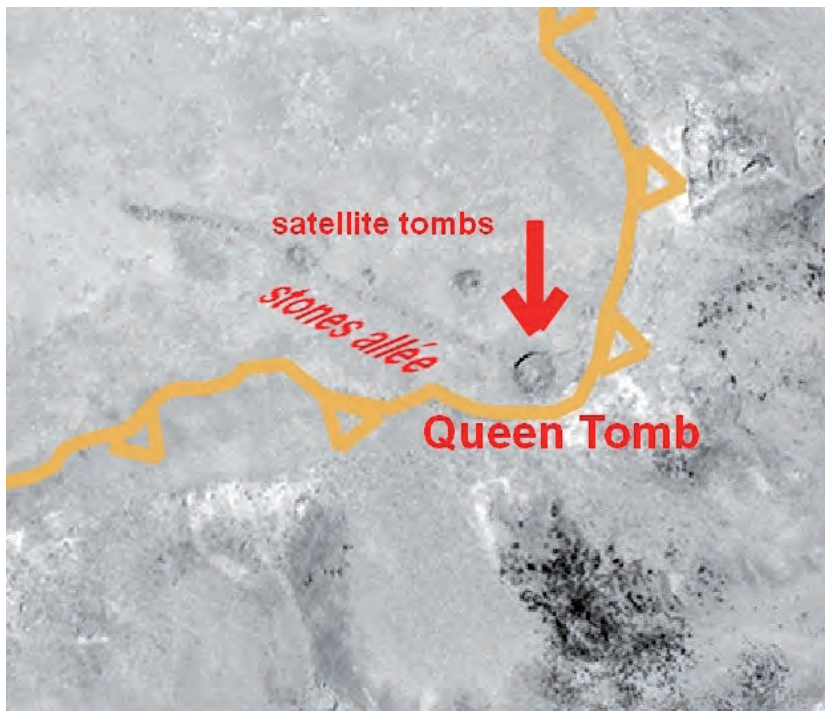


Fig. 17. Enlargement of Terra/WV01 image showing “Queen Tomb” near the escarpment bordering the “caravan route”

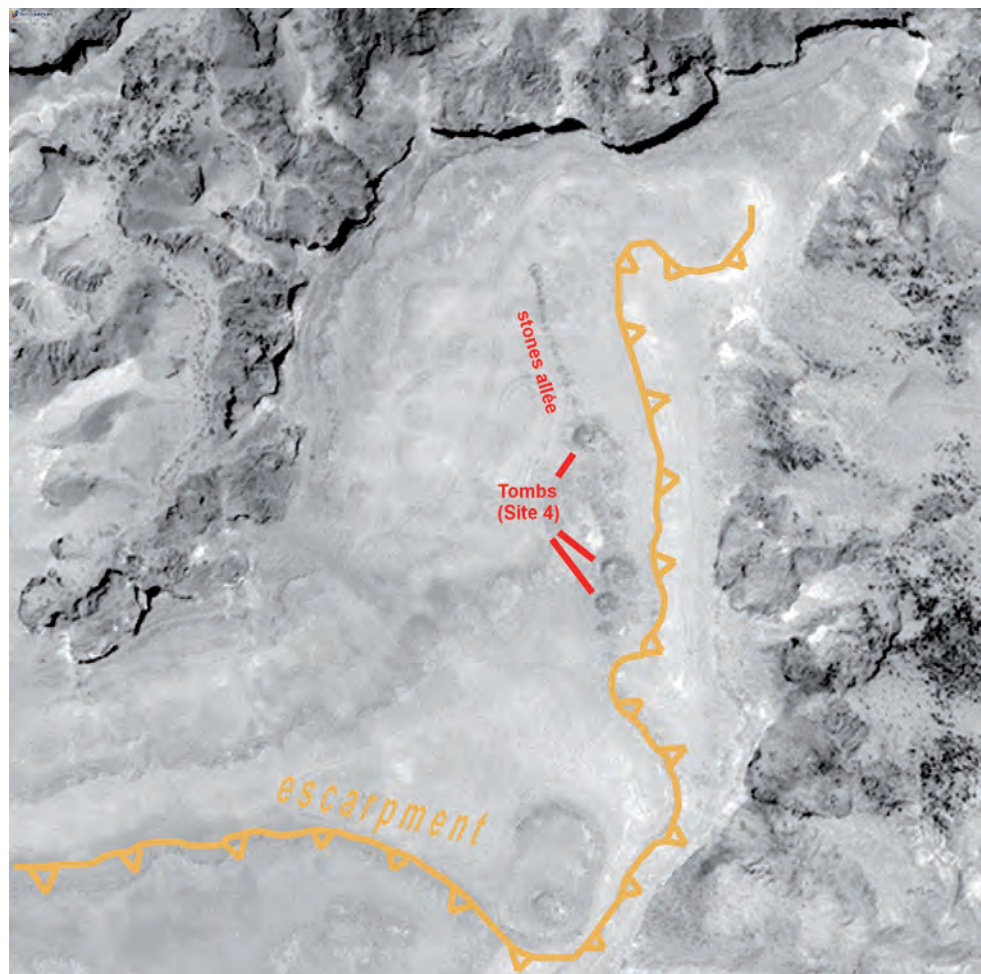


Fig. 18. Site 4 tomb complex on Terra/WV01 Pan image (0.5 m of resolution)

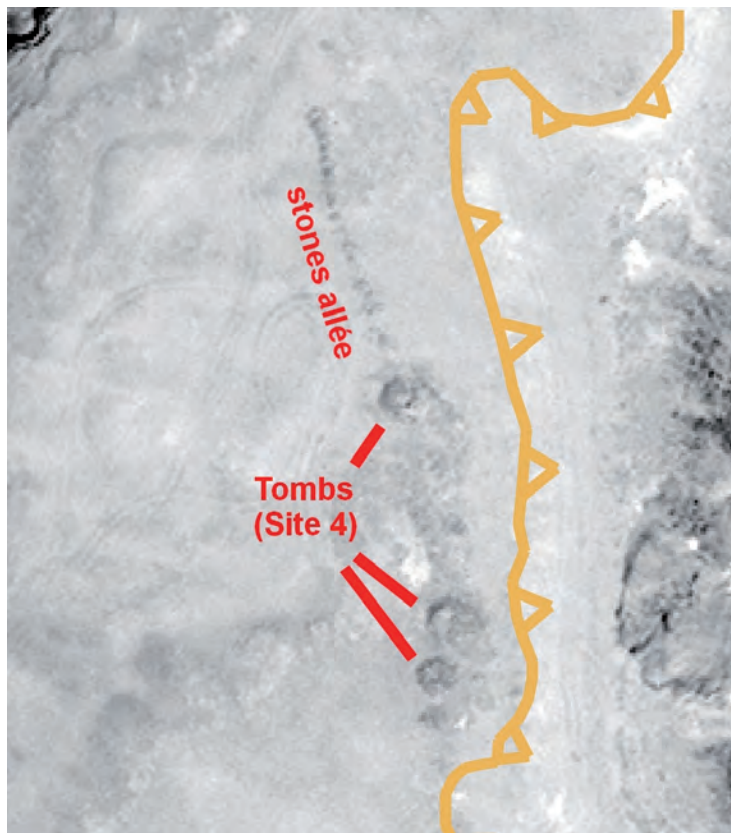


Fig. 19. Enlargement of Terra/WV01 Pan image over Site 4

From the above examples it clearly emerges that tomb clusters (“necropolis”) stand in positions dominating the edge of steep escarpments, easily seen from far away as peculiar spots in an almost monotonous landscape. Therefore they represent either landmarks for “caravan routes”, or at a more symbolic level the presence and guidance of ancestors among the present society.

Last but not least, once again a geomorphological approach, based on remote sensing interpretation and ground control, has proved essential for quick and productive geo-archaeological survey mainly in desert areas with scarce logistic facilities.

Survey to the east: new sepulchral evidence in its archaeological and historical context (Romolo Loreto)

Since 2012 the topic of the definition of ancient Dûmat al-Jandal interregional's trade routes has been studied by integrating a geomorphological approach with the archaeological and epigraphical sources. On the basis of previous studies,³ analyses of satellite images and field survey a north Arabian trade system has been suggested, linking Dûmat al-Jandal with Jordan and Bilâd ash-Shâm, to the north, and ancient Mesopotamia to the east.

For the 2013 field season the eastern routes were chosen. The strategy adopted was to verify the suggested paths, based solely on geomorphological interpretation of satellite images, with field analyses devoted to the systematic recognition of archaeological and epigraphical evidence. At this stage of analysis, in the Tamriyat area, a wide complex of Bronze Age necropolises was detected.

In spite of the few Bronze Age tumuli identified at Dûmat al-Jandal, numerous attestations of the Bronze Age are still visible along the course of the wâdî al-Sirhân. These include megalithic and trilithic monuments associated with the first structures built to control the water supply (mainly wells), from Qulbân Banî Murra to the funerary complex of Rajajîl, situated about 10 km south-east of Sakâkâ as well as from Rasîf to Shaqîq, a proto-oasis, which, based on the excavation of wells, is dated to the Early Bronze Age.⁴

These areas began to be provided with hydraulic systems catering for the reduced availability of water and anticipated the formation of oases in the 1st millennium BCE. It was in fact the formation of the oases, offering travellers security and the certainty of supplies, that provided the greatest impulse to the development of overland traffic in historical times.

³. Potts 1988; de Maigret 2000; Robin 1991.

⁴. Gebel 2013.

Tamriyat archaeological evidence

The data that have emerged from the 2013 campaign of the Saudi-Italian-French archaeological project in Tamriyat, 120 km northeast of Dûmat al-Jandal, are particularly promising.

The necropolises recorded are located on high ground at the edge of the wâdî banks. Their position makes them visible from the wâdî bed from a long way off, while as one approaches the edges of the wâdîs, they are hidden by the high ground.

Following a preliminary investigation 9 different necropolises have been identified, with a variable density of structures (less than 10 to more than 20 tombs) and architectonic typology (tumulus – **Figs. 20, 22**, tower – **Figs. 20, 21**, and turret tombs – **Figs. 12, 13**).

Generally there is one larger burial (tumulus or tower type tomb which may be as large as 7-8 m in diameter and as tall as 1.80 m) surrounded by a series of satellite structures varying in size (1 m to 4-5 m in diameter). Only the turret tombs, measuring not more than 1.5 m in diameter and not more than 1.80 m in height, have no satellite tombs, standing in isolation. It may be that these “turret tombs” were actually a sort of milestone indicating the route to be taken (**Figs. 12-13**).



Fig. 20. Necropolis 1. Different tomb types. Tumulus (left) and tower type (right)



Fig. 21. Necropolis 3 main sepulchral structure. Tower type



Fig. 22. Necropolis 1. Tumulus type tomb

Necropolis 1

The first necropolis found - N30 28 04.0 E40 23 29.5 – shows two kinds of sepulchral structures: tower tomb and tumulus (**Figs. 23-24**). Tower tombs show a uniform circular shape with no main structure emerging above the other (average size 5 m diameter). The structures revealed an advanced architectonic technique with a double curtain circular wall made of squared blocks surrounding a single burial chamber. The state of preservation is also uniform: in most of the cases the burial chamber has been already illegally excavated and part of the wall has been dismantled to reach the chamber (**Fig. 25**). In contrast, tumulus tombs present both a variation in dimension (average size 3-5 m diameter) and state of preservation; this last feature, in particular, may suggest an early origin of this tomb type. A tumulus tomb is defined by an inner circle of vertical stone slabs inserted in the ground (**Fig. 26**), defining the burial chamber (single or multiple deposition). Then, the tumulus is obtained by the deposition of flat stone slabs simply taken from the ground, without any sign of masonry, laid on the ground until the chamber is completely covered.



Fig. 23. Necropolis 1 along wādī floor, on top of the valley escarpment



Fig. 24. Necropolis 1. Tomb cluster



Fig. 25. Necropolis 1. Turret type tomb



Fig. 26. Necropolis 1. Tumulus type tomb

Necropolis 2

The second necropolis found - N30 28 20.3 E40 22 57.5 – preserves only tumulus type tombs (average size 2 m diameter). The state of preservation is quite bad: only the inner wall defined by stones inserted vertically in the ground is visible (**Figs. 8, 27**).



Fig. 27. Detail of Necropolis 2 tumulus type tombs

Necropolis 3

The third necropolis found - N30 27 11.5 E40 23 03.1- preserves the most impressive structures, both in dimension and arrangement complexity (**Fig. 28**). In particular, it revolves around the widest tomb recorded up to now (**Figs. 9, 21, 28**). It is a 1.80 m high tower tomb, with a diameter of 8 m. Arranged around a single burial chamber, the tomb is defined by a double curtain wall made of worked limestone blocks. The tomb, located at the edge of the wâdî slope, is the main point of a necropolis made of at least nine randomly arranged tombs and 20 smaller tower tomb types arranged in a single row starting from the main sepulchral structure and leading to northwest (**Figs. 29-30**).

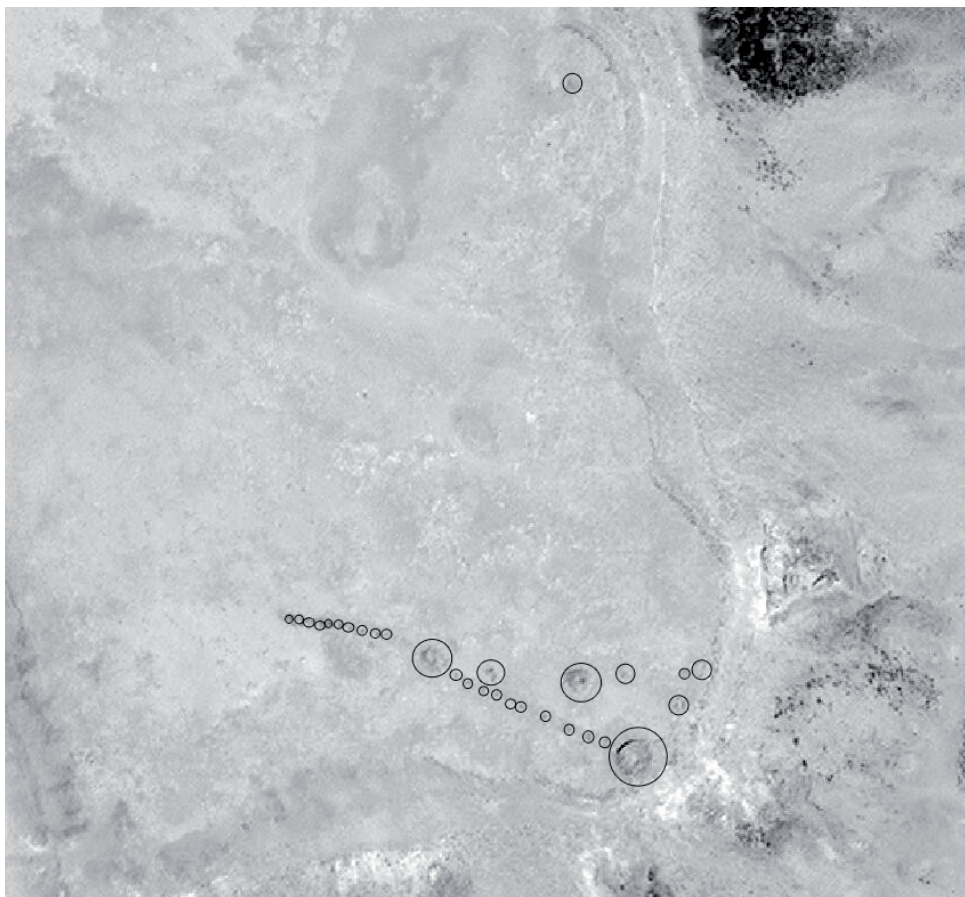


Fig. 28. Terra/WV01 Pan image (0.5 m of resolution) of Necropolis 3



Fig. 29. Detail of Necropolis 3 tomb cluster



Fig. 30. Detail of Necropolis 3 tomb cluster

Necropolis 4

The fourth necropolis found - N30 26 28.0 E40 19 59.8 – appears to be quite similar to Necropolis 3, although it does not preserve any particularly impressive tomb (all of them are tower type tomb) (**Fig. 31**). The necropolis is defined by a long north-south arrangement (**Figs. 31-32**): two main tombs with a diameter of 5 m (**Fig. 33**); three small tombs with an average diameter of 2.5-3 m; 16 smaller tombs arranged in a single north-south row are linked to the northern main tomb.

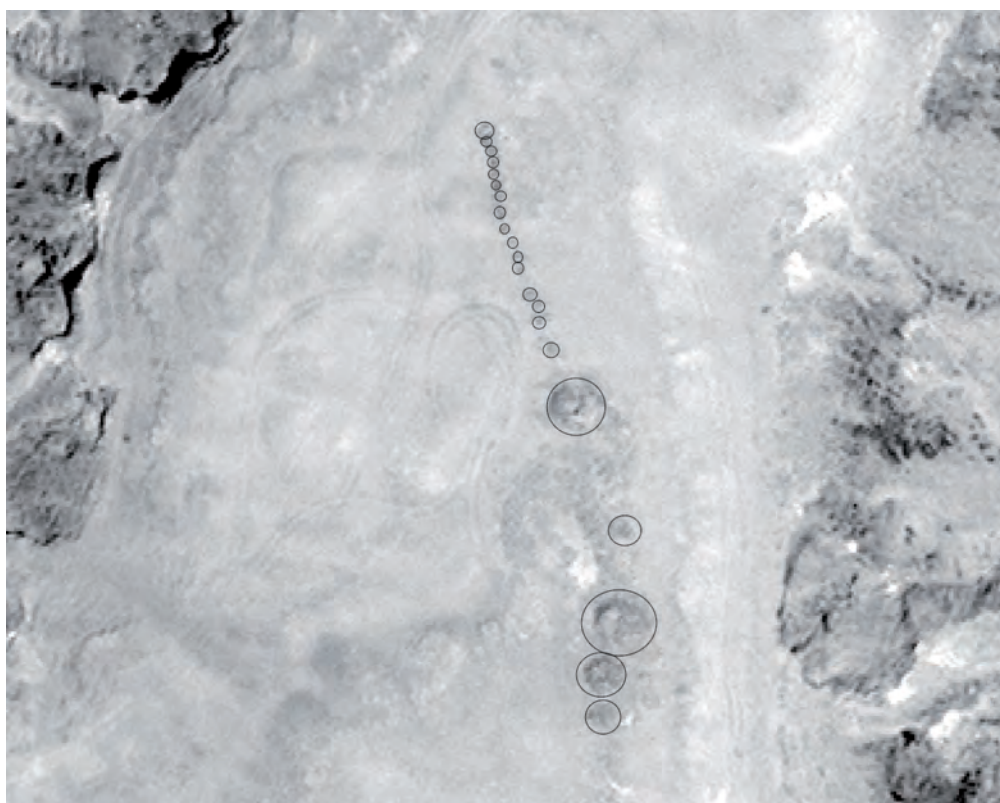


Fig. 31. Terra/WV01 Pan image (0.5 m of resolution) of Necropolis 4



Fig. 32. Necropolis 4 along wādī floor, on top of the valley escarpment



Fig. 33. Detail of Necropolis 4 tomb cluster

Necropolis 5

The fifth necropolis found - N30 27 01.9 E40 21 40.4 – preserves only few traces of tumulus type tombs. One single structure with a diameter of 10 m emerges (**Fig. 34**). Other tombs (not more than 2 m in diameter), always in a very bad state of preservation (**Fig. 35**), always stand above the slope's edge (**Fig. 36**).



Fig. 36. Necropolis 5. Tumulus type tomb



Fig. 35. Necropolis 5. Tumulus type tomb



Fig. 34. Necropolis 5. Tomb cluster

Necropolis 6

The sixth necropolis - N30 28 30.1 E40 22 56.6 – is the first to be composed only of turret tombs (**Fig. 12**). Three structures were recognized. They appear as small tombs, with a maximum height of 1.50 m. It must be stressed that the small size of the structures could suggest a different purpose.

Necropolis 7

The seventh necropolis found - N30 28 52.5 E40 23 10.9 – is the second turret type tomb necropolis identified, although only one structure can be seen in its full height (**Fig. 7**).

Necropolis 8

The eighth necropolis - N30 29 04.8 E40 23 11.3 – seems related to necropolis 5, since it is composed of tumulus type tombs in a very bad state of preservation (**Fig. 14**).

Necropolis 9

The ninth necropolis found - N30 29 48.3 E40 22 33.4 – shows a common pattern: a series of tower tombs (ten) arranged along the edge of the wâdî slope (**Figs. 37-38**).



Fig. 37. Necropolis 9 along wâdî floor, on top of the valley escarpment



Fig. 38. Necropolis 9. Tower type tomb

Tamriyat necropolises in the Arabian context

Although no archaeological dig has yet been carried out (the necropolises have already been pillaged, though a few have some intact parts remaining), on the basis of the architectonic typology it is possible to attempt a dating for the structures. The tumulus type tombs can be confidently dated to the Bronze Age, at least as far back as the 3rd millennium BCE. The tower type tombs can also be dated to the Bronze Age, although parallels from Southern Arabia may suggest a more recent dating;⁵ we cannot rule out the possibility that finds of materials that can be dated to the Iron Age will indicate the re-occupation of more ancient structures. Lastly the turret tombs, which on account of their small size do not apparently contain a funerary chamber, are at present difficult to date.

Apart from the architectonic features which can distinguish one tomb from another, the general context in which the burials occur is striking, on high ground which is clearly visible from the valleys down below, i.e. the wâdî beds, according to a scheme which is found elsewhere in the Peninsula, e.g. in the Yemen⁶ and Oman.⁷ In general, these are burials relating to nomadic contexts dating from between the Bronze Age and the Iron Age, in the Yemen, and from the end of the 4th to the beginning of the 2nd millennium, in Oman.

⁵. Crassard *et al.* 2010.

⁶. de Maigret & Antonini 2005.

⁷. Bortolini & Tosi 2011; Méry 2010.

Neolithic settlement model and kites of Harrat al-Harrah volcanic field: ancient landscape and human adaptation

(Bruno Marcolongo & Romolo Loreto)

The Neolithic era in the Jawf valley, extensively attested along the northern flank of wâdî al-Sirhân and in the desert of al-Harrat al-Harrah, and recently identified near Dûmat al-Jandal (Aşfân, on the northern edge of the Nefûd), testifies of a period of intense exploitation between the Levantine regions and Northern Arabia.⁸

The particular conformation of the Peninsula created a series of hydrographic systems which flowed eastwards from the high ground in the west towards the Arabo-Persian Gulf, giving rise to the major wâdîs (wâdî Rima, wâdî Batin, wâdî Dawasir, the wâdîs stretching from the Najd and the ‘Asir towards respectively the basin of Sabhat Matti and Uruq al-Mutarida, etc.).⁹ This was in fact a particularly favorable and generalized environmental situation which saw the development of human cultures, associated with the Neolithic era, throughout the Arabian Peninsula. They moved and settled along the water courses and lakes which served as routes of transit, extending as far as the regions ranging from what is now Jordan¹⁰ to northern Syria.¹¹

Thanks to favourable climatic conditions and the availability of water supplies, the whole wâdî al-Sirhân environment saw the development of communities of hunter-gatherers, identified by the so-called “desert kites”, also widely attested in the Levant and along the whole western side of the Arabian Peninsula. Communities of hunter-gatherers grew up along the basalt outcrops of al-Harrat, from Syria through Jordan to Saudi Jawf and on into the western areas of Arabia, with a common adaptation pattern and covering a huge geographical area.¹²

Moreover, the repertory of stone tools associated with Neolithic communities of hunter-gatherers near Aşfân testifies to contacts between the Jawf valley, the Syro-Palestinian areas and, at least, Northern Arabia, though for the Neolithic era one cannot actually speak of a “pan-Arabic” circulation of peoples throughout the Peninsula.¹³ Thus during the Holo-

⁸. Loreto 2013; Aurino & Loreto in press; Marcolongo in press.

⁹. Sanlaville 2010; Parker & Rose 2008; Parker *et al.* 2006; Petraglia *et al.* 2011.

¹⁰. Richter *et al.* 2009.

¹¹. Sanlaville 1996.

¹². Kennedy 2012; Holzer *et al.* 2010; Kempe & al-Malabeh 2010.

¹³. Crassard & Drechsler 2013.

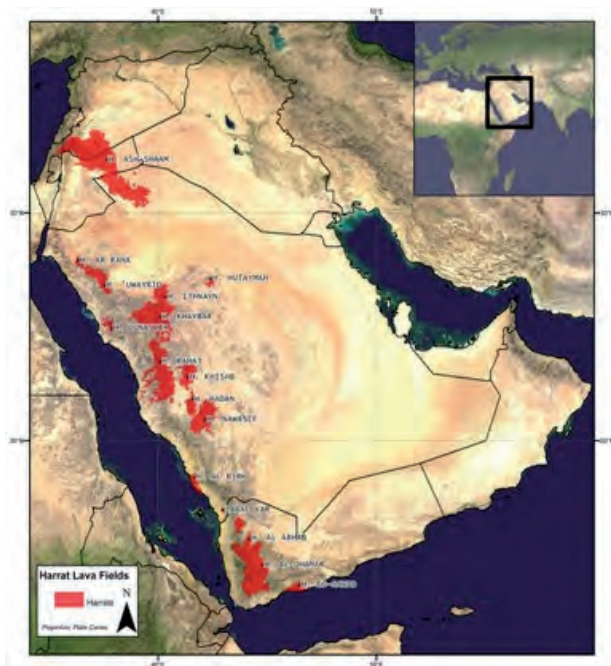


Fig. 39. Harrat lava field in the Arabian Peninsula

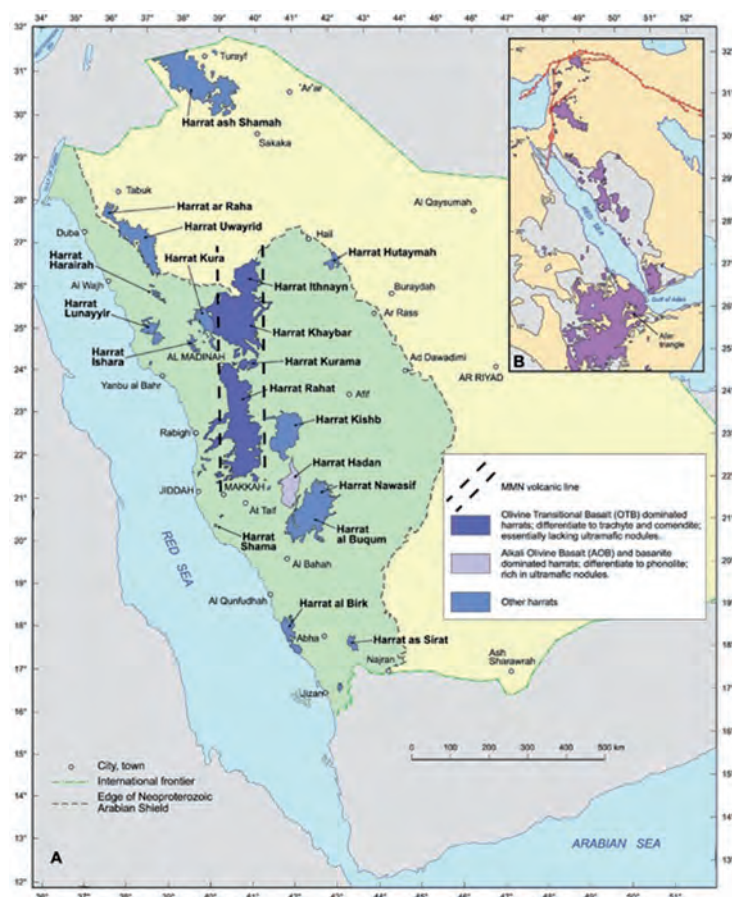


Fig. 40. Harrat in Saudi Arabia with Harrat Al-Harrah in the northern province

cene we can recognize a scenario in which Arabia was a region with particularly rich water resources,¹⁴ traversed by water courses which would have permitted the passage of peoples even over great distances.

Harrat Al-Harrah is a large volcanic field, formed by basalt flows, cones and dikes, extended in the northern province of Saudi Arabia and belonging to the wider Harrat As-Shaam.

The Arabian peninsula is dotted with many of these lava flows that occurred over a long span of time from the Oligocene to Recent Quaternary (**Figs. 39-41**).

Harrat Al-Harrah is bordered to the west by the course of wâdî as-Sirhân upstream of Dûmat al-Jandal.

It was intensely populated during the Neolithic period thanks to the presence of a savannah environment, due to a more humid climate (“Holocene climate optimum” from 9.000 to 5.000 years B.P.) and the presence of a volcanic parent material forming clayey soils more stable and moist than sandy eolian soils, thus attracting a wide variety of fauna.

Starting from that, we decided to perform a preliminary geo-archaeological interpretation of high resolution images from Google Earth and we led to identify all the stone structures spread across the entire Harrat (**Fig. 42**). In particular we have recognized different types of circular and elongated structures, grouped in simple or complex clusters, together with “kite” corrals of various shape for capturing wild goats and gazelles.

It is evident from the above sketch that there is a tight relationship between environmental parameters (soil, soil moisture, shallow ground-water conditions) and a Neolithic settlement model with “kites”, uniquely distributed on Harrat al-Harrah (**Fig. 43**).

The following snapshots captured from Google Earth show outstanding examples of circular stone features and “kites” (**Figs. 44-48**).

So far more than 300 such circular stone structures and “kites” have been recognized and located.

The next step will be to check their presence on the ground and to establish a catalogue based on morphological classification linked to a Geographical Information System, which is currently under construction and being implemented as new data are gathered.

¹⁴. Engel *et al.* 2012.

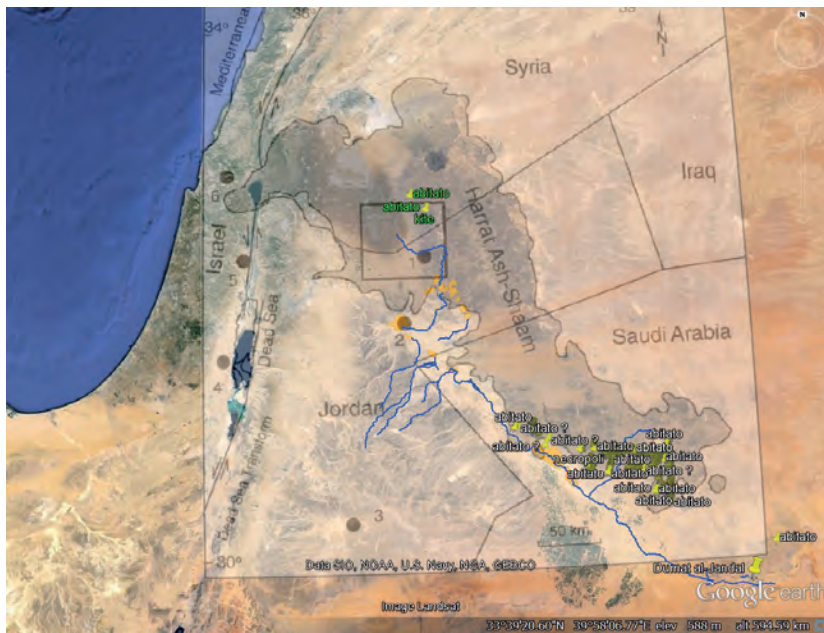


Fig. 41. Hattat al-Harra on Google Earth



Fig. 42. Circular Neolithic sites and “kite” corrals, spread on the volcanic lavas field of Hattat al-Harra



Fig. 43. Sequence of Neolithic sites along one of the Hattat al-Harra paleo-wadis



Fig. 44. Kite - 30°41'27.94"N
39°03'41.57"E



Fig. 45. Kite -
30°45'16.51"N
38°58'8.79"E



Fig. 46. Circular stone
structures - 30°41'38.35"N
39°04'15.79"E



Fig. 47. Circular stone structures - 30°39'33.85"N 39°01'56.00"E



Fig. 48. Average dimension of circular cluster stone structures – 30°43'19.28"N 39°06'52.55"E

Archaeological and Epigraphic Surveys

Guillaume Charloux, Marianne Cotty, Yann Gayet,
Frédéric Imbert, Céline Marquaire, Ahmad A. al-Qaeed,
Charly Poliakoff, Christian Robin & Ariane Thomas

The 2013 archaeological survey campaign was carried out in two phases. The first one, which has systematically targeted the west of the oasis, was carried out in the months of October and November because of its immediate proximity to sector C, which facilitated the displacement in the two contiguous sectors. The second phase of archaeological and epigraphic surveys in the area surrounding Dûmat al-Jandal took place in the month of January 2014, during the extension of the Najrân mission. Several specialists were able to visit both sites. Finally, we took advantage of this survey campaign to cross the wâdî al-Sirhân on Saturday 25th, in order to better understand its specific and admittedly not so spectacular environment and to visit the sites of Kâf and Ithra.



Fig. 1. The surveyors (DJ2013a0021)

Systematic surveys in the western sector of the oasis

Systematic surveys were conducted from October 23rd to November 12th 2013 by Yann Gayet, an arabic speaker, in the western part of the oasis. He was occasionally assisted by archaeologists, notably Marianne Cotty and Ariane Thomas (**Fig. 1**).

The work this season extended the survey into the non studied squares, and also supplemented and verified those incompletely surveyed.¹ We should bear in mind that the purpose of the exploration work remains both to produce a precise archaeological inventory of the sites of the oasis between 2010 and 2018, and to find new remains susceptible of being excavated². 191 GPS marks and around 350 selected pictures were added to the database. Twenty-seven squares have been entirely studied (**Fig. 2**):

- O-P 13
- R 18-19
- S 14-21
- T 16-21
- U 17-21
- V 18-22

The study has, in particular, allowed us to find numerous wells and manholes, belonging certainly to qanât networks as well as to the remains of presumably funerary structures identified on the surface in the necropolis area (**Fig. 3**).



Fig. 3. Wall appearing on the surface in the sector of the ancient necropolis (DJ2013a0778)

1. For the state of surveys in 2012 refer to Arbach *et al* forthcoming (*Dûma* 3, 2012).

2. The employed method is detailed in Arbach *et al* forthcoming (*Dûma* 2, 2011).

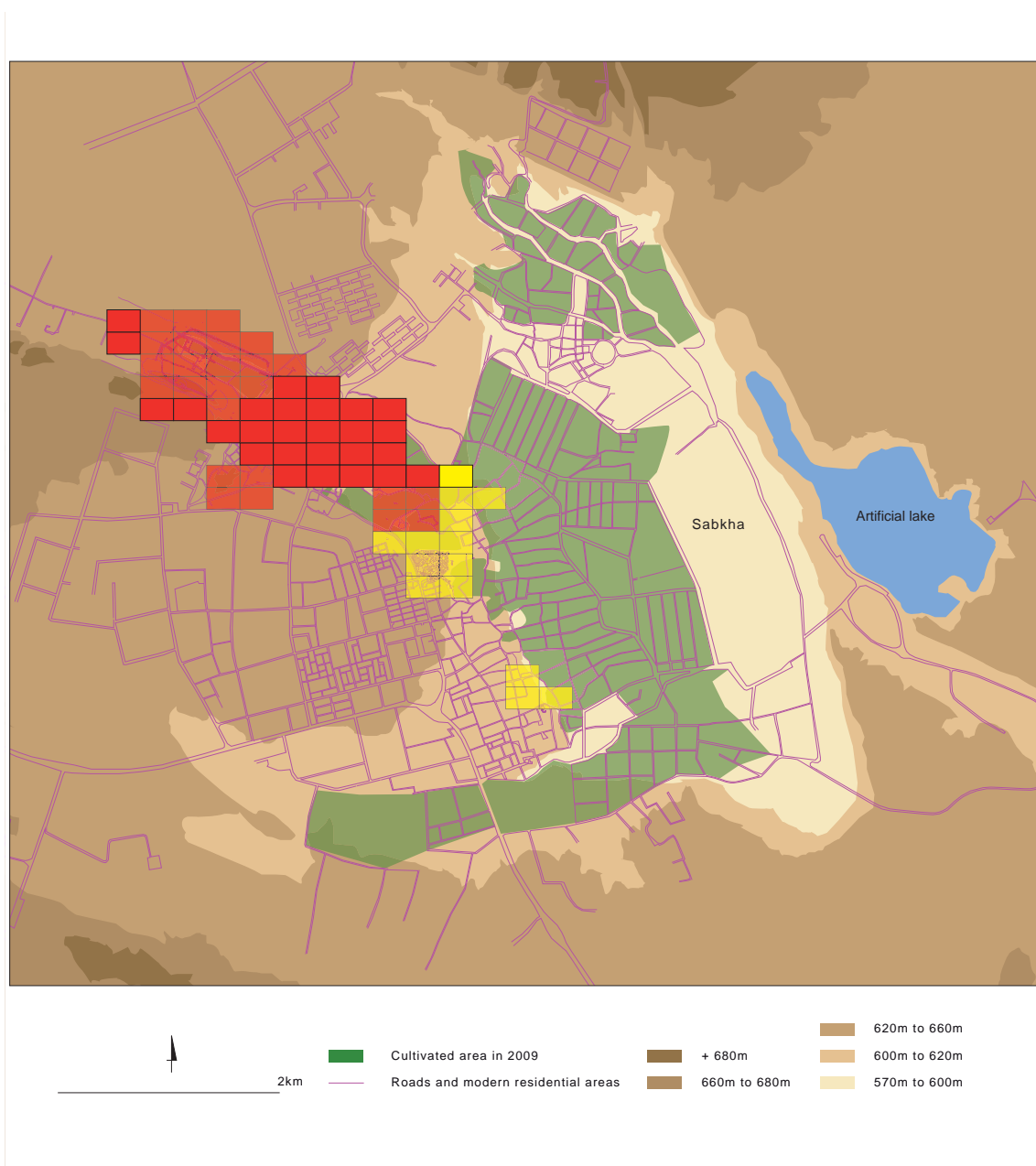


Fig. 2. Map of the oasis, with the location of surveyed sectors (red: completely surveyed ; yellow: partially surveyed / transparent done until 2012, others in 2013)

Archaeological and epigraphic surveys around Dûma

The short mission conducted from 21st to 25th January 2014 aimed at surveying the area around Dûmat al-Jandal in the hope of finding new archaeological and epigraphic evidence in the Dûmat al-Jandal region, as well as to locate well-known inscriptions (for instance those identified by Winnett and Reed in the 1960) (**Fig. 4**).

Due to various problems, the period of our stay at Dûma was much reduced and we had only four days of work in the field. During these days, survey activities were concentrated on different localities to the north of the oasis, mainly between Djebel Hamamiyat and al-Qudayr. We targeted the survey areas based on three criteria, the presence of walls (generally in sandstone) suitable for engraving, topography and circulation axes. Thus this year we focused our research on the southern contour of a large sandstone plateau (sector of al-Hiqna), which prevents a straight passage towards Sakaka, forcing one to pass either from the south, via Qudayr and Tuwayr, or from the north along the path known as “the ancient route”, built in asphalt. Eight sites (sites 40 to 47) and 22 photographs were added to the database during our season. More than 70 photographs of inscriptions concern the Islamic period (see Imbert, this volume).

Sector of al-Hiqna

Site 40

It consists of a small concentration of scattered rocks, low and sometimes flat, in a rocky and desertic environment, located not far from the tip of the rocky plateau. Some rock carvings, Thamudic and Arabic – the most interesting have been inventoried. (**Fig. 5**).

Site 41

Site 41, on the same alignment as the previous one, but located at the base of the plateau, spanned several hundred metres on an east-west axis. Unlike the previous site where they are in the open air, carvings were made in protected spaces and away from the sun (**Fig. 6**) The site has mainly delivered an interesting quantity of Arabic inscriptions, as well as engravings of the “hands of Fatima.”

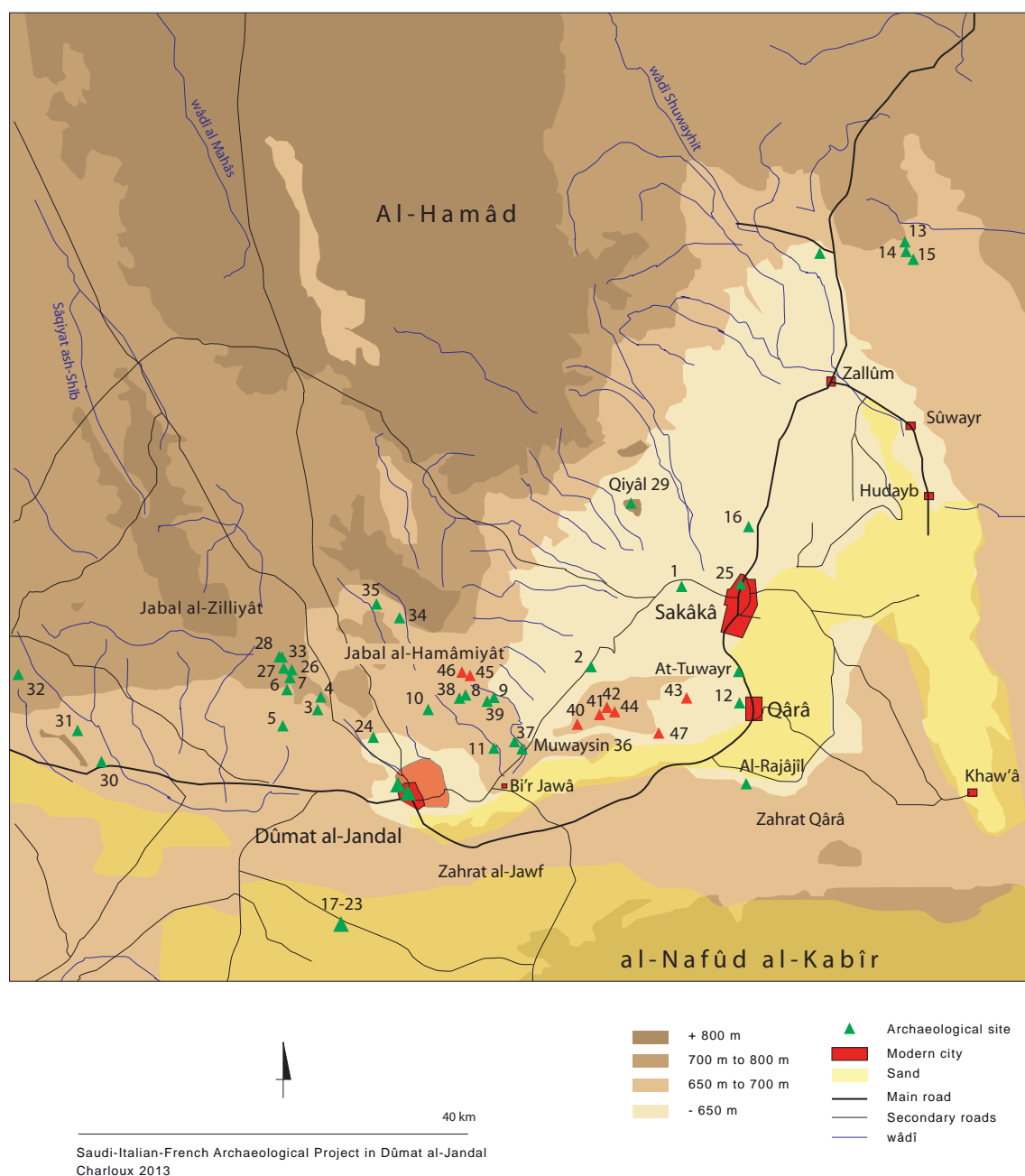


Fig. 4. Map of the region, with the location of newly discovered sites (red triangles)



Fig. 5. Site 40 - Arabic inscription (DJ2013a1272B)



Fig. 6. Site 41 (DJ2013a1283B)

Site 42

Site 42 (**Fig.7**) is situated a few kilometres further east. It consists of a long wall located high up and of a collapsed block front, presenting some engravings depicting dromedaries, and some Thamudic and Arabic inscriptions. An Arabic inscription has been discovered across the rocky promontory a few hundred metres away.



Fig. 7. Site 42 (DJ2013a1294B)

Site 43

Site 43 (**Fig. 8**) seems entirely original. Located on the plateau, it consists of an extended block of highly weathered sandstone, with planar and dark surfaces, on which there are many linear and interleaved engravings. Essentially it consists of animal representations and enigmatic circular symbols in the shape of a medallion. More recent Thamudic and Arabic inscriptions have also been found.



Fig. 8. Site 43 (DJ2013a1321B)

The site has recently been across in its centre by an asphalt road. The day of our visit, technicians were taking topographic measurements with levels and it is likely that the site will disappear very soon, if it has not already.

Site 44

A single engraving (**Fig. 9**), located near three cairns, has been observed on site 44, in the recess of a rocky cliff. This engraving of a dromedary is fairly exceptional, for its dimensions, since the animal is almost life-size, but also by the quality of the engraving, in a pure and precise style, adapting perfectly to the underlying bedrock panel contours and playing with the brown orange colours of the sandstone.



Fig. 9. Site 44 (DJ2013a1333B)



Fig. 10. Site 45 (DJ2013a1358B)

The Jabal Hamamiyat

The two neighbouring rock art sites 45 and 46 are located in the Jabal Hamamiyat, in a very desertic and rocky environment, flat, except for fairly prominent scattered hills.

Site 45

Site 45 (Hamamiyat 6) had been spotted for the first time following a visit by the team in October 2013 and we returned on site on January 22nd for a more comprehensive review. It is located at the base of the slope of a rocky hill (**Fig. 10**). A few scattered blocks show richness of rock carvings, especially the heads of ibex and other weathered prehistoric representations, but also some original patterns (snake, wheel). Add a few Thamudic inscriptions, and Arabic inscriptions of fine quality.

Site 46

The small rock art site 46 (Hamamiyat 7) is situated approximately 300 m west of the previous one (**Fig. 11**). A few monograms as well as Arabic and Thamudic inscriptions have been engraved on a collapsed block. A vertical Thamudic inscription, beautifully made, was recorded on a rock up the hill.



Fig. 11. Site 46 (DJ2013a1363B)



Fig. 12. Site 47 (DJ2013a1419B)

Sector of Qârat Duwayfina

Site 47

Site 47 (**Fig. 12**) develops over a wide area in the sector of Qârat Duwayfina, not far from Jouf airport. Scattered and flat blocks of sandstone are located in a large sandy plain with sparse vegetation. It was reported to us by Hans Gebel in November 2013, before we returned at the beginning of year 2014.

Our attention has been drawn by several rocks, presenting a strong richness of engravings, notably of beautiful Thamudic and Arabic inscriptions, alongside a classic Nabataean inscription, another Greek, and two transitional Nabataean-Arabic texts. There are also many common animal representations.

Related sites

On the occasion of the survey of 28 Palaeolithic sites (sites 48-75) (see Crassard & Hilbert, in this work), prehistorians Rémy Crassard and Yamandu Hilbert have found several scattered engravings bearing the site numbers 76-84, but they have no specific interest except the Nabataean inscription from site 84.

New Arabic Inscriptions around Dûmat al-Jandal in Saudi Jawf

Frédéric Imbert (Aix-Marseille University)

Surveys carried out in the region of Dûmat al-Jandal in January 2014 follow those that took place in November 2012. These epigraphic surveys, aiming to enrich a corpus of Islamic graffiti, had proved particularly rich in 2012 as about 300 graffiti, many of them unpublished, were then identified and analyzed mainly on the sites of Qarat Nisa (DaJ11) and al-Muwaysin (DaJ47). As part of the dissemination of these findings, several articles have been published or are still in press.¹ As for the preliminary results, they were exposed at various seminars and conferences in France, Europe and the U.S.A.²

The epigraphic mission “Dûmat al-Jandal 2013” set as its goal to continue investigations in the main areas where Arabic inscriptions had been identified in previous missions. During three days of surveys, 55 Arabic texts, mostly graffiti, were identified and photographed. They are divided as follows (see **Charloux et al. Survey: Fig. 4**):

Site	No. of texts
Sector of al-Hiqna (DaJ41)	24
Jibâl al-Ḥamâmiyât (DaJ45-DaJ46)	13
Muwaysin (external) (DaJ37)	8
Qudayr (Tuwayr) (DaJ12)	6
Sector of Qârat Duwayfina (DaJ47)	4
Total	55

Tab. 1. List of visited sites

1. Imbert 2014 a, b.

2. March 2013: Paris, Colloque Syrab, *Du Syriaque à l'arabe* ; April 2013: Notre Dame University, South Bend U.S.A.: *Qur'an Seminar*; April 2013: Paris, *Académie des Inscriptions et des Belles Lettres*: communication; september 2013: Oxford University *Graffiti Conference*; October 2013: London, Institute for Ismaili Studies: *Fragmentation and Compilation: The Making of Religious Texts in Islam*.

Surveys in al-Hiqna

It is in the area of al-Hiqna (DaJ41), located east of Muwaysin, that we have found the largest number of Arab graffiti. This is an escarpment located immediately next to the road leading to the locality of Muwaysin al-Tuwayr. It is just below this escarpment, at various levels, that more than twenty Kufic texts were discovered. In the lower part, not far from the track leading to agricultural facilities (Qâ' al-Hiqna), a large rock reveals ten inscriptions that are mixed with representations of hands or palms (**Fig. 1**). The form of such graffiti is reminiscent of many texts known in the region, which mainly consist of requests for forgiveness and mercy. In this they are quite consistent with the local tradition of which we have many examples in Muwaysin (DaJ37) and Qarat Nisa (DaJ11), a few kilometres from al-Hiqna. They are formulas, asking for forgiveness, that begin by *Allahumma ighfir/Irham* ("O God, forgive/have mercy").

However, one of the peculiarities of the texts discovered in the valley of al-Hiqna, is the presence of women. They are generally not present in the graffiti that are rather echoing the prayers of men of Islam. One 'Abîka (ou 'Ubayka)³ ask for forgiveness for her sins and claims to be the author of the engravings (*katabat 'Abîka* is 'Abîka wrote) (**Fig. 2**). Another woman's name is repeated not far: the 'Âtika found also written in the middle of a palm design with the word *li-'Âtika*, to the attention of 'Âtika which can also be understood as "the palm of 'Âtika" (**Fig. 3**).

Anyway, the representation of open palms with written statements inside seems to resemble a local practice. However, it is still difficult to put forward a hypothesis about the symbolism of these designs. We generally associate them with positive and protective values (see the so-called "Fatima Hand"), but it seems that the uses are more varied: between Muwaysin and al-Hiqna we now have a series of palms, of hands and of forearms that will serve us to advance some hypotheses: hands of forgiveness, hands that protect, hands of the prophet, hands containing the names of women (**Fig. 4**).

3. The name is attested under these two forms in Zubayr 1991: 4/2003.



Fig. 1. Wall of graffiti and representations of palms at al-Hiqna



Fig. 2. al-Hiqna, invocation and signature of woman



Fig. 1. al-Hiqna, palm and kufic text addressed to a woman



Fig. 2. On the heights of al-Hiqna, kufic text on a fallen rock

Continuation of survey in Jibâl al-Ḥamâmiyât

In November 2012, we conducted surveys around Muwaysin and the heights of Jibâl al-Ḥamâmiyât towards the northwest. We had found Kufic texts of great interest notably some mentioning Prince al-Walid b. ‘Abd Al-Malik, future caliph al-Walid 1st. In 2014, we decided to continue our investigations in the same sector (DaJ45-DaJ46) from the last point reached during the previous mission. Thirteen Kufic Arabic inscriptions were recorded. The texts were rather on the foothills of the rocky massif, or at the mouth of passes that allowed traveling between these ranges.

The found texts with names and invocations for forgiveness and mercy. Among them, we noticed a specular inscription (engraved as a mirror image). It is interesting to note that the stonecutter struggled to produce his engraving in reverse and some Kufic characters remain written in the normal direction of the Arabic script (**Fig. 5**).

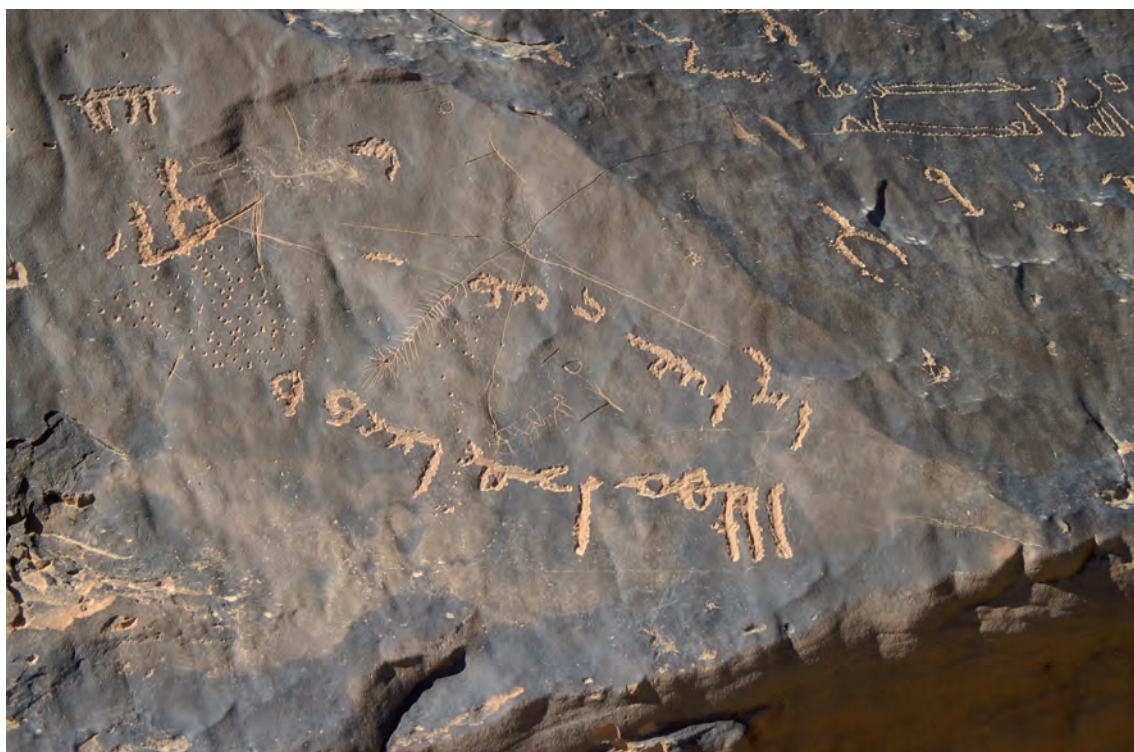


Fig. 5. Jibâl Hamâmiyât, kufic graffiti engraved in reverse

Site of Qudayr/Qadeer

A short visit to the site of Qudayr (Qadeer locally; DaJ12), between the towns of Qara and Tuwayr south of Sakaka, has allowed us to record six Arabic inscriptions from various periods. This is a very interesting element to the extent that the majority of entries we gathered in the region of Dûmat al-Jandal/al-Jawf are generally Kufic texts dating from the late 7th and 8th century AD. At Qudayr, we have a panel that covers a great stretch of time: two graffiti are clearly ancient and composed in Kufic on the lower parts of the hill near the Thamudic engravings.

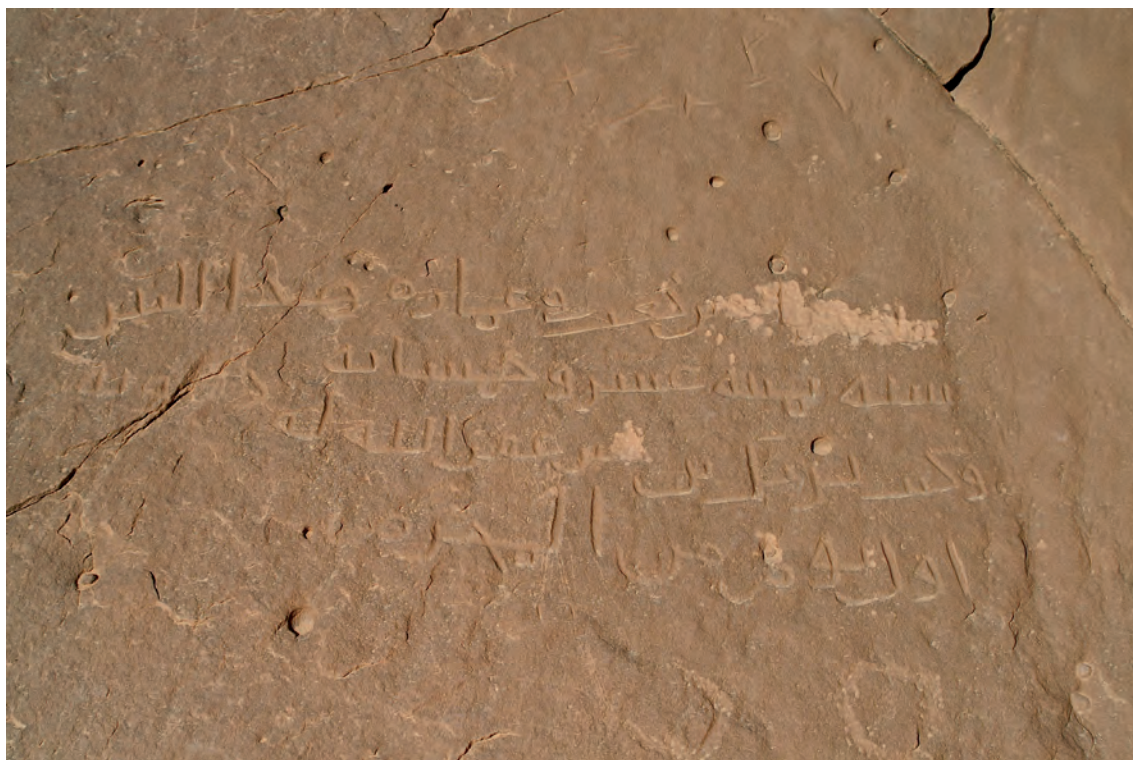


Fig. 6. Graffito of Ayyubid era dated from 518/1124

In contrast, a graffito located a little higher on the rock to the right of the ruined tower dates from the Ayyubid era, which is rare in the region. It bears the exact date of the first of Muharram in the year 518 AH (19 February 1124) and commemorates the construction of a well. For some reason, the first letters of the name of the character have been intentionally hammered out (**Fig. 6**). It reads:

- (١) (و... عماد ؟) بن كعب في عمارة هذا البئر
 (٢) سنة ثمانية عشر وخمسة (م)ائة
 (٣) وكتب بريل بن خير غفر الله له ذ[ن]وبه
 (٤) أول يوم من المحرم

- 1) ... 'Imâd (?) b. Ka'b in the construction of this well
 2) In the year 518.
 3) Barbal⁴ b. Khayr has written, may God forgive his sins
 4) The first day [of the month] of Muharram.

A little higher on the rock, there are two Mamluk graffiti, which were read. One is dated to 644/1246 and the other to 736/1335. They were probably left by soldiers in garrison or passing by the Jawf region. We find very similar texts (in writing and in form) in the east of Jordan, at the northern mouth of the wâdî al-Sirhân at the site of Jabal Qurmâ.⁵ The Mamluk texts of Qudayr are very finely engraved in a Mamlûk naskhi style. The text of the 1246 inscription is the following (**Fig. 7**):

- (١) حضر في هذا المكان
 (٢) علي ابن ... ابن أحمد
 (٣) ابن يوسف ابن الشيخ
 (٤) أبو القاسم
 (٥) سنة أربع وأربعين
 (٦) وستماية
 (٧) من شهر جمادى
 (٨) الآخر رحم الله من
 (٩) قراه ودعا لكاتبه
 (١٠) بالتوبة ولجميع المسلمين

- 1) Has been present in this place
 2) 'Alî b. ... b. Ahmad
 3) b. Yûsuf son of Shaykh
 4) Abû l-Qâsim,
 5) in the year
 6) 644,
 7) During the month of jumâdâ
 8) the second, may God have mercy on
 9) who read the inscription and invoked for forgiveness
 10) to whom wrote it and to all Muslims !

⁴. The name is attested in Zubayr 1991: 2/1168.

⁵. Imbert 1996: II, p. 465, 598.



Fig. 7. Graffito of Mamluk era dated to 644/1246

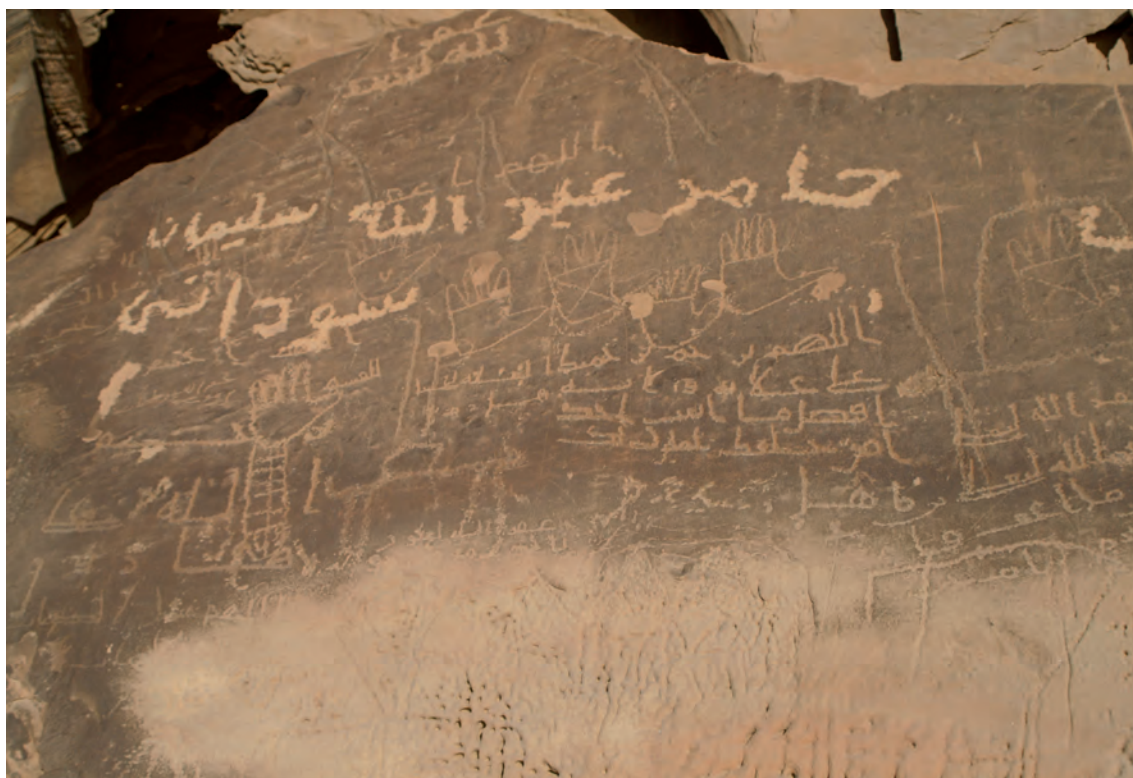


Fig. 8. New panel of graffiti outside the site of Muwaysin

Return in Muwaysin

During our previous mission, we conducted an extensive recording of all Arabic texts on the site of Muwaysin (DaJ37). Some of these texts had previously been published by Kh. Al-Muaikel.⁶ In 2014, we extended the surveys along the rocky escarpment that extends from the fort of Qasr Muwaysin to the site of Muwaysin which is protected by a fence.

To the west of the fence on the outside and top of the escarpment, we discovered a batch of eight unpublished Kufic inscriptions (**Fig. 8**). As the texts that are within the site, the graffiti are accompanied by engravings of hands or forearms. In these texts we found the names of some characters that are listed within the site. Not being protected, this batch of engravings has suffered some damage in the form of modern graffiti.

⁶. al-Muaikel 1994.

Survey in the zone of al-Jawf airport

In an area widely known as Qarat Duwayfina (DaJ47), north of the airport of al-Jawf and east of al-Hiqna, we found some Arabic graffiti on rocky outcrops. Only a small set of Kufic texts were found during this survey (**Fig. 9**).

In conclusion, fifty Arabic texts collected during a relatively short exploration phase give an idea of the epigraphic density of the area immediately northeast of the city of Dûmat al-Jandal. For two campaigns (2012 and 2014), we conducted an investigation of an east-west corridor that generally stretches from Jibal Hamamiyyât to the town of Qara. It is now appropriate to continue these surveys, south of the city and especially further north to Sakaka and its vicinity.



Fig. 9. Graffiti on a rock from Qârat Duwayfina

Studies of Wells and Qanâts in Dûmat al-Jandal 2013 Campaign

Olivier Testa, Matthieu Thomas & Paul Courbon (Fédération Française de Spéléologie)

Following the short campaign in which we participated in 2012,¹ many issues remained outstanding and it was necessary to return to the field to understand the design, operations and development of the wells and qanâts of Dûma. During the second half of November 2013, the team of the French Federation of Speleology was in charge of the in-depth study of the sector called “historic” in the centre of the oasis, and of the area situated further northwest, already visited in 2012. During the previous year, the study of the historical area had provided us with the hypothesis that the qanâts may have served the function of well-cisterns, which, however, needed to be verified by altitude measurements. We also started to explore long qanâts in the second area that appear to be different from those found in the historic area.

Thanks to the systematic inventory by Guillaume Charloux and Yann Gayet, and the various elements observed in the field, we went down several wells not listed last year, which helped to show the connection between several wells connected by qanâts. A long process of documentation and study of this system (PU211 -PU212 -PU537 -PU538 -PU540 -PU541) ensued. In parallel to this work, our research on satellite and aerial imagery, supplemented by field surveys, have enabled the unexpected discovery of many wells, some of which included an entry into other qanâts.

Each well orifice was found and photographed and added to the mission georeferenced database. The wells that were descended into and the qanâts that were followed were the subject of detailed topographic planning and complete photographic coverage.

¹. Thomas, Testa & Courbon, « Les puits et qanâts de Dûmat al-Jandal (Arabie saoudite) »; Thomas, Testa & Courbon, « Preliminary Study of Wells and Qanâts of Dûmat al-Jandal ».

Finally, meticulous work helped to further document the qanâts named ‘Ain al-‘Abbas between the current crop area and the historic area. Work was undertaken to unblock well PU150.

In order to understand the fluctuations of the water table and see if it followed a logic, the water level of each well was measured systematically throughout the mission.

During our fieldwork, we were able to talk with the inhabitants of the oasis. These discussions have yielded some very interesting information concerning the operation of the wells and understanding of the qanât systems joining them.

The long task of data compilation and review was then conducted. so far we have recorder at this stage 89 wells and qanât manholes on the surface; 63 wells are still open and have been explored. Twenty-two wells are along three qanâts totaling almost to 600 m of development, making Dûma a place of choice for the study of underground hydraulic structures in the region (**Fig. 1**).

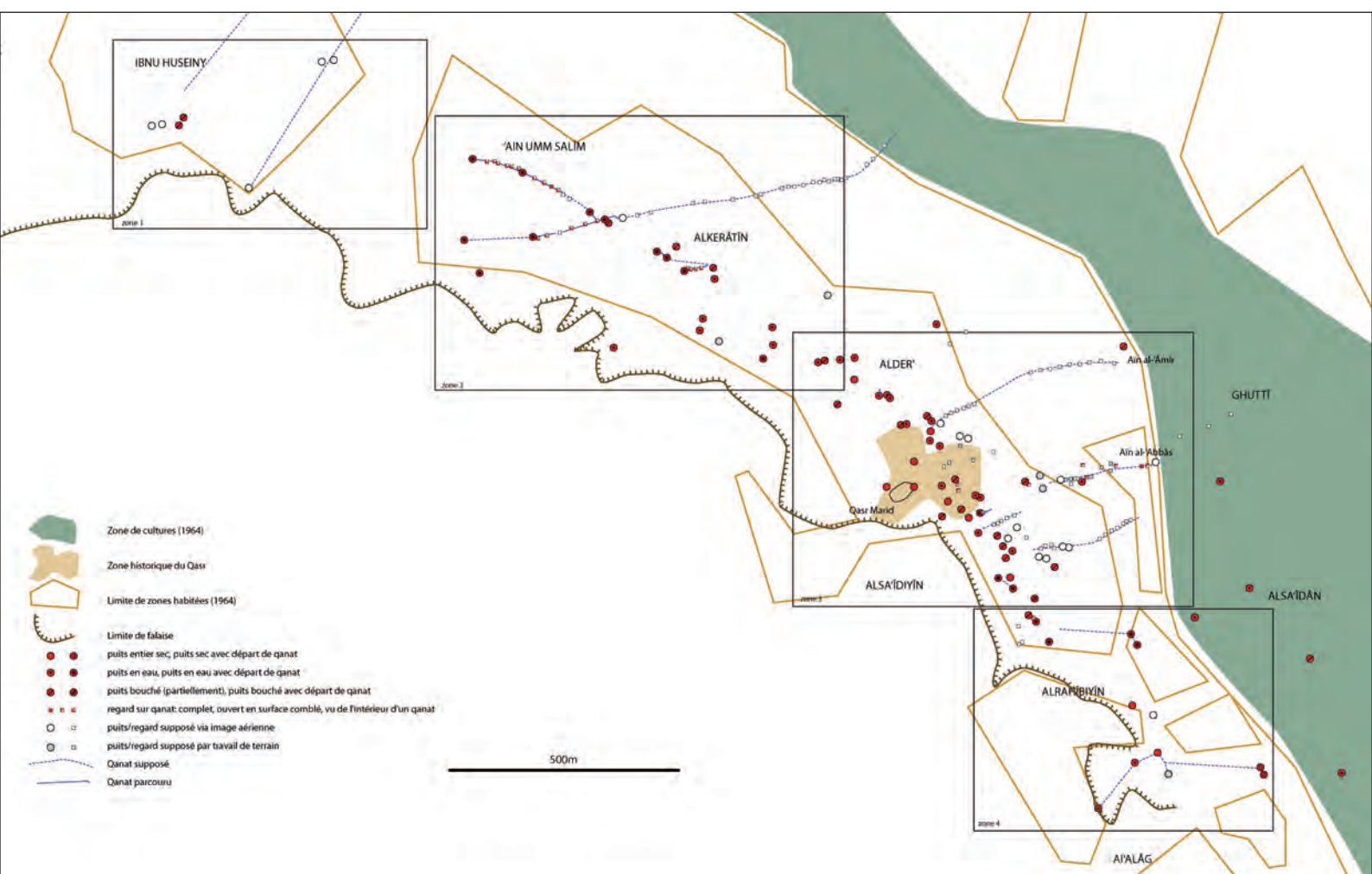


Fig. 1. Mapping of all wells and qanâts explored in 2012 and 2013 in the northwest part of the oasis.

Data from explorations

Cartography of the zone under study

Zone 1

In this area (**Fig. 2**), we have not found trace of the wells that were distinguished on aerial images. Discussions with local owners have taught us of the existence, in the past, of two qanâts. No trace of these qanâts is visible, either on the ground or on the aerial images from 1964.

Discussion with Mohammed Abdallah Al-'Arjân

Mohammed Abdullah Al-'Arjân (64 y. old) started working at the age of 4. He participated in the cleaning of two qanâts for up to 12 years, at which time prosperity arrived and his family entrusted the cleaning of the qanâts to workers.

He led to in Bir al-Tal'a (point 408), located next to a pond. The now collapsed well is obstructed at 1 m of depth. But in the past the water was about 20m deep, level barely above that of the qanât, limiting the flow in it. It is unclear exactly what the water depth was. A circular staircase allowed to reach the base of the masonry part and the beginning of the qanât. The water leaving the qanât reappeared in the open air at Ain al-Lâqî (Item 403) which was the start of an irrigation canal. The slope of the qanât joining Bir al-Tal'a and Ain al-Lâqî was stronger than that of the qanât located further east, where he also worked. The direction of the flow of the qanâts was the same as that of the slope of the ground.

There was a manhole roughly every 40 m. These manholes were used for aeration and disposal of sediments during cleaning. To avoid earth or dirt falling into the manholes over time, they were blocked at 1m of depth by a slab that was covered with earth. To find them on the surface and reopen them, the worker in charge of cleaning the qanât from the inside banged with a stone slab on the closure. People present on the surface found the manhole following the noise and unblocked the access to it.

This well-qanât system generally belonged to a family to irrigate their own land. Sometimes there was an agreement between two families for common use. Some 25 to 30 years ago the wells still had water in them, before they went out of use.

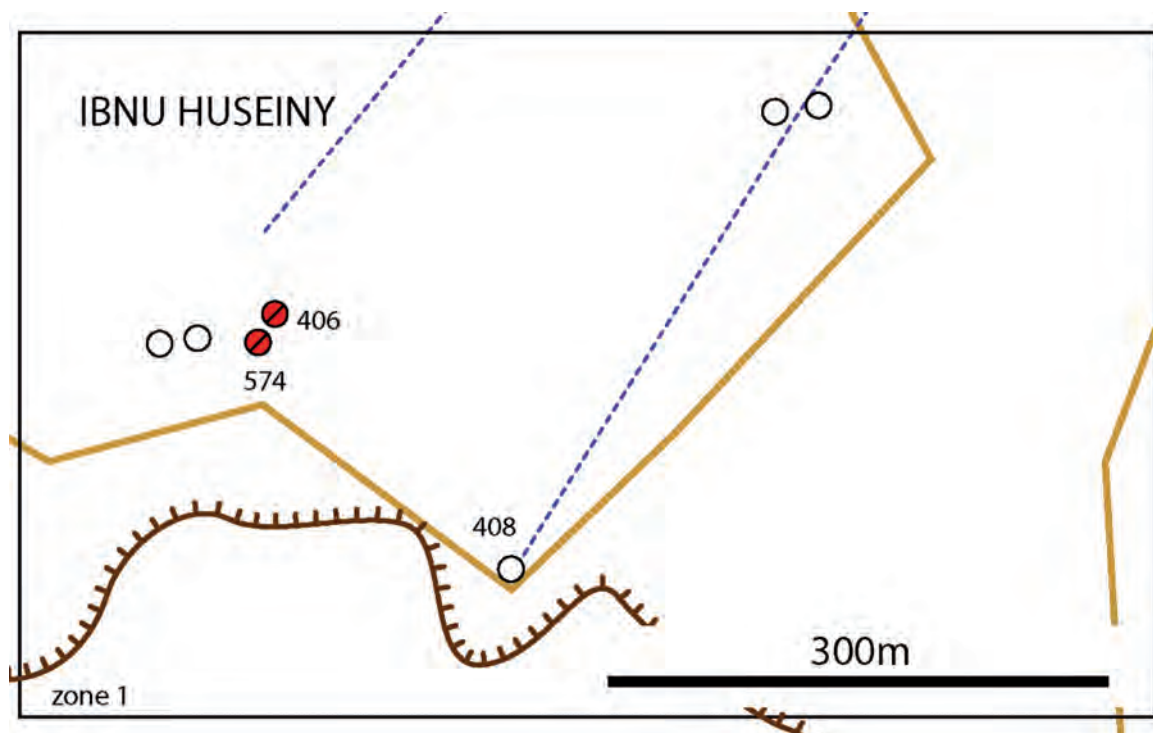


Fig. 2. Detail of zone 1

Discussion with Ahmed Ben Hamdan Al-'Arjân

Ahmed Al-'Arjân (around 60 years old) made identical comments to those of Mohammed Al-Bir Al-'Arjân Tal'a (point 408): excavation of 20 m, stairs, direction of flow.

A well was dug until the hard rock on which the masonry of the well was built. The excavation was continued about 10 m in this hard rock before reaching the aquifer.

There were stairs down into the well, but in the many wells without stairs the workers in charge on maintenance were lowered and raised by a rope attached to camels.

The first pumps arrived there around 60 years ago (1949) and the carrying of water skins by camels was abandoned 50 years ago or more. According to him, the pumps were abandoned for irrigation using the new steel pipe network 17 years ago. This differs from the 25-30 years mentioned by previous speakers.

According to Ahmed al-'Arjân, the cleaning of the qanâts was done irregularly, but at the most every three months, which seems a lot.

	First network	Second network
Well of departure	Bir Al-Habâz	Bir Al-Tal'a
	Al-Derbî	Bir Abu Siran
	Bir Al-Khyama	Bir Al-Nejem
	+ many others which he does not remember.	Bir Al-Bâri
Qanât of exit	Aïn Al-Gharb	Aïn Al-Lâqi

Tab. 1. Qanât network according to oral information

Ahmed Al-‘Arjân describes two networks of wells and qanâts, the second network confirming what Mohammed Abdullah Al-‘Arjân had told us.

Zone 2 (Fig. 3)

The dismantling of the masonry in PU540 allowed access a qanât heading to the network of PU211-PU212, but the connection is interrupted by a collapse or sediments (**Fig. 6**). On the aerial image of 1964, a well-manhole is visible exactly at the location of the supposed junction. A second repair of the masonry is visible in PU540. A qanât joins PU 541 and 538 and continues towards the PU211 without reaching it. Altitude measurements taken follow the flow of qanât 5 well (**Fig. 7**).

In PU537 one distinguishes a repair of masonry that could lead to PU540. PU260, located about 10 m from PU212 is filled surface. Covered with a large pile of leaves, we do not know if this well is completely filled, or if the fill is only superficial. Perhaps this well makes the junction with the qanât 69-63?

In PU 63, we photographed the qanât until we stumbled over a wall. At the foot of the wall, a small opening allows a glimpse of the qanât leading to PU69 in the daylight (**Fig. 8**). All other wells in the area are in water and we have not seen the start of any qanâts.

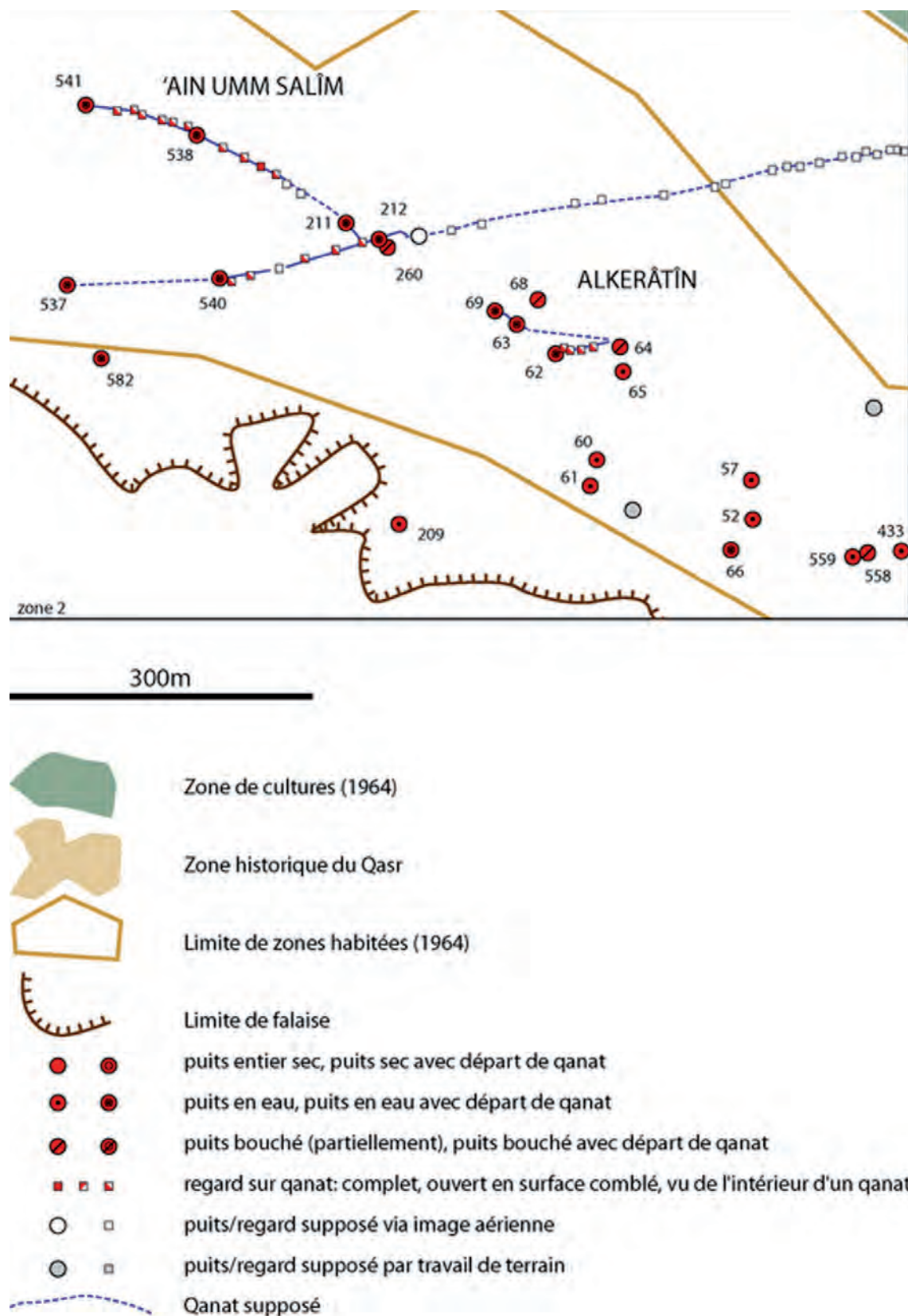


Fig. 3. Detail of zone 2

Zone 3 (Fig. 4)

This zone is partly occupied by the historic area.

At the top of PU560, we entered a gallery, very close to the surface. It is 50 cm wide, 30-80 cm high, with masonry on the walls and ceiling, and the gallery is collapsed in places. We have penetrated 21 m and it stops on a landslide (**Fig. 9**).

In PU176, we have observed in the wall two qanâts superimposed at their beginning. We have unclogged the top and thus entered a gallery 49 m long (**Fig. 10**). The gallery is dug in yellow sandstone and is not bricked. At a height lower than the one of the qanâts in Zone 2, the typology seems nevertheless very close. As for the lower qanât, examined in 2012, it is in masonry and filled with sediment after about 10 m. The presence of two superimposed qanâts raises questions which we will discuss in the typology of qanâts.

In PU581, we see a repair of masonry that we have not attempted to unseal. We have also observed, still in place, a metal chisel, extremely corroded, planted between two rubble stones of the masonry of the well.

The three rows of qanât manholes, clearly visible on the aerial photographs from 1964, are invisible today. Recent constructions (roads, buildings) have been built exactly in their place.

Interview of November 21st with Abdallah Fadel 'Abbas

The interview of Abdallah Fadel 'Abbas (66 years old) was attended by one of his brothers and Abdul Aziz Al-Sha'lan. It complemented the discussions we had on the ground with three other members of the same family and helped us to better study the area.

What we call a manhole (R150) because it has a diameter of 1 m, is actually a well. The smallness of its diameter is because it was shallow, it was not intended for continuous traction of water skins by camels. Nevertheless, on its surface we found a stone striated from the rubbing of ropes and at a depth of 1 m an identical reused stone. A qanât passing through the well came out in the open air, to the east, in Ain Al-'Abbas, bringing the water to a moat for irrigating lands downstream. To the west, therefore upstream, this qanât was going towards a bifurcation stemming from water points of the Abbas and Falha families. Several blocked or collapsed manholes were indicated to us, including a well of the Falha family. But these qanâts were blocked without being able to reach the wells located below Qasr Marid. Due to time constraints, we were unable to complete the unblocking of P150, conducted up to 3.5 m deep, with a sounding to 4.5 m without finding water. By contrast, this was attained at a 15 m distance inside manhole R566 (**Figs. 5, 6 and 13**), allowing us to construct a new hypothesis.

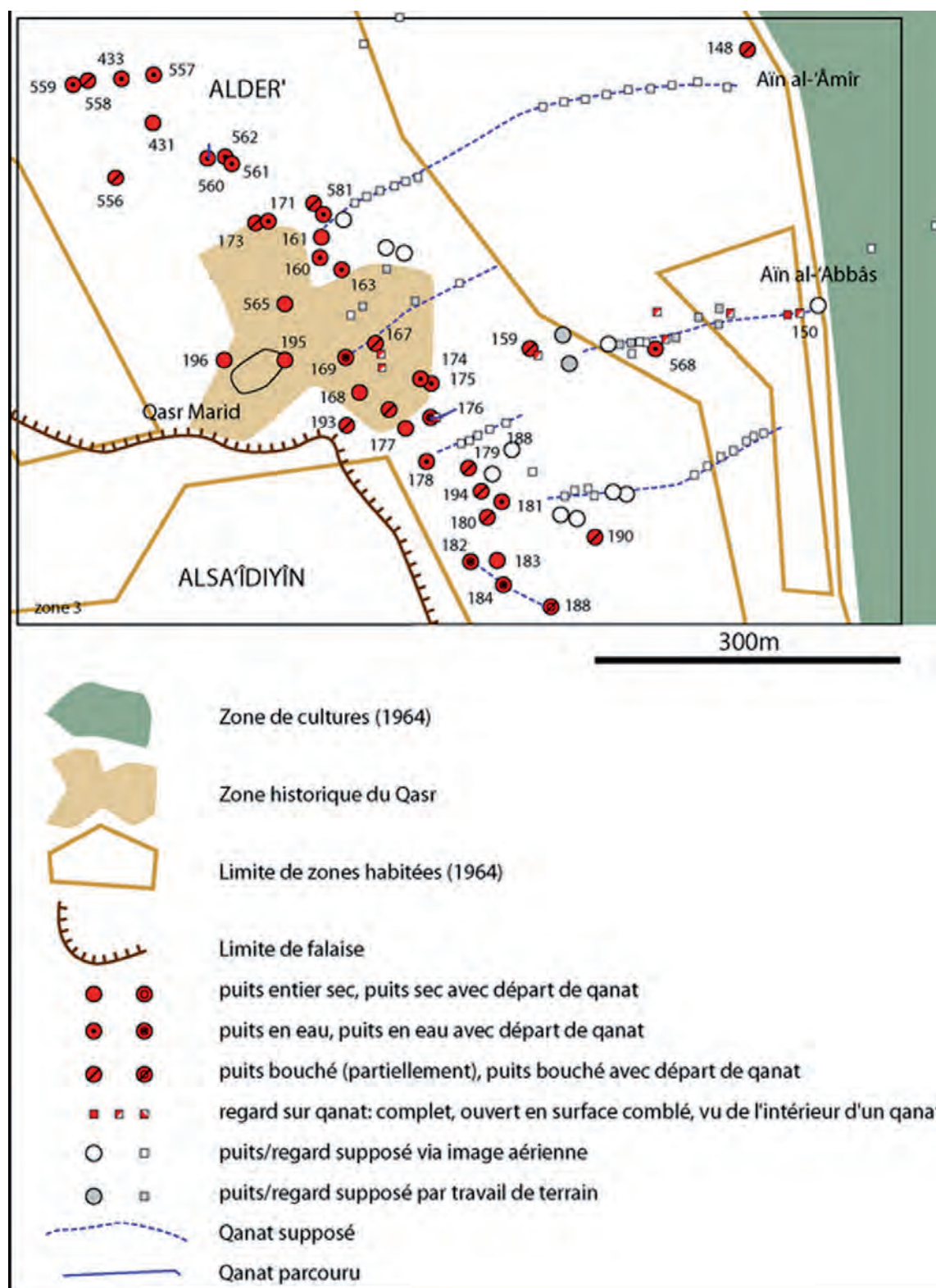


Fig. 4. Detail of zone 3

Interpretation of altitude measurements

It is in this area that our altitude measurements were the finest and tightest in order to understand the flow of water in the qanât systems (Fig. 6).

We must specify that during our presence on site, significant water leaks were observed in the system of irrigation pipes in the area, distorting and increasing the water level in the lower parts. However, two alignments that characterize this historic area ought to be considered.

The alignement below Qasr

In the historic area, of the 32 wells into which we descended, the northwesternmost one is numbered PU171 and the southwesternmost is numbered 189. With the exception of three of them located a little further down, these wells are at an altitude between 600 and 603 m. The water level varies; it is 579.3 m at PU171 and 587.3 m at PU174. We must specify that in PU174, water is 4 m higher than in PU175 located at a distance of only 5 m. Therefore, we cannot draw any useful conclusion from these levels.

The northeastern alignement

This alignment is located 10 m below than the preceding one. The distance between the two alignements varies from 200 to 450 m. We have found four wells, while others have disappeared with urbanization or road works.

Starting from the north, Ain Al-Amir is the first well. It is completely clogged, and the only things to emerge from the soil are the pump and its support rails. Further south, there is well P150, with a diameter of 1.1 m and that we have unclogged up to 3.5 m of depth, stopping at 1.1 m of water level as indicated by the manhole found 20 m to the west. Further away towards the south both wells P261 and 575 open up, where

Name	Altitude top of the well shaft	Altitude water	Total depth
Manhole 566 (Near Aïn ‘Abbas)	593.3	587.6	7 m +?
P159	592.5	587.5	6 m
P568	589.5	587.0	4.5 m
P261	594.2	586.8	37.5 m
P575	594.4	586.6	48.8 m
P569	587.3	584.1	20 m

Tab. 2. Water points in the bottom of the south zone

we found water at a depth of 7.5 m. These four wells are located between 591.5 and 594 m of altitude.

P569 is located further east, on slopes descending towards the sebkha, it is to be expected that the water level will be lower.

In this low area, the water level is almost constant, we have said that it had surely increased because of irrigations and the losses of the irrigation system. Remarkably, in wells P261 and P575, the qanâts are barely 25 cm above the water level, say at 586.5 m. In manhole 566, near the exit blocked by Ain al-‘Abbas to feed an irrigation canal downstream, the floor of the qanât must be at a similar altitude (= 593.3-7 586.3 m); everything is consistent. If we consider well P176 which is part of the wells below Qasr and which is located in an alignment leading to Ain al-‘Abbas, the two superimposed qanâts are at an altitude of 588 m and 589.4 m. There is no doubt that we had a flow in the direction PU176 -Ain al-‘Abbas. We’ll get back to this later.



Fig. 5. On the aerial photo from 1964, the two alignments indicated by the residents and leading to Ain al-‘Abbas. Under PU178, there are manholes of qanâts that have now disappeared. We see that on the edge of the historic area, there are no more crops, wells have not been in use for a long time

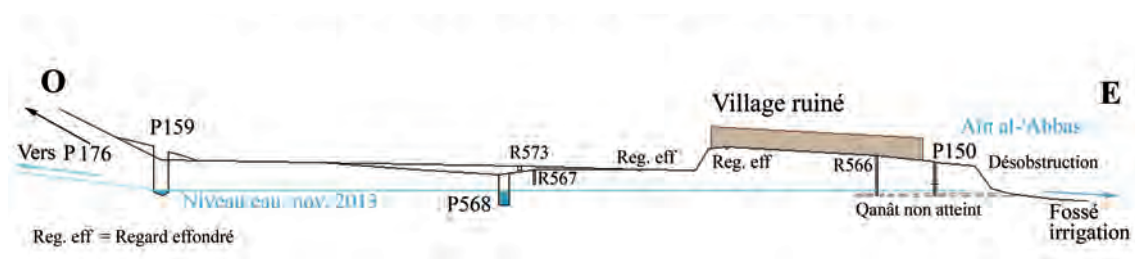


Fig. 6. Profile of water points near Ain Al-‘Abbas

Zone 4 (Fig. 7)

In this area to the southeast of the historic sector, the start of the qanâts in wells PU185, PU187, PU261 and PU575 make the presence of a long qanât connecting these wells likely. We have visited the qanât of PU261, it is built in masonry, obstructed after 5 to 6 m and very low (0.4 m)

Equally, a little further south, residents confirmed that in their childhood, they saw a working qanât linking wells PU514, PU264, PU263, PU584, PU279 and PU280.

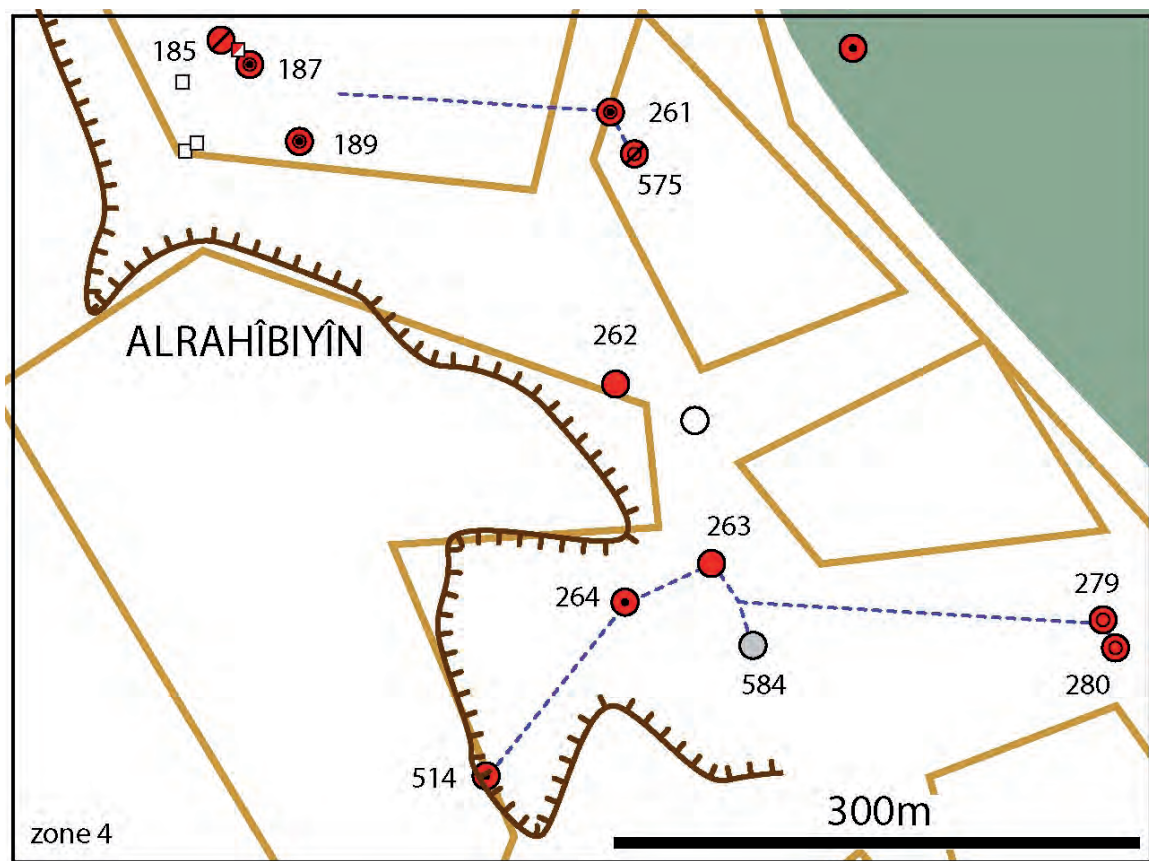


Fig. 7. Detail of zone 4

Topography of wells and associated qanâts

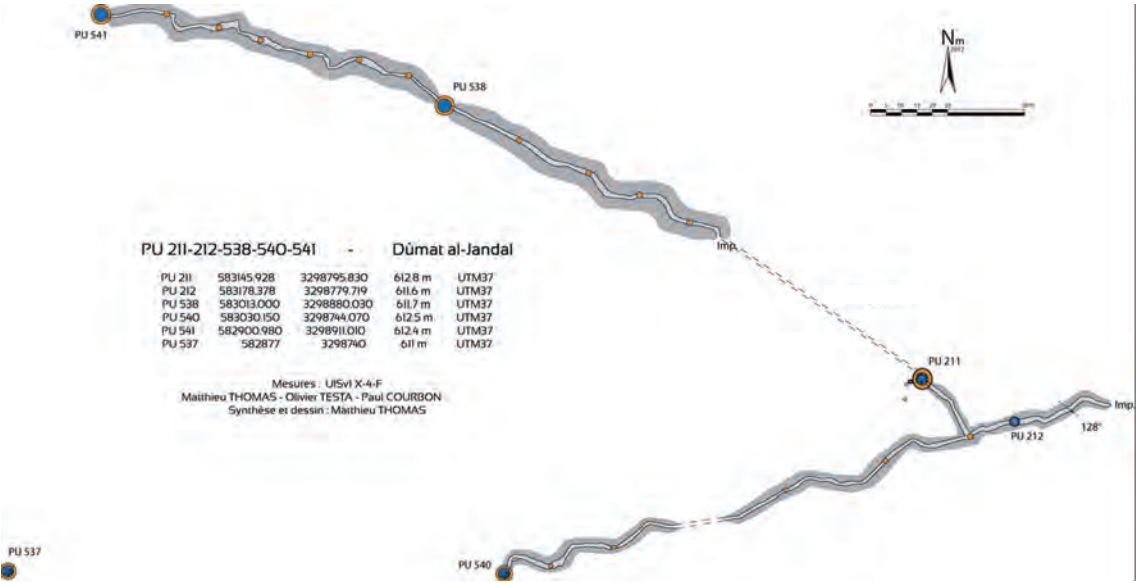


Fig. 8. General plan of system of qanât PU541-PU538-PU211-PU212-PU540

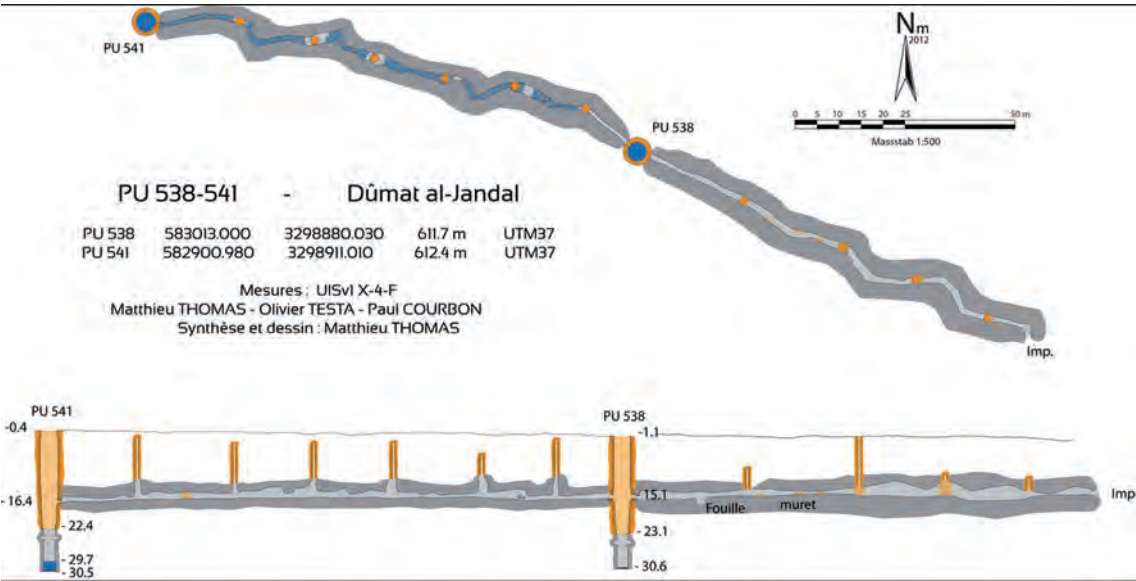


Fig. 9 . Plan and section of qanât of PU538-541

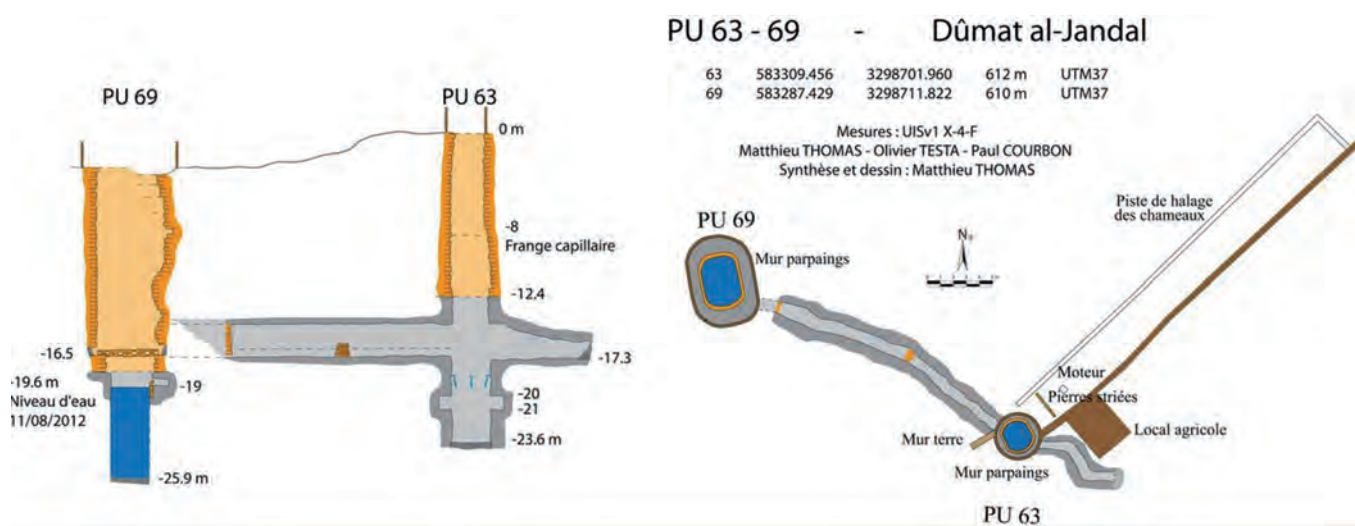


Fig. 10. Plan and section of qanât of PU63-PU69

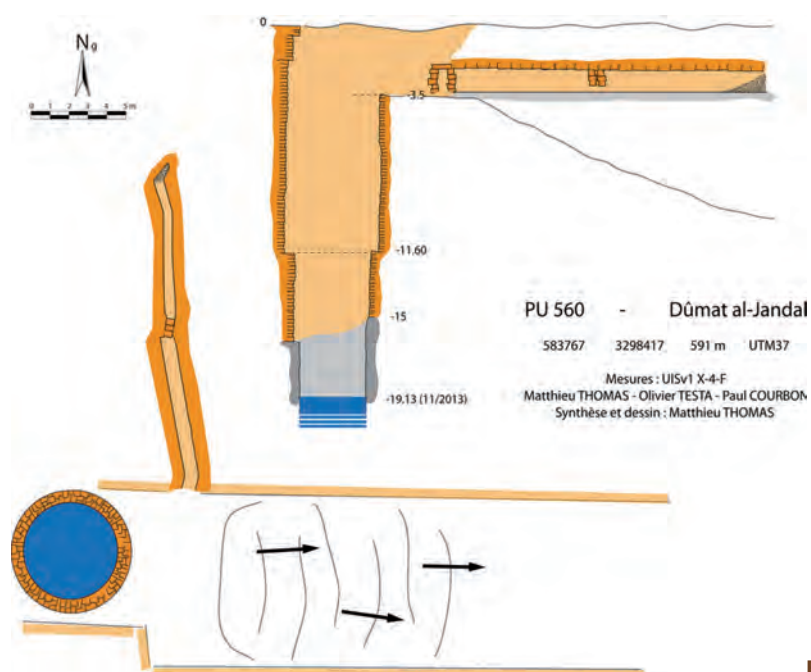


Fig. 11. Plan and section of well 560 and tunnel

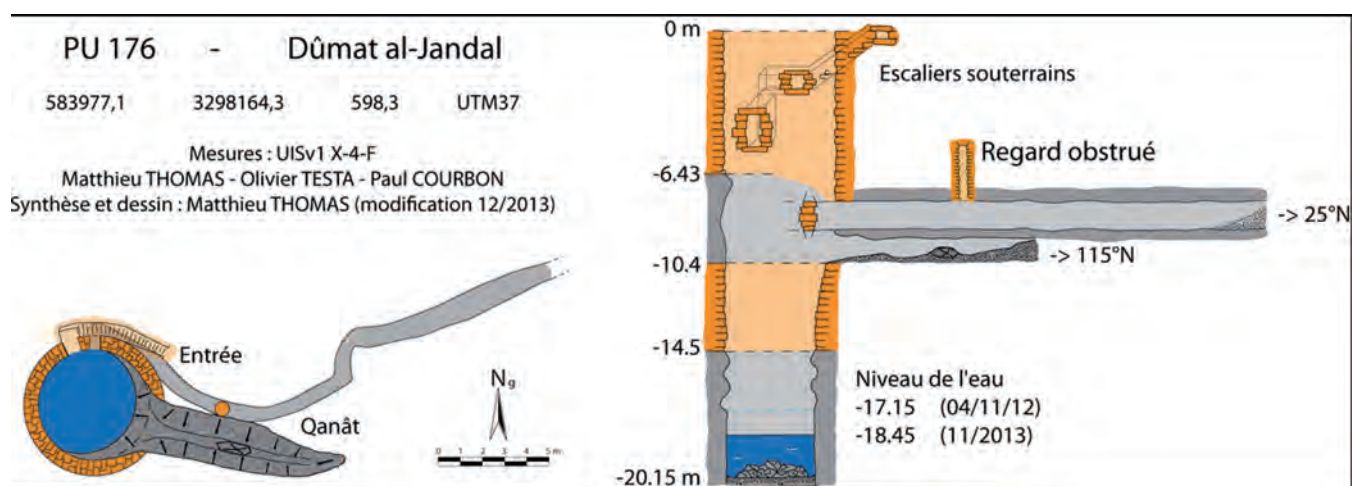


Fig. 12. Plan and section of well 176, with its two super-imposed qanâts

The digging of the wells

As we wrote last year, the first part of the wells, dug into soft rock, is always bricked down to the limit of the hard rock. In the hard rock, the diameter decreases and has only 2.5 to 3 m instead of 4 for the masonry part.

Understanding the digging of the wells has been one of the main challenges of our research. It is impossible to know the exact depth of the wells of Dûma because their bottom is systematically cluttered with fallen stones of masonry, sand brought by the wind or waste. This is the case in well P211 which is the deepest we have descended because it was almost dry; at the depth of 31 m we have landed on rocks, tyres and other items that passed through the water (**Fig. 14**). The thickness of this filling has not been determined. Similarly, we have explored several other wells of equivalent depth, but without reaching their bottom which is drowned under 3-15 m of water. However, in some cases we have been able to estimate more accurately the exact depth of the well, thanks to the length of the hauling wells where camels were pulling water skin hanging from a rope (PU 63, PU 198) (**Fig. 10**).

As for the qanâts, their average depth is 15 m, often at the base of the masonry of the wells.

If the testimony of the qanât “s “ we met in zone 1 is correct, the water could have been pumped continuously without interruption with motorized pumps. Now if water flowed in abundance, a question arises about the digging of wells in water depths exceeding 15 m. The study of PU575 allowed this issue to be reconsidered. At 8 m from the surface a qanât starts at water level. Below we have observed 40 m of water at the bottom where the depth of the stones is unknown (presumably a few metres). Similarly, the nearby well P261 included 30 m of water. So how were they dug under 30-40 m of water? Only the assumption of an artesian vein seems to help answer this question, a hypothesis that has been confirmed by an owner who had seen his well dug during his childhood. The diggers were digging completely dry wells. Several witnesses confirmed that they were coming on a hard, waterproof layer: when this layer was pierced, water flowed and filled the well.



Fig. 13. Man hole 566, of a diameter of 0.6 m, is not easy to explore. It has allowed us to determine the altitude of the qanât



Fig. 14. The bottom of PU211 at a depth of 31 m, shows the impossibility of collecting ceramics

Typology of qanâts

The explorations of 2012 and 2013 revealed about twenty qanât departures in different wells which we have explored and which highlighted the junctions between several of them. We estimate that there are at least 12 qanât systems in Dûma, joining the wells with each other to come out in the open air, as indicated by the inhabitants: in Ain Al-Gharb, Ain al-Lâqî or Ain al-‘Abbas. The water drained by the qanâts made it possible to irrigate the lands downstream.

As we have observed in the course of the study of zone 2, the area situated in the north revealed several alignments of wells connected by qanâts, the latest of which results in output in the open air to supply an irrigation pit. This is the case of the alignment starting at Bir Al-Tal’a at the foot of the steep cut of the graben, and which after passing three other wells, springs in Ain Al-Lâqî. In general, these exits to open air are called Ain (spring). Qanât topographies in the northern part confirm this pattern.

Two networks have been almost completely followed and explored. Four other qanâts could not be followed because their entrances were filled with sediments. Three other qanât alignments were derived from the study of aerial photographs but not longer exist. Finally, the last three are derived from information supplied by locals, but we have found no trace on the ground or on aerial images. Surprisingly, two types of qanâts are distinguished by their design and their distribution in the field. Depending on their location on the ground, the elevation of these conduits is between 588 and 598 m.

Qanât masonry, their geographic distribution and hydraulic operation

During the initial explorations, we observed a set of qanâts whose entrance and the entire route are made of dry stone masonry. This category is limited to the historic area, the northernmost qanâts are found in well PU169 and the southernmost in well PU189. The best example is given by the two qanât departures from well PU187 (filled by sediments after less than 10 m unfortunately). The duct ceiling is formed of large slabs placed directly on the masonry of the side walls and overlapping one over the other like snake scales. This small size conduit: 80 cm to 1 m high and 40-60 cm wide is encumbered by sediments of different nature (concretions, late filing ...) (**Fig. 15**).



Fig. 15. Qanât masonry, of low rise and a challenging course

In this sector, well PU176 has two bunk qanâts, a unique configuration in Dûma. The bottom qanât is in masonry, while the upper qanât, followed for about 40 m and dug into a layer of sandstone, is not. As we shall see, the access to this qanât was walled. PU560 should be distinguished for the moment, because curiously, its masonry qanât does not lead directly into the well (**Fig. 11**), it is located at the edge, over rocks streaked by the lifting ropes.

All walled qanâts could not be followed for more than a few metres because they were filled with sediment or collapsed. Small in size, they do not match the description made by Wallin: *there are discovered subterranean aqueducts, built of hewn square stones of a most careful and excellent workman-ship.... an ancient aqueduct was laid open in Al-sa'idin,² which was so spacious that a man could stand in it almost erect, and which seemed to lead to the only well, existing in that plantation.³*

On the outskirts of this historic area, the aerial photograph of 1964, where several rows of manholes appear, had raised high hopes, but all holes are unfortunately blocked or covered with debris. During our field investigations, the owners showed us three manholes with masonry that was still visible, and another three for which nothing was left but the depression marking their collapse, and a final one, clogged by a plastic container surrounded by earth that prevented us from studying it in detail.

However, the inhabitants, encountered during the clearing of PU150 claimed to have seen a working qanât linking PU176 -PU159 -manholes -PU150 -and another qanât passing through PU 568 and R573 (Qanât al-Falhâ) and joining the former one.

2. Al sa'idin corresponds to the eastern part of the historic area.

3. Wallin 1854: 145.

Geographical distribution and hydrological operation

Based on our current observations, qanâts not in masonry are often large (1 to 1.5 m wide and 1-3 m high) and are located north of the historic area, the only exception being the previously observed top qanât of PU176. The length of explored galleries exceeds 100 m.

Only the entrances of these qanâts included in the masonry of the wells are built in masonry. The manholes, fitted in the ceiling of the qanâts and serving as ventilation chimneys or trapdoors, are also sometimes supported by masonry walls. On the side of the qanâts, we also encountered small reinforcing installations upstream of meandering curves to prevent the water from flowing to undermine the walls of the gallery.

These qanâts are not made of masonry as they are dug in a sandstone layer strong enough to ensure their stability and duration (**Fig. 16**). In the historic area, we do not find this layer of sandstone in well P176. The weaknesses of the rock, its fracturing in particular, were exploited during the digging of the qanâts. When they met a fracture, well diggers excavated the gallery in the centre of this divide. When the fracture stopped, the gallery forked to go in the desired direction. This explains the zigzag shape of some galleries, particularly between wells PU540 and PU212 (**Fig. 8**).

From the evidence obtained, the water level was slightly above the altitude of the threshold of the qanât. Therefore qanâts located below the groundwater level were used to continuously supply all the wells and downstream piping. Regular cleaning several times a year was necessary for the proper functioning of these systems.

Repair of masonry in wells

We have observed multiple times a redevelopment of the masonry of the wells, either to consolidate those that had partially collapsed, or to close off qanâts entrances that had fallen out of use.

Several wells explored in 2012 have on their wall obvious signs of repair of masonry, as if qanât entrances had been intentionally blocked by the diggers. To confirm this, we have removed some of these masonry repairs. This task was not easy, sometimes impossible, due to a significant seal linked to a limestone deposit in the rubble (PU537, PU540). As previously explained, in PU176 we discovered in 2013 a second qanât, perched above the one explored in 2012.



Fig. 16. Qanât in sandstone, it is spacious and allows the masonry of the well to be seen

The oasis dwellers now aged sixty years and having worked in the cleaning and maintenance of these qanâts during their childhood have confirmed that some masonry repairs are recent and some qanâts were sentenced to survive some decades only.

For this reason, some wells deserve to be revisited in the future. In addition, there are the aerial images from 1964 of alignments of qanât manholes leading to wells PU178, PU581, PU181 for example. But no start of qanâts was visible in these wells during the preliminary exploration. A closer examination of the photographs taken inside these wells could reveal the existence of arrivals of qanâts, now bricked.

It is clear that the run of a qanât was closely linked to groundwater level. The entrance of a qanât located slightly below the groundwater level played the role of threshold and the water flowed continuously and regularly in the duct. In the 1950s, the arrival of mechanical pumps, replacing water skin hauling by camels, and the modern city development and agricultural activities have resulted in a higher water consumption. The groundwater level has dropped under the threshold of many qanâts, making them useless. In addition, new wells were drilled bringing additional water taps.

Tentative dating of wells and qanâts

It is clear that the wells and qanâts of Dûma are related to the human occupation of this oasis. Goblot recalls that qanât should not be confused with aqueduct.⁴ An aqueduct is an overhead or underground conduit for capturing a source or collecting runoff water. Qanâts are a mining technique which consists of exploiting the groundwater through infiltration galleries. According to him, the idea that gave birth to qanâts and their use in irrigation would have come from the need to drain galleries of flooded mines in the Zagros Mountains in Iran, about a millennium BCE.⁵ His book provides valuable information on the techniques used and on topographic methods to give a correct slope to qanâts (Between 1 and 2 per 1000). The first written mention of qanâts appears in a report written after Sargon II, king of Assyria, who destroyed the qanâts supplying water to the city of Ulhu (714 BCE).⁶ Therefore, it is quite plausible that in the Nabataean period people were using this technique.

In Dûma, well-qanât schemes do not, however, follow the classic qanât pattern. The wells being filled or drowned, we have not found ceramics or artifacts related to their use, especially in the well of the mosque. In addition, we have found no registration and no mortar that could provide a date. In addition, the building typology varies little and that technique, transmitted from generation to generation, did not experience a great evolution. Therefore, we can only learn about the human occupation attested by archaeologists in their excavation areas. Excavations conducted by the Italian-Saudi team of Romolo Loreto in the historical area show a first occupation of the area in the Nabataean era. P169 and other nearby wells, even retrofitted later, seem to be related to this period. Later, in the 7th century, the construction of the Mosque of Omar bin al-Khattab and the excavation of his well provide another indication, and wells dug under the old village probably date from this period. Finally, it is also clear that the two wells in the Qasr Mârid go back to the construction of the fortress.

The historic area appears to have been abandoned in the 19th century and aerial photos from 1964 show that most of it was not cultivated. Moreover, several wells in the area are without pumps.

However, the area further north appears to be a more recent extension of the oasis in this direction. The testimonies of some people in this area suggest that the wells will have been rehabilitated or dug in the modern era, before the advent of new in-depth drilling.

⁴. Goblot 1979: 27.

⁵. Goblot 1979: 63.

⁶. Goblot 1979: 67.

Pierre-Louis Viollet remembers the good organization that existed in the Muslim world to share the water with hourly or half-daily rotations, which may explain the presence of six pumps in well P211. It is hard to imagine that its flow was sufficient to cover all needs. Therefore, each pump must have operated for only 1 or 2 hours a day to feed their respective owners in turn.

Regarding the large number of wells, it is probably due to the limited flow of a well and the slow pulling of water skins by a camel to irrigate a small area. The expansion of cultivated land would have required the excavation of a larger number of wells.



Fig. 17. Reuse of striated stone of a curbstone in the reconstruction of a well.

The modern era

With the development of the city during the modern period (from the 19th century) and the development of irrigation, wells and other qanâts were dug, extending the agricultural area available on both sides of the historic area. Until the first half of the 20th century, water arrived into the qanâts by gravity. It was transported on camels and distributed by a surface canal system.

It is certain that the wells were maintained or use was resumed after a period of neglect. In the historic area, rocks striated by the strings of camels are found in the masonry (**Fig. 17**), showing a reuse at a time of repair of the wells.

The arrival of pumps driven by a motor, from 1949, has greatly increased water consumption. In some wells, it is likely that the increase in withdrawals decreased the level of the water table. In these wells, the water came under the threshold of the qanâts, making them obsolete. Some qanât entrances were then blocked. This particular solution would explain the difference in altitude of the two qanâts of PU176.

We have encountered several motorized pumps in some wells. Differently from what is found in other oases, they are not suction pumps. In the pipe that descends down to the water there is an axis rotating some helical turns which allow to pump 20 m deep, against 8 m for a suction pump. The hose end is always located several metres below the level of the entry of the qanât, where available. In many wells, pumps are located above the current water level, confirming the lowering of the water table. The “coup de grace” for the old hydraulic system seems to have been given with the introduction of the last pump during the commissioning of a large drilling in 1985.

Hydrogeological approach of the enclosing rock

Pluviometry

The Saudi rainfall card provided by BRGM confirms the oral information obtained at the meteorological cell at the Airport of Jawf: regional rainfall is slightly less than 50 mm / year. Groundwater of the area is very much fossil. Bear in mind that the age of the sheet of Al-‘Ula, 500 km to the west, was estimated to be 8,000 years old.

Measuring the water level in the well

In an effort to understand the movements of the water table and the link that may exist between the different wells, in 2012 we measured the water level and the altitude of the explored wells. In 2013, we measured again the level of water in the same wells, but we could not draw any useful conclusion. The level of some wells decreased while others increased.

How to explain also a water level difference of 4 m for two wells, PU174 and 175, only 5 m apart? Probably the seepage from the abundant current sprinkles and the permanent leaks in the irrigation systems artificially influence the level of the wells, preventing any interpretation.

Overview of the geological structure

As in 2012, it was unfortunately impossible to obtain geological reports preceding the deep drillings to capture the artesian groundwater table of Dûma. We can therefore analyze the area in a superficial way.

Although the explored wells did not go as deep as the drillings went, we cannot ignore the artesian characteristic of the region. We had previously formulated it by seeking an explanation for the great depth of some of the explored wells.

At the micro-regional level, the oasis is located in a graben structured by benches and compartmentalized units for faulted structures. This structuring complicates the hydrogeological interpretation and the understanding of the logic of groundwater flows. In fact, this

structure puts in touch permeable and non-permeable layers allowing water to be lost from one compartment to another, and not necessarily in the same geological formation.

In addition, depending on the location within a faulty structure, the depth of the same aquifer layer is not the same, and makes the digging of wells deeper or shallower, more or less complicated to achieve. Thus, hydrogeology is characterized by a set of faults and impermeable layers, free layers, close to the surface and semi-confined or confined layers deeper down.

Despite having supposed a geology that is close to that of the Sakâka mission, in our previous report, after the study, we have found a different stratigraphic structuring. This is not surprising given the distance of 100 km between the two oases. Therefore, lateral changes of geological facies must exist.

We conducted rock sampling up to the masonry and to the bottom of PU 163, 175, 176 and 211. The reaction tests with acid and the porosity test gave very different results, preventing the establishing of a general scheme. The layer of Sha'iba Member appears heterogeneous, alternating thin layers of marl and cement sandstone, of different porosities.

Hypotheses and outlook

To date, we believe there are several types of wells and qanâts in Dûma, corresponding to different periods of occupation.

Regarding the ancient period, we assume that the wells were associated with a network of qanâts in masonry, as described by Wallin (1854) and that today are found in the historic area completely filled with sediment or collapsed. Their short length and the bulk sediment prevented an accurate measure of the slopes and the flow of water. In 2012, we hypothesized a NE – SE flow from artesian wells such as Ain al-‘Amir, existing in palm groves, these flows feeding the well-cisterns. As seen in study area 3, following our altitude measurements and the discovery of manholes in 2013, this assumption must be abandoned. In addition, the rock porosity measurements in four wells of the area makes the well-cisterns hypothesis impossible. In some wells, close to 20% porosity prevents any sealing required for a cistern. It should be noted that all cisterns have a seal coating, which is not the case for the wells we visited.

Therefore we return to the scheme described in the cartography of the studied areas with the existence of a network of wells and qanâts leaving from the high area located on the steep cut of the graben and descending towards the centre of the oasis or qanâts brought out under the domination of springs (“Ain”).

The ancient inhabitants, who took care of the qanâts in their youth, have repeatedly reported that the flow in these qanâts was always from the west (plateau escarpment) to the east (graben depression). This information was confirmed by the forms of sedimentation (dunes, crescents) visible in two sedimentary loggings in the eastern qanât of PU538 and the western qanât of PU212. Excavation has allowed us to identify 1 m of sandstone sediment before arriving on a thin layer of floating calcite, covering a black sludge composed of abundant organic matter of roughly 20 cm thick.

This second archaeological mission for speleologists has largely helped to complete the inventory and exploration of the wells and qanâts of Dûmat al-Jandal beyond our expectations. The data are still incomplete, and questions remain unanswered. Certainly old wells were used in modern times, but we have, to date, no formal indication of the date when the shafts were made, even for those in the present historical area.

Acknowledgements

Besides the classical thanks: Jerome Perrin of BRGM on mission in Riyadh for the information and documents provided to us, Henri Paloc and Baldwin Lismonde, hydrogeologists with whom we discussed the issue of the wells at Dûma.

Appendixes

Well (PU)	Type	Summary Description	Altitude of the water table in 2012	Altitude of the water table in 2013
52	well with water	16 m deep well with 3 pumps. Masonry ends at 11.15		
57	well with water	17 m deep well used for trash. Bottom of pumps in the garbage.		
60	well with water	Well. 3 pumps. start of 2 qanât with wall	592.5	592.5
61	well with water	Well. water. no pumps	591.9	591.3
62	well with water	Well. 2 qanâts entered	585.0	585.6
63	well with water	Well whose bottom filled with trash. no pumps. 2 qanât entered.	586.1	585.2
65	well with water	Well with water. 1 pump	590.7	590.4
66	well with water	Well with water. 1 qanât collapsed at the entrance	587.3	587.8
69	well with water	Well with water. niches. openings of qanâts not penetrated	588.8	589.2
130	well with water	well with water at 2 m		
160	well with water	23 m deep well. with 2 old pumps. 3 niches with old carved rocks inside	580.3	577.4
163	well with water	21 m deep well with square opening	580.4	578.0
169	well with water	18 m deep well with 17 small niches and a qanât	586.2	581.9
171	well with water	28m deep well with 2 steps	579.3	576.4
174	well with water	25 m deep well with an exterior staircase. one window and a door	587.3	587.5
175	well with water	17 m deep well with a pseudo-square section	583.3	582.0
176	well with water	20 m deep well with an exterior staircase with a niche. a qanât and a supposed closed qanât	581.4	580.1
178	well with water	18 m deep well. with a spiral staircase	582.4	580.8
181	well with water	13 m deep well. one pump. masonry partly collapsed. masonry and rock alternate	582.8	581.0
182	well with water	20 m deep well. opening of a qanât filled with sediments. System 182-183-184	581.3	579.0
184	well with water	13 m deep well. with a qanât. quickly filled with sediments. Corbel. System 182-183-184	583.9	579.9
187	well with water	16 m deep well. with 2 qanât openings. (one with wooden 'lin-tel'. one with large opening. 10 m long qanât). and fauna	586.1	585.5
189	well with water	16 m deep well. with a small qanât (?) with flowing water. corbel. and a strange shape of the masonry	587.7	586.8
209	well with water	23 m deep well. with on old pump	592.1	592.2
211	well with water	28 m deep well. with 6 pumps. 2 entrances of qanât. Part of the 211-212 triqanât system	582.5	580.1
212	well with water	21 m deep well. leading to the 211-212 triqanât system. gate at the top preventing from descending it	594.7	

261	well with water	Well with trash at the bottom and water. An opening of a qanât at the level of water	586.8	
264	well with water	not descended		
268	well with water	? 2.5 diametre-3 m water		
433	well with water	13 m deep well		
514	well with water	No qanât opening seen but supposedly there is one. A reinforcer concrete slab was made but broken. Not descended		
537	well with water	24 m deep well with a gate.		
541	well with water	30 m deep well with a gate.		
557	well with water	13 m deep well		
559	well with water	23 m deep well with 2 kind of masonry		
560	well with water	19 m deep well with side tunnel and 2 levels.		
561	well with water			
562	well with water			
563	well with water	Well	587.0	
568	well with water	Masoned well 2x2.5. water at 2.50. base at à 4.5		
569	well with water	Masoned well 4x4.5. water at à 3.2. base at 20m	584.1	
575	well with water	Well with opening on the side (staircase) and 3 opening at the bottom (qanât and staircase ?). Not descended	586.6	
576	well with water	Well		
577	well with water	well		
581	well with water			
582	well with water	pumps. niches. qanât ? To be seen again		
584	well	shown in the distance by locals		
161	well without water	20 m deep with masonry to the bottom. One old pump		
168	well without water	well with masonry collapsed from top to bottom on one side		
177	well without water	12 m deep well. with the masonry collapsed on one side. Potentially dangerous		
183	well without water	7 m deep well. filled with rocks and branches. System 182-183-184		
188	well without water	12 m deep well. filled with palms (palmtrees). One large opening of qanât or staircase. filled with sediments		
195	well without water	deep well within in the castle. near the top.		
196	well without water	24 m deep well within the castle. Water dripping		
197	well without water	7 m deep well outside of the oasis. with a stone circle. filled with sand		
198	well without water	well outside the oasis		

199	well without water			
262	well without water			
263	well without water	one niche and one opening. Not descended		
431	well without water	19 m deep well		
565	well without water	Well of the mosque		
566	well without water			
579	well without water	supposedly 3 m deep and qanât. Not descended		
580	well without water	supposedly 3 m deep and qanât. Not descended		
167	qanât	manhole in masonry to a supposed qanât. filled with rocks		
186	qanât	Narrow 6 m? deep aeration hole. filled with rock. Part of the system 185-186-187		
202	qanât	opening of a qanât. Filled.		
207	qanât	opening of a qanât. Filled.		
567	qanât	qanât with masonry. 2.4 m. .40x0.5. Stop on sediments		
570	qanât	collapsed manhole. in a house		
64	filled well	well filled with sediments. 2-3 m deep.		
68	filled well			
150	filled well	Filled well. Square section. 1m deep. Excavated in 2013 on 3 m.		
155	filled well	filled well with a remaining opening on the ground 8 m x.2 m		
156	filled well	Filled well. remains of the masonry. 0.8m deep		
159	filled well	filled well with masonry collapsed on 2/3 of perimeter.		
165	filled well	Masonry on 1/3rd of a circle. the remaining being collapsed		
173	filled well	7 m deep well without masonry. collapsed		
180	filled well	Depression on the ground. supposed to be a filled well.		
192	filled well	Small filled well. 192-193 system		
193	filled well	Large filled well. remains of masonry 5m high. entrance of a qanât?		
194	filled well	Depression in the middle of a field. An old pump remains		
260	filled well	Well filled with sediments. 4 pumps around. so it must be an important well		
556	filled well	Well with pumps		
558	filled well			
574	filled well	Well filled with sand. The pumps remain.		
583	filled well	Only the pumps remain		

The Western Settlement

Sector C

Guillaume Charloux, Marianne Cotty, Martin Makinson, Céline Marquaire,
Ahmed A. Al-Qaeed, Dara'an al-Qahtani, Thomas Sagory & Ariane Thomas

One previous sounding (SD6) and four new soundings (SD10, 11, 12, 13) were opened in 2013 in the lower part of sector C, with the same objectives: understanding space, chronological sequence and function of the ancient western enclosure wall (**Fig. 1**).

Several periods without workmen were employed in the recording and production of a DTM of the sector using differential GPS. This work has then been completed by performing a 3D reconstruction of the sector in photogrammetry for a dense correlation of photographs (K. Guadagnini) taken with a kite by Th. Sagory.

Sounding SD6 (Makinson) has been extended to the south, where several new pieces are partially exposed. A corridor appeared to the south, giving access to the “cistern” (or an extraction pit?) whose excavation has been completed. We expect to extend the sounding to the south and west next year.

Sounding 10 has been opened in the centre of unit 2 of the Western enclosure at the supposed location of the main door of the oasis (Thomas & Marquaire), but the assumption has proved to be incorrect.

Four construction phases were nevertheless identified, particularly a collapsed mud brick structure located under the base of the enclosure. Archaeologists have been able to determine that a double enclosure wall (M2027 & M2029) had been built and an internal reinforcement (M2028) was added. The last phase is marked by the collapse of the brick wall and the abandonment of the enclosure.

Sounding 11 (Charloux & Marquaire) has focused on an opening (postern) in the masonry of unit 8, at the base of the enclosure. Four phases have been identified, including in particular the identification of a mud brick wall earlier than the enclosure and the observation of a redevelopment of the enclosure.

Sounding 12 (Cotty), located against a large archaeological section created as a result of the destruction of an archaeological sector by bulldozers, has unearthed a large square structure, probably a tower.

Sounding 13 has been initiated during the campaign but could not be completed on time. The sounding opened 30 m in front of the western enclosure (unit 3) has confirmed the existence of a high retaining wall preserved for over 2 m and built with a pronounced batter. Results will be presented in the report of the next campaign.

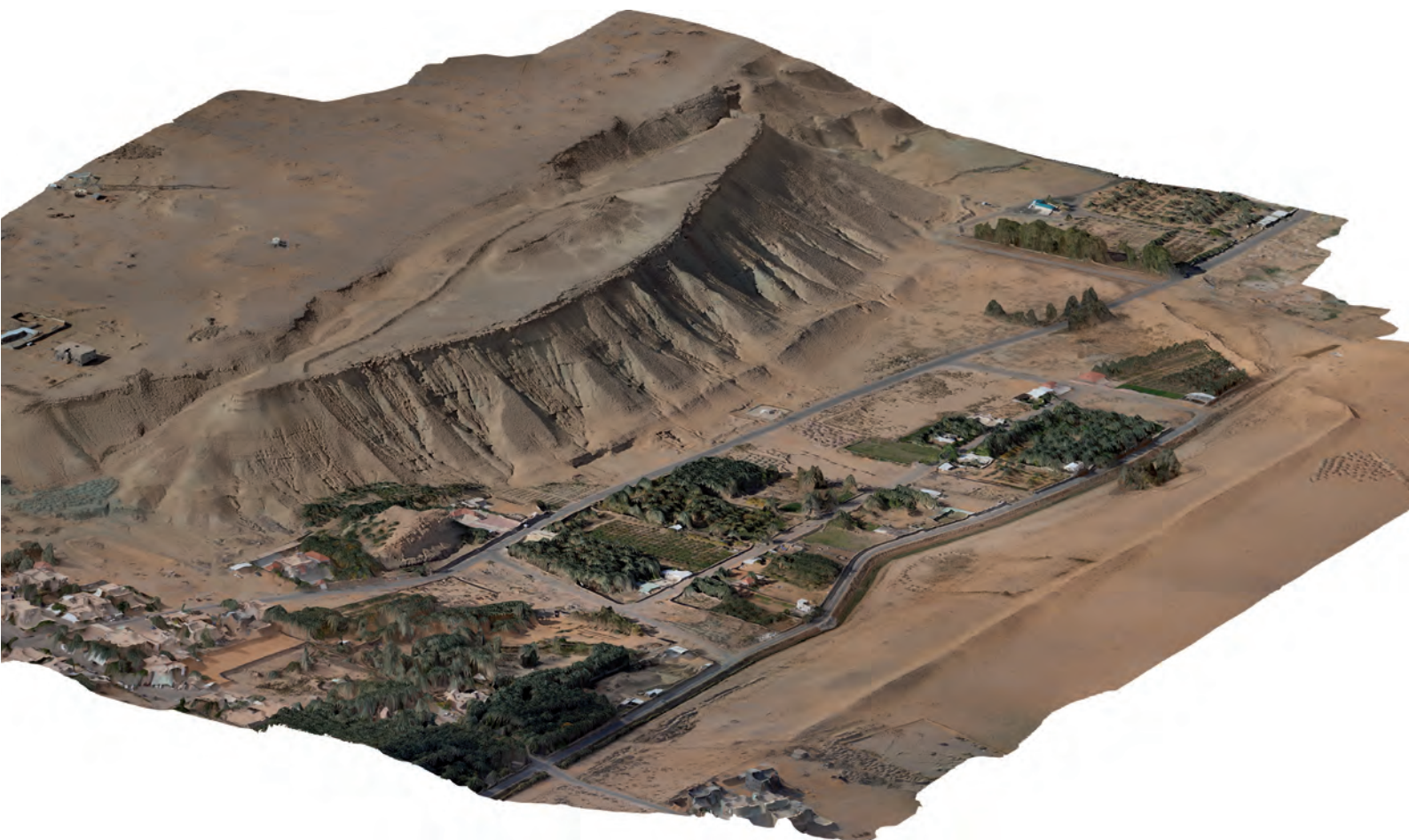


Fig. 1. 3D reconstruction of the western sector in photogrammetry

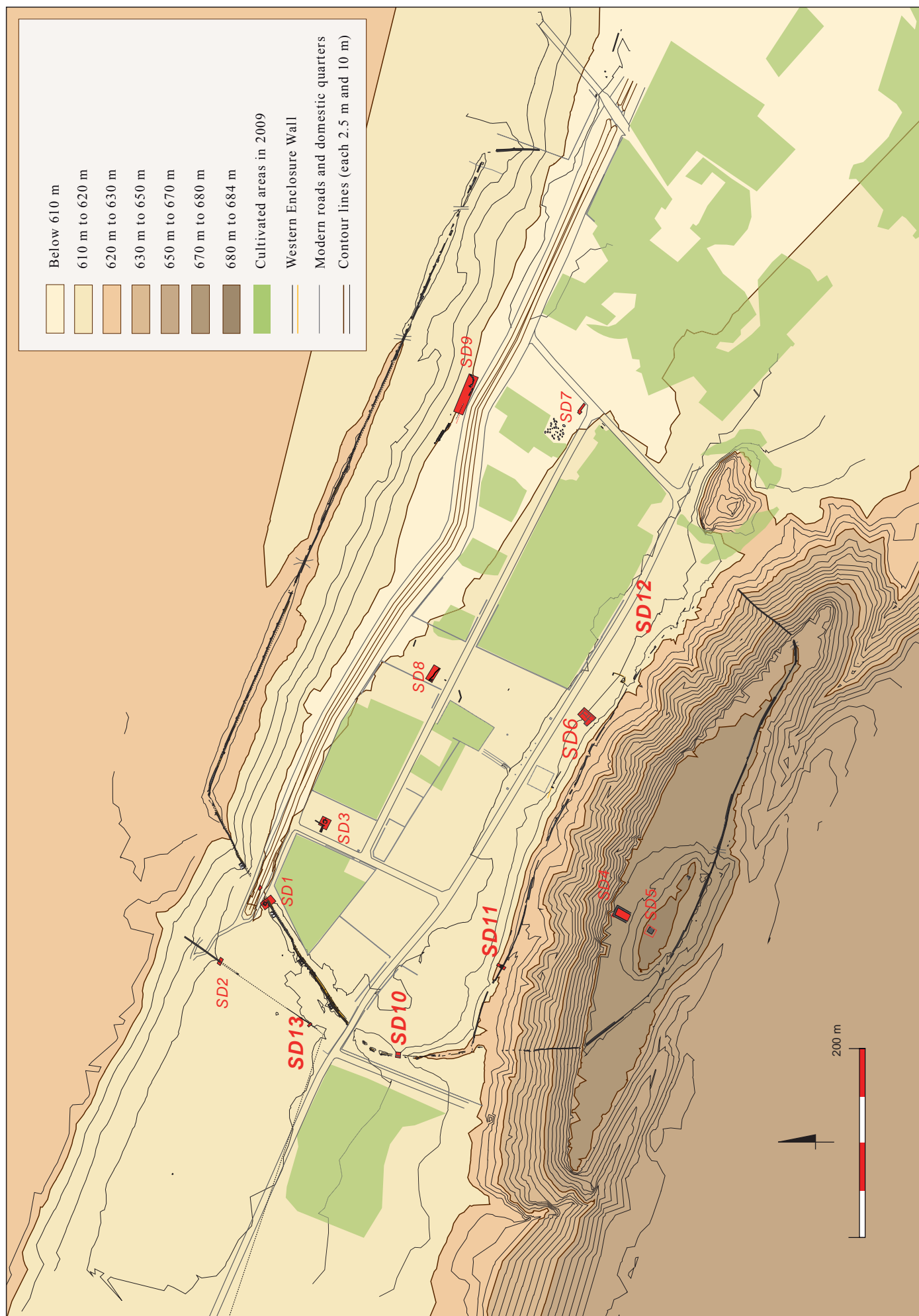


Fig. 2. Plan of the western settlement at Dumat al-Jandal (sector C). In red, the soundings opened in 2013

Sounding 6

Martin Makinson (University of Geneva)

This season's excavations in sounding 6 have brought to light a building centered around a basin dug directly into the impermeable marl bedrock (**Figs. 1 & 2**). This construction was located quite close to the western sector's enclosure and could in future seasons illustrate the relationship between this wall and the urban planning in the city (see **Fig. 1, Charloux et al sector C**). Two main phases of architecture, with sub-phases, were revealed by fieldwork in 2013, completing and sometimes challenging conclusions obtained the previous year.¹



Fig. 1. Sounding 6 at the end of 2013 season, looking east. Copyright Thomas Sagory - www.du-ciel.com

¹. Makinson 2016 (*Dûma* 3, 2012 report).

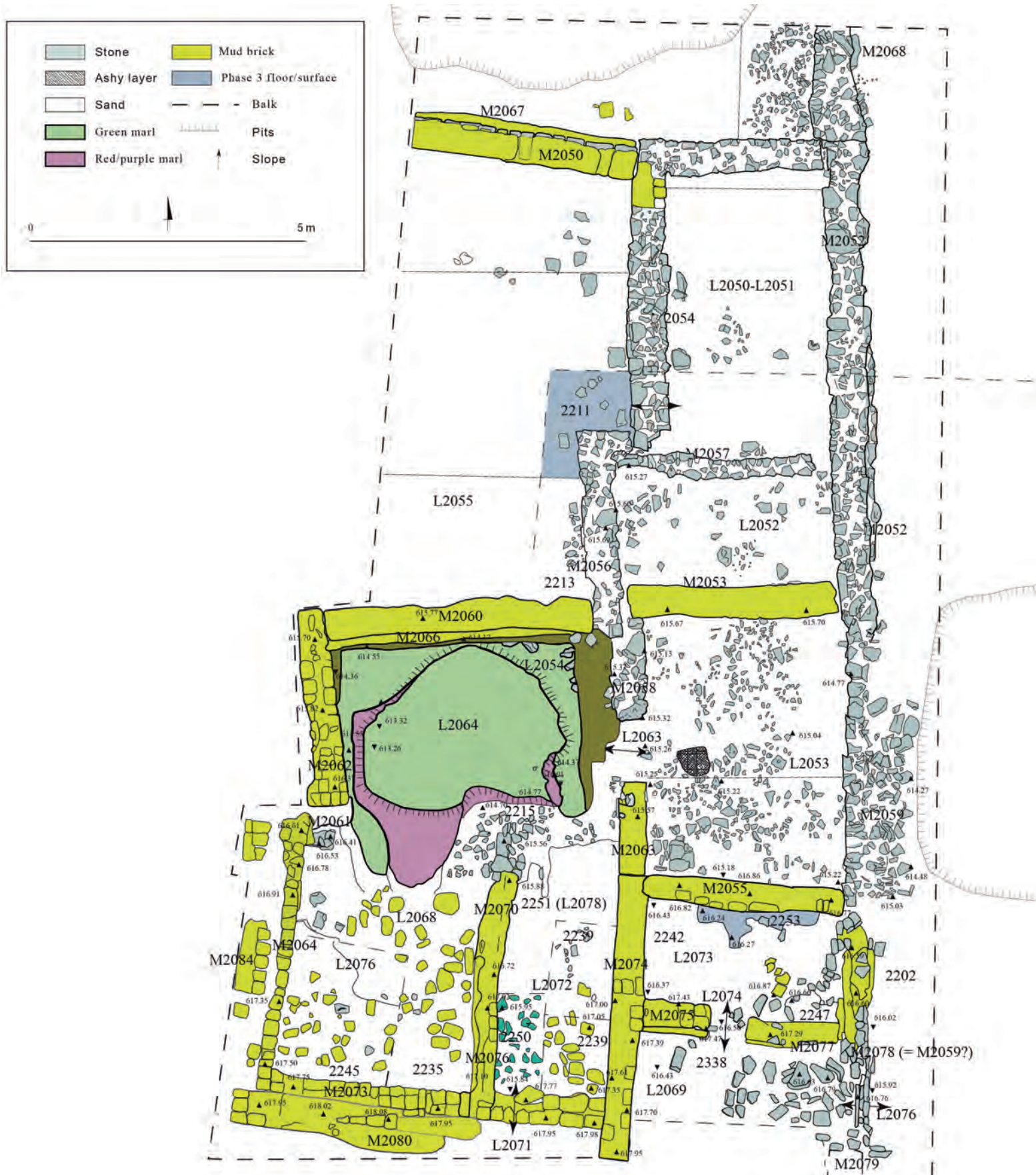


Fig. 2. General plan of sounding 6

Installation L2064

The installation (L2064 in room L2054) is an oval 4.35 m across, dug into the bedrock to a depth of 615.13 m (**Fig. 3**). Its bottom was the green marl bedrock, regular and formed an octagon or oval of red marl. The digging of L2064's bottom appears to have followed fracture lines of this oxydised marl. Nevertheless, the edges of the basin appear to be far more irregular (**Fig. 4**), being made of green friable marl which, when dry, tends to fracture into small pieces and collapse into L2064. Yet this green marl is in fact hardened clay, and when humid, tends to bond and become impermeable. Its porosity is due only to desiccation and to the abandonment of L2064.

Initially, it was puzzling to think that such a water conservation device would be excavated in such a friable geology; a rainstorm, however, demonstrated how impervious to infiltration the marl bedrock (essentially hardened clay) was, and how quickly the basin would have filled with rainwater. A niche of sorts, 1.70 m across, was cleared in the northwestern corner of the feature. The blue marl, bordered by a layer of red or purple marl forming straight edges around most of the basin, was quite attractive to the eye, contrasting with the drabness of the mud brick all around it. How this basin was filled with water and how the latter was channeled into L2064 is however still uncertain.



Fig. 3. Southern part of sounding 6 which was excavated in 2013, looking south. The installation L2064 is located at the bottom of the aerial view. Copyright Thomas Sagory - www.du-ciel.com



Fig. 4. Installation L2064 during the removal of filling, looking east

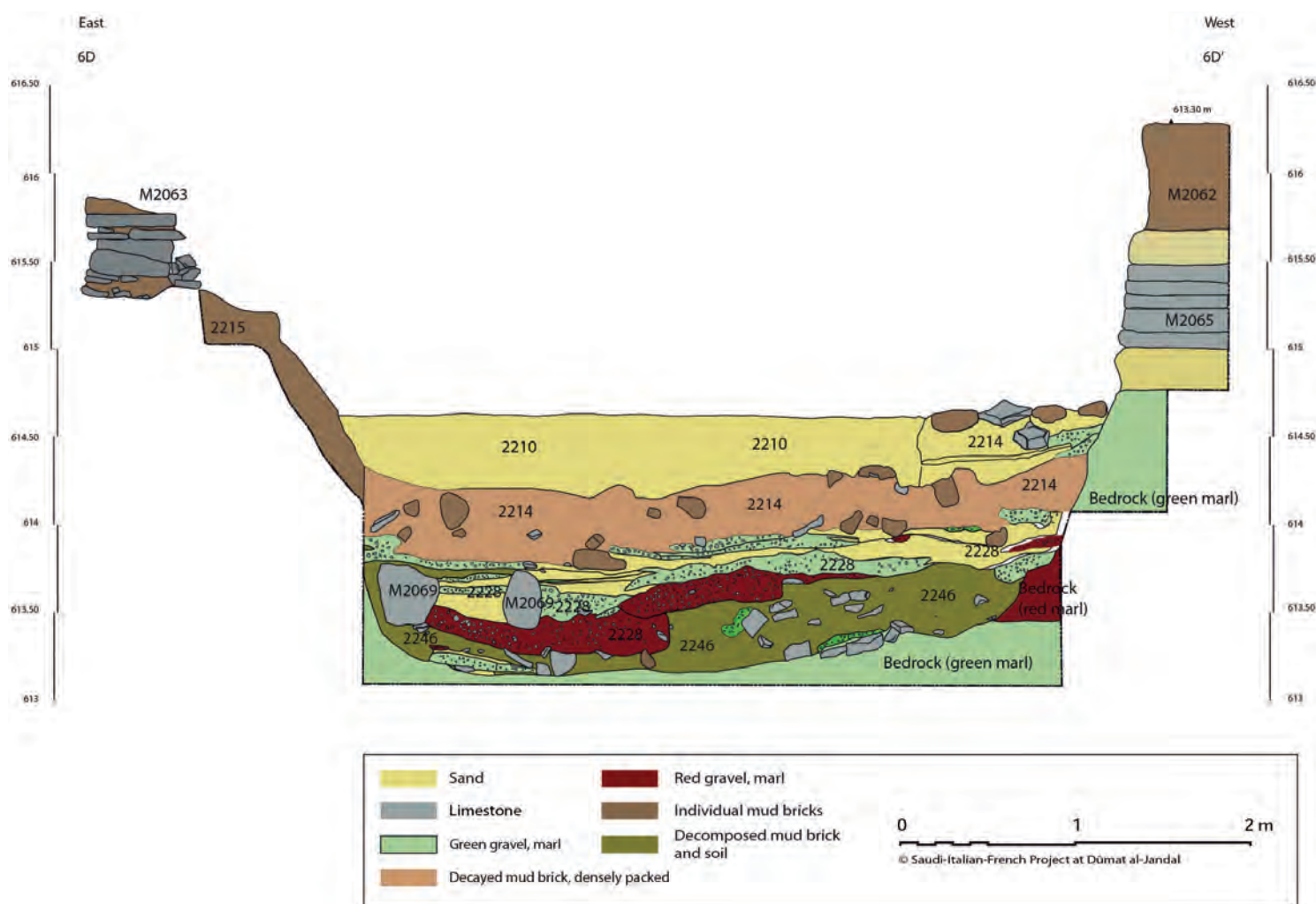


Fig. 5. Section 6D-D' inside installation L2064

Passage L2072

On the very first days of the season, a passage (L2072) bordered by ‘parapet’ walls (M2076 and M2074) was uncovered (Figs. 2-3). L2072 appears to lead directly and in a straight line to water installation L2064 and space L2054, and does not turn to enable access into adjacent room L2068 (Fig. 6). The interior was filled with collapsed material, mostly mud brick debris fallen from above; it was thought that this level of fill (US 2239) might seal a staircase enabling access into the installation. No steps were discovered, so it was thought that L2072 might have been either a ramp, or a water channel taking advantage of the slope. Certainly leaching due to runoff took place: much pottery and debris were washed down into L2072; moreover, a trodden floor (context 2251) was found in the western part of this ‘ramp’, consisting of hard-packed, compressed mud brick over which water had flowed. L2072 is now seen as a corridor, a passage leading to the basin from rooms upslope.



Fig. 6. Installation L2064 and room L2068 to the south delimited by ramp L2072 to the east, looking south.

A doorway (L2071) at the end of this passage was discovered (**Fig. 7**); at some point, it was blocked with sand overlain by five courses of squared 21 cm long rectangular mud bricks. This probably happened in the very last phase, when another access from the east (from room L2053) became the only way into L2054, the space with the basin in its centre.

No occupation floor was found in the passage, but rather two fills (US 2250 and US 2252), consisting of large chunks of marl and limestone in the case of the latter and finer marl gravel with the former (**Fig. 8**). US 2252 was a surface that appears to have pre-dated the construction of passage L2072 itself. The fill of mud brick covering these two fills on which people must have walked was in addition where most SD6 pottery shapes and type fossils were found.



Fig. 7. Doorway at the southern end of passage L2072, looking south.

Fig. 8. Section E-E'

Rooms L2073 and L2069

To the east, two rooms (L2073 and L2069) were partly excavated, but floors, nevertheless, were not reached (**Figs. 2, 9**). Both spaces were rectangular, quite small in size and were filled with a level of mud brick collapse and fallen slabs of stone, especially close to the terracing wall M2078 (the continuation upslope of M2059, exposed last year). These rooms were connected by a doorway and were separated by thin 40 cm wide partition walls. L2069, the room to the south, was not completely excavated. However, a pleasant surprise was the discovery of a door into the room, which enabled entrance from the outside. This entrance (L2076) possessed a well-hewn threshold (a perfectly flat and rectangular slab of 94 cm), itself placed on two raised steps of three squared stones each. However, the rooms were not connected to passage L2072, nor was there any passage into room L2053 to the north.



Fig. 9. Rooms L2073 and L2069, looking southwest. Copyright Thomas Sagory - www.du-ciel.com.

Sounding 10

Ariane Thomas (musée du Louvre, Department of Near Eastern Antiquities)
& Céline Marquaire (University of Paris 1 Panthéon-Sorbonne)

Sounding 10 was excavated between October 27th and November 10th 2013, under the responsibility of Ariane Thomas, curator of the Department of Near Eastern Antiquities of the Louvre, and Céline Marquaire, a student at the University of Paris 1 Panthéon Sorbonne. Four workers were involved in the clearances: Gumah Tareq Mohammed Osman, Ashraf Abu Sadiq and Abd'al Majoud Abou.

The trench was open at the western rampart (unit 2),¹ 50 m south of the modern road, on a vacant lot and protected by fencing set up by the Committee on Antiquities and Tourism (**Fig. 1**). This land is located in a depression between two artificial mounds north and south, consisting of the remains of the wall, which merges with the soil surface. At the location of the sounding itself, a long line of stones were visible in the alignment of those seen more clearly on the surrounding hills.

The main objective of the trench on this as yet unstudied part of the ancient wall was to determine if it was the location of the door of the western enclosure, as was previously supposed.² Indeed, the average altitude of trench is 615 m while the mounds bordering the north and south reach an altitude of 619 m at their highest point (**Fig. 2**). No door was discovered on the wall, several assumptions were then considered for the location of the west gate of the wall:

- At the spot of the sounding, according to the apparent depression in the enclosure wall at a lower altitude;
- Where the modern road passes (modern roads frequently following the course of old road tracks), that is to say, to the north of trench 10;
- North of Unit 2, south of the modern road, such as suggested by the location of the water retention basin excavated in 2010.³

1. Charloux *et al.* 2014: 158 – 162.

2. Charloux *et al.* 2014: 161, Fig. 12.

3. Charloux *et al.* 2014: 156, Fig. 7.



Fig. 1. Sector C before opening sounding 10, looking north (DJ2013a0035B)

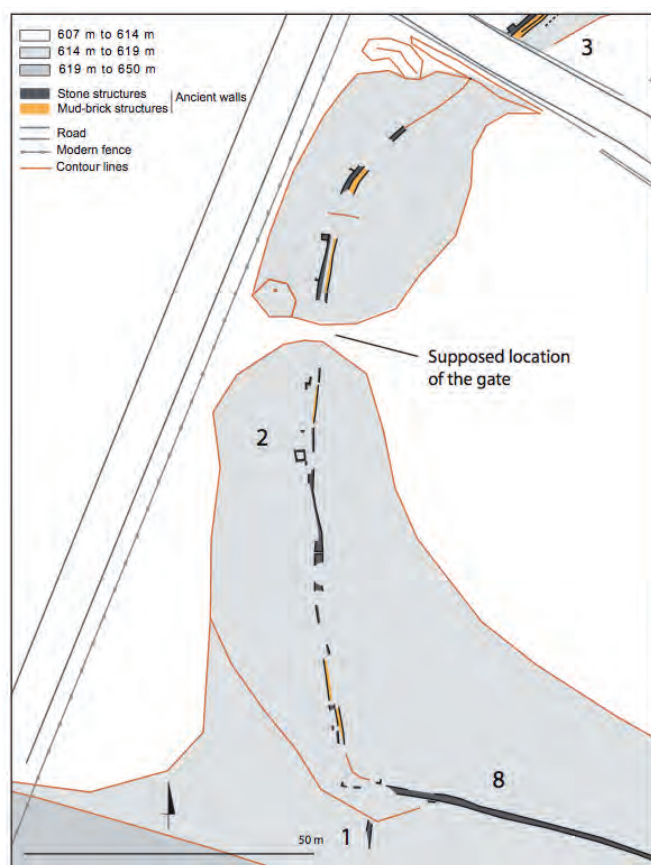


Fig. 2. Topographical plan of unit 2 (Charloux et al. 2012 : 161, Fig. 12)

Preliminary operations

The surface was first cleaned of various plants and waste littering the ground at this point. Context 2137, composed of loose beige sand and small stones scattered from the wall, was exposed, revealing the alignment of stones more clearly (**Fig. 3**).

After the surface cleaning, the levelling course of the emerging walls was exposed revealing a triple stone wall (**Fig. 4**), all cut and polished, dry assembled without mortar:

- M2027 in the centre, with a thickness of 80 cm and made of stones of mixed size (10 to 15 cm in length for the smaller ones, between 30 and 50 cm for the largest);
- M2028 to the east, with a thickness of 115 cm and whose stones are fairly regular and fairly large (about 30 cm in length);
- M2029 in the west, no regular surface whose continuity was not visible (assuming a counter could be considered at this stage of operations although M2029 appeared to continue in the north and south on two mounds). The thickness of this wall is similar to that of M2027 (about 80 cm); it is made of stones whose size varies between 30 and 50 cm in length. The leveling course of M2029 is located 5 cm below the other two walls.

The excavation perimeter was then defined as a rectangle 6 m from east to west and 5 m from north to south, largely centred on the junction between M2027 and M2028 .

This perimeter was then cut in half to deepen the trench: an area of 2.5 m (north-south) x 6 m (east-west) was defined, joining the southern boundary of the perimeter. This area was then divided into two separate parts (**Fig. 5**):

- SD10A corresponding to the eastern half (inside the wall) and including walls M2027 and M2028 2.5 m from north to south for 3 m from east to west;
- SD10B corresponding to the western half (outside of the wall) and including wall M2029, 2.5 m from north to south for 3 m from east to west.



Fig. 3. Sector C, view of sounding 10. Location after surface cleaning, looking north (DJ2013a0036B)

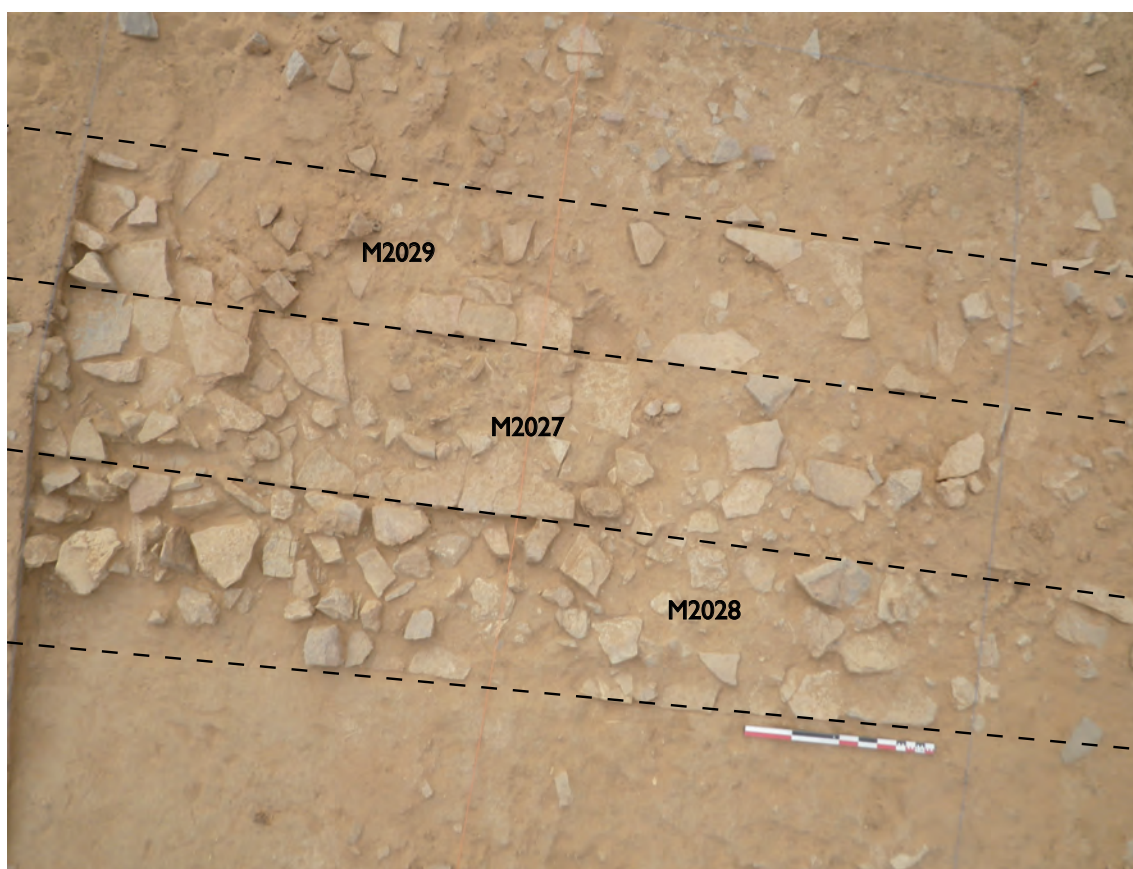


Fig. 4. Sounding 10, view of the three walls (DJ2013a0119B)

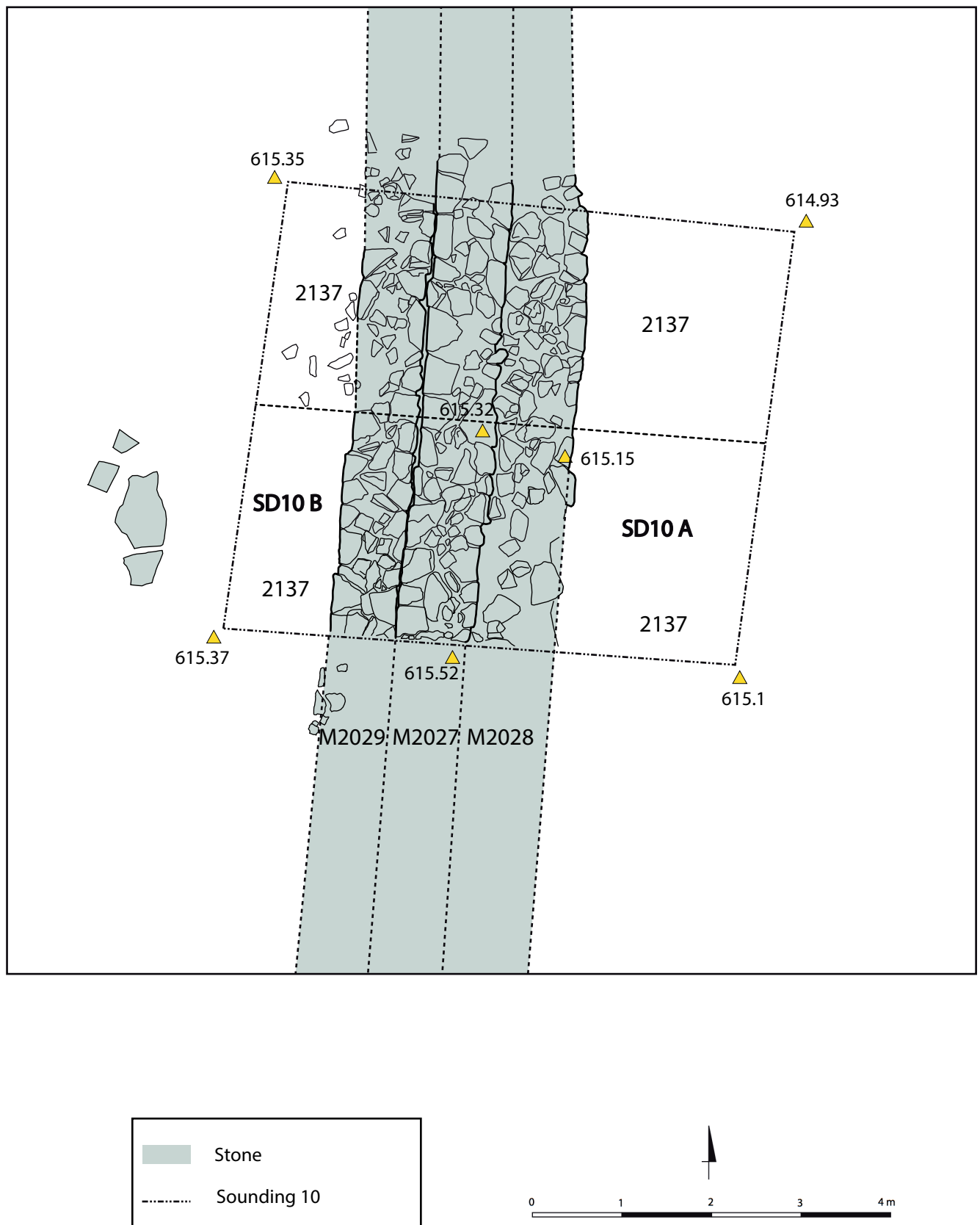


Fig. 5. Plan of the Sounding 10: distribution in SD10 A and SD10 B

Stratigraphy

Four construction phases could be distinguished:

- Phase 1: demolished mud brick structure (under the foundation level of the enclosure).
- Phase 2: Construction of two stone walls: M2027 and M2029.
- Phase 3: Internal reinforcement with the addition of a wall of mud brick on stone foundation M2028 joined to M2027 .
- Phase 4: The collapse of the mud brick wall and abandonment of the enclosure.

The length of the interval between phases 2 and 3 is difficult to determine because it is based solely on differences in level of foundation between the walls M2028 M2027 and M2029.

Phase 1: mud brick structure (L2031)

Within SD10 B, mud bricks were identified at an elevation of 613.96 m, in context 2143, composed of loose beige sand. This collapsed structure, partially excavated, was called L2031.

Located on the north and south of the excavated perimeter, the bricks were following a regular line, likely result of the collapse of the structure to which they belonged and which was located to the west of the trench (**Figs. 6-7**). A sample was taken and analysis is underway to date these bricks. Apart from these raw bricks, only a piece of coal was found in this layer.

Further analyses should clarify a date obviously preceding the construction of the wall. Being placed outside the wall, below the foundations of the latter, the collapsed mud brick structure, which should extend to the west beyond the perimeter of excavations, remains to this day enigmatic.

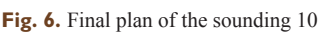




Fig. 7. The mud bricks structure in SD10 B, looking east (DJ2013a0330B)

Phase 2: installation of the rampart

This is the construction phase of walls M2027 and M2029. The foundations of M2029 are at an elevation of 614.42 m while those of M2027 are at an elevation of 614.52 m. It is possible that M2029 predates M2027 as it is also suggested by the slight difference in their level of foundation (**Fig. 8**). Both are entirely in stone.

Similar to the observations on Unit 3 of the enclosure, we note that the foundations rest on unstable soil :

Context 2142 for M2029: a compact dark gray clay layer mixed with stones whose width reaches 29 cm;

The soil on which M2027 rests is difficult to determine because it is impossible to see any stratigraphy towards west due to M2029 and in the east due to M2028 and the foundation pit which has prefigured its construction (Context 2144 composed of very loose beige sand).

An occupation floor 2030 was detected at an altitude of 614.90 m. It is the only observed soil whose thickness varies from 0.5 to 1 cm (east to west). Light gray, it is distinguished by its hardness from the layers surrounding it.

Note that the M2029 foundations are buried at 48 cm below the occupation floor, at an elevation of 614.42 m. Should we then assume that the foundations of the walls were buried

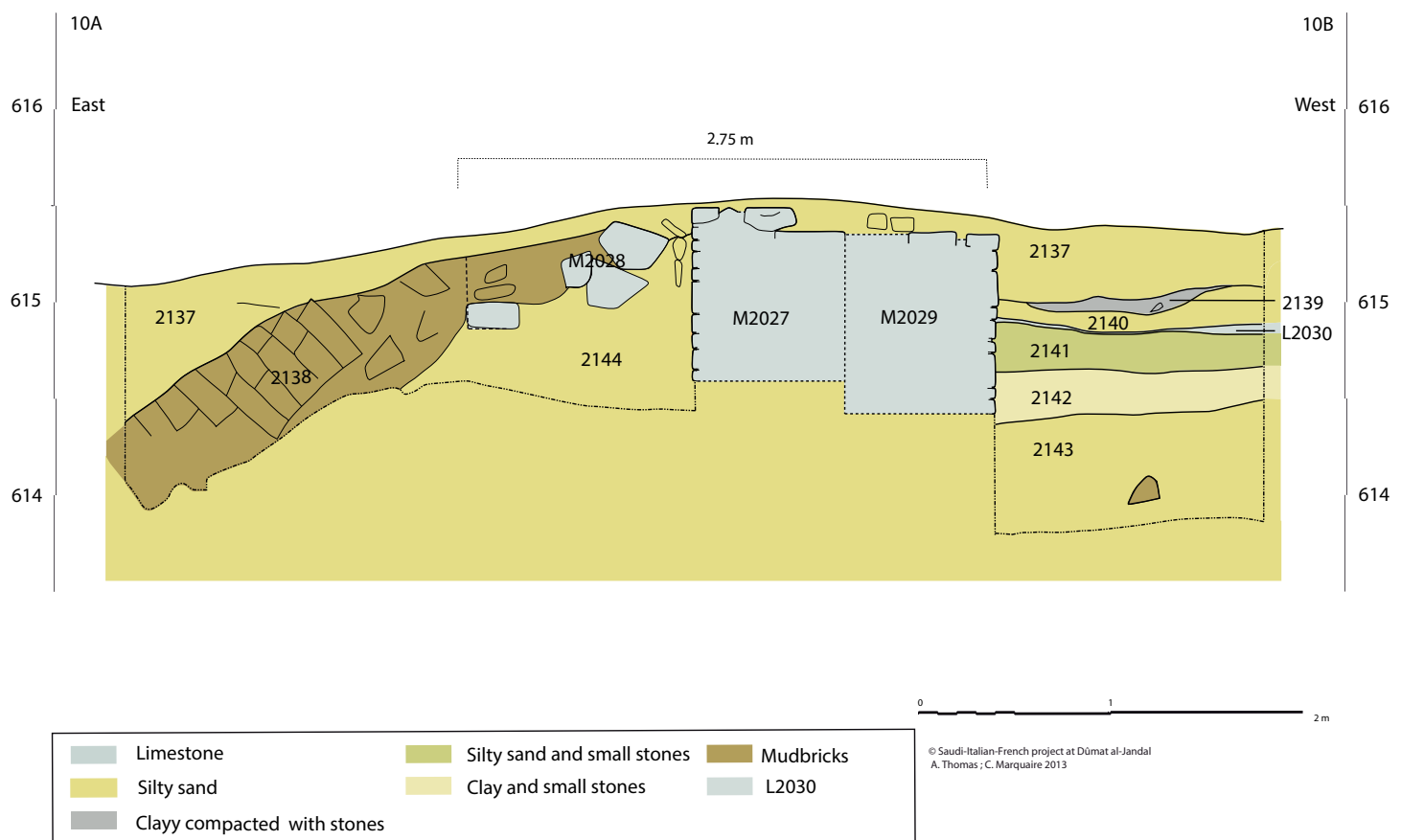


Fig. 8. SD10 : transversal south section.

close to 50 cm below the ground? Or is the occupation floor succeeding the construction simply no longer discernible? Perhaps layers 2141 and 2142 (respectively consisting of a beige sand layer mixed with gravel with a thickness of 36 cm at its thickest point for 2141 and a dark gray layer of packed clay mixed with stones whose thickness reaches 29 cm in 2142).

Phase 3: reinforcement of the enclosure

Subsequently, the double stone wall was strengthened by the addition of wall M2028. The latter appears to consist of a mud brick elevation on stone foundations: only the stone foundations of the wall were found in place, the bricks having collapsed during the next phase (**Fig. 8**). By comparison with the internal walls of the enclosure of unit 3, which also consisted of mud brick elevation on stone foundations, we favour this restitution. Note that the M2028 foundations are shallower than those of M2027 with a gap of 31 cm (**Figs. 9-10**).



Fig. 9. View of SD10 A, looking west (DJ2013a0390B)

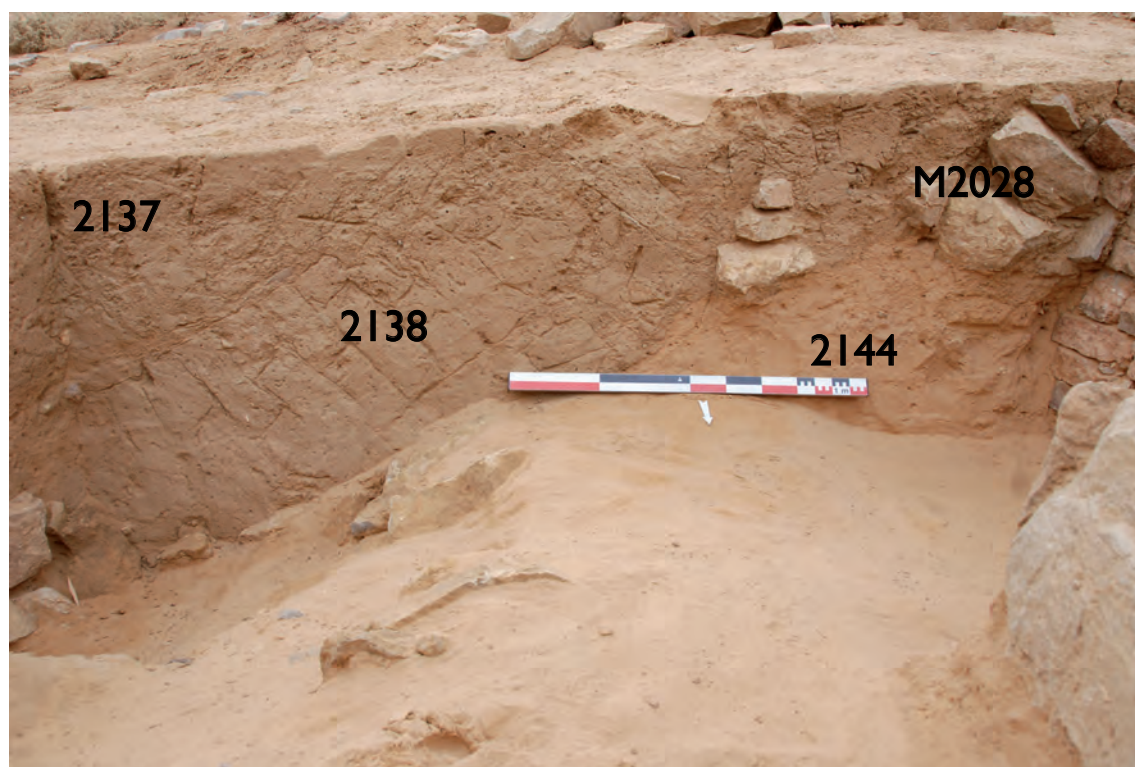


Fig. 10. View of the SD10 A transversal south section (DJ2013a0405B)

Indeed, the foundations of M2027 are at an elevation of 614.52 m while those of M2028 are 614.83 m, which suggests that the erection of M2028 happened in a second phase, without necessarily implying a big hiatus between these two phases. M2028 was built on layer 2144, consisting of very loose beige sand probably corresponding to the digging of a foundation trench prior to the installation of the wall.

Phase 4: collapse of wall M2028 and abandonment

This last phase is the collapse of elevation M2028: 11 levels of collapsed mud bricks were discerned in section and form layer 2138 consisting mainly of mud brick containing (Figs. 6, 8, 10-11) sherds of pottery and charcoal remains.

Part of elevation M2028 collapsed over a length of 1.50 m from the western boundary of the perimeter and the stones that made up the base of the wall were found lower in the trench (Fig. 9). Thus, it appears that the mud brick structure, in collapsing, has retained a part of the foundation of M2028.

It is also noted that the terrain must have sloped downwards towards the east since collapsed mud bricks were found below the foundation of M2028: up to 613.90 m, or 93 cm below the foundation level of M2028.

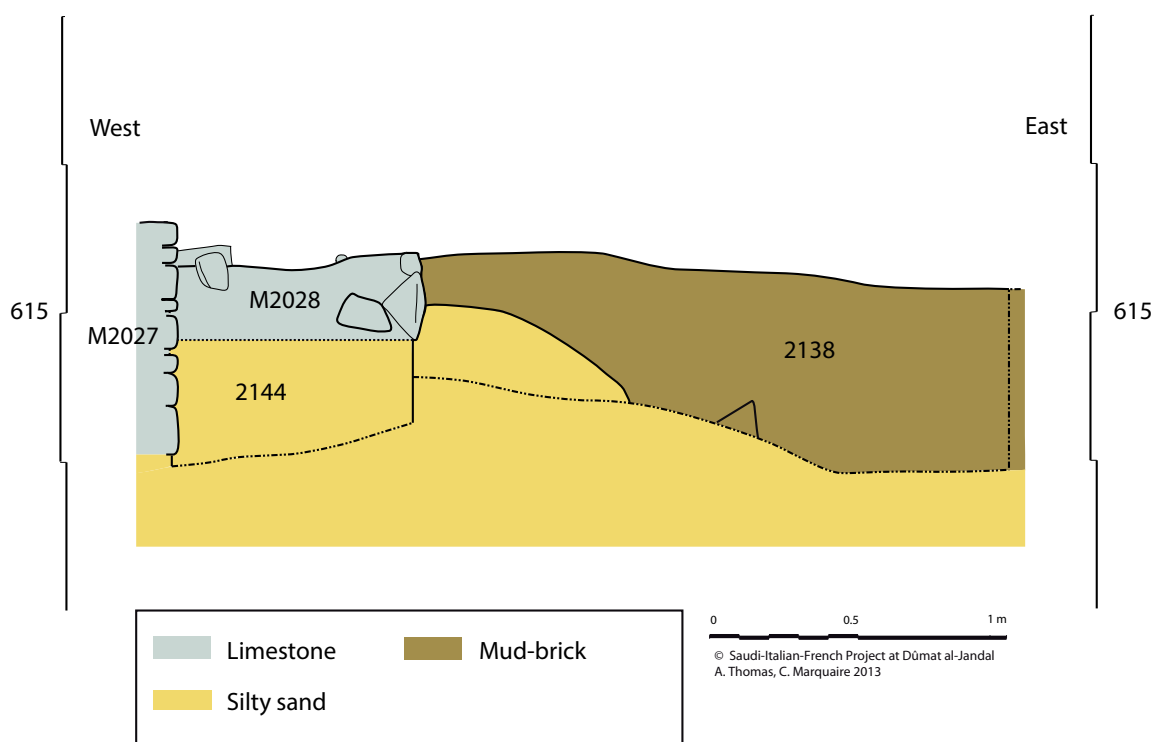


Fig. 11. SD10 A: transversal north section

Conclusions

Sounding SD 10 has demonstrated that in this spot there was no door, which probably was located on the site of the current road just to the south. This work has also identified another wall section confirming the continuity of the latter in Unit 2 and completing a little more our knowledge of construction techniques. This section of the rampart consists of a triple wall of which two are entirely of stone, the third of mud brick on stone foundation collapsed thereafter. These stone walls are based on sand, moreover on land sloping slightly to the east, especially in the inner part of the wall (highlighted in SD10A). The masonry technique employed is the same for the three walls and similar to that used on the already studied sections of the wall, suggesting a contemporary dating (**Fig. 12**).

Walls M2027 and M2029 appear to extend since the levelling course is distinguishable in the same alignment on both hills surrounding the trench north and south, in contrast to wall M2028: should we conclude that this wall is a later addition which served to reinforce this point of the enclosure in particular? As such, we see the same later addition of a wall in trench 11 with the addition of wall M2050 - M2053 succeeded the previously erected double wall. If it is found that M2028 is subsequent to the double stone wall, analyses of the mud bricks constituting the latter will establish its date. Similarly, the dating of collapsed mud brick structure L2031 should determine the time interval between the collapse and the construction of wall M2028.

To better preserve the structure, trenches SD10 A and B were filled at the end of the season.



Fig. 12. Sounding 10 looking south (DJ2013a0388B)

Sounding 11

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assisted by Céline Marquaire (université Paris 1 Panthéon-Sorbonne)

Sounding 11 was opened on the site of a break in the masonry of the inner wall of the western sector (Unit 8, sector C) identified in 2010. At this location, the levelling courses of contiguous structures appear on the surface and the break is evidenced by a linear joint between the two walls of the enclosure and the presence of which resembled two hillocks located on both sides of a small depression (**Fig. 1**). We therefore hypothesized the existence of a door connecting the valley to the terrace at the base of the promontory Rijm al-Burj (see **Charloux, Cotty et al., Fig. 1**, in this work).

The excavation (**Fig. 2**), conducted from October 28 to November 13, 2013, actually unearthed this type of installation, but with the added interest of revealing a complex sequence of construction and sediment accumulation. Six phases were distinguished in two soundings opened on either side of the wall (SD11a SD11b north and south). Unfortunately, the search has produced no ceramic form, and only a few undatable shards.



Fig. 1. View of the gate before excavation (DJ2013a0069B)



Fig. 3. Plan of sounding 11 and orthorectified image (G. Charloux & Thomas Sagory -www.du-ciel.com)

Phase 1. Installation of the rampart (M2358 and M2359)

The first phase (**Fig. 4**) is marked by the establishment of the rampart on ground with a strong south-north gradient, due to the slope of the adjacent promontory (**Fig. 5**). In the south, we met a layer of likely geological green marl, which, however, has not been identified in SD11a north, where the Wall M2358 is based on a layer of aeolian sand 2163 (**Fig. 6**). This sand is indistinguishable from the higher aeolian accumulations, except when anthropogenic layers separate them.

The main problem with this phase is the relationship between walls M2358 and M2359 for which we do not have precise stratigraphic data, these being joined together. Of almost identical thicknesses (1.00 m and 1.10 m for M2358 M2359), their foundations are made of stone and mud brick elevations. Nothing prevents them from following each other (over an indeterminate length of time); the foundation of M2358 appears to be based lower than that of M2359, but it could also be explained with the desire to adapt to the slope of the land.

In SD11b layers 2165 and 2166 are probably related to the first state, passing under wall M2350-M2353.

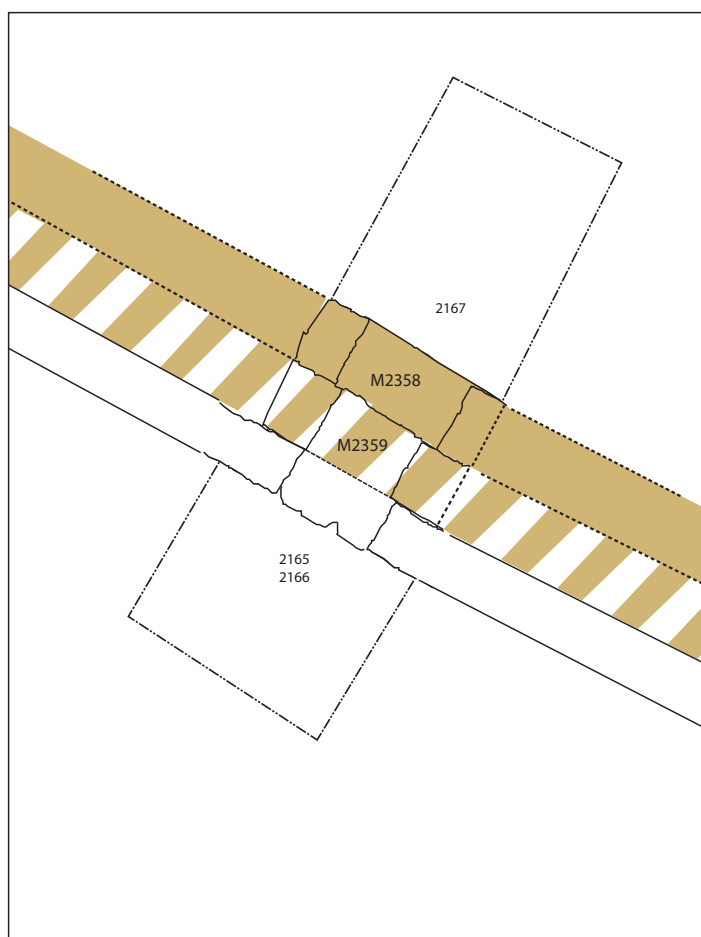


Fig. 4. Phase 1



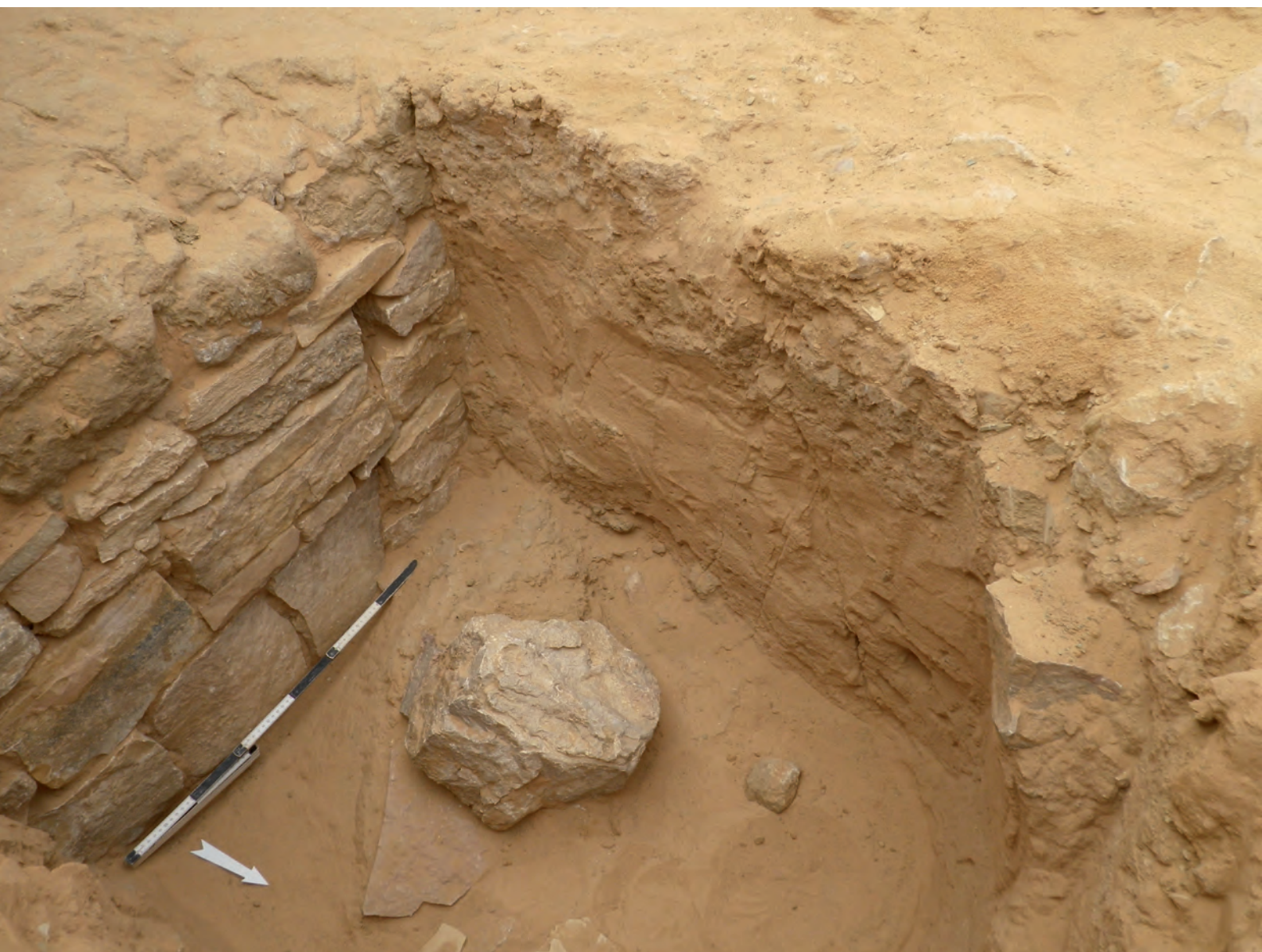


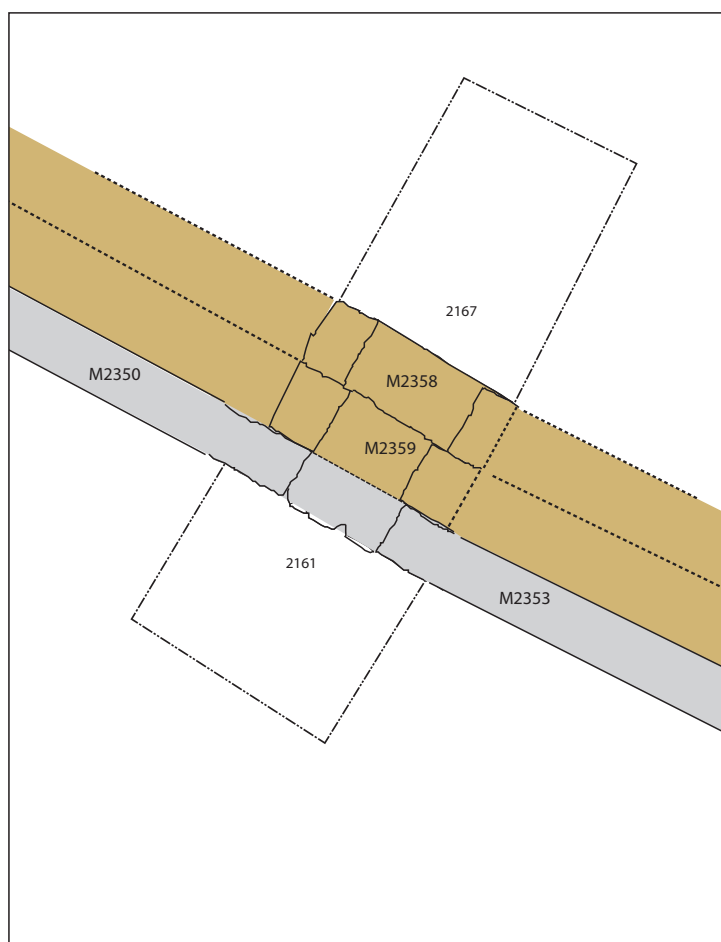
Fig. 6. Sounding in aeolian sand 2163 (DJ2013a1060B)

Phase 2. Adding the exterior wall (M2350-M2353)

Phase 2 (**Fig. 7**) probably corresponds to the addition of the exterior wall M2350-M2353 in the Western sector. This assumption is based on the presence of a layer of mud brick moulding under the base of the wall (**Figs. 5, 8**); this layer is probably later than the destruction of the upper part of a wall of mud brick, either M2359 or more likely M2358. The 0.80 m thick wall is built in worked stone over its entire height. At this stage, the enclosure consists of three walls for a total thickness of 2.90 m.

The reason for this addition remains enigmatic for two reasons: unit 3, to the west, consists only of two adjoining walls, unlike unit 8, which is also located at the base of a promontory. It is therefore difficult to understand such a consolidation, especially as units 1, 6 and 7 surround the promontory and thus protect the inner rampart. Are units 1, 6 and 7 later additions? Is the need to consolidate the rampart the consequence of increased dangers in the region?

Note however that the addition of M2350-M2353 may very well have happened as a result of the construction of M2358 and M2359 not necessarily with a long hiatus.

**Fig. 7.** Phase 2**Fig. 8.** View of the southern part of eastern section 11B (DJ2013a1644B)

Phase 3. The building of door L2180 and its first utilisation

The building of door L2180 involved a major overhaul of existing structures (**Fig. 9**) with on the one hand the sectioning of the exterior stone wall over its full height (M2350 to the west and M2353 to the east) and the rise of mud brick walls M2358 and M2359 (**Fig. 10**), and on the other hand the embedding of stone door posts inside the mud brick masonry of the walls once sectioned: M2351 (west) and M2354 (east) M2359 and M2352 to M2357 and M2358 in (**Fig. 11**).

This step is also marked by the installation of a large door block in the masonry of M2369 using a threshold stone and slabs, in its southern extension, which is found in the base of the wall M2353 in SD11b (Fig. 12 west cut), probably so that the path was levelled. A wooden door closed the passage from the inside of the enclosure (to the north), as indicated by the presence of a stone socket in the corner of the door jambs M2357 and M2354, in SD11a (**Fig. 13**).

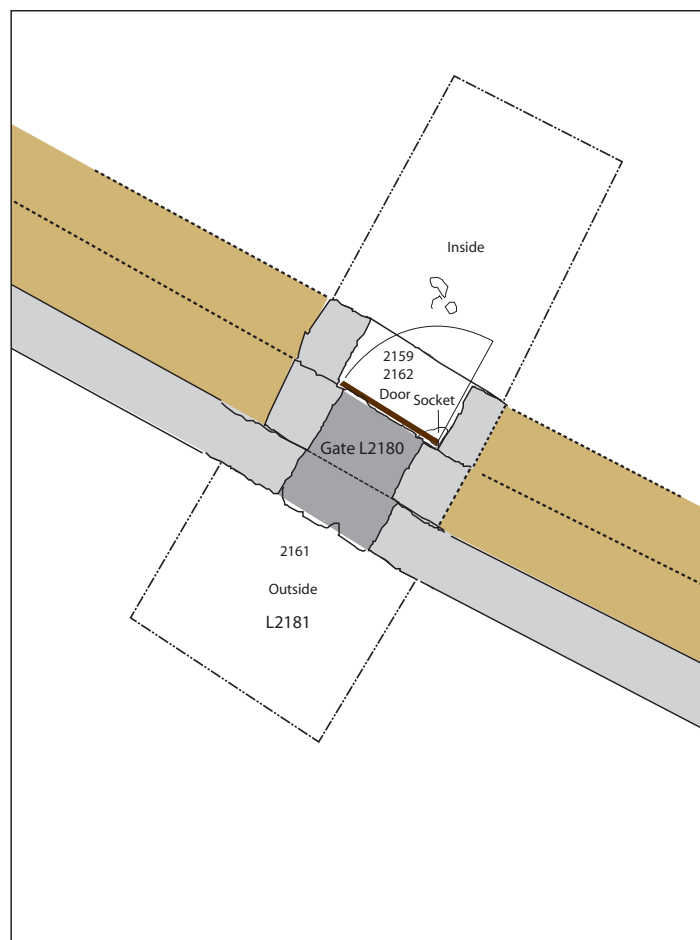


Fig. 9. Phase 3

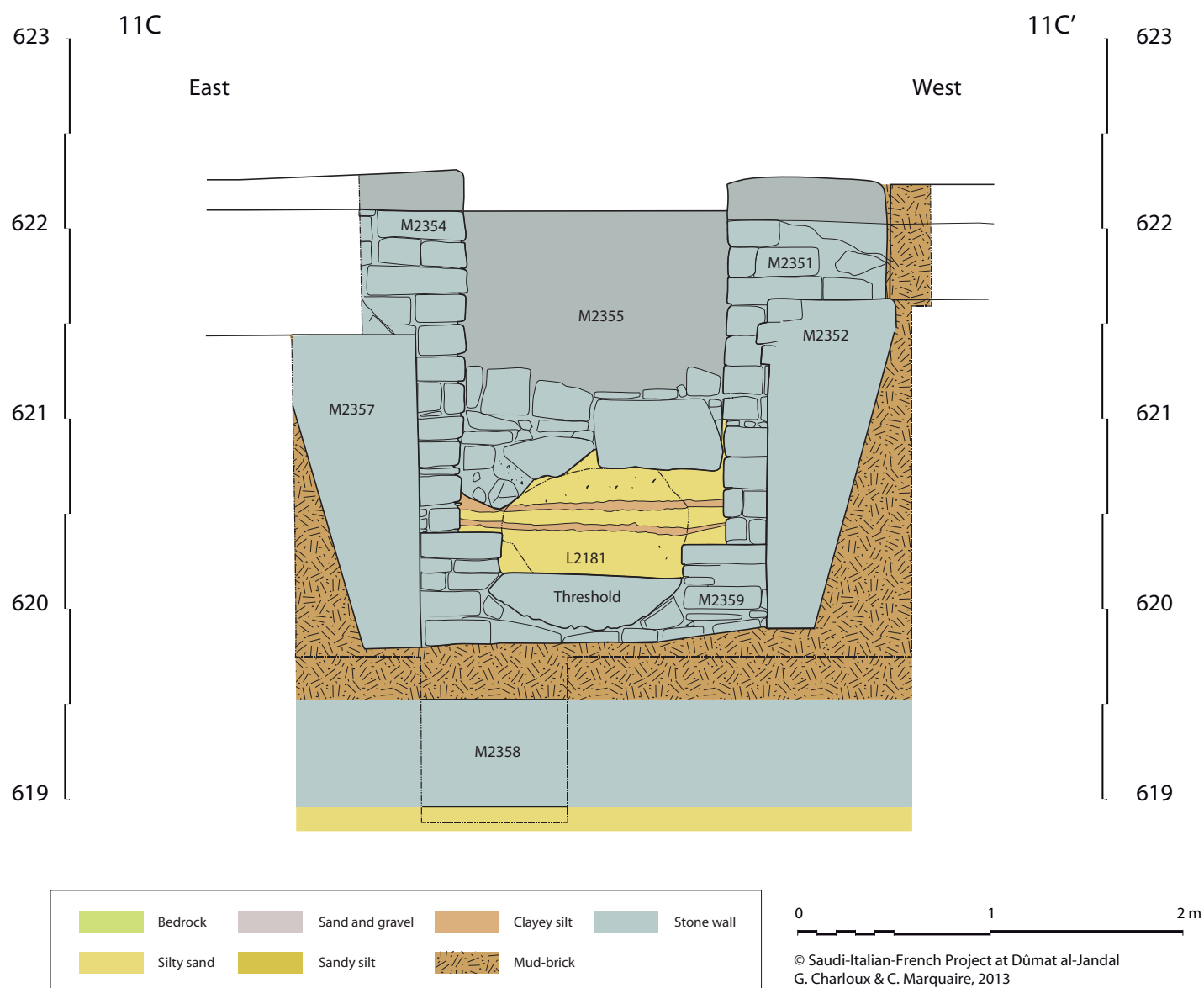


Fig. 10. Southern archaeological section 11C



Fig. 11. View of the gate, looking southeast (corresponding to section 11C) (DJ2013a1664B)

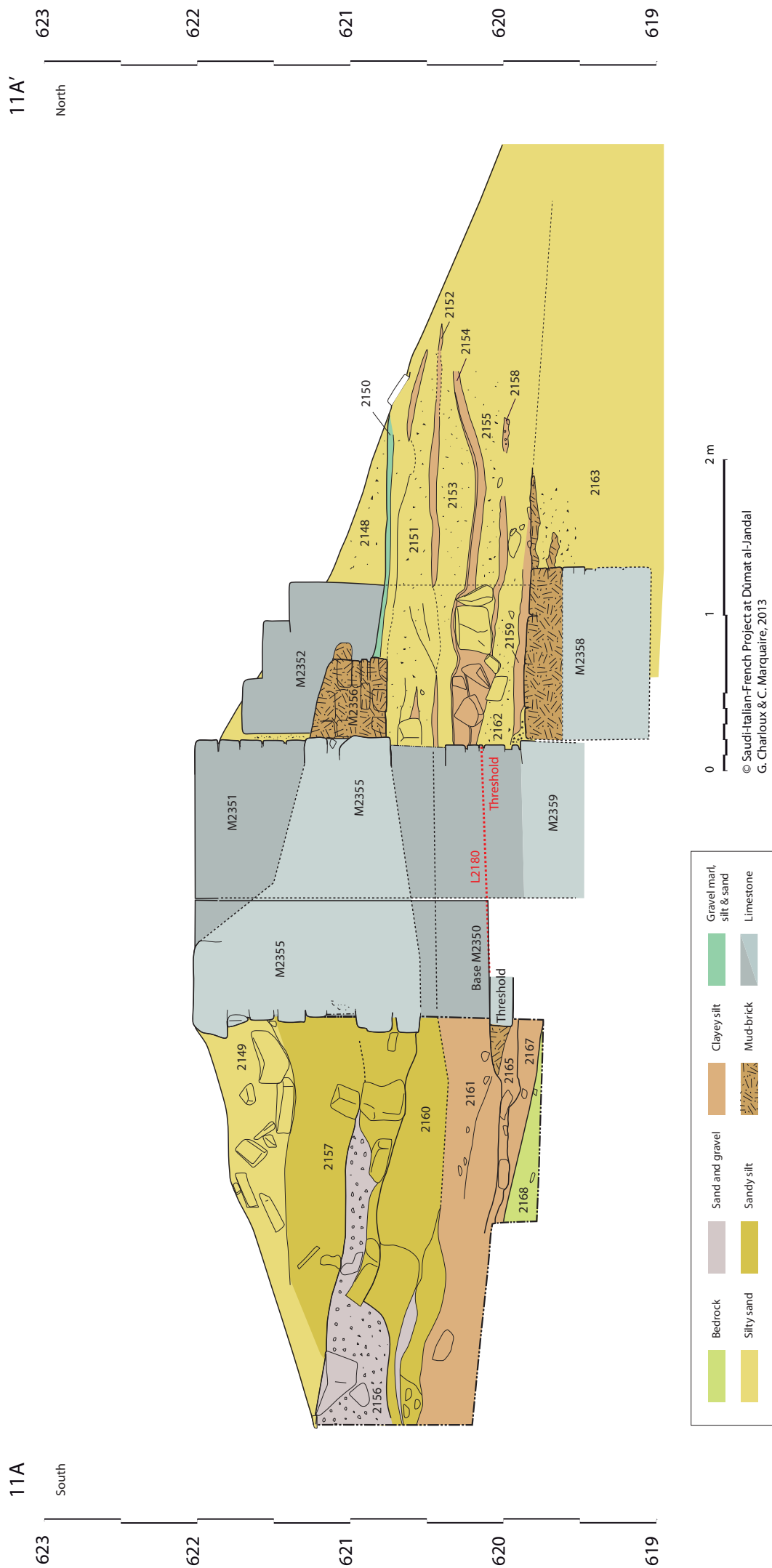


Fig. 12. Western archaeological section 11A



Fig. 13. Socket front of the gate, on which stands the scale, looking south-east (DJ2013a1677B)

Phase 4. Removal of the door and sediments accumulation

During phase 4 (**Fig. 14**), the door disappeared, freeing the passage in and out of the enclosure. The layers are in fact accumulated on the socket. These were successive layers (2158, 2155, etc.) marking each anthropogenic circulation episode followed by deposition of aeolian sand (**Fig. 15**). The deposits, sloping to the north as shown in the western section (**Fig. 12**) suggest that the wind rushed from the south. Moreover, there is much less accumulation in SD11b.

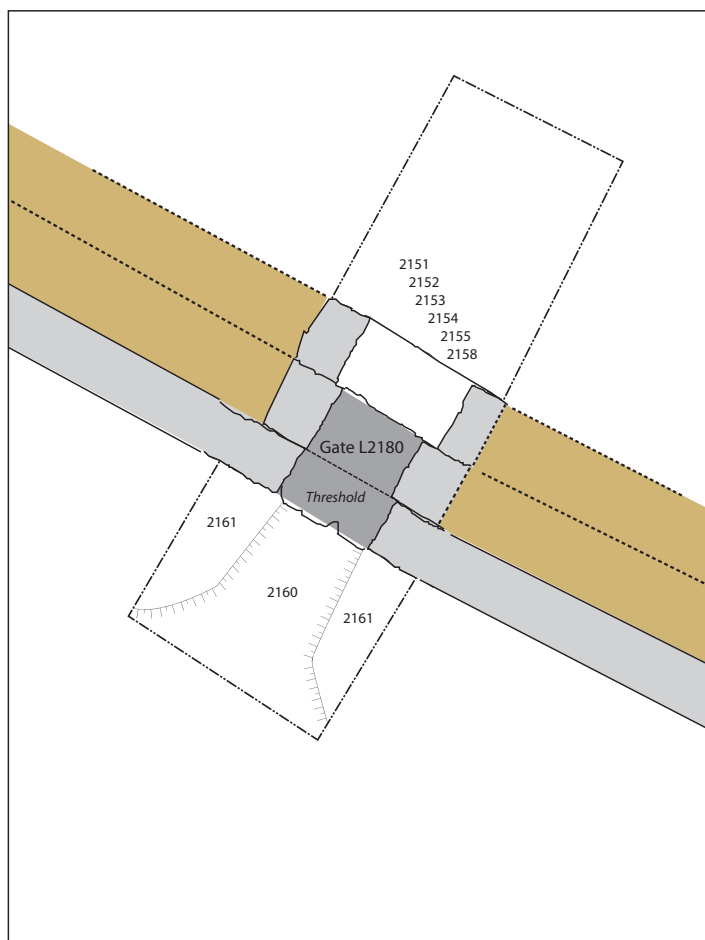


Fig. 14. Phase 4



Fig. 15. Northern part
of the western section
(corresponding to section 11A)
(DJ2013a0266B)

Phase 5. Sealing of the door (M2355 et M2356)

The sealing of the door takes place during phase 5 (**Fig. 16**). First, the passage south between M2350 and M2353 was carefully closed (wall M2355), following the alignment of the facing of the enclosure and not disappearing with the foundations of adjacent walls (**Fig. 17**). The inner filling is more randomly composed of uneven stones (**Fig. 18**). On the north side, a small mud brick wall M2356 installed between the posts of door M2352 and M2357 consolidates the masonry in the back of M2355. So it seems that the intention of this closure was to prevent entrance from the south and therefore from the base of the promontory.

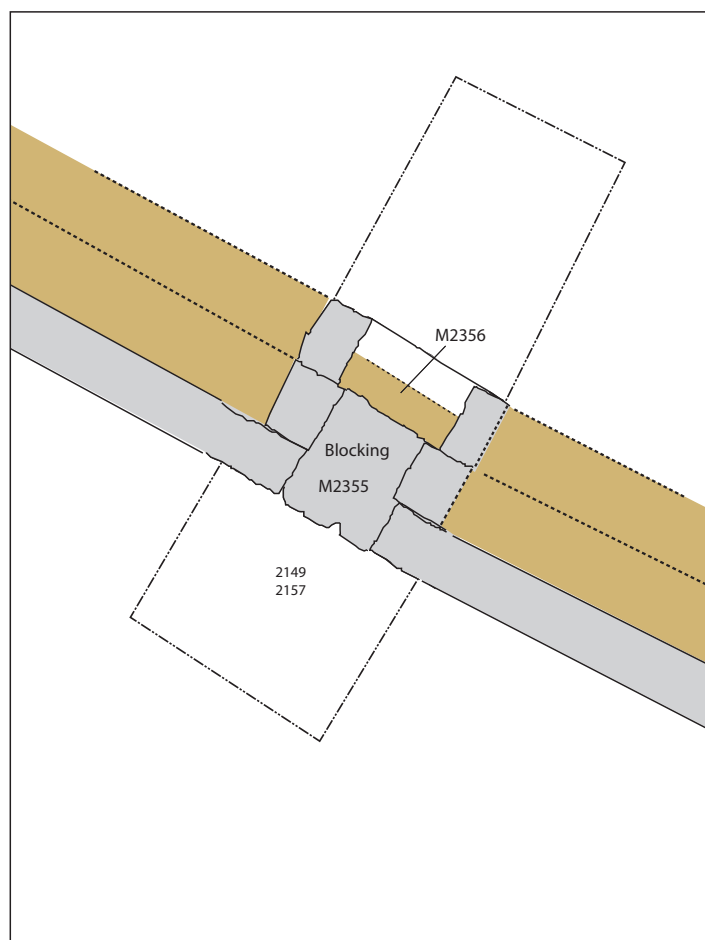


Fig. 16. Phase 5



Fig. 17. The gate in sounding 11 looking northwest (DJ2013a1653B)



Fig. 18. Gate seen from above during excavation, looking east (copyright Thomas Sagory -www.du-ciel.com) (DJ2013a0200B)

Phase 6. Looting

The last phase observed in the excavation of sounding 11 (**Fig. 19**) is a looting pit of unknown date, which not only destroyed layers all over the height of the passage, but also reaches the base of the threshold of door L2180. On this occasion, wall M2358 was also destroyed. Nothing is left but two fragmentary remains on both sides of the passage (**Fig. 20**).

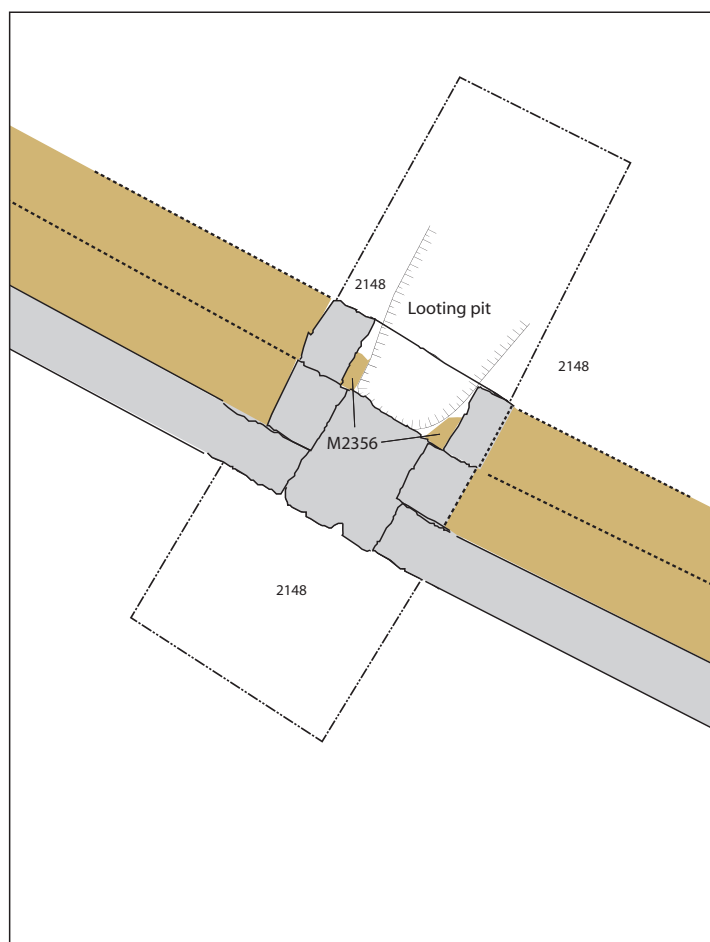


Fig. 19. Phase 6

Conclusions

The main point of interest of sounding 11 was finding, for the first time in sector C, a sequence of construction and adjustments that could be quite long. Such a sequence was not revealed for example at the time of sounding SD1 in 2010, where there was no clear indication of the existence of several phases of construction or a long use of the enclosure. The second point of interest is to question the internal organization of sector C: why develop a door at that location, when the space is limited between the base of the promontory and the rampart, especially as the goal is to close the door from inside and thus provide access to the outside of the enclosure? Why does door L2180 not exist in the first two stages of construction? Does this mean an internal change in the space of sector C? Also, what need led to the development of such a door? And above all, what does this door lead to?



Fig. 20. Excavation of the gate in progress, looking south (DJ2013a0197B)

Sounding 12

A tower in the valley

Marianne Cotty (Musée du Louvre. Department of Near Eastern Antiquities)

In November 2013, part of the team moved to the heart of the oasis in an area located below the Rijm el Burj and intermediate enclosure (unit 8) (**Charloux et al. Sector C, Fig. 2**). This sector had been completely leveled by a bulldozer in 2010 and covered an area more than 150 m long by 30 m wide. Tens of cubic metres of sediments and rocks had been removed, destroying a large part of the archaeological remains of the area. Its clearing operations had damaged part of the intermediate enclosure (unit 8), weakening it for 10 m, and had partially destroyed a large masonry building. The remains of the latter are now visible in a section more than 20 m.

This year, the first operations consisted of cleaning and extending the section (**Fig. 1**); and a sondage of 12.50 x 4 m was opened at the foot of the section (**Fig. 2**). It has among other things, exposed the extension of two large walls visible in section (M2311, M2310) as well as another one linked to them (M2314). On the front of the section, a perpendicular wall has also been brought to light (M2318). Its ruins draw the outline of a square building of 49 m² (7 m side) (see **Fig. 6**). The thickness and quality of the walls and the robustness of the foundations suggest that this is a massive edifice of great importance. Reading the horizontal and vertical stratigraphy, three phases have been identified.

Phase 0

Phase 0 corresponds to the construction phase of the square building and its preliminary works. In the southern section, we noted the geological soil: a red to green marl that plunges in section to about 45° (**Figs. 1, 11**). This bedrock has sometimes been reported elsewhere in the oasis. This disintegrated marl (sometimes mixed with sand: 2339) is present throughout the western ¼ of the sounding (**Fig 3**). It is also found in blocks (near M2312, M2315) (**Fig. 2**). The use of such levelling has been observed at other places on the site.¹

These terracing operations were obviously intended to ensure the stability of buildings. An additional preparation layer was added above: a level of coarse blocks, sand and very compacted gravel was observed under M2311 at an elevation of 613 m (**Fig. 4**) (2349). In contrast, no foundation trench was observed. Above was a sandy layer mixed with red marl (2340). The preparation layer (2349) allowed the roughly squared rubble to sit horizontally, held together by a compact clay sediment mixed with small stones (2334) (**Figs. 4-5**).

The bad state of preservation of the walls in the western part of the sounding permitted however a better understanding of the foundations of the structure. It consists of roughly squared rubble that can be followed for 2-3 courses (**Fig. 4**). The foundations of M2311 are 1 m wide, those of M2314 are also made of the same types of rubble on 1-2 level courses. The stones used for the foundations vary between 20 and 50 cm. Elevations of the foundations range from 613.20 m in the north and 613.46 m in the south, where the wall disappears. Moreover, the association with M2310 remains unknown. It will be noted that within the building, at the junction between M2314 and M2311, there is a pit (2342) filled with nodules of bricks, gravel of heterogeneous size, charcoal and wind-blown sand (**Fig. 5**).

The elevations of the building are made of double-sided polished stone with a core composed of irregular stones of medium size, of a few square blocks and sandy loam. In places this core is particularly compact. Although M2311 was heavily damaged in its western part, there are still a dozen courses visible in section. Its summit reaches an elevation of 615.20 m. To the south, one can follow M2310 on 18 courses (2 m) (**Fig. 7**). Its summit reaches an elevation of 615.90 m. Wall M2318, which we have not excavated is 7 m long and 1.15 m wide. Its altitudes range from 615.83 m to 614.85 m south and north.

This part of the building allows us to observe the beautiful quality of the work (**Fig. 7**). The effect made by the pseudo-isodomic device (horizontal courses but variable heights) is accentuated by the colour of red, gray and white limestone and by a very neat chaining.

1. See *Dûma* 3, 2012 report: Makinson, SD6: 217-256; Lanoë, SD9: 283-300

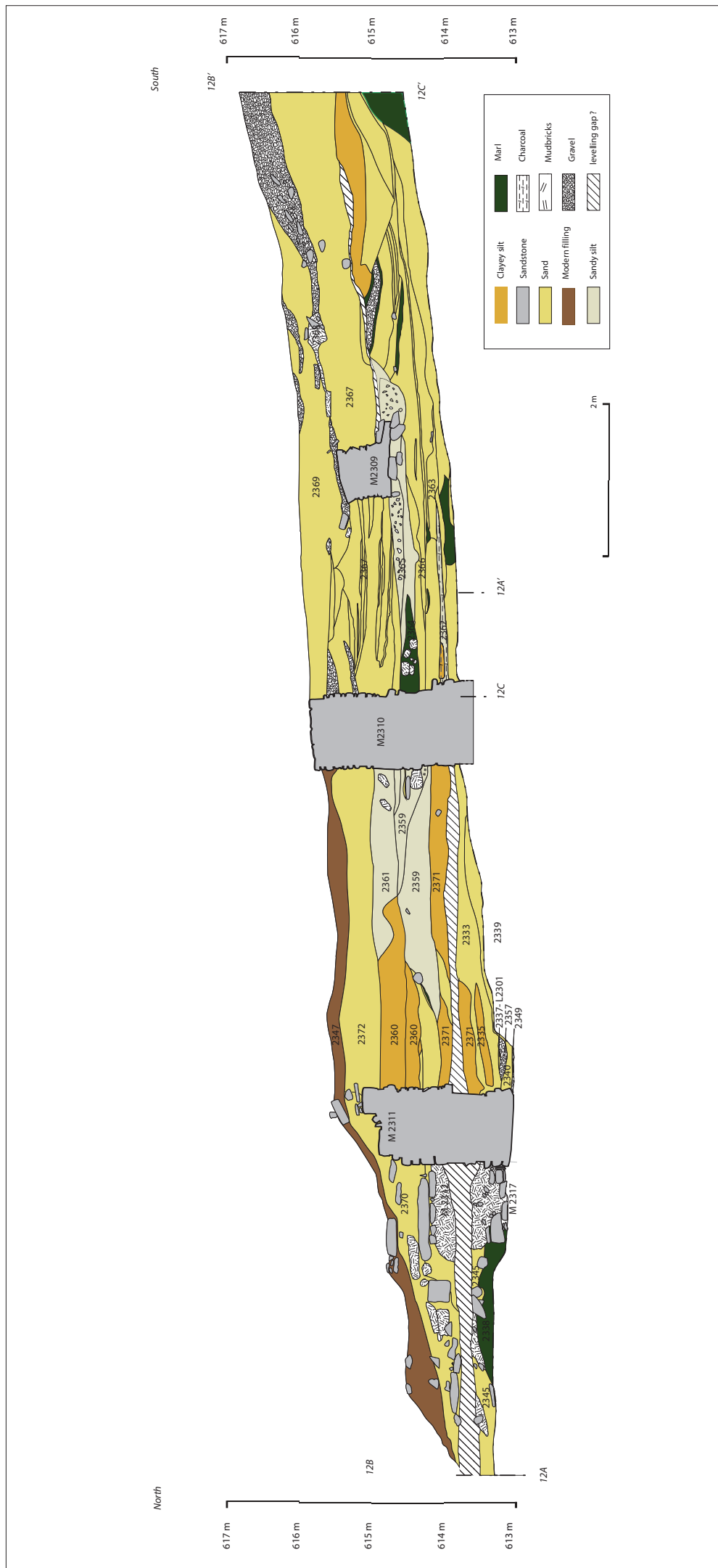


Fig. 1. Sounding 12. Archaeological north-south section





Fig. 3. View of sounding 12 from the south.

But despite undeniable architectural qualities, we can assume some weaknesses. Indeed, in the foundations level the walls are 1 m wide when in elevation they are sometimes 1.20 m wide. These construction techniques are reminiscent of the enclosure and that of other buildings in the oasis. A study of construction techniques and a metrological study would help define some typological aspects and refine our knowledge of the oasis.

Another development probably belonging to phase 0 is located outside the building, to the north (**Fig. 2**: between M2315 and M2312). This is a disturbed area adjacent to M2311: at an elevation of 613.16 m a few slabs were in sterile sand reflecting ancient furnishings difficult to interpret in that stage.



Fig. 4. The foundations: M2313 seen from the south

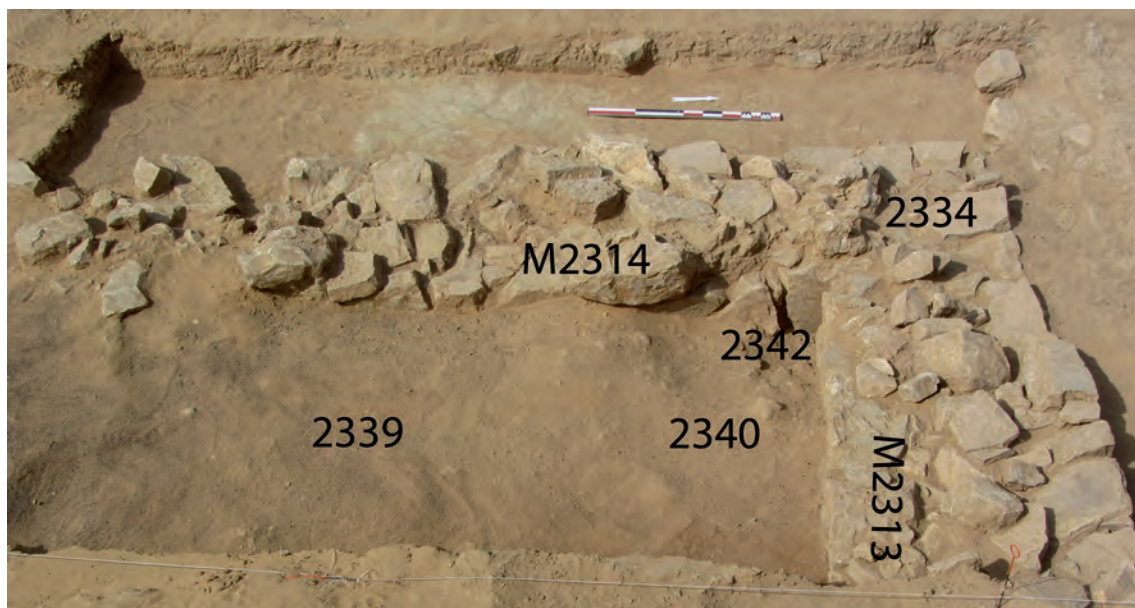


Fig. 5. M 2313 and M 2314 during the excavation seen from east



Fig. 6. View of SD6 from the kite (copyright Thomas Sagory - www.du-ciel.com)

Phase 1

The next phase corresponds to the first occupation in the square building. It is the reading of the stratigraphic section (**Fig. 1**), which allows us to complete the information obtained during the excavation.²

Above the sandy layer mixed with red marl (2340) several layers are present (observed mainly in northeastern part of the building): at an elevation of 613.34 m there was a floor (L2301) bearing traces of burning and potsherds laid flat and a fragment of a zoomorphic figurine (2337). Another sandy layer (2333) also provided ceramics. Against M2311 was a compact layer of clay loam and phosphate 10 cm thick (2335).

The upper levels are known only in section (**Fig. 1**). They consist of layers of gray sandy loam with coarse gravel (2359) (at an average elevation of 614.10 m to 65 m). Note the presence of more ashy pockets, like the one located against M2310 (at an elevation of 614.25 m). The brick blocks that this layer is associated with (on either side of M2310) (at an elevation of 614.40 55 m) indicate that this is a horizon. The consecutive layers are of clayey silt mixed with gravel and sometimes ashy concentrations (in 2360) and very compact sandy silt (2361) including fragments of collapsed bricks. There are also some lenses of aeolian sand and marl.

Phase 1 also corresponds to the first deposits on the outside of the building to the south. They consist of succession of sandy levels (2366), sometimes mixed with red and green marl. It must be noted that US 2362 and 2363 with charcoal and clay nodules show anthropogenic inputs outside the building. Blocks of collapsed bricks (at a 614.50 m elevation) show a collapse or perhaps rudimentary adjustments on both sides of M2310. On these layers rests wall M2309. The stability of the latter was guaranteed by a sandy loam layer (2365) mixed with roughly squared small stones (614.60 to 614.70 m elevation). Therefore this wall seems to rest on a “terrace” of sand that rests against M2310. M2309 is a double-faced limestone wall but smaller than the square building. It is preserved on 0.70 m and its summit reaches 615.40 m. It is difficult to make the connection between M2309, the square building and the intermediate wall (unit 8). Indeed, it is unclear whether M2309 could protect the square building against landslides from the promontory, thereby limiting the accumulation of aeolian sand or if it was a partition wall with a different use.

². Which has started at an elevation of roughly 613.70 m.



Fig. 7. Wall M2310 looking west. In the background: the marl and the intermediate enclosure (U8)



Fig. 8. Staircase abutted to wall M2311

To the north, outside the square building other constructions belong to this phase: one of these consists of the remains of a staircase parallel to wall M2311 (**Fig. 2**). The evidence is weak, but there remains a step in limestone bearing signs of lime coating. It rests at an altitude of 614.20 m on some blocking stones lying flat to ensure its stability (**Fig. 8**). Between 613.20 and 613.40 m above sea level, there is still another structure (M2317); it is probably the first step. Between these two steps is located a core of compacted clay and carefully organized mud brick (M 2312) (**Fig. 9**). This mud brick cored staircase with stone steps has been reinforced with green marl blocks, next to which a heavily eroded metal tool was found (**Fig. 10**). The difference in level between the two stone steps is about 1 m (leaving room for about five steps).

Westward, at an elevation of 613.30 m lies another clump of bricks (M2315), it is also parallel to M2311 and is located in an extension of the staircase and was certainly linked to it (**Fig. 2**). Unlike the latter, which is attached to the stone wall, clump M2315 is slightly further off. It is composed of compacted mud bricks and clay. This clump extends into a north-south oriented limestone wall (M2316) which we only followed for 2 m. It is a simple double-sided wall which is clearly distinguished from the more massive walls of the square building.

East of M2316, lies a disturbed area (probably because of the passage of the bulldozer) composed of coarse blocks mixed with sand and resting on a strip of marl.



Fig. 9. Wall M2311-M2313. Towards the north, the remains of the staircase



Fig. 10. Tool O.2338-1

Phase 2

This phase of the abandonment of the building and is only attested by the stratigraphic section (**Fig. 1**).

Towards the north, outside the building, we observed a layer of sand mixed with brick and limestone blocks (2370). This is probably the demolition of wall M2311. Within the building, the sandy layers of sediment mixed with marl (2372) and the backfill containing modern materials (2347) that also belong to this phase.

Southwards, outside the building, phase 2 corresponds to the aeolian deposits on both sides of M2309 (2367). We note that they are homogeneous between M2309 and the intermediate rampart (Unit 8) and “layered” between M2309 and M2310: these correspond to alternating wet and dry periods. This also demonstrates that sand accumulations were probably low and sporadic between walls M2309 and M2310. Layer 2368 corresponds to the collapsed blocks of the intermediate rampart (Unit 8) sometimes mixed with bricks.

Discussion

Despite the destruction and partial excavation of the area we can say that this building would likely have been enormous and provided with a floor accessible by stairs. Indeed, although the walls are only preserved for a little over 2 m one imagines, with regard to the width of the walls and the quality of the system, the square structure had to be much higher; these arguments point towards identifying it as a tower. Note that the location of the stairs against the building shows, logically, that the entrance of the building was not from below (especially as no door or opening were observed). Access had to be from a few metres above. Equally, this will mean that there had to be a floor and that the bottom (basement or ground floor) had an occupation (phase 0 and 1). Indeed, there is no evidence of a collapse of the floor: the pseudo-horizontal archaeological layers (about 1 m) and the absence of limestone blocks collapsed inside the building, demonstrates that the lower part of the building was not a “crawlspace”. Nevertheless, we do not know what kind of human activity might have taken place in the cellar. Indeed, the lack of an equipped home or tools makes it difficult to attribute it either to a military or domestic context. However, in the next campaign, sediment samples will be taken in the ashy layers against the walls (2364 and 2359). Their study will, hopefully, allow us to get an archaeobotanical and xylologic assemblage, and thus to better identify periods of occupation. Although archaeological layers provided only a modest amount of

ceramic artefacts it is still possible to get a glimpse of domestic activity within the building. Indeed, the ceramic assembly is especially represented by the sometimes burnt and broken tableware. Level 2333 of Phase 1 also provided some examples of ceramic decorated with zigzag motifs and palmettes and red painted potsherds. Note also the presence of a flint tool on soil 2355 (**Fig. 12**).

The function and chronology of the square building are still uncertain and it is the same for its associations with the hydraulic installations nearby (SD6), the intermediate rampart (unit 8) and the promontory area. Yet a few remarks will perhaps enrich the discussion on the urban network of the area. First, given the proximity of sondage 6 (SD6) and the square building the interdependencies between these two buildings seem obvious. Maybe it was a watchtower: a public building strengthening the defense of the hydraulic system? It should be noted, secondly, that the terracing techniques and the mixed use of stone and brick are used in the two areas. While this does permit the statement that these are strictly related and contemporary buildings, it reflects the urban coherence of the neighbourhood and the execution of large terracing works in the oasis. Also noteworthy is the presence in the oasis of another square structure³ (perhaps related to the rampart) and another tower on top of the promontory:⁴ a much more strategic position than the lower part of a rocky hill!

The tower is equally close to the rampart unit 8 (there are about 12 m between M2310 and the rampart). This is a portion of relatively narrow and low rampart: a dozen foundations are still visible (**Fig. 11**). At this stage of the work, we assume that the construction period and the duration of its use are synchronous with the rest of the rampart.⁵ But it must be remembered that the purpose of wall unit 8 is not certain and it is sometimes difficult to differentiate a rampart from a retaining wall. Nevertheless, even if the relationship between the rampart unit 8 and the building still remains to be demonstrated, it can be assumed that the sediments accumulated against M2310 (2362-2363-2364-2366) had to exert a strong pressure, perhaps this was one of the reasons for the construction of wall M2309.

3. Charloux *et al.* 2014 (*Dûma* 1): 183, Fig. 37.

4. Charloux *et al.* in press (*Dûma* 2): 81.

5. A study started in 2013 on the western part of Unit 8 will certainly allow a better understanding of this sector. (see in this volume, reports Thomas, Marquaire and Charloux, SD10 & SD11).



Fig. 11. View of Unit 8 and the cut marl



Fig. 12. US2355: sherds and a flint tool laying flat

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