Iron Age landscape in the Tanuf District, Ad-Dākhliyyah Governorate: A transmountain hypothesis based on surveys and excavations in 2017–2023.

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ABSTRACT

The Iron Age in Oman is characterised by socioeconomic transformations, including the emergence of regional centres, the revitalisation of sedentary agriculture, and the aflāj water-supply system. Compared to the alluvial basins and oases at the fringes of the inner desert, the sociocultural characteristics of the canyons of the Al Hajar Mountains remain to be explored. Based on the results of our archaeological investigation in the Tanuf District from 2017 to 2023, we demonstrate the transformation of archaeological landscapes in Al Jabal Al Akhdar and along the Wadi Al Abyad in Ad-Dākhliyyah Governorate. In the survey area, we documented 11 Iron Age sites, including cemeteries, occupations, and possible fortifications. These findings reveal the dichotomous Iron Age landscapes in the Tanuf District. The landscape of the canyon of Wadi Tanuf, where temporal occupation was evidenced in a cave, was oriented toward mobility. In contrast, the floodplain areas in Wadi Al Abyad are characterised by an oasis-based sedentary agricultural landscape. A comparative study of the Al Jabal Al Akhdar and Nizwa areas revealed that the spatio-temporarily transitional landscape of the Tanuf District bridges the up- and downstream areas, and the intermediate canyons might have been used as transportation route connecting Al Jabal Al Akhdar and the lower basin.

KEYWORDS: Iron Age, Wadi Al Abyad basin, Cemetery, Settlement, Fort.

المشهد الأثري في العصر الحديدي بمنطقة تنوف في محافظة الداخلية: فرضية عبر الجبال استنادا إلى عمليات المسح والتنقيب الأثري في الأعوام من ٢٠١٧ إلى ٢٠٢٣

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الملخص:

يتميز العصر الحديدي في عمان بالتحولات الاجتماعية والاقتصادية، بما في ذلك ظهور المراكز الإقليمية، وتنشيط الزراعة المستقرة، ونظام إمدادات المياه بالأفلاج. بالمقارنة مع الأحواض الغرينية والواحات على أطراف الصحراء الداخلية، لا يزال يتعين استكشاف الخصائص الاجتماعية والثقافية لأودية جبال الحجر. بناءً على نتائج تنقيباتنا الأثرية في منطقة تنوف من عام ٢٠١٧ إلى عام ٢٠٢٣، نوضح تحول المشاهد الأثرية في الجبل الأخضر وعلى طول الوادي الأبيض في محافظة الداخلية. قمنا في منطقة المسح بتوثيق أحد عشر موقعاً من العصر الحديدي، بما في ذلك المقابر والاستيطانات والتحصينات المحتملة. كما تكشف هذه النتائج عن المشاهد الأثرية من العصر الحديدي ثنائية التقسيم في منطقة تنوف. كان المشهد الخاص بأخدود وادي تنوف موجهاً باتجاه الحركة والتنقل، حيث تم في الكهف الاستدلال على وجود للاستيطان المؤقت. في المقابل، تتميز مناطق السهول الفيضية في الوادي الأبيض بالمشهد الزراعي المستقر القائم على الواحات. كشفت دراسة مقارنة لمنطقتي الجبل الأخضر ونزوى أن المشهد الانتقالي المكاني المؤقت لمنطقة تنوف يربط بين المناطق المُحيطة بأعلى وأسفل المصب، وربما تم استخدام قنوات الأودية الوسيطة كطريق نقل يربط الجبل الأخضر والحوض المائي السفلي.

الكلمات المفتاحية: العصر الحديدي، حوض وادي الأبيض، مقبرة، مستوطنة، حصن.

1. INTRODUCTION

Southeast Arabia experienced many new changes during the Iron Age (ca. 1300 BCE–300 CE; Degli Esposti et al., 2018). Among these are the revitalisation of sedentary agriculture using water supply systems with subterranean canals (*falāj*, pl. *aflāj*; Charbonnier, 2015), the emergence of large fortifications, and regional socioeconomic and political centres (Avanzini and Degli Esposti, 2018; Kroll, 2013). Furthermore, the domestication of the dromedary began during the Early Iron Age (ca. 1300–300 BCE) (Almathen et al., 2016; Magee, 2014), although Sala (2017) claimed that it originated in the Third Millennium BCE. The domestication of the dromedary likely contributed to long-distance trade across deserts, increases in loading capacity, and the reorganisation of new intra- and inter-regional networks.

These changes likely affected the distribution pattern of archaeological sites at microregional scales, as observed e.g. in Qumayra (Bieliński et al., 2023). The number of Iron Age sites increased again after the temporal depression during the preceding Late Bronze Age (ca. 1600–1300 BCE)[1]. Traces of ritual aspects, such as offerings to a presumed deity for warriors, were also confirmed at Jabal Madmar (Gernez, Benoist, and Jean, 2017), and miniature metal weapons from such a context reveal ritual aspects relating to combat.

For the Late Iron Age (ca. 300 BCE–300 CE), Yule (2016) emphasised the differences in material culture between the *Période préislamique récente* (PIR) assemblage in the west (modern UAE and westernmost northern Oman) and the Samad Late Iron Age assemblage in the east (the rest of northern Oman) (Yule, 2016). These aspects can be interpreted as the earliest evidence of the historical landscape of Southeast Arabia, which continued until pre-modern times.

The recent discoveries of the Early Iron Age sites of Sallut and Madmar highlight the geopolitical importance of the modern Ad-Dākhliyyah Governorate of North-Central Oman (e.g. Avanzini and Degli Esposti 2018; Gernez, Benoist, and Jean, 2017). This view is strengthened by the Early and Late Iron Age evidence in Izki at the outlet of Samail Gap in the same governorate (Schreiber, 2007). Such recent discoveries are consistent with evidence previously identified from Lizq for the Early Iron Age and Al Muyassar and Samad ash Shan for the Late Iron Age in the northern part of the Ash-Sharqiyyah North Governorate (Kroll, 2013; Yule, 2001) (Figure 1; Table 1). Among the abovementioned sites, Sallut, Jabal Madmar, and Izki are briefly reviewed.

The archaeological complex at Sallut consists of a large fort (Husn Sallut); several settlements, including Qaryat Sallut and other surrounding localities (Avanzini and Degli Esposti, 2018; Degli Esposti, 2021), and a shrine with six pillars on the adjacent hill (Phillips, 2015). Husn Sallut is one of the largest known fortified towns in Southeast Arabia and is composed of many Early Iron Age mud-brick complexes around the highest point of the fort and the Late Iron Age stone structures with several facilities, including copper workshops and public and ritual spaces. Continuous habitation was also confirmed in Qaryat Sallut throughout the Iron Age. The largeness of this site complex (ca. 0.7 km^2) with a citadel, a fortified town, and a cemetery is distinctive in Southeast Arabia. Sallut played important socioeconomic and possibly political roles in the Early Iron Age when the Kingdom of Qade was mentioned in a Neo-Assyrian text (e.g. Potts, 1985), and its importance continued in the Late Iron Age.

The Madmar East site contains several buildings with evidence of rituals. Building 1 yielded an assortment of miniature bronze weapons in a room (Gernez, Benoist, and Jean, 2017). In addition, there is a monumental wall complex on the slope of a hill where numerous metal weapons and snake figurines have been uncovered (Jean, Pellegrino, and Gernez, 2018; Jean et al., 2021). Thus, the Madmar East site produced new aspects related to Early Iron Age warrior-god rituals in the Ad-Dākhliyyah Governorate.

1 For the list of the Early Iron Age sites, see Kroll, 2013:215–220. Currently only the term 'Late Bronze Age' is used to indicate this chronological range rather than the term 'late Wadi Suq', which is obsolete and misleading (cf. Velde 2003).

Figure 1: *Location of the Tanuf District and the sites mentioned in the text. Wadi Tanuf and As Suwayhriyyah Areas are included. The square indicates the location of the Tanuf District, while the dots indicate the location of archaeological sites in other districts (Basemap: National Survey Authority, Sultanate of Oman).*

Table 1: *List of the Iron Age sites mentioned in the text. The numbers are equivalent to those in Figure 1.*

	Site Name	Latitude	Longitude	Bibliography
1	**Tanuf District**	23.064	57.469	de Cardi, Collier, and Doe, 1976; Kuronuma, Miki, and Kondo, 2021; 2022a; 2022b; Miki et al, 2020; 2022
2	**Balad Sayt**	23.190	57.389	Gaube et al., 2012
3	**Al Jabal Al Akhdar**	23.110	57.582	Schreiber, 2007
4	**Ghubrat Nizwa**	22.978	57.564	Schreiber, 2007
5	**Nizwa**	22.943	57.541	Schreiber, 2007
6	**Karsha**	22.819	57.543	Schreiber, 2010
7	**Sallut**	22.748	57.229	Avanzini and Degli Esposti, 2018; Condoluci and Degli Esposti, 2015
8	**Madmar East**	22.459	57.650	Gernez, Benoist, and Jean, 2017; Jean, Pellegrino, and Gernez, 2018
9	**Izki**	22.919	57.757	Schreiber, 2007; Yule, 2015
10	**Al Muyassar**	22.809	58.125	Yule, 2001; 2016; Weisgerber, 1980; 1981
11	**Samad ash Shan**	22.804	58.156	Yule, 2001; 2016; Weisgerber, 1980; 1981
12	**Lizq**	22.708	58.171	Kroll, 2013; Weisgerber, 1980; 1981
13	**Bawshar**	23.544	58.397	Costa et al., 1999
14	**Wadi Tiwi**	22.816	59.262	Schreiber and Häser, 2004
15	**Qumayra /Al Ayn**	23.876	56.191	Bieliński et al., 2023
16	**Hili**	24.291	55.780	Boucharlat and Lombard, 1985; Karacic et al., 2020
17	**Rumeilah**	24.276	55.761	Boucharlat and Lombard, 1985; Lombard, 1985
18	**Jabal Al Buhais**	25.011	55.797	Jasim, 2012

Finally, the site complex of Izki has historiographical and geopolitical importance in the First Millennium BCE context. Izki possibly corresponds to Izke, mentioned in a Neo-Assyrian text from the Ishtar Temple in Nineveh as a residence of Pade, the king of Qade (e.g. Potts, 1985). This text recorded the visit of Pade in Nineveh in 640 BCE during King Assurbanipal's reign. This date largely corresponds to the late Early Iron Age in Oman. Izki and its hinterlands have been surveyed several times. Schreiber (2007) reported 80 Early and 21 Late Iron Age sites, including graves, settlements, and fortifications. Yule (2001, 2015) also reported the discoveries from the Early Iron Age to the Samad and Non-Samad Late Iron Age, including the Izki-type rectangular tomb.

These discoveries highlight the socioeconomic and political importance of this region and the archaeological landscape during the Iron Age. In particular, the sites located south of the Al Hajar

Mountains such as Sallut on the desert fringe and Izki on the Samail Gap have geopolitical significance as centres of oasis-based large-scale site complexes.

However, the status of the landscape of the peripheral area, such as the junction between the Al Hajar Mountains and the floodplains, remains unclear. The Wadi Al Abyad basin around Nizwa and the eastern part of the Al Jabal Al Akhdar Districts belonging to the Wadi Al Miaaydin basin are exceptional, and there is rich Iron Age archaeological evidence after a scarcity of Late Bronze Age activity (Al-Shanfari and Weisgerber, 1989; Yule and Weisgerber, 2015) (Figure 2). Schreiber's contribution to these two surveyed fields is significant in considering the diachronic and topographical transformation of the Iron Age landscape along the Wadi Al Abyad.

The difference in land use is particularly obvious between Al Jabal Al Akhdar and Nizwa. In the eastern part of Al Jabal Al Akhdar, Schreiber (2007) reported 11 Early Iron Age spots including stone circles, tombs, and a fort. Schreiber (2007) also recorded Iron Age spots in Nizwa (43 Early Iron Age, 2 Late Iron Age, and 3 undetailed Iron Age). In addition, an Early Iron Age cemetery was reported in Karsha (Schreiber, 2010).

'However, the situation in the intermediate areas between the mountain and lower wadi basin remains unclear. Owing to the nature of this area as a transportation hub, archaeological investigations are strongly expected to reveal the archaeological landscape in this area, which constitutes a transition between the highland (Al Jabal Al Akhdar) and lowland (lower Wadi Al Abyad basin).

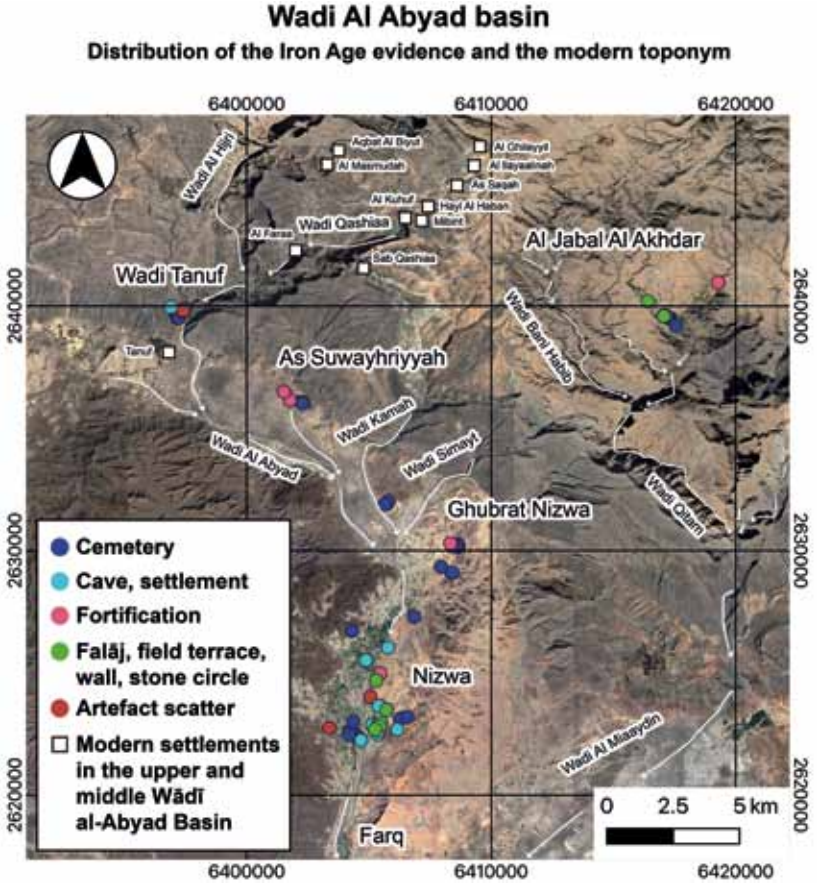


Figure 2: *Archaeological sites in the Iron Age in the Wadi Al Abyad basin, including the Tanuf District and Al Jabal Al Akhdar. Plotted dots in the part of Nizwa, Ghubrat Nizwa, and Al Jabal Al Akhdar are cited from Schreiber (2007). The coordinate system is UTM40Q. Base map is Google Maps applied with QGIS. (Produced by Taichi Kuronuma).*

In this regard, the Japanese team has worked in the Tanuf District which connects the upper and lower basins since 2017. The Tanuf District contains not only a deep canyon, but also a floodplain of the relatively wide valley from Nizwa, and geographically connects the upper and lower basins. The team discovered evidence of canyon usage and Bronze and Iron Age sites (Kuronuma, Miki, and Kondo 2021; 2022a; 2022b; Miki et al., 2020; 2022). The Bronze Age landscape is a combination of possible sedentary agriculture, represented by the towers and collective tombs of the Umm An Nar period (ca. 2700–2000 BCE) on the floodplain outside the canyon, and a mobility-oriented subsistence strategy indicated in the temporal use of a cave on a cliff and many individual tombs in the canyon during the Wadi Suq period (ca. 2000–1600 BCE). Based on these arguments, the Iron Age landscape is worth considering in terms of the historical differences and continuity within the same area.

This paper discusses the archaeological landscape in the Tanuf District from the viewpoint of the transformation of the Iron Age landscape from upstream in western Al Jabal Al Akhdar to downstream in Nizwa via the Tanuf District, together with the upstream of Wadi Al Miaaydin for the eastern Al Jabal Al Akhdar.

2. RESEARCH SETTINGS

2.1. Topography of Wadi Al Abyad basin and Tanuf District

Wadi Al Abyad runs through various topographies along its route. The basin originates on the southern side of the Al Hajar Mountains and flows into the inner deserts of Oman. We divide the Wadi Al Abyad basin into the upper, middle, and lower parts.

The upper basin embraces the plateau of Al Jabal Al Akhdar in the Al Hajar mountains. There are numerous small wadis on this high plateau, running in the direction of either Wadi Al Abyad or Wadi Al Miaaydin, and the topography is rugged with relatively rich vegetation.

The middle basin, which is the focus of this study, corresponds with modern Wadi Tanuf, Tanuf, and As Suwayhriyyah. Wadi Tanuf originates in the high cliffs at the western part of the plateau of Al Jabal Al Akhdar and runs through the limestone formation, which dates back to the Cretaceous (Autochthonous Unit "B"; Sultanate of Oman Ministry of Petroleum and Minerals, 1986) and forms steep cliffs and rugged terrains on both sides. Wadi Tanuf has two upstream wadis (Wadi Al Hijri to the west and Wadi Qashiaa to the east) which originate from the cliffs at the border of Al Jabal Al Akhdar and converge in the middle of the canyon. In some places, the canyons are characterised by cliffs approximately 400 m in height at the edges. In most cases, both sides of the wadi are directly on such cliffs. However, there are relatively gentle slopes in some areas, especially near the outlet of the canyon (Figure 2). These gentle slopes are covered with many screes, gullies, and large rolled and angular boulders. After the outlet from the canyon, the basin terrain is characterised by a broad floodplain in modern Tanuf and As Suwayhriyyah. Tanuf is the confluence point of Wadi Tanuf and a wadi which flows from the west. From this confluence, the wadi becomes Wadi Al Abyad. The broad floodplain of Wadi Al Abyad flows further down to the southeast. Its left shore is characterised by isolated inselbergs and low hills of the Hawasina Nappe and the southern rims of the Cretaceous limestone formation of the Al Hajar Mountains. The slopes of these mountains are gentle towards the south, with ridges, small wadis, and gullies. The right shore is the hills of Samail Ophiolite Nappe.

The lower basin corresponds to an area further downstream from Ghubrat Nizwa to Karsha, including Nizwa and Farq. Wide floodplains enable sedentary oasis agriculture using *aflāj*. Geologically, the wadi runs through the valley between the Hawasina Nappe to the left and Samail Ophiolite Nappe to the right, gradually running into the inner desert.

Considering this geological and topographical context, the border area between the Al Hajar Mountains and other topographies should be examined to identify the archaeological landscape

which reflects adaptation to varied topographies with rich water resources. Thus, we investigated the Tanuf District, which is composed of the canyon of Wadi Tanuf, and the broad floodplains in Tanuf and As Suwayhriyyah.

2.2. Archaeological research activities in the Tanuf District

Archaeological investigations in the Tanuf District were limited before the Japanese expedition. In 1974–1975, B. de Cardi and her team members surveyed Tanuf and surrounding areas, and reported Sites 27, 28, and 29 (de Cardi, Collier, and Doe, 1976:160–161, Figure 34). Sites 28 and 29 are two towers of the Umm An Nar period, and one of the towers (Site 28) probably corresponded to Tanuf01 of J. Schreiber and J. Häser (Schreiber, 2007:219). Site 27 is reportedly four cairns of the Hafit period (ca. 3300–2700 BCE) built on the slopes on both sides of a pass to the west of modern Tanuf (de Cardi, Collier, and Doe, 1976:160). However, we confirmed that de Cardi's Site 27 actually contained two groups of tombs on separate hills, and thus we separated her site into the northern area with a cairn and the southern area with four cairns (Kuronuma, Miki, and Kondo, 2022b).

The canyon of Wadi Tanuf is also known archaeologically because of its rock art. Some rock art has been visited and reported (Clarke, 1975; Preston, 1976; Jäckli, 1981; Lockwood, 2014). In the last two decades, Fossati (2019) surveyed the canyon and published pecked as well as painted rock art. In 2020, the Australian team led by Diane Fitzpatrick opened a test pit in WTN09 (Australian nomenclature WTN#01) seeking Palaeolithic deposits and reported lithics without detail (Meredith-Williams et al., 2022).

The Japanese archaeological project (Project ISTIDAMA) began in 2017 in the Tanuf District aiming at the reconstruction of the transformation of millennial-scale archaeological landscapes in water-rich environments in arid piedmont areas to understand the long-term sustainability of Oman (Kuronuma, Miki, and Kondo, 2021; 2022a; 2022b; Miki et al., 2020; 2022). The chronological scope of our investigation spans prehistory to modern times. As a result, we have confirmed 30 sites so far as of the end of the 2022–2023 season. The new discoveries include examples from the Iron Age. Thus, our investigations contribute to the understanding of the Iron Age landscape in the Tanuf District.

2.3. Investigation Methods

We carried out surveys and excavations in the Tanuf District. The survey was full-coverage-oriented and was combined with satellite imagery surveys before and after fieldwork (Kuronuma, Miki, and Kondo, 2022). Archaeological sites were recorded on a worksheet. For the geolocation of the features, we used a high-precision positioning system (Emlid Reach RS+), where available; otherwise, we used a business-as-usual handy positioning device (Garmin GPSMAP 60CSx). The geolocation of features by the Emlid system is more accurate than that by portable GPS devices, with an accuracy of a few centimeters, indicating its capability to distinguish individual built features or even stones and their layouts. Thus, this device is particularly useful for surveying the clustered Early Iron Age features and mapping their correct distributions.

The approximate size on the ground, preserved height, and current condition of each surveyed feature were documented on worksheets. However, in some cases with a good level of preservation, the features were also recorded by generating three-dimensional models created using Metashape and Polycam software[2]. Metashape can generate more accurate models than Polycam, but data procurement using Polycam is quicker in terms of recording features during fieldwork and reproductivity in laboratory documentation work. These software packages were used to optimise the output. The field documentation and three-dimensional models were cross-checked in the laboratory, and the records were modified if required. Each feature was photographed and sketched. In addition to

2 For Metashape, see the website, https://www.agisoft.com. For Polycam, see the website, https://poly.cam.

the structural characteristics, local topographical conditions were recorded by applying preset attributes, such as hill slopes, ridges, alluvial plains, and terraces, and were integrated into the GIS database. Diagnostic artefacts were collected to identify chronological dates. The assumption of the relative dating of each feature was based on the collected artefacts and/or typology of the identified features.

The investigated sites were registered using site codes combined with areal toponym initials and sequential numbers. The area codes were WTN for the canyon of Wadi Tanuf, TNF for the floodplain of modern Tanuf (not used herein), and SWH for the floodplains and surrounding hills in As Suwayhriyyah.

We also structured a database for the previously identified archaeological sites around the Tanuf District, such as those in Ghubrat Nizwa, Nizwa, and Al Jabal Al Akhdar (Schreiber, 2007). This database enables the comparison of archaeological landscape along the Wadi Al Abyad basin.

3. RESULTS

Our surveys in the Tanuf District identified 11 sites with Iron Age evidence (Figures 3–5; Table 2). These sites included cemeteries, occupations (including possible settlements), and probable forts.

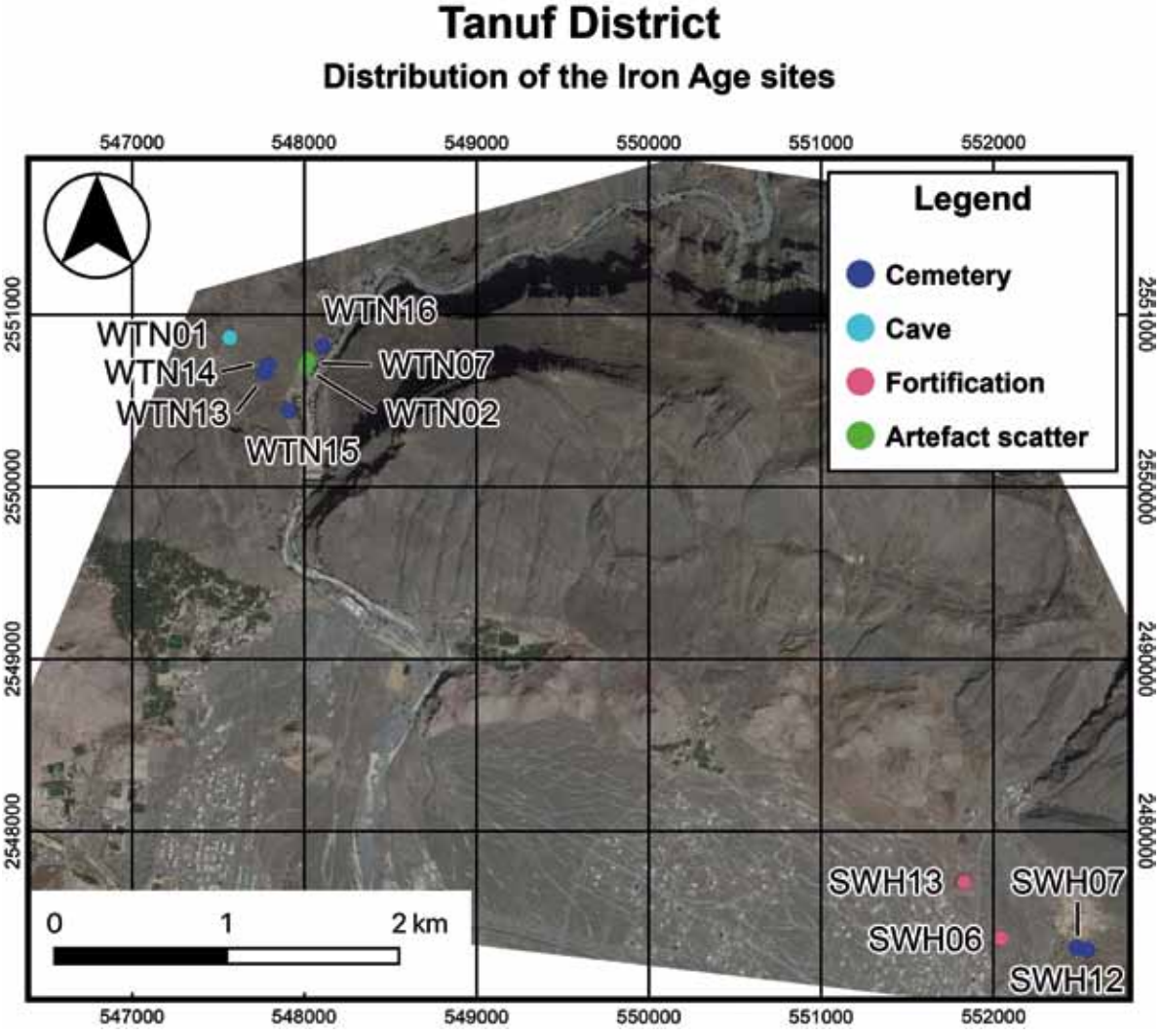


Figure 3: *Distribution of Iron Age and other archaeological sites in the Tanuf District. The coordinate system is UTM40Q. Background image: AW3D Ortho Imagery © DigitalGlobe, Inc., NTT Data Corporation.*

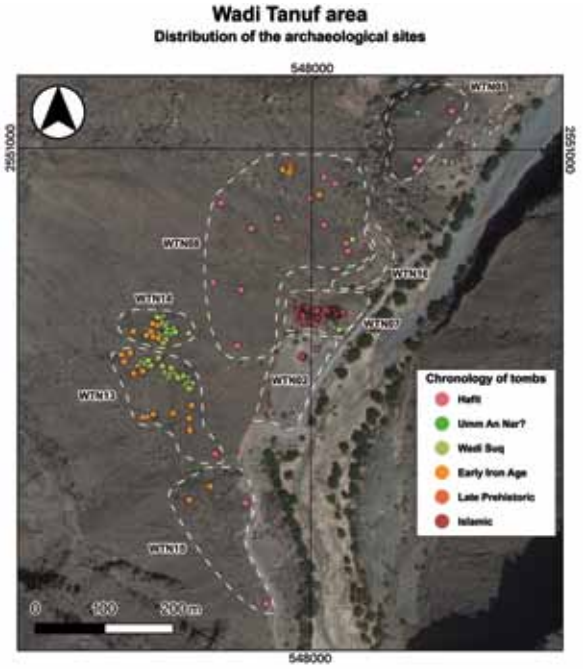


Figure 4: *Distribution of archaeological sites in the Wadi Tanuf area at the end of the 2022–2023 season. White broken lines indicate the boundary of archaeological sites. Dots indicate the location of tombs. The cemetery of WTN16 was not recorded in detail, as indicated in the main text. The coordinate system is UTM40Q. Background image: AW3D Ortho Imagery © DigitalGlobe, Inc., NTT Data Corporation.*

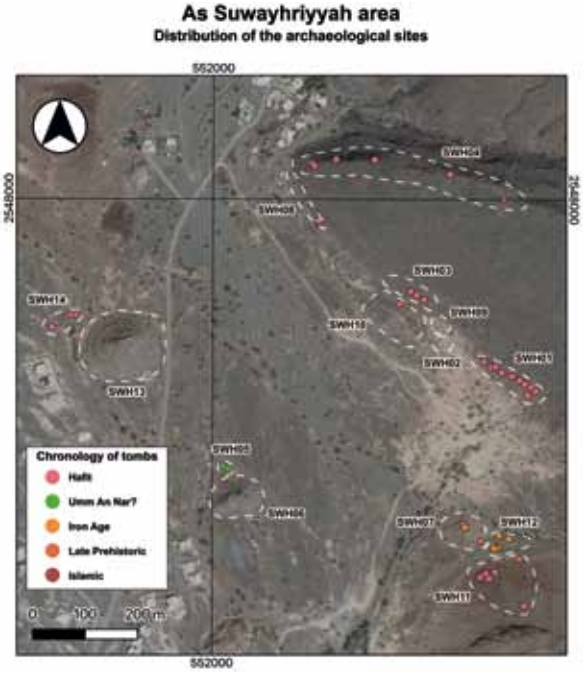


Figure 5: *Distribution of archaeological sites in the As Suwayhriyyah area at the end of the 2022–2023 season. White broken lines indicate the boundary of archaeological sites. Dots indicate the location of tombs. The coordinate system is UTM40Q. Background image: AW3D Ortho Imagery © DigitalGlobe, Inc., NTT Data Corporation.*

Table 2: *List of Iron Age sites in the Tanuf District confirmed by ISTIDAMA Project during the 2017–2023 season*.

Site code	Latitude	Longuitude	Type	Relative chronology	Remarks on Iron Age evidence
WTN01	23.066	57.464	Cave	Hafit?, Umm An Nar, Wadi Suq, Early Iron Age	Ash layers and hearth from TP1 (cf. Miki et al. 2020, 2022). Excavated in 2017-2020.
WTN02	23.064	57.469	Settlement?	Early Iron Age?	Surveyed in 2022-2023.
WTN07	23.065	57.469	Settlement	Early Iron Age?	Surveyed in 2022-2023.
WTN13	23.064	57.466	Cemetery	Hafit, Wadi Suq, Early Iron Age?	17 Iron Age tombs. Ten tombs from the surveys in 2019-2020 were reported (Kuronuma, Miki, and Kondo 2021, 2022b). Seven tombs were newly surveyed in 2022-2023.
WTN14	23.064	57.467	Cemetery	Wadi Suq, Early Iron Age	Seven Iron Age tombs. All tombs were newly surveyed in 2022-2023.
WTN15	23.062	57.468	Cemetery	Hafit, Early Iron Age?	Two Iron Age tombs surveyed in 2022-23.
WTN16	23.065	57.470	Cemetery	Iron Age?, Islamic	Initially surveyed in 2022-2023. Detailed surveys are upcoming.
SWH06	23.034	57.508	Fortification	Iron Age?, Islamic?	Surveyed in 2022-23.
SWH07	23.034	57.512	Cemetery	Hafit, Early Iron Age?	A rock shelter tomb. Surveyed in 2022-2023.
SWH12	23.033	57.513	Cemetery	Iron Age?	Five tombs. Surveyed in 2022-2023.
SWH13	23.037	57.506	Fortification	Iron Age?, Islamic?	Surveyed in 2022-2023.

3.1. Mortuary evidence

WTN13 is the largest cemetery on the edge of gently inclined talus slopes of Wadi Tanuf, mainly composed of tombs from the Wadi Suq period (Kuronuma, Miki, and Kondo, 2021). However, there are also some Early Iron Age tombs. As already reported with figures, we identified three so-called Hut-tombs (Kuronuma, Miki, and Kondo, 2022b:82, Figure 6) and 14 rock-used tombs (e.g. Kuronuma, Miki, and Kondo, 2021:109, Figure 9).

Figure 6: *Tomb 52 in WTN13 from the south. (Photographed by Taichi Kuronuma).*

Additionally, we also found an example of the later reuse of a Hafit cairn by adding a newly built annexe, the date of which is certainly late prehistoric[3] or more probably Iron Age based on the structural characteristics (Kuronuma, Miki, and Kondo, 2022b:83, Figure 7). Interestingly, four of the 14 rock tombs were clustered and attached to a large natural rock (Kuronuma, Miki, and Kondo, 2021:109, Figure 8). This clustering nature is comparable to the so-called Honeycomb tombs, such as those in Bawshar (Costa et al., 1999). Similar examples of the rock-used tomb were reported in the canyon of Wadi Tiwi and dated to the Late Iron Age based on recovered pottery (Schreiber and Häser 2004:325, Figure 9). Such parallels are comparable with the examples in the Tanuf district, although we assume that the chronology dates back to the Early Iron Age, as indicated below in the case of WTN14.

The remainder of the rock -used tombs were rock-shelter tombs, and Schreiber (2007:139 Abbildung 24) reports similar parallels at Izki. More examples have been reported in Jabal Al Buhais, where 36 Early Iron Age rock-shelter tombs were excavated

3 The term 'late prehistoric' in this paper generally means the period after the Wadi Suq period and before the arrival of Islam in this context.

(Jasim, 2012). These examples are suggestive when considering the dating of our discovered tombs. The Hut-tombs were confirmed on the ridge in the southern part, and were probably built using materials reused from a Hafit cairn on the same ridge (Kuronuma, Miki, and Kondo, 2022b).

Additional surveys conducted in the 2022–2023 season led to the confirmation of six rock-shelter tombs, four of which were built at large boulders along a small gully (Figure 6). Although the details will be presented in the survey report in the future, this confirmation enhances our current view of the diachronic use of WTN13. Thus, the funerary landscape in WTN13 is a combination of natural environmental characteristics and intermittent use from the Early Bronze Age to the Early Iron Age.

WTN14 is the northern neighbour of WTN13, beyond a small gully. The site was identified in 2019 (cf. Kuronuma, Miki, and Kondo, 2021:111, Figure 11) and documented in detail during the 2022–2023 season. Nineteen Wadi Suq free-standing tombs, seven probable Early Iron Age rock-shelter tombs, and one possible subterranean Iron Age grave were identified. The rock-shelter tomb is relevant to Type 3b (Figure 7), which was defined in the WTN13 cemetery. Type 3b is defined as a structure combined with a rock shelter as a de facto ceiling and a stone enclosure for the cavity (Kuronuma, Miki, and Kondo 2021: 108). Our initial supposition regarding the dating of the rock-shelter tombs as Early Iron Age is more certain because of the discovery of surface-collected potsherds near Tomb 19. The initial examination of these potsherds indicates that they can be classified as grey-angular-sand tempered coarse ware (Figure 8). Although there were not so many artefacts on the surface, the amount of collectable artefacts was larger than those of WTN13. Most of the artefacts were pottery with the same ware type. Thus, the use of this cemetery during the Early Iron Age is more likely. Topographically, WTN14 is characterised by a greater number of huge natural rocks, which strongly suggests the presence of more rock-used tombs. The western limit of the cemetery has not yet been confirmed, and we expect more rock-shelter tombs.

Figure 7: *Tomb 25 in WTN14 from the south. (Photographed by Taichi Kuronuma).*

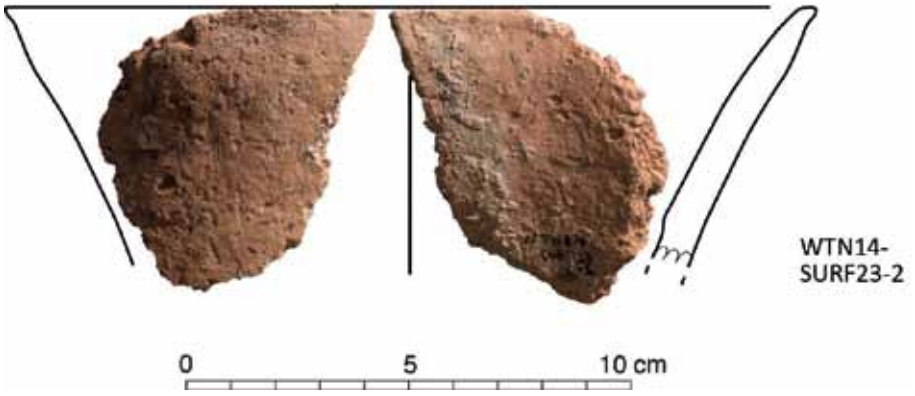


Figure 8: *An open vessel collected near Tomb 19 of WTN14. (Photographed by Takehiro Miki, drawing by Taichi Kuronuma).*

To the south of WTN13, a survey of WTN15 was partially conducted during the 2022–2023 season at the northern boundary of this cemetery. We found two examples of rock-shelter tombs, one of which (Tomb 4) was almost complete, with a small break to the south (Figure 9). As mentioned in the case of WTN14, there are many large rocks and boulders in this cemetery. After the completion of the survey, the number of tombs is expected to increase.

Figure 9: *Tomb 4 in WTN15 from the east. (Photographed by Taichi Kuronuma).*

WTN16 is also a newly discovered cemetery on the terrace of Wadi Tanuf. The initial survey conducted during the 2022–2023 season indicated that this cemetery was mainly used during the Islamic period. However, there were a few tombs without standing stones (*shawāhid*), but with solid external walls and a possible collapsed superstructure (Figure 10). A detailed survey to map the positions of the tombs remains to be completed, but it is clear that these tombs are structurally different from typical Islamic graves.

Figure 10: *An example of a tomb in WTN16 from the east. (Photographed by Taichi Kuronuma).*

The resurvey at SWH07 in 2022–2023 indicates the presence of a rock shelter tomb (Tomb 2) which is similar to the parallels in Wadi Tanuf (Figure 11). The tomb was built under a large natural rock on the lower hill of SWH07. It is probable that the stones for the wall were reused from the adjacent Hafit cairn (Tomb 1) in a largely destroyed condition.

SWH12 is a newly discovered cemetery in the 2022–2023 survey situated on natural levees between a wadi and the Hawasina Nappe hill with SWH11 cemetery. The cemetery consists of five oblong or circular subterranean tombs (Figure 12). The structural characteristics and long axis directions likely exclude the chronological possibility of either the Wadi Suq or the Islamic period. However, we were unable to collect accompanying artefacts from this cemetery. Thus, the chronological assumption is based only on the structural characteristics. Nevertheless, SWH12 is currently the only identified clustered cemetery in As Suwayhrriyah, and it also implies possible human activity on the left side of Wadi Al Abyad.

Figure 11: *Tomb 2 in SWH07 from the south. Tomb 1 (Hafit cairn) is seen in the background to the left (with vegetation). (Photographed by Taichi Kuronuma).*

Figure 12: *Tomb 1 in SWH12 from the east. (Photographed by Taichi Kuronuma).*

3.2. Occupational evidence

Contrary to the relatively rich mortuary evidence of the Iron Age, traces of occupational activity are scarce in the Tanuf District, except for three registered sites (WTN01, WTN02, and WTN07; Figures 3–5).

Excavations at the Mugharat Al Kahf Cave (WTN01) yielded cultural deposits which were continued from the preceding Bronze Age. Iron Age evidence is characterised by the temporal usage of this cave; no features were identified. However, potsherds and a chlorite stone vessel fragment were recovered. Nevertheless, 21 Iron Age potsherds and a chlorite stone vessel fragment have been recovered (Miki et al., 2020; 2022). Among them, 12 sherds were collected from the surface inside the cave, and the other 9 sherds were excavated from Test Pit 1. The identified genuine Iron Age ware types were red-angular-sand tempered brown coarse ware (Figure 13), while the Iron Age ware was mineral-and-vegetal-tempered brown coarse ware and mineral-tempered brown coarse ware. Similar pottery has been reported in Sallut (e.g. Condoluci, Degli Esposti, and Phillips, 2018). All excavated sherds were from Layer Ia of Test Pit 1. A chlorite vessel sherd from the cave terrace (Miki et al., 2022:99, Figure 12:13) had a ring base, which is probably an incomplete example owing to the rough interior surface (cf. Harrower et al., 2016). The ring base was uncommon during the Bronze Age, although it could be possible for an Early Iron Age date (Pellegrino et al., 2019; Yule, 2001; Ziolkowski, 2001). Talc-rich materials indicate a probable late prehistoric date (Velde, 2018).

Figure 13: *Early Iron Age potsherds collected from WTN01. (Photographed by Takehiro Miki).*

WTN02 is an artefact scatter with a few remnants of structures on the southern half of the terrace from the wadi bed. The site is currently bulldozed, although several tombs, including Islamic tombs, are preserved today. Time-lapse satellite imagery indicates that the bulldozing occurred within the last decade, although some types of structures were confirmed in older satellite imagery. In 2022, we carefully examined the levelled surface and identified some reminiscent foundation traces of a bi-face wall structure (Structure 1). Although its original state is hard to estimate, small-scale permanent structures may have existed during the Iron Age. We collected some Iron Age pottery sherds from the northern part of the site boundary. Preliminary observations indicate that it includes Early Iron Age pottery with red-slipped red-angular-sand tempered ware, as well as a potsherd with a sequence of incised cross marks (Figure 14). Some Early Iron Age potsherds were subjected to petrographic analysis (Miki et al., in prep.). We confirmed the foundation of a structure in the northeastern part from which the collected pottery could be derived.

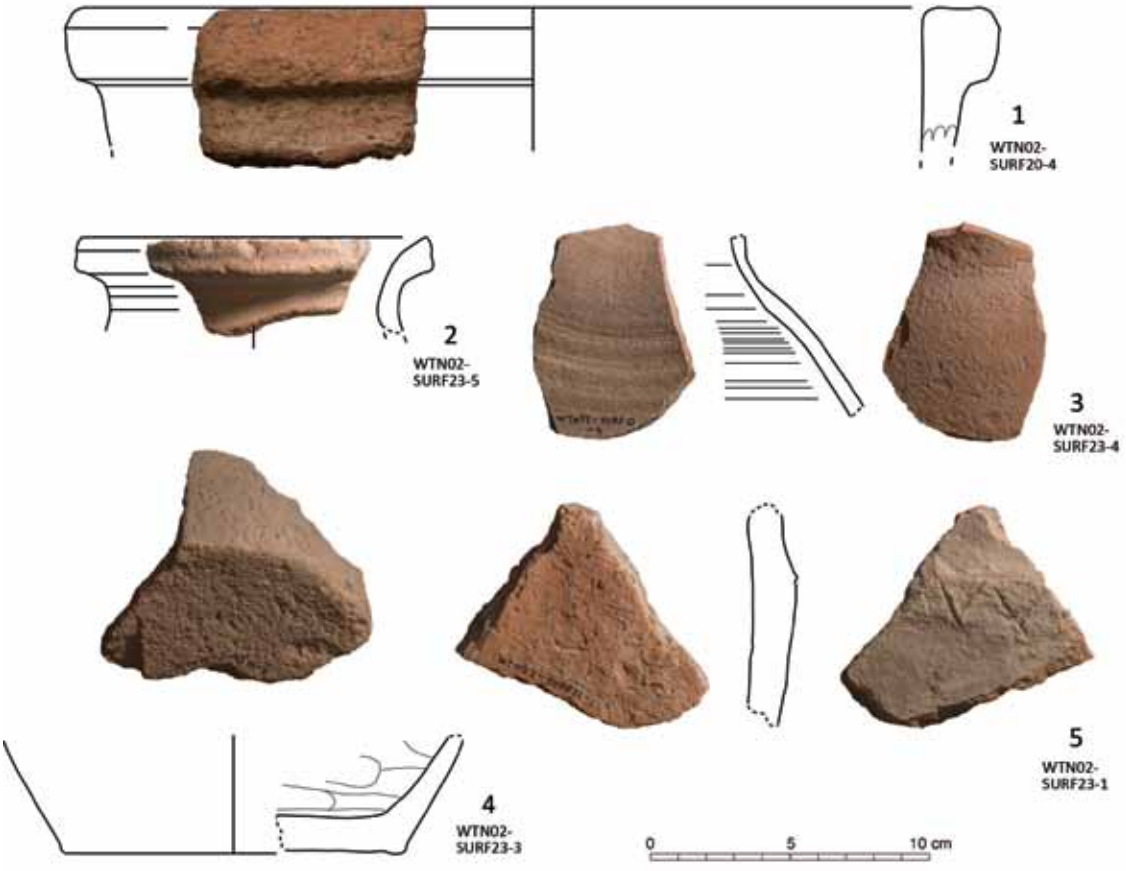


Figure 14: *Potsherds collected from WTN02. (Photographed by Takehiro Miki, drawings by Takehiro Miki and Taichi Kuronuma).*

WTN07 is situated on the northern half of the terrace from the wadi bed in the continuity of WTN02. This site is a multi-period archaeological complex which includes an early Islamic cemetery and possible Bronze Age walls, structures, tombs, and mound-like features. No certain Iron Age features were identified, although we confirmed scattered probable Early Iron Age sherds amidst Islamic graves in our survey during 2022–2023. The date of the identified structures is unknown, although the Iron Age is one of the candidates. Thus, the site was an extension of WTN02 to the south during the Early Iron Age.

3.3. Defensive structures

Fortification evidence has been discovered in the floodplain of Wadi Al Abyad in As Suwayhrriyah. SWH06 is a small fortification on top of an inselberg. The fortification structure occupies the summit and creates a flat top (Figure 15). The stone protective and enhanced walls were constructed by filling the uneven parts of the original rock shape. The size of the fortification is ca. 55 m^2. There are some possibly associated structures at the foot of the inselberg. Very few artefacts have been found, although this fortification could have been built during the Iron Age, as reported for Ghubrat Nizwa (Schreiber, 2007:202–203).

SWH13 is also a fortification atop of an inselberg approximately 800 m northwest of SWH06, ca. 400 m^2 and larger than SWH06. Unlike SWH06, stone walls were confirmed on almost the entire part of the inselberg from around the slope surface to the summit (Figure 16). The presence of some possibly associated structures at the foot of the inselberg also resembles SWH06. There are a few artefacts on the surface at this site. SWH13 is presumed to be combined with SWH06 owing to their close relative placements within ca. 300 m intervals and the similarities in their structural characteristics.

4. DISCUSSION

Surveys in the Tanuf District have identified a wide variety of Iron Age archaeological structures. These pieces of evidence are comparable with the already known records and contribute to closing the gap in our understanding of the Iron Age landscape in the lower Wadi Al Abyad basins and Al Jabal Al Akhdar (Figure 17).

4.1. Contrastive Iron Age landscape in Al Jabal Al Akhdar and the lower Wadi Al Abyad basin around Nizwa

It is apparent that the Iron Age landscapes from Al Jabal Al Akhdar to the lower basin of Wadi Al Abyad are not only varied but also transformed. In particular, Early Iron Age landscapes are common among Al Jabal Al Akhdar, the Tanuf District, and the area around Nizwa. To consider the Iron Age landscape in the Tanuf District, the contrastive landscape in Al Jabal Al Akhdar and the lower Wadi Al Abyad basin needs to be evaluated first.

As indicated by Schreiber (2007), there is archaeological evidence in the highland of Al Jabal Al Akhdar, including Early Iron Age cemeteries, stone circles, and a fort, yet evidence for contemporaneous settlements and *aflāj* systems has not been reported. The absence of habitational structures implies limited activities in the highland area during the Early Iron Age, but the discovered evidence implies a possible mountain adapted sedentary landscape comparable with the modern landscape represented by the sedentary settlements along the valleys with terraced fields and small scale *aflāj*. Meteorological conditions could constitute an important background to such highland activities. As seen today, Al Jabal Al Akhdar receives rainfall from the Indian Monsoon (300 mm maximum precipitation per annum; Shahalam 2001:1), and water is procured from the springs through *aflāj* (e.g. Siebert, Nagieb, and Buerkert, 2007). Irrigation is indispensable, even in mountainous regions (Siebert, Nagieb, and Buerkert, 2007). It is assumed that these meteorological conditions have not changed significantly since the Iron Age. Small-scale Early Iron Age sites have also been confirmed in modern Balad Sayt on the northern side of the Al Hajar Mountains, where sherds are scattered on slopes (Gaube et al., 2012). Such evidence indicates human adaptation to the mountainous environment during that period.

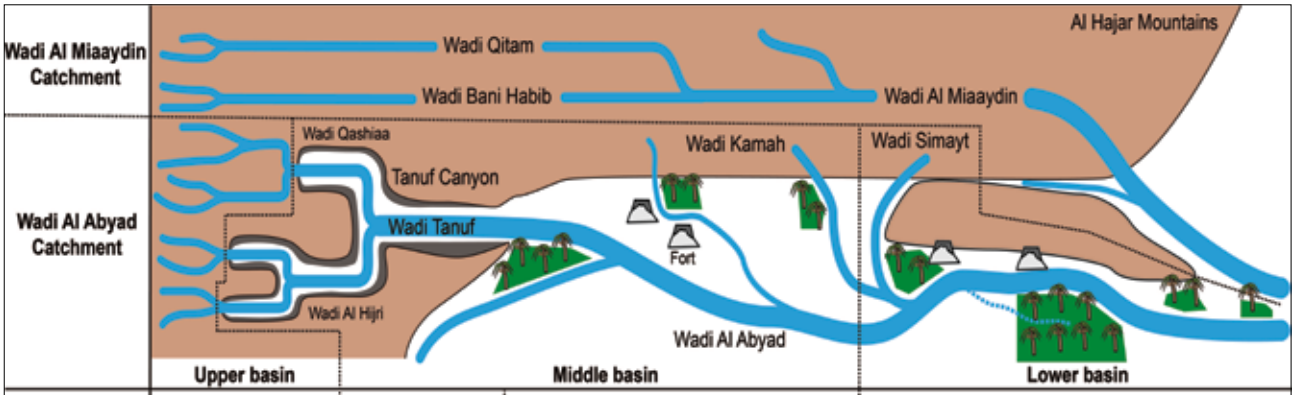
In contrast, the lower Wadi Al Abyad basin is characterised by oasis settlements, occupying broad floodplains and gathering surface water fed by several wadis from the Al Hajar Mountains. As reported by Schreiber (2007), the presence of oasis settlements is supported around Nizwa throughout the Early and Late Iron Ages. In particular, evidence for the Early Iron Age varies from cemeteries to settlements, walls, terrace fields, fortifications, and a possible *falāj* (N0064; Schreiber, 2007). Such components in the Nizwa area differ from those in Al Jabal Al Akhdar, especially in terms of

Figure 15: *SWH06 from the southeast. (Photographed by Taichi Kuronuma).*

Figure 16: SWH13 from the southeast. (Photographed by Taichi Kuronuma).

population capacity and agricultural scale. Agrarian and defensive facilities are basic components of traditional oasis settlements in Oman, aside from habitational areas. Together with the presence of a possible *falāj*, they indicate that a prototype of the Omani oasis settlement was probably present in the Early Iron Age. The difference of Nizwa from Al Jabal Al Akhdar is also emphasised in the presence of Late Iron Age cemeteries and settlements (Schreiber, 2007), which indicate a long-lasting oasis settlement around Nizwa, together with Ghubrat Nizwa.

These two contrasting landscapes differ in the adaptations required to local environmental conditions, represented by climate and topography. In other words, it is likely that Iron Age people flexibly adapted to the local environment, and archaeological evidence was regulated by their adaptational style.



Topography	Mountains Plateaus Numerous valleys	Canyons Cliffs Slopes & terraces	Broad floodplains Inselbergs Hills			Broad floodplains Hills			
Toponym	**Al Jabal Al Akhdar**	**Wadi Tanuf**	**Tanuf**	**As-Suwayhriyyah**	(Kamah)	**Ghubrat Nizwa**	**Nizwa**	(Farq)	**Karsha**
Cemetery	+	+	-	+	?	+	+	-	+
Settlement	+	+ (temporal?)	-	-	?	-	+	-	-
Agrarian facility	? (Wall, stone circle)	-	-	-	?	-	+ (Falāj etc)	-	-
Fortification	+	-/?	-	+	?	+	+	-	-
Cave	-	+ (temporal)	-	-	?	-	-	-	-
Artefact scatter	-	+	-	-	?	-	+	-	-
Landscape	· Sedentary · Rainfed water based agriculture (no aflāj?) · Mortuary · Defence	· Mobility-oriented · No-agriculture? · Mortuary	*Unevaluable*	· Sedentary? · Mortuary · Defence	*Un-evaluable*	· Sedentary · Agriculture? (unidentified) · Mortuary · Defence	· Sedentary · Aflāj based oasis-agriculture · Mortuary · Defence	*Un-eva-lu-able*	· Mortuary
Landscape transformation	Sedentary (Highland)	Transportation Bridge	← Terminus of sedentary based lowland landscape			Sedentary (Lowland)			
		Transitional							

Figure 17: *Schematic indication of landscape transformation along the Wadi Al Abyad basin during the Iron Age. Brown coloured boundary indicates Al Hajar Mountains. Light blue coloured lines indicate wadis. Green places indicate the location of modern oases. The question marks (?) in Kamah mean unsurveyed. The possibility of the walls and stone circles at Al Jabal Al Akhdar being agricultural facilities remains suspected. (Drawing by Taichi Kuronuma).*

4.2. Significance of Iron Age landscape in the Tanuf District

Considering these points, albeit patchy, the Iron Age evidence in the Tanuf District is significant in terms of its embodied landscape which bridges those in Al Jabal Al Akhdar and the lower basin of the Wadi Al Abyad, particularly during the Early Iron Age. As indicated above, Early Iron Age evidence is common in Al Jabal Al Akhdar, the Tanuf District, and Nizwa despite the varied local environmental conditions. Together with the chronologically unspecifiable examples, we can model the border of the Iron Age landscape between the beginning of the broad floodplains of Wadi Al Abyad at Tanuf and the end of the canyon of Wadi Tanuf as below, indicated from down- to up-stream.

At As Suwayhrriyah on the floodplain of Wadi Al Abyad (Figure 17), there are two possible forts (SWH06 and SWH13) and two cemeteries (SWH07 and SWH12), albeit habitational evidence is lacking. We have no firm evidence of the Early Iron Age in As Suwayhrriyah; however, there were long-lasting activities somewhere during the Iron Age. This point similarly applies loosely to the landscape in Nizwa, where Early and Late Iron Age evidence has been discovered (Schreiber, 2007), but no evidence of sedentary agriculture has been confirmed. Although accessibility of water is evident because of its location near the confluence, there is also no evidence of ancient water-supply systems. The only confirmed evidence is a mortuary sphere represented by chronologically unspecifiable subterranean and rock-shelter tombs. The two forts in As Suwayhrriyah are topographically and structurally similar to the hill fort N0026 in Nizwa (Schreiber, 2007). This similarity supports the inference that the pair of forts in As Suwayhrriyah originated in the Iron Age, although most parts likely belong to the Islamic period. The presence of accompanying buildings at the foot of each fort is also similar to the case reported in Nizwa (Schreiber, 2007). Thus, the landscape component of As Suwayhrriyah has some aspects in common with the Nizwa area.

The current lack of Iron Age evidence around modern Tanuf town (Figure 17) also presents the difficulty of reconstructing the landscape at the mouth of the canyon; the results of upcoming surveys are awaited.

Wadi Tanuf presents a contrast with the other two surveyed areas in the Tanuf District and is differentiated by the mortuary as well as the occupational evidence, which exhibits temporary rather than permanent aspects. The rich Early Iron Age mortuary evidence on the slope and terrace of the Wadi Tanuf indicates frequent use of the canyon as a resting place. However, unlike Nizwa and Ghubrat Nizwa, there is currently no evidence of sedentary agriculture. Thus, we currently believe that the mortuary evidence is likely not related to sedentary activity; rather, it likely indicates funerary activities along the transportation route, namely a cemetery for occasional deaths along the movement in the canyon. The occupational evidence in the cave of Mugharat Al Kahf (WTN01) and the sites of WTN02 and 07 during the Early Iron Age indicates a sojourn inside the canyon along the transportation route (e.g. Miki et al., 2022).

Based on the above-mentioned evidence, we interpret that the Tanuf District in the middle basin of the Wadi Al Abyad basin not only includes the terminus of a lowland sedentary-agriculture-based landscape which continues to Nizwa, but also the intermediate landscape bridging the lower Wadi Al Abyad basins and the high plateau of Al Jabal Al Akhdar, particularly during the Early Iron Age. In this context, the capability of Wadi Tanuf to serve as a transportation route is important.

4.3. Possible significance of Wadi Tanuf canyon as a transportation route

As indicated in the previous section, Wadi Tanuf has significance in connecting the highland and lowland via the canyon. We have already suggested that this canyon had been used from the Hafit period (cf. Miki et al., 2022). Today, there are a few known accessible trekking routes which connect the canyon bed and the high plateau of the western part of the Al Jabal Al Akhdar. Some routes are visible in the satellite imagery. One route from the wadi bed reaches the modern village of Qashiaa at the end,

where Wadi Qashiaa originates. We observed on site that goat herds walked one such route daily. Nevertheless, this does not mean that the goats make daily round trips between the wadi bed and upland settlements, but rather that some routes around the cliffs are used today.

Identifying ancient trekking routes is difficult; however, patchy archaeological evidence is suggestive of ancient routes. Although there is no reported Early Iron Age evidence, Schreiber mentioned some Hafit cairns above the cliff of the western Al Jabal Al Akhdar (Schreiber, 2007:251, Abbildung 61). We also identified some possible cairns on cliffs in Wadi Tanuf from satellite imagery. Such evidence likely enhances the importance of Wadi Tanuf as a transportation route in the prehistoric period and probably during the Early Iron Age as well, since the pedestrian-accessible routes are topographically limited regardless of the period. From Qashiaa, there is an upland pedestrian route to the Sayq Plateau, where Schreiber (2007) identified Early Iron Age sites. Thus, it would be reasonable that Wadi Tanuf also had significance for mobility during the Early Iron Age, bridging the gap of the transformation of the archaeological landscape between Al Jabal Al Akhdar and the lower Wadi Al Abyad basin.

This point also implies the presence of past small transportation routes besides the major corridors such as Samail Gap and Wadi Jizzi. Unlike the large corridors which embrace Izki or Hili and Rumeilah at the interior end, Wadi Al Abyad is not a major corridor and there are small to medium-size Iron Age archaeological complexes such as in Nizwa. However, the rich evidence in the Tanuf District surely indicates a transportation route bypassing Wadi Al Abyad–Wadi Tanuf with occasional forts built for possible protective and vigilant purposes. Together with the rich mortuary evidence, the archaeological landscape in Wadi Al Abyad illustrates the identity of this basin during the Iron Age. The canyon as a transportation route can be considered from the examples in Wadi Tiwi, where archaeological evidence was discovered (Schreiber and Häser, 2004). These parallel examples enhance our understanding of the importance of canyons as transportation routes in the past.

5. CONCLUSIONS

Our evidence in the Tanuf District fills gaps in our understanding of the topographical transformations of archaeological landscapes in the Wadi Al Abyad basin. Unlike the socioeconomic and political centres such as Sallut or Izki (sometimes supported by ancient texts), the Wadi Al Abyad basin embraces no sites of a comparable scale. However, it provides a particular peripheral perspective along the Al Hajar Mountains. On the southern fringes, Iron Age people carried out oasis-based sedentary agriculture in relatively large floodplains, but they also utilised the canyon as a corridor route and a final resting place. Thus, topographically adapted lives were present in the Wadi Al Abyad basin. Our results in the Tanuf District can contribute to understanding the networks of the Iron Age society and the inter-site mobility connections between the high- and lowlands, especially in the Early Iron Age, that was likely realised by more complex routes not limited to the major corridors.

Adaptation to the various terrains is also evidenced along the Wadi Al Abyad basin from the high plateau of Al Jabal Al Akhdar to the lower floodplains through the canyon. The Tanuf District includes the upstream terminal point of the chain of oasis-based sedentary agricultural communities, but it also contains the starting point of the mobility-oriented landscape of the highland-adapted sedentary agricultural community. At this point, the district was a connection point where the varied adaptive styles of the Iron Age could occur.

Nevertheless, this view is still preliminary, and many unresolved gaps remain in the Tanuf District. The lack of contemporaneous evidence in modern Tanuf and of firm Late Iron Age evidence in the entire district are such points. We also note that, aside from the fact that it can be dated to the Iron Age, the precise date of each discovery in our study area remains vague. Therefore, further archaeological investigations are necessary to test

the current model. In doing so, our understanding of the hierarchical relationships between the centres and the periphery amidst the Al Ḥajar mountains can be enhanced, and the multi-layered and steadily transformed archaeological landscape by region or terrain can be further understood.

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AUTHOR CONTRIBUTIONS

All the authors collected the data. Taichi Kuronuma analysed the survey data and wrote the manuscript. Yasuhisa Kondo coordinated the research project, including the study presented herein. All the authors have read, discussed, and approved the final manuscript.

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