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1 Landscape and settlement process in al-Kharj oasis (province of Riyadh)

2 Jérémie SCHIETTECATTE¹, Antoine CHABROL², Éric FOUACHE³

3

4 Abstract

5 *This paper confronts the proto-historical and historical settlement pattern in al-Kharj oasis*
6 *(Central Arabia) with the environmental context by taking into account the results of the recent*
7 *fieldwork. By superimposing an archaeological map of the oasis on the geomorphological map,*
8 *different settlement strategies appear at different period of time. During the Bronze and Iron*
9 *Ages, the location of the sites – mostly necropolises – is dictated by the geological, topographic*
10 *and hydrological contexts. Systematically close to a source of water, the necropolises are*
11 *nevertheless located far enough from the threat of floodwaters, in a dominant position. As*
12 *markers in the landscape, they played a role in the appropriation of land by Bronze Age*
13 *populations. The settlement pattern drastically changes at the turn of the Christian era. Then,*
14 *the location of sites – mostly settlements – is dictated by the close proximity of arable lands. At*
15 *a certain stage of their development that we are inclined to date to the very Late Pre-Islamic*
16 *and Early Islamic periods, local populations started to take benefit of all the water sources*
17 *available in the oasis for agricultural purposes, including those outside the alluvial plain, by*
18 *digging monumental hydraulic structures.*

19 Keywords

20 Arabia; Najd; Bronze and Iron Ages; Late Pre-Islamic and Early Islamic periods; settlement
21 pattern; land-use; qanāt.

22

23 In the 5th century, a notable from Zafār, capital of the kingdom of Ḥimyar, the king maybe, had
24 someone put the account of a military campaign in Central Arabia down in writing.⁴ A region
25 unheard-of appears for the first time: Yamāmat^{an}. One would easily see behind this ancient
26 name the Arabic al-Yamāma, the area which stretched out from the eastern piedmont of the
27 Jabal Ṭuwayq to the coastal region of al-Baḥrayn and which was centred on the cities of Ḥajr
28 (Riyadh area) and Jaww al-Khiḍrīma (al-Kharj area).

29 Mediaeval sources abound in mentions of al-Yamāma, its mines, its large oases and the
30 countless number of villages and towns peppering the landscape.⁵ Echoing this literary
31 tradition, H. St J. Philby, while describing his travel through this territory, concluded in saying
32 that: « *I trust that I have said enough to show that there is much in Southern Najd to encourage*
33 *further investigation, and to show that in Kharj and Aflaj, in distant Jafura, in Wubar, and*
34 *possibly other buried cities of the southern sands, there lies open a fruitful field for the*
35 *archaeologist of the future.* »⁶

36 In spite of this, archaeological remains in Central Arabia have rarely been noticed. During a
37 journey in the Najd in 1917–18, Philby mentioned the presence of tumulus fields, underground
38 water channels and a large ancient settlement, al-Yamāma (owing its name to that of the ancient

¹ CNRS, UMR 8167 “Orient & Méditerranée”, Paris, France; jeremie.schiettecatte@cnrs.fr.

² École française d’Athènes, Greece; antoine.chabrol@gmail.com.

³ Université Paris-Sorbonne, Abu Dhabi, UAE; eric.fouache@psuad.ac.ae.

⁴ Sabaic inscription al-‘Irāfa 1 (GAJDA 2004).

⁵ AL-ASKAR 2002; AL-JUHANY 2002.

⁶ PHILBY 1920: 185.

1 region).⁷ In 1945, Col. G. De Gaury reported the presence of tumulus fields nearby al-Kharj.⁸
2 A few years later, Philby completed the description of the oases of al-Kharj, al-Aflāj and the
3 Wādī Dawāsir.⁹ In 1978, a comprehensive archaeological survey of the Kingdom of Saudi
4 Arabia was carried out in Central Arabia and identified sixteen sites in the oasis of al-Kharj
5 alone,¹⁰ confirming the potential of the area. Consequently, in the late 1980s and the 2000s,
6 Abdalaziz al-Ghazzi initiated soundings at four sites in the oasis: Ḥazm ‘Aqīla,¹¹ al-Yamāma,¹²
7 al-‘Afja,¹³ and Abraq Farzān¹⁴.

8 Although limited in their duration or by their scope, these previous studies registered the
9 existence of a variety of sites where one could expect to find answers to several of the current
10 research issues in the Arabian Peninsula. Stimulated by this prospect, a Saudi-French
11 archaeological Mission started to explore and excavate sites in al-Kharj oasis in 2011.¹⁵

12 The purpose was 1) to draw archaeological and geomorphological maps of the oasis; 2) to
13 understand how the environment evolved during the Holocene; 3) to cross environmental and
14 archaeological data in order to understand settlement strategies and the evolution of the
15 settlement process through time.

16 The prehistorical survey and the excavations on the site of al-Yamāma have been recently
17 published.¹⁶ Consequently, this contribution will only focus on the issue of the environmental
18 context confronted with the proto-historical and historical settlement pattern in al-Kharj oasis
19 by taking into account the results of the recent fieldwork.

20 **Geographical setting**

21 **Topography**

22 Al-Kharj area is a major oasis of Central Arabia, 70 km south-west of the capital of the
23 Kingdom of Saudi Arabia, Riyadh. The area lies between latitude 23.8° and 24.4° N. and
24 longitude 46.9° and 48° E. (fig. 1). The region is characterized by a hot, dry climate, where
25 annual rainfall rarely exceeds 100 mm.

26 The geological context of al-Kharj includes large units of limestone and sandstone of the
27 Jurassic and Cretaceous forming more or less eroded plateaus, dissected by valleys (wādīs).
28 Nowadays there is very little flow in them, but in the past it was sufficient to incise them for
29 several tens of metres in depth. The major part of wādīs within the oasis of al-Kharj is
30 influenced by series of grabens, marked by west–east direction faults.

31 The area is bounded on the west by a Jurassic mountain, the Jabal Ṭuwayq, through which the
32 Wādī Nisāḥ flows from west to east inside grabens. The Wādī Ḥanīfa comes from Riyadh in

⁷ PHILBY 1919, 1920.

⁸ DE GAURY 1945.

⁹ PHILBY 1949.

¹⁰ ZARINS *et al.* 1979.

¹¹ AL-GHAZZI 1996, 2009.

¹² AL-GHAZZI 2010.

¹³ AL-GHAZZI 2011a.

¹⁴ AL-GHAZZI 2011b.

¹⁵ The project is headed by A. al-Ghazzi (King Saud University, Riyadh) and J. Schiettecatte (CNRS, Paris). It is founded by the Saudi Commission of Tourism and Antiquities, the French ministry of Foreign Affairs (programmes “Oasis d’Arabie déserte” & “Médée”), the laboratory “Orient & Méditerranée” (CNRS, EPHE, University Paris-Sorbonne and Panthéon-Sorbonne), and the research programmes LABEX *Resmed* [ANR-10-LABX-72] and *SYRAB* [ANR-09-BLAN-0328-01].

¹⁶ SCHIETTECATTE *et al.* 2012, CRASSARD & HILBERT 2013; SCHIETTECATTE *et al.* 2013; SCHIETTECATTE & AL-GHAZZI [ed.] in press.

1 the north-west, along the cuesta of the Jabal al-Jubayl, and this escarpment forms the northern
2 boundary of the oasis. South-west, the Wādī al-‘Ayn comes from the slopes of the Jabal
3 Ṭuwayq, and then follows the escarpment of the Jabal al-‘Uruma, on the south side of the oasis.
4 These three main wādīs reach the centre of the oasis and join to form the Wādī al-Sahbā’. It
5 continues toward the east and is lost in the sands of al-Dahnā’ desert.

6 In the valleys, recent sedimentary cover includes both fluvial deposits (silt, clay, etc.) and
7 aeolian deposits, with barkhan fields in numerous places. Current erosion comes mainly from
8 wind, since the very low rainfall has minimal impact on the ground. Because of the sedimentary
9 context, karst morphologies are common in the oasis of al-Kharj: the most impressive features
10 are swallow holes south-west of al-Kharj¹⁷ (figs. 2a & 2b). Three swallow holes are located in
11 ‘Ayn al-Dila’, with a diameter of 60 to 80 m, and an average depth of 50 m. These features were
12 formed by the phenomenon of dissolution in calcareous layers.

13 Holocene dynamics

14 • Slope dynamics

15 Slope dynamics are minimal in the region. These slopes are mainly affected by the phenomenon
16 of thermal fracturing. The fine particles (clay, silt, sand) are in turn subject to a sometime
17 intensive deflation. Even the slopes that are affected by large-scale faults are not subject to
18 intense erosion. Rivers often incise already fractured rocks and their dynamics do not allow
19 them to form large alluvial fans at the mouths of the valleys. The best evidence to illustrate the
20 weakness of these dynamics is archaeological: in the necropolis located on the southern side of
21 al-Kharj, even the tombs on the line of the greatest slope are still in place and have not been
22 affected by erosion. Regionally, all the observations argue for high slope stability, at least
23 during the Holocene.

24 • Wādī dynamics

25 Regionally, the four main wādīs are the Wādī al-‘Ayn to the south, the Wādī Ḥanīfa to the
26 north-west, the Wādī Nisāḥ to the west and the Wādī Abā al-Dharr to the east.

27 The Wādī Nisāḥ is bordered by the slopes of a graben made of limestone and sandstone
28 formations. Its course is constrained, it does not reach the plain of al-Kharj and ends in *khabra*
29 deposits.

30 The Wādī al-‘Ayn, to the south, is larger and has a few tributaries. They have incised the
31 limestone plateau and a large glacis to the west. The talwegs are more pronounced but the bed
32 of the wādī remains narrow and shallow in the plain. Currently, its course stops at the town of
33 al-Kharj.

34 The Wādī Ḥanīfa is more complex. Associated with several tributaries, it is probably the cause
35 of most of the alluvial sedimentation in the plain of al-Kharj. It stops around the archaeological
36 site of al-Yamāma. Several palaeo-channels found downstream of the site, in the valley of the
37 Wādī Sahbā’, can however be attributed to it. This is a sign of more significant past dynamics.

38 The Wādī Abā al-Dharr, south-east of al-Kharj, is the most active. The downstream part is still
39 in water and is used to irrigate agricultural areas, particularly using a reservoir approximately
40 200 m in diameter. In its upper part, this wādī is much more incised and bordered by well-
41 marked alluvial terraces (fig. 3). These terraces refer to past hydrological dynamics
42 incommensurate with those currently underway and most probably going back to the
43 Pleistocene.

44 The Holocene alluvium is not very thick in the plain of al-Kharj and around the archaeological
45 site of al-Yamāma. The study of abandoned wells in villages around the site shows the existence

¹⁷ VASLET *et al.* 1991: 35–36

1 of a low terrace consisting of pebbles and gravels (fig. 4). This terrace is the product of much
2 more powerful past alluvial dynamics. The study of six different wells allows us to locate this
3 terrace between 3 and 5 m below the actual topographic surface. Without any absolute date, it
4 is difficult to comment on the age of this lower terrace, but it is generally accepted in the
5 Arabian Peninsula that these terraces were established during the late glacial period or during
6 the early Holocene. Therefore, a sedimentation of about 4 m over the last 8,000 years in the
7 middle of the plain can be inferred.

8 • Palaeolakes

9 To the south-west of al-Kharj and to the north of the Wādī Nisāḥ, two large, flat areas can be
10 interpreted as palaeolakes (fig. 5). The first is currently crossed by the Wādī al-‘Ayn and the
11 second is located at al-Barra, at the foot of a graben, near a palaeo-course of the Wādī Ḥanīfa.

12 These large tracts of former lakes were filled with water due to a rise in the water-table,
13 probably during periods of wetter climate. These lakes are conspicuous in the topography. A
14 survey conducted in the first lake indicates the presence of a very hard brown clay layer, about
15 60 cm deep. This clay, encrusted with gypsum, bears witness to the sedimentological setting of
16 an area of shallow water. It is difficult to date the end of the existence of these lakes precisely.
17 However, a radiocarbon date was done on a shell from the lake of al-Barra. The resulting date
18 is 7,000 ± 400 years BP-uncal.¹⁸

19 • General dynamic of the rivers

20 Overall, the Holocene dynamics are minimal. Sedimentation is slightly marked and refers to
21 past dynamics. In spite of a wide hydrological network, there is no permanent river and surface
22 flow is also very limited. We can assume that most of the water resources are underground and
23 mainly through groundwater underflow that could emerge locally (water sinkholes, artesian
24 springs) and create shallow lakes.

25 The convergence of underground water flow, artesian springs and water sinkholes in the
26 neighbourhood of al-Kharj offered permanent source of water and contributed to make
27 sedentary life and agriculture possible during the last millennia. These elements are decisive
28 for the comprehension of the past regional occupation.

29 Occupation of the oasis during the Bronze and Iron Ages

30 All the sites dated to the Bronze (or Iron) Age are either isolated tombs or tumulus fields. (fig 6).
31 Among these, two major sites are identified, the necropolises at al-‘Afja and ‘Ayn al-Ḍila’ 1.
32 According to previous research¹⁹ and our own excavations,²⁰ these necropolises were built
33 during the Bronze Age and reoccupied in (or continuously occupied down to) the Iron Age. No
34 settlement dated to this period has yet been discovered. It is not possible to say whether these
35 necropolises were those of mobile groups or if contemporary settlements are to be sought
36 beneath the sedimentary deposits in the alluvial plain.

37 Two large necropolises: al-‘Afja and ‘Ayn al-Ḍila’ 1

38 • Al-‘Afja

39 The necropolis at al-‘Afja stretches over 7.5 km from west to east along the Quwayd Farzān, a
40 sandstone outcrop (fig. 7). Hundreds of tombs are visible over the outcrop. The main

¹⁸ VASLET *et al.* 1991: 33.

¹⁹ ZARINS *et al.* 1979; AL-GHAZZI 2011a.

²⁰ SCHIETTECATTE & WERMUTH 2014.

1 concentration occurs south of the town of al-‘Afja where more than 180 tombs have been
2 counted. The site was mentioned by Philby²¹ and by the Saudi Comprehensive Survey.²²

3 Tombs are built in dry-stone masonry. Most of the graves are circular; a few have a tail up to
4 20 m long. The most monumental ones are stepped: two or three stone cylinders are built one
5 above the other (fig. 8). Another category consists of tapered structures, with the basic outline
6 of an elongated wedge.

7 Several graves were excavated in 2004–2005.²³ One of these (Area 2, no. 4) yielded a bronze
8 socketed spearhead²⁴ reminiscent of those found in the Yabrīn oasis, Dhahrān, and Bahrain,
9 dated to the early second millennium BC.²⁵ Grave L10 yielded an iron axe and an iron pin,²⁶
10 which attest reoccupation during the Iron Age at the earliest.

11 • ‘Ayn al-Ḍila‘ 1

12 By far the largest necropolis of the oasis, ‘Ayn al-Ḍila‘ 1 is 4.4 km long and up to 0.5 km wide
13 (fig. 9). The site is mentioned by Philby.²⁷ It has been visited by G. De Gaury in the early
14 1940s.²⁸ In 1978, archaeologists taking part in the Comprehensive Survey of the Kingdom of
15 Saudi Arabia registered this site.²⁹

16 During our survey, more than 3000 tombs were numbered and located (fig. 10). Four kinds of
17 tomb were identified:

18 - Circular structures with a peripheral wall made of vertical slabs and a filling of rubble and
19 stones between this wall and the one of the funerary chamber. When visible, the walls of the
20 funerary chamber are either made of standing slabs or horizontal stone courses.

21 - Rectangular structures having the same kind of peripheral wall and funerary chamber as the
22 previous one.

23 - Tapered structures: gathered in the southern part of the necropolis, 16 tapered structures have
24 been registered so far. They are long walls about 1 m high and between 9 and 41 m long,
25 widening at one end, and ending with a linear wall. The funerary chamber is built in the widened
26 end of the structure.

27 - Wall-tomb: A single wall-tomb has been identified, in the southern part of the site. The
28 structure is an elongated heap of rubble and stones, ca. 30 cm high, bordered by small slabs set
29 vertically. It is enlarged in its central part. There, a rectangular funerary chamber is bordered
30 by large limestone blocks set vertically.

31 The excavation of five graves from types 1 and 2³⁰ showed that tombs shared the same
32 architectural features and that they were intended for a single individual (fig. 11).

33 Waiting for the results of ¹⁴C datings, a few clues are available for dating the building and use
34 of these tombs.

²¹ PHILBY 1920: 161.

²² Site 207-31; ZARINS *et al.* 1979: 23.

²³ AL-GHAZZI 2011a.

²⁴ AL-GHAZZI 2011a: 204, pls. 10, 109.

²⁵ BIBBY 1973: fig. 57; AL-MUGHANNAM 1988: pl. 3/A; CLEUZIQU 1989: 29; LOMBARD 1999: 58.

²⁶ AL-GHAZZI 2011a: pl. 110.

²⁷ PHILBY 1920: 169.

²⁸ DE GAURY 1945: 152.

²⁹ No. 207-20; ZARINS *et al.* 1979: 23–25.

³⁰ SCHIETTECATTE & WERMUTH 2014.

1 Firstly, the use of the same architectural principles for the building of the excavated tombs
2 (areas H9-H10) would be indicative, at least in that part of the necropolis, of an almost
3 contemporary practice.

4 Secondly, a *terminus ante quem* to the building of the first tombs has been provided by the
5 discovery of a short socketed spearhead on the surface which is reminiscent of the ones found
6 in the necropolis of al-‘Afja, Yabrīn oasis, Dhahrān, and Bahrain, dated to the early second
7 millennium BC.³¹

8 - Finally, the rare artefacts found within the graves indicates the long duration of the use of this
9 place: a carnelian bead in the oldest burial in tomb AD1-01, assigned to the EBA; the presence
10 of an iron artefact in the earliest burial in tomb AD1-01, dated at the earliest from the first
11 millennium BC; the discovery of a bronze sickle sword in tomb AD1-05 whose closest parallel
12 dates back to the LBA.³²

13 Thus, the necropolis was a burial place for population living in the area from the Early Bronze
14 Age down to the Iron Age. The process of reoccupation of Bronze Age tombs more than a
15 millennium after their abandonment is well attested in Ḥaḍramawt, Yemen.³³ In al-Kharj area
16 however, it cannot be said whether the occupation of this place was uninterrupted or not.

17 **Isolated tombs and small necropolises**

18 Besides the two large necropolises, dry-stone tower-tombs or tumuli either isolated or gathered
19 in small clusters were located at the top of rocky ridges, on the edge of limestone plateaus or
20 on the terraces overlooking the wādīs (figs. 5–6). These are:

- 21 • Khafs Daghra 3: collapsed tower-tomb;
- 22 • Khafs Daghra 4: a dozen of tumuli, some having a tail;
- 23 • Jibāl Mughra 1: two isolated circular tombs;
- 24 • Jibāl Mughra 2: an isolated circular structure, probably a grave;
- 25 • Quwayd Farzān North 1: cluster of circular and rectangular dry-stone tombs. Several
26 have a tail being less than 15 m long.
- 27 • Al-Rufaya‘ 1: tapered structure (26 × 6 m);
- 28 • Al-Rufaya‘ 2: circular grave;
- 29 • Al-Rufaya‘ 3: small necropolis with a dozen of circular dry-stone graves (up to 9 m in
30 diameter) and a single 60-m-long tapered structure;
- 31 • Wādī Abā al-Dharr 1: necropolis with circular graves.

32 **Land-use strategy during Bronze and Iron Ages**

33 The location of these necropolises is dictated by the local geology and geomorphology (fig. 5).
34 They are all located at the interface between a limestone or sandstone formation and the alluvial
35 plain, and more specifically by a source of water in the plain (wādī bed, sinkhole or palaeolake).
36 The sites al-Rufaya‘ 1, 2 and 3 are spread across a limestone terrace and overlook the course of
37 the Wādī Ḥanīfa. The sites Jibāl Mughra 1 and 2 are located respectively on a sandstone outcrop
38 and on a rocky outcrop bordered by Quaternary sheet gravel, both close to a palaeo-course of
39 the Wādī Ḥanīfa. The sites Khafs Daghra 3 and 4 and ‘Ayn al-Ḍila‘ 1 are all on the western and
40 north-western edge of the Jabal al-Qusay‘a, a clayey limestone plateau in close proximity to
41 water sinkholes.

³¹ BIBBY 1973: fig. 57; AL-MUGHANNAM 1988: pl. 3/A; CLEUZIQU 1989: 29; LOMBARD 1999: 58; AL-GHAZZI 2011a: pl. 109.

³² Cf. SCHIETTECATTE & WERMUTH 2014: 51 compared to GERNEZ 2007: fig. 5, no. 3.

³³ CRASSARD *et al.* 2011; MCCORRISTON *et al.* 2011

1 Beyond its proximity to the sinkholes, the necropolis ‘Ayn al-Ḍila‘ 1 also overlooks the
2 lacustrine deposits of a palaeolake crossed by the Wādī al-‘Ayn. Similarly, the sites of Quwayd
3 Farzān North 1 and al-‘Afja are located either at the top or at the foot of the sandstone outcrop
4 of Quwayd Farzān, bordered to the north by the Holocene palaeolake of al-Barra.

5 As previously mentioned, the former lakes would have been filled with water due to a rise of
6 the water-table, probably during periods of wetter climate. A radiocarbon date on a shell from
7 the lake of al-Barra shows lacustrine activity during the Early / Mid-Holocene humid
8 optimum.³⁴ But the fact that the two largest Bronze Age necropolises of al-Kharj area (‘Ayn al-
9 Ḍila‘ 1 and al-‘Afja) are located almost on the shores of palaeolakes suggests a possible rise of
10 the water-table and an increase in lake levels during the Early Bronze Age, a wetter period
11 recognized as the Mid / Late humid Holocene. It is regionally attested in the ‘Awāfī lake
12 sequence in the UAE,³⁵ in the Dead Sea transgression phases,³⁶ and in the Ḥaḍramawt fluvial
13 system.³⁷

14 Therefore, the location of these necropolises is dictated by both the geological context (rocky
15 outcrops providing building material) and the hydrological context (proximity of water sources
16 such as wādī beds, sinkholes at a time when they offered water, and possibly active lakes).
17 Lastly, the topography might have also been decisive: necropolises are spread over terraces,
18 plateaus and outcrops, away from the threat of floodwaters, and are in a dominant position. As
19 markers in the landscape, they could have been part of the appropriation of land by Bronze Age
20 populations.

21 Late Pre-Islamic and Islamic sites

22 During these later periods, the settlement pattern is radically different. These periods are
23 characterized by a sedentarisation process and the development of agricultural practices. This
24 is shown by the discovery of eight settlements and two subterranean water channels (fig. 6).

25 A single large city: al-Yamāma

26 This site is the largest ancient settlement reported in the region of al-Kharj. It is located in the
27 centre of the oasis, west of the confluence of the Wādīs Ḥanīfa and Nisāḥ.

28 The existence of this site was first reported by H. St. J. Philby.³⁸ During the Comprehensive
29 Survey of Saudi Arabia in 1978, the site was registered.³⁹ Soundings were carried out in the late
30 1980s by A. al-Ghazzi.⁴⁰

31 The archaeological area stretches over 75 ha, north-west of a village named al-Yamāma, on the
32 edge of palm groves (fig. 12). Many mudbrick structures are visible on the ground, together
33 with a large quantity of pottery sherds. According to pottery sampled on surface and a deep
34 sounding carried out in the northern part of the site, the occupation dates from at least the
35 3rd century BC to the 18th century AD.⁴¹ The main phase of occupation dates back to the very
36 Early Islamic and Abbasid periods. This is consistent with epigraphic and literary sources: If
37 we agree in identifying the site with the ancient city of Jaww al-Khiḍrīma,⁴² it is mentioned in

³⁴ VASLET *et al.* 1991: 33.

³⁵ PARKER *et al.* 2006a, 2006b.

³⁶ MIGOWSKY *et al.* 2006.

³⁷ BERGER *et al.* 2012.

³⁸ PHILBY 1920: 168.

³⁹ No. 207-30; ZARINS *et al.* 1979: 27, 30.

⁴⁰ AL-GHAZZI 2010.

⁴¹ SCHIETTECATTE *et al.* 2013; SCHIETTECATTE & AL-GHAZZI (ed.) in press.

⁴² AL-JUHANY 2002: 45; AL-GHAZZI 2010: 45–47; ROBIN in press.

1 preislamic inscriptions from the 4th-5th centuries AD⁴³ and in many literary sources from the
2 9th to the 12th century.⁴⁴ A hiatus in the occupation of the site has been observed in the 13th-
3 15th centuries: no material from that period has been found in excavated areas and the site is
4 no more mentioned in written sources.

5 Villages and small settlements in the oasis

6 The other sites registered in al-Kharj area are:

7 • Wādī al-Hayāthim 1

8 The site Wādī al-Hayāthim 1 is located on the southern edge of the Wādī al-Hayāthim, 2 km
9 west of the water sinkholes of ‘Ayn al-Dīla’. As we visited the site after rain, a few mudbrick
10 structures were visible on the ground in the shape of very low mounds. According to the surface
11 pottery, this site would date back to the turn of the Christian era. Pottery sherds mainly fall into
12 two categories: red ware with grey-black core and very abundant chaff temper, a pottery type
13 which has been found at al-Yamāma in the lower levels of the deep Sounding, dated to the 4th-
14 2nd centuries BC according to ¹⁴C datings,⁴⁵ and green chaff-tempered jars with a vertical neck
15 and a rounded rim, a kind of jar well attested in South Arabia at the turn of the Christian era.⁴⁶

16 • Ḥazm ‘Aqīla

17 The site is located in the central valley of the oasis, ca. 4 km south-east of al-Yamāma, west of
18 the confluence of the Wādī al-Sahbā’ and the Wādī Abā al-Dharr. The remains of a dense
19 ancient settlement used to be visible on the ground. Most of the archaeological remains have
20 now disappeared due to recent building activity, though a few sherds are still scattered on the
21 ground. It was registered by the Comprehensive Survey⁴⁷ and archaeological investigations
22 were thereafter carried out.⁴⁸ At that time, it was estimated to extend across 1 km². According
23 to pottery material, a Late Pre-Islamic occupation has been postulated.⁴⁹ An Early Islamic
24 occupation of the site cannot be ruled out either.⁵⁰

25 • Wādī Nisāḥ 1 to 5

26 In the river bed of the Wādī Nisāḥ, south of the sandstone outcrop of Quwayd Farzān, five sites
27 with two or three low mounds each covered with stones, pebbles and pottery have been located:
28 Wādī Nisāḥ 1 to 5. Settled over the glacia of the Quaternary sheet gravels, immediately north
29 of the wādī bed, the sites were protected from floods. Geomorphological surveys in that area
30 showed that surface flow here is very low and that most of the water resources are groundwater
31 underflow that could emerge locally and create shallow ponds. These structures, located near a
32 wādī bed with easily accessible groundwater (by digging wells), might have been small farms

⁴³ Two South Arabian pre-Islamic inscriptions mention the toponym Jawwān (*Gwⁿ*) in association with Kharjān (*Hrgⁿ*) and Yamamatān (*Ymmⁿ*), respectively inscription ‘Abadān 1, dated to AD 360 (ROBIN & GAJDA 1994) and ‘Irāfa 1 from the 5th cent. (GAJDA 2004). The toponym Jawwān is likely to be identified with the mediaeval Jaww [al-Khidrīma] also associated with the valley of al-Kharj and the region of al-Yamāma (ROBIN in press).

⁴⁴ Ibn Khordādhbeh and al-Balādhurī in the 9th century (Khordādhbeh – de Goeje 1889, 113; al-Balādhurī – Hitti 1916, 141–142), al-Hamdānī and al-Mas‘ūdī in the 10th century (al-Hamdānī – Müller 1968, 139; al-Mas‘ūdī et al. 1861–1877 iii, 106, 276, 287–288), and Yāqūt in the 12th century (Yāqūt – Wüstenfeld 1866–1873 ii, 120, 161).

⁴⁵ Lyon-10996: 2235±35 ¹⁴C BP / 389-204 cal-BC; Lyon-10997: 2230±30 ¹⁴C BP / 384-204 cal-BC; Lyon-10998: 2295±35 ¹⁴C BP / 409-211 cal-BC; Lyon-16206: 2165±30 ¹⁴C BP / 360-116 cal-BC.

⁴⁶ At Jujā in levels 2 and 1 (2nd cent. BC–5th cent. AD, HANSEN *et al.* 2004: figs. 34 and 37); at Shabwa, in levels VII to X of the stratigraphic sounding (2nd cent. BC–1st cent. AD, BADRE 1991: fig. 16.338, fig. 32.258–265); and at Qanī’, in the ‘Lower Period’ levels of area 4 (1st cent. BC / AD, AKOPIAN 2010: figs. 59.525 and 61.548).

⁴⁷ No. 207-26; ZARINS *et al.* 1979: 27.

⁴⁸ AL-GHAZZI 1996; 2009.

⁴⁹ AL-GHAZZI 1996: 46–48.

⁵⁰ SCHIETTECATTE *et al.* 2012: 1384–1385.

1 or seasonal settlements for pastoralists. According to surface pottery, these sites might have
2 been occupied during the Abbasid period⁵¹ and perhaps more recently.⁵²

3 **The draining channels (*kharaz*)**

4 Two subterranean water channels, locally called *kharaz*, have been registered in the oasis.

5 • ‘Ayn al-Ḍila’ 4

6 The site of ‘Ayn al-Ḍila’ 4 is located near the two swallow holes ‘Ayn al-Ḍila’ 2 and 3. The
7 *kharaz* is badly preserved over a 1-km-long stretch. It was fed by a watered swallow hole, where
8 the channel had its source 10 m below ground-level.⁵³ When the Comprehensive Survey of the
9 Central Province was carried out, the source was dried up and the structure abandoned. Such
10 was not the case in the 1920s when Philby travelled in al-Kharj.⁵⁴ According to his description,
11 the *kharaz* watered the area of Qurayn, 5 km downstream.

12 • **Abraq Farzān**

13 The second underground water channel was approximately 5 km long, linking the foot of a
14 sandstone outcrop, Abraq Farzān, to the village of al-Salmiyya, to the east. Philby described
15 the structure at a time when it was still in use.⁵⁵ This channel was also described during the
16 Comprehensive Survey of the Central Province⁵⁶ and was the subject of a detailed study by
17 A. al-Ghazzi.⁵⁷

18 It is fed by two branches (fig. 13). The first one begins as an open-air canal, which takes water
19 from an artesian spring west of the Abraq Farzān outcrop. This section goes down into an
20 underground channel whose course can be followed from the surface by shafts more than 3 m
21 wide over a distance of 500 m. It is joined by a second branch coming from the south-west,
22 visible for 500 m thanks to 41 shafts. The initial section of this branch has been wiped out by
23 modern cultivation. Since the subterranean channel was dug at least twice, we can infer that
24 this was linked to a drop in the groundwater level and indicates that the second branch was
25 watered by seepage rather than an artesian spring.

26 These two branches merge into a single channel which runs toward south-east, and which is
27 preserved for 600 m. The outlet of the channel was located in the village of Salmiyya, 5 km
28 away from its source. The outlet was recently wiped out by road construction.

29 • **Tracing back the origin of these *kharaz***

30 These hydraulic structures are all of the same kind: they are underground water channels
31 (draining galleries), bringing water from a source to cultivated areas 5 to 6 km away. On the
32 surface they resemble the Iranian *qanāt*, but differ from them by the way they gather the water.
33 *Qanāt* are catching galleries, supplied by a deep aquifer (phreatic table), whereas the *kharaz* of
34 al-Kharj area either gather surface runoff (from artesian springs) or swallow hole water; they
35 can also be draining galleries fed by the seepage of underflow in the alluvial plain or alluvial
36 fans. These systems are dependent on the variation of the subsurface water table and cannot be

⁵¹ SCHIETTECATTE *et al.* 2012: 1387.

⁵² D. Kennet draw our attention on the fact that a pottery type (blue glazed jars with reddish body) initially considered as Abbasid (SCHIETTECATTE *et al.* 2012: 1387) could be compared to Persian blue speckled wares found in contexts dated to the 14th-17th centuries (KENNET 2004: 42).

⁵³ ZARINS *et al.* 1979: 29.

⁵⁴ PHILBY 1920: 169.

⁵⁵ PHILBY 1920: 167–168.

⁵⁶ ZARINS *et al.* 1979: 29.

⁵⁷ AL-GHAZZI 2011b.

1 considered as fully perennial. They depend on seepage into the gallery from a shallow water
2 table, or from the flow of a water source which can dry up seasonally.

3 The hydraulic technique of the *kharaz* resembles that of the Omani Iron Age *falaj* (catchment
4 of shallow water tables from alluvial fans),⁵⁸ but differs in the building technique. The Omani
5 *falaj* that appeared at the end of the 2nd millennium BC⁵⁹ are zigzagging galleries with narrow
6 shafts,⁶⁰ while the *kharaz* of al-Kharj are straight galleries, punctuated by shafts 3 to 4 m wide.

7 Thus, from the point of view of hydraulic technique, the *kharaz* of al-Kharj resemble the Omani
8 Iron Age *falaj*, from the point of view of building techniques, they are reminiscent of the Iranian
9 *qanāt*.

10 Tracing back the origin of these structures and dating them is uneasy. Nowadays, these
11 hydraulic systems are dried up, generally filled with rubbish and partly destroyed. But in the
12 1920s, the subterranean galleries that Philby described were still in use.⁶¹ A much older
13 *terminus ante quem* for their digging is provided by the description of the neighbourhood of the
14 capital city of al-Yamāma (which we are inclined to identify with Jaww al-Khiḍrīma,⁶² i.e. the
15 modern site of al-Yamāma), by the Persian traveller Nāṣir-i Khusraw, in the mid-11th cent. AD,
16 who mentions subterranean channels watering the palm groves.⁶³

17 Tracing a relationship between the Omani *falaj*, a technique abandoned at the end of the Iron
18 Age⁶⁴ and the *kharaz* in al-Kharj, attested at the latest in the 11th cent. AD, would be
19 inconsistent. However, a relationship between the Iranian *qanāt*, that appeared during the first
20 millennium AD,⁶⁵ and the *kharaz* of al-Kharj could be a working hypothesis, providing that the
21 technique was adapted to the specific regional environmental conditions (presence of abundant
22 sub-surface water and digging of draining galleries rather than galleries drawing on the deep
23 water table). This influence is all the more probable since Persian farmers and mineworkers
24 settled in the region at the time of the Muslim conquest, according to several sources from the
25 9th–13th centuries AD.⁶⁶

26 Settlement strategy during the Late Pre-Islamic and Islamic periods

27 The early Islamic sources describe the valley of al-Kharj as a densely populated area and as part
28 of the wider region of al-Yamāma.⁶⁷ Yet only a few settlements have been found, most often
29 located in remote or fenced areas (fig. 6). This scarcity, in contradiction with written sources,
30 can be related to either a permanent occupation of most of the fertile areas of the oasis, thus
31 hiding more ancient occupation, and / or to the modern urbanization process that has led to the
32 rapid disappearance of many sites (e.g. Ḥazm ‘Aqīla).

33 Be that as it may, the location of these sites is dictated by factors other than those in play during
34 earlier times. Proximity of water sources and building material was decisive in the location of

⁵⁸ BOUCHARLAT 2003.

⁵⁹ BOUCHARLAT 2003: 169.

⁶⁰ AL-TIKRITI 2010.

⁶¹ PHILBY 1920: 167–168.

⁶² SCHIETTECATTE *et al.* 2013: 299–300.

⁶³ KHUSRAW – SCHEFER 1881: 225

⁶⁴ BOUCHARLAT 2003; MOUTON & SCHIETTECATTE 2014.

⁶⁵ BOUCHARLAT 2001: 177–178, 2003: 169.

⁶⁶ MORONY 2002: 28–29.

⁶⁷ See in al-Hamdānī and Yaḳūt the several settlements in al-Kharj valley and a description of the valley as the most fertile in the Yamāma region (YĀQŪT – WÜSTENFELD 1866–1873, ii, 419; iv, 529, 577, 630; AL-HAMDĀNĪ – MÜLLER 1968, 139–140). On the settlement pattern of al-Yamāma and the high number of its inhabitants: WÜSTENFELD 1874: 198–214; AL-JUHANY 2002: 39–48.

1 protohistoric sites, but the pattern evolved. All the settlements from the Late Pre-Islamic and
2 Islamic periods are located in close proximity to the alluvial plain (Wādī Nisāh 1–5) or above
3 the alluvial deposits near the confluence of wādīs (Wādī al-Hayāthim, al-Yamāma, and Ḥazm
4 ‘Aqīla) (fig. 5). This settlement strategy is dictated by the close proximity of arable lands. The
5 geomorphological survey has shown the weakness of surface runoffs in this oasis and how the
6 exposure of sites to potentially destructive floods was limited. Destructive floods in al-Kharj
7 region were largely the consequence of a recent urbanization that prevents the flows from
8 following their natural course.

9 Equally, the geomorphological survey has demonstrated the importance of groundwater
10 underflows in the alluvial plain and how shallow the water table was before the intensive
11 pumping of the last 40 years.

12 Thus, within the alluvial plain, digging wells was the easiest way to stock up on water for
13 agriculture, animals and human needs. Simple structures 7 to 10 m deep provided an easy
14 access to the water table (fig. 4) and were sufficient to make the most of the groundwater
15 underflow.

16 But at a certain stage of their development, local populations started to profit from all the water
17 sources available in the oasis for agricultural purposes, including those outside the alluvial plain
18 (swallow holes, artesian sources) by digging monumental structures, the *kharaz*, over 5 to 6 km
19 long. This increased their agricultural productivity. We are inclined to associate these
20 developments with the coming of Persian communities during the Sasanian period, a period
21 also described by Arab-Islamic sources as one during which the region was densely settled.

22 The fact that the few ancient settlements located in the oasis are for the moment dated to the
23 Late Pre-Islamic and Early Islamic period and that the growth of al-Yamāma settlement went
24 through a boom in the very Early Islamic period has reinforced the idea of a time of agricultural
25 expansion which could have been the consequence of the digging of the *kharaz*.

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Figures

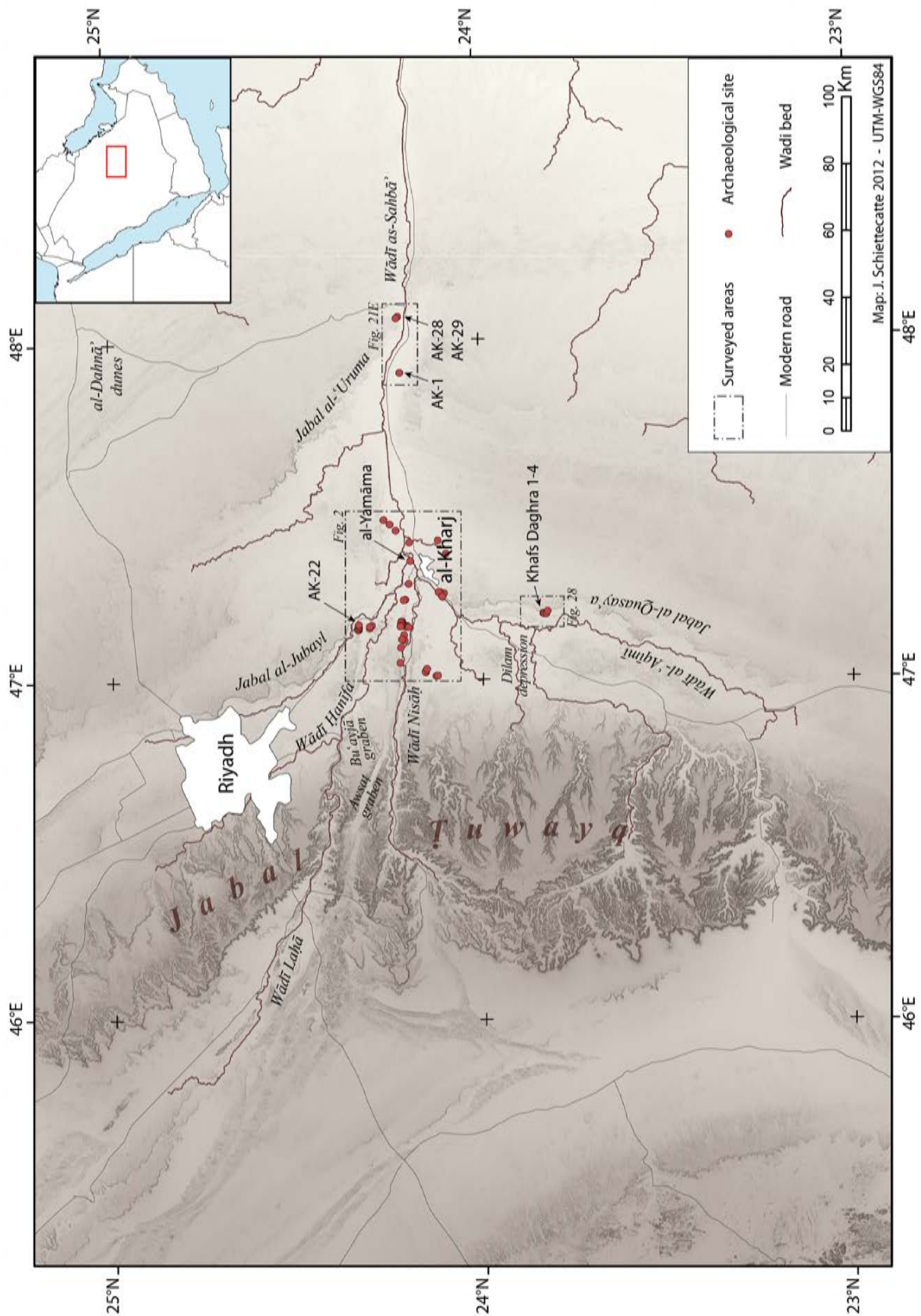
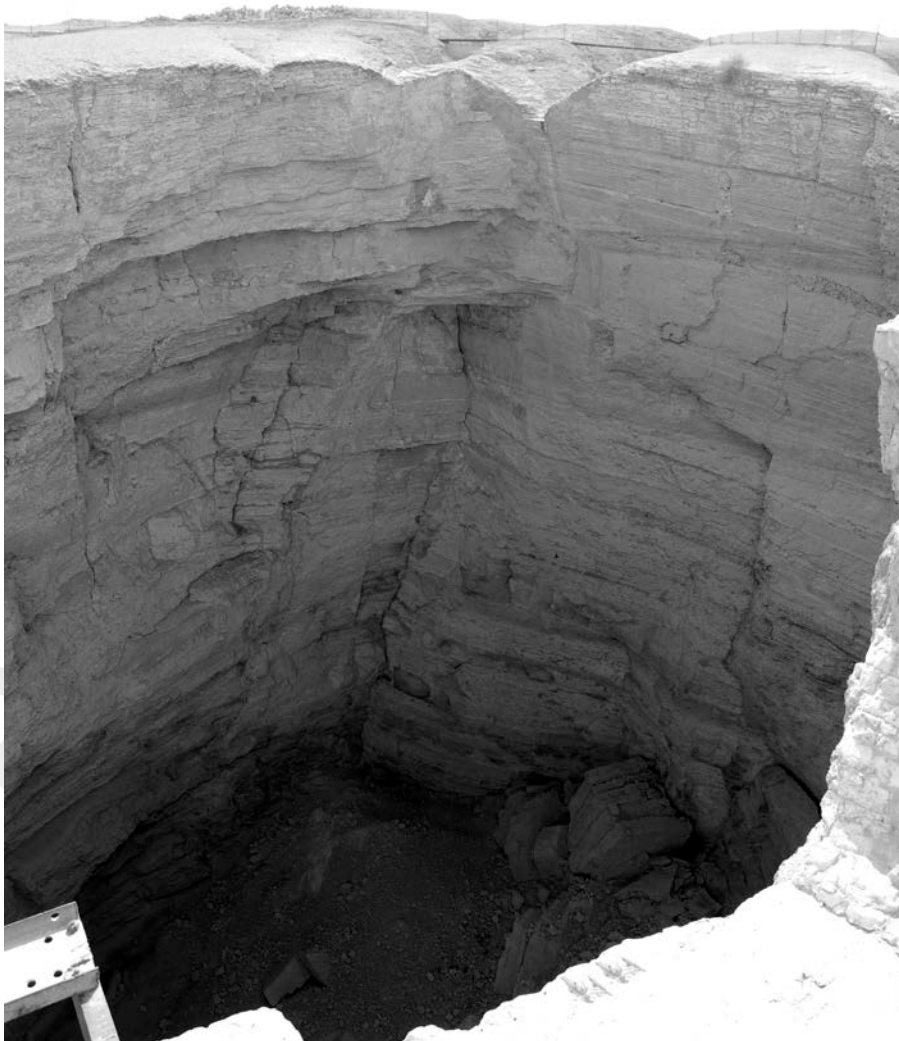


Figure 1: The location of the oasis of al-Kharj and its setting (J. Schiettecatte – French-Saudi Archaeological Mission in al-Kharj).



(a)



(b)

Figure 2: Swallow hole at 'Ayn al-Dila' 2: (a) in January 1975 (Courtesy of Saudi Aramco World/SAWDIA); (b) in 2011 (J. Schiettecatte – French-Saudi Archaeological Mission in al-Kharj).

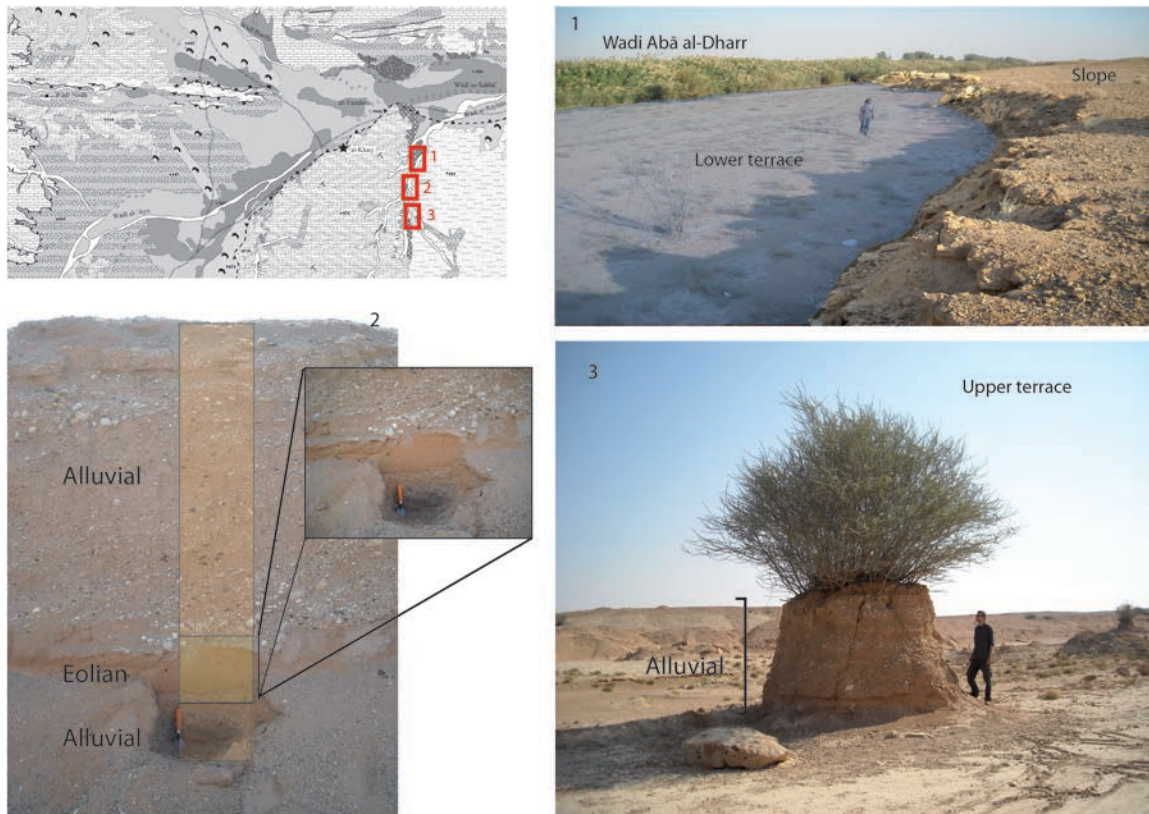


Figure 3: Alluvial terraces in the Wādī Abā adh-Dharr (A. Chabrol & G. Fortin – French-Saudi Archaeological Mission in al-Kharj).



Figure 4: Low alluvial terrace in a well, seen in an abandoned village east of the archaeological site of al-Yamāma (A. Chabrol & G. Fortin – French-Saudi Archaeological Mission in al-Kharj).

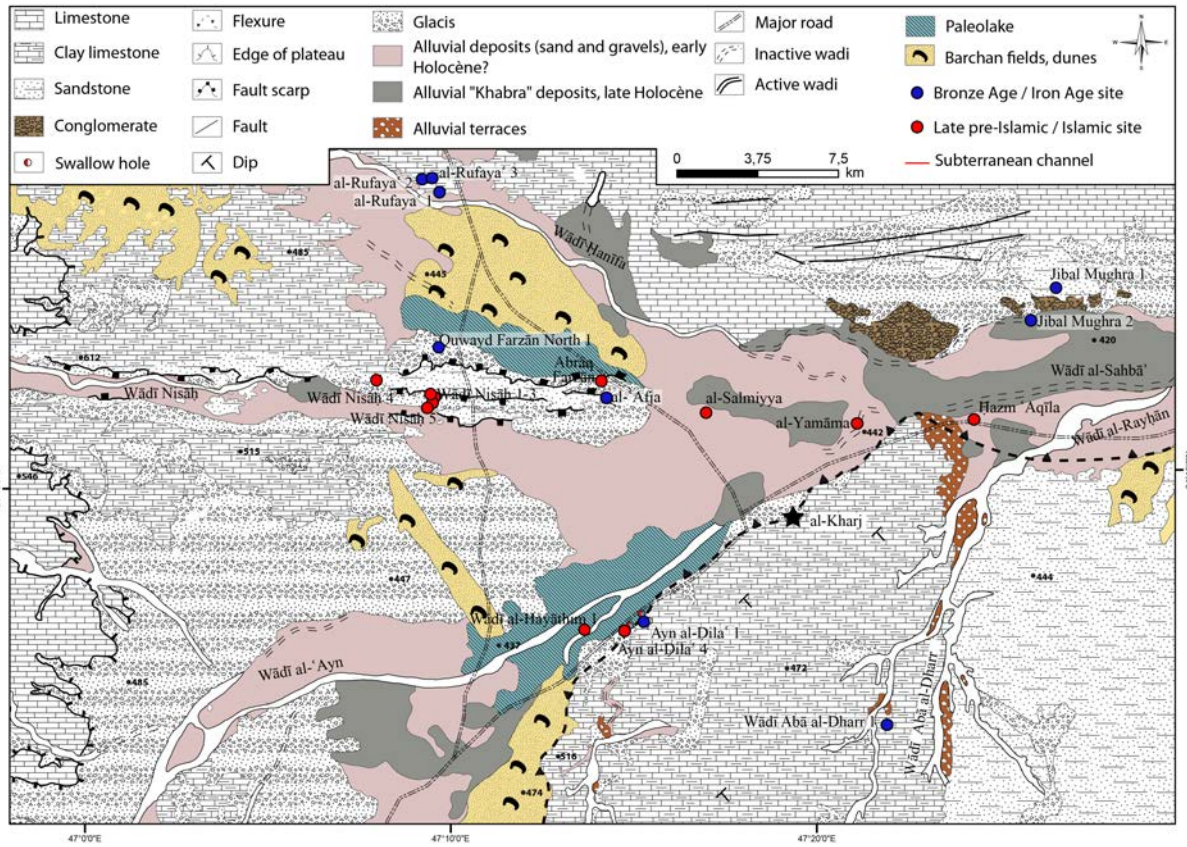


Figure 5: Geomorphological map of the oasis of al-Kharj (A. Chabrol, G. Fortin & J. Schiettecatte – French-Saudi Archaeological Mission in al-Kharj).

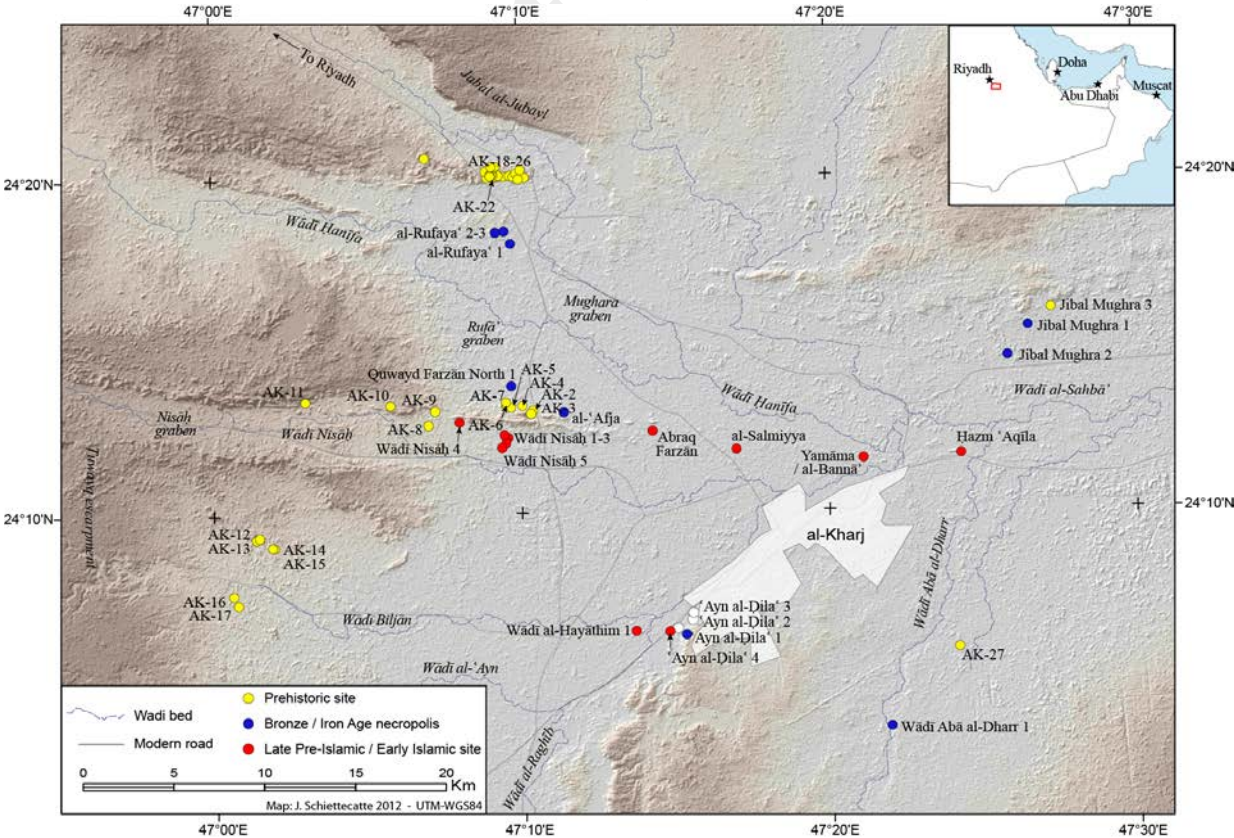


Figure 6: Archaeological map of the oasis of al-Kharj (J. Schiettecatte – French-Saudi Archaeological Mission in al-Kharj).



Figure 7: Necropolis at al-'Afja, over the Quwayd Farzān, a sandstone outcrop, looking east (P. Siméon – French-Saudi Archaeological Mission in al-Kharj).



Figure 8: A monumental stepped tomb at al-'Afja (M. Niveleau – French-Saudi Archaeological Mission in al-Kharj).



Figure 9: Aerial view of the necropolis at 'Ayn al-Dila', on the limestone plateau of the Jabal al-Qusay'a, looking west (Th. Sagory – French-Saudi Archaeological Mission in al-Kharj).

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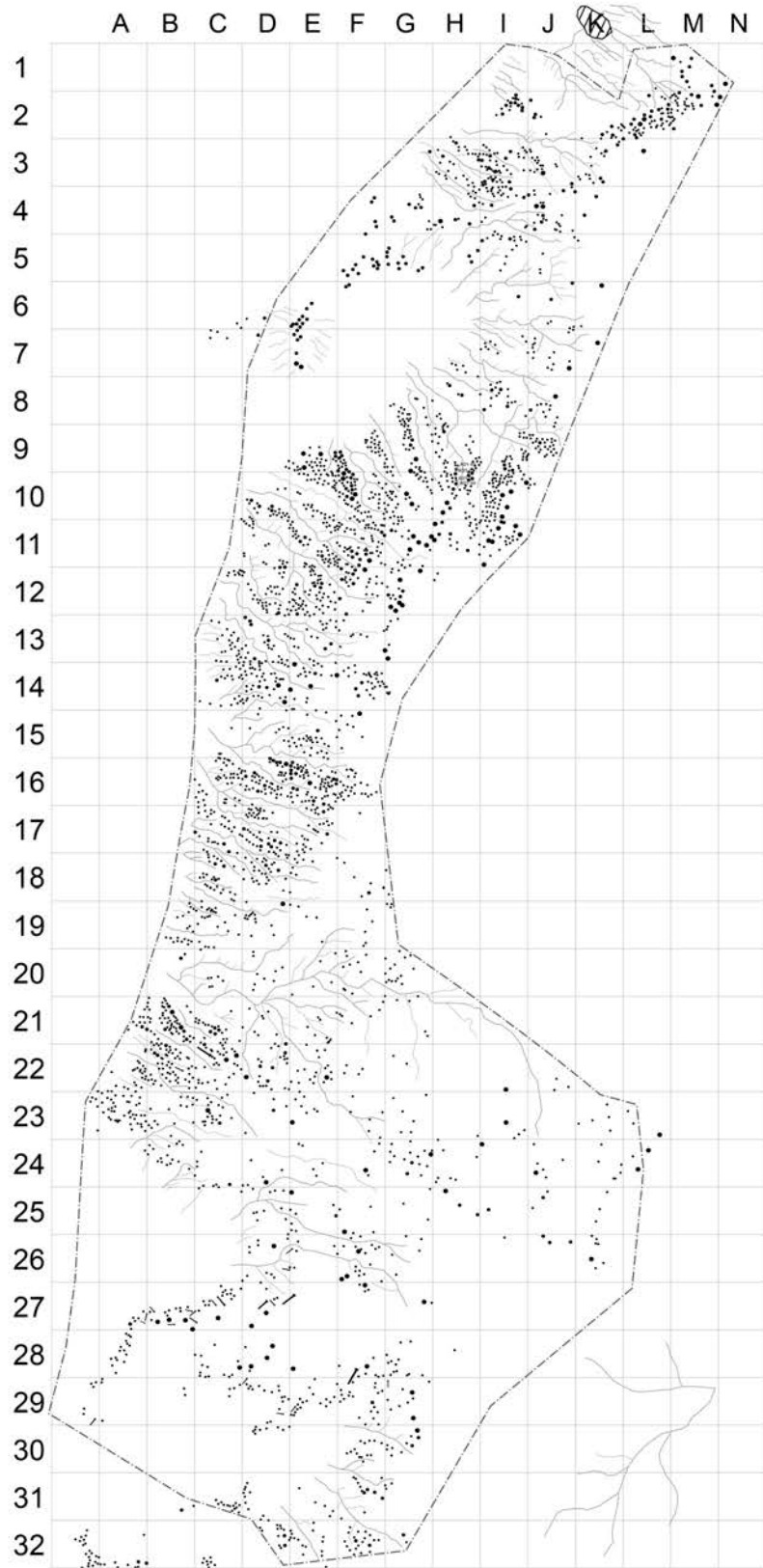
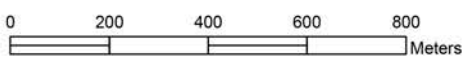


Figure 10: Map of the necropolis at 'Ayn al-Dila' 1 (E. Wermuth – French-Saudi Archaeological Mission in al-Kharj).



Necropolis 'Ayn al-Dila' 1

© E. Wermuth - French-Saudi archaeological Mission in al-Kharj
 After Google Earth imagery - 2011, Digital Globe



Figure 11: 'Ayn al-Dila' 1: Aerial picture of tombs AD1-03 (top left), AD1-04 (bottom left) and AD1-05 (right) (Th. Sagory – French-Saudi Archaeological Mission in al-Kharj).

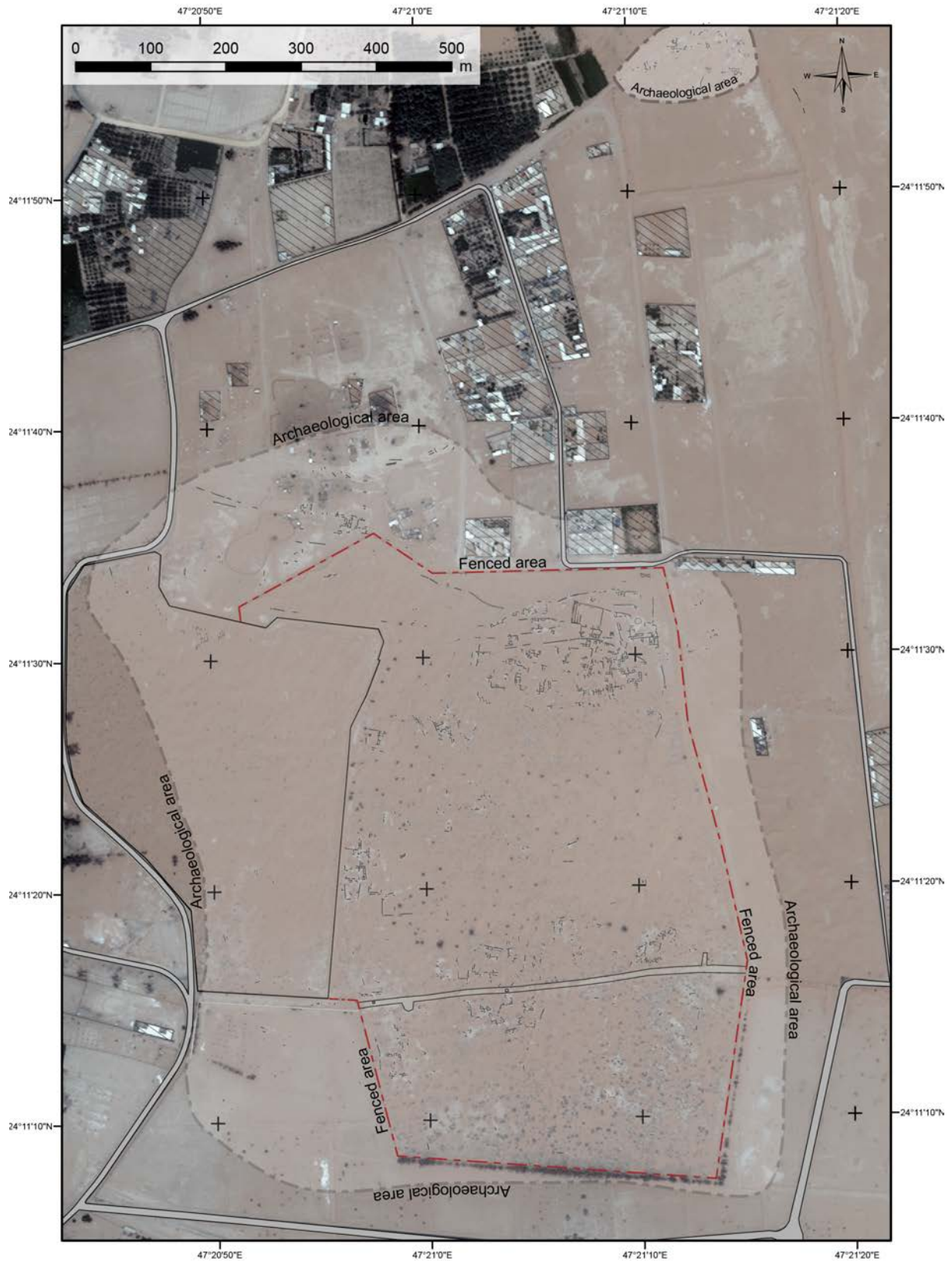


Figure 12: Al-Yamāma: map of the archaeological area and fenced area (J. Schiettecatte – French-Saudi Archaeological Mission in al-Kharj/Includes World-View-2 Products ©DigitalGlobeTM, distributed by e-GEOS).



Figure 13: Abraḡ Farzān: Aerial view of the *kharaz* at the junction of the two branches (Th. Sagory – French-Saudi Archaeological Mission in al-Kharj).