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Peshdar Plain Project Publications

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Continuing the excavations at Qalat-i Dinka and the Lower Town

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Karen Radner, F. Janoscha Kreppner and Andrea Squitieri

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Umschlagabbildung: Trench QID1 on Qalat-i Dinka at the end of excavations (3 May 2018). Photo by Andrea Squitieri, taken with a DJI Phantom 4 Pro drone.

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B2. Geoarchaeological work at the Dinka Settlement Complex, 2018

Mark Altaweel & Eileen Eckmeier

The geoarchaeological work conducted during the autumn season of 2018 focused on clarifying the gaps in the built-up settlement, as observed in the magnetogram of the Dinka Settlement Complex[19]; on identifying alluvial terraces and their evolution in relation to the site; on determining the relationship of the Lower Zab in antiquity to the site; and on gaining a better understanding of soils and land use in and around the settlement.

To these ends, we excavated three geoarchaeological trenches (GA43-GA45), took eleven sediment cores (C10-20), and collected five topsoil samples (F1-F2; O1-O3) in 2018. Overall, we were able to answer our questions at least partially during fieldwork while further laboratory analysis at LMU Munich, supervised by Eileen Eckmeier, shed significant light on the identified issues. **Fig. B2.1** indicates the location of the 2018 cores, geological trenches and other samples. The figure also shows a channel flow modelled between Gird-i Bazar and Qalat-i Dinka as well as identified terraces.

The locations of the available cores and profiles can be divided into five spatial groups:

(1) the northwestern part (in the excavation areas DLT2 and DLT3);
(2) the northeastern part outside the settlement areas (core C10; topsoil samples F1-F2, O3);
(3) the central transect along the ancient wadi (geoarchaeological trenches GA43-GA45, cores C11-C14);
(4) the lower terrace in the south (cores C15-C20); and
(5) the off-site wadi profiles in the north (topsoil samples O1-O2).

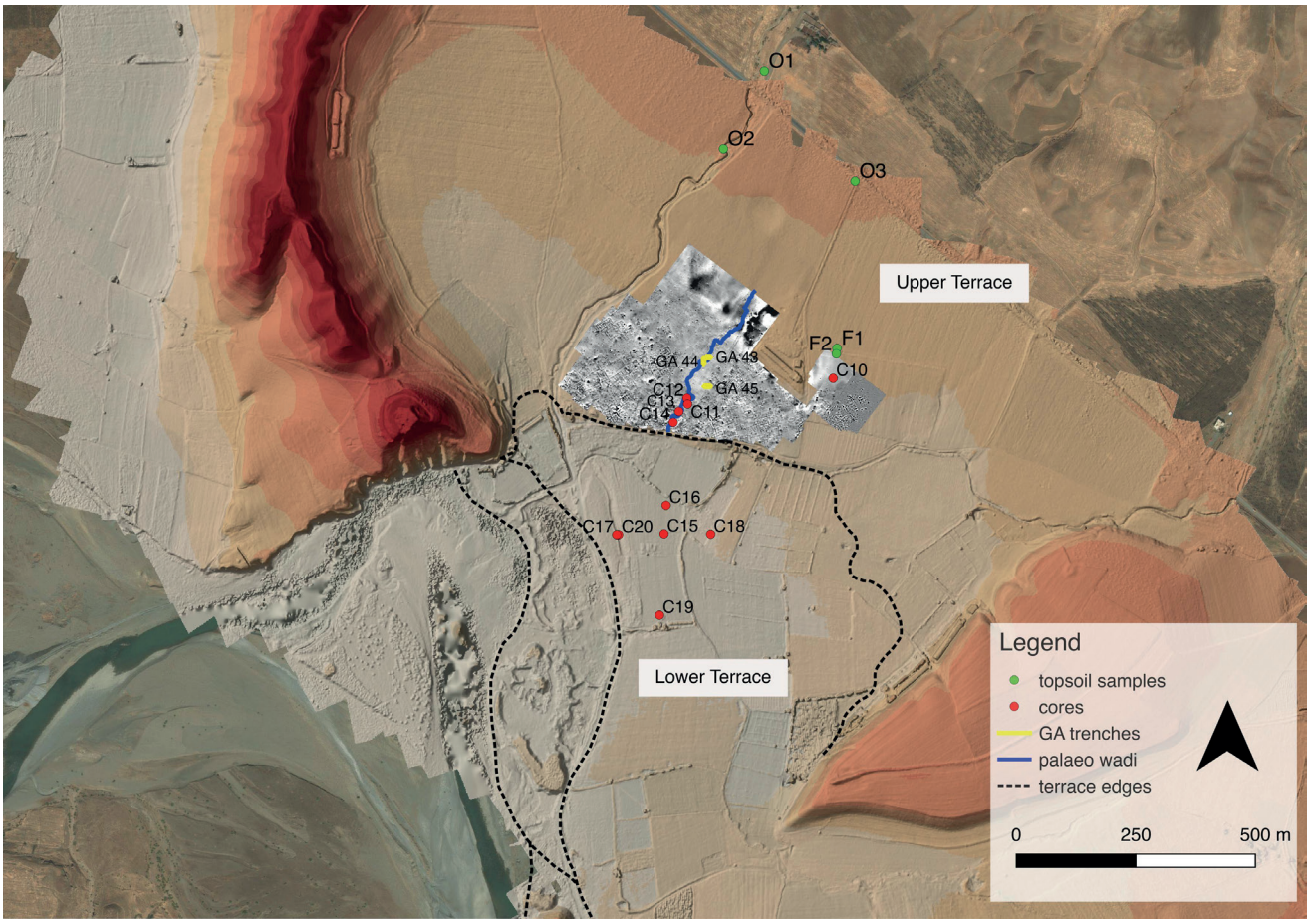

Fig. B2.1: Geoarchaeological areas studied in the 2018 autumn field season. Prepared by Cajetan Geiger.

19 Fassbinder *et al.* 2017; Fassbinder *et al.* 2018.

B2.1 A wadi cutting through the Dinka Settlement Complex

(*with contributions by Cajetan Geiger*)

In the geophysical surveys that began in 2015 and continued through 2018, gaps were noticed in the architectural occupation of the Dinka Settlement Complex, as identifiable in the magnetogram. The cores C11-C14 sampled in the area around Gird-i Bazar were taken to help explain the gap in the built-up settlement and to clarify whether and how erosion may have affected the settlement. Additionally, three geoarchaeological trenches (GA43-GA45) were excavated with a backhoe excavator. The trenches were placed in areas were no intact architecture was evident from the magnetogram and the surface in order to test the accuracy of the magnetogram. The precise positions of these trenches were selected based on the results of a hydrologic flow model created on the basis of the digital elevation model constructed from the 2016 drone flight[20], which suggested the probable existence of a channel or wadi; the three trenches were positioned so that they would intersect this possible channel.

The 2018 trenches and cores suggest that the Dinka Settlement Complex has experienced erosion since the site's abandonment. Cores C11-C14 confirmed the presence of silty-clayey material, sometimes interlayered with gravel; the depths of the cores ranged between 1-3 m. This demonstrates the existence of alluvial deposits within an erosional landscape affected by overbank/floodplain channel deposits, suggesting seasonal low-to-medium intensity flooding. In the cores, artefacts were present only up to a depth of 50-60 cm, and in mainly fine sediment.

During the occupation of the Dinka Settlement Complex in the Iron Age, a wadi eroded the site in this area. It may have been a source of fresh water and was likely used to drain waste water from the site. In fact, given the size and width of the wadi's gravel deposits, it may have been the main channel cutting through the site during the Iron Age. Drains running from the houses of Gird-i Bazar's Iron Age occupation into alleyways were exposed in the excavations, suggesting that the wadi was used to drain water from the site, as the observed drains are oriented towards this wadi[21].

Both cores and trenches revealed an absence of large stones for architectural structures, except when they were found as parts of eroded structures. Gravel or stones were present only at greater depths, and often in layers. This was clearly visible in the trenches, where well-sorted layers of fine sediment material, gravel, and stones alternated. There was no evidence for the accumulation of materials as would be typical of a large flood event. Any earlier material could have been removed, and gullying (or a channel) might have formed due to an event or re-occurrence of flooding, with the area later refilled with sediment in subsequent events. The presence of angular stones in GA43-GA45 at depths of 50-100 cm shows that the deposited sediments had not been transported over a long distance.

In GA43 (**Figs. B2.2a-b**), the soil reaches down to a depth of about 0.5 m. Below this, a homogenous, silty-clayey sediment mixed with pebbles was found. A depression about 1 m in diameter can be seen approximately in the middle of the trench, with its lowest edge approximately 1 m deep. At the bottom of the trench, a slight accumulation of pebbles could be observed. These observations fit with what might be expected from channel/wadi deposits as well as what was suggested by the hydrologic flow model. Beyond some irregularly distributed cobbles and some smaller pebble concentrations, nothing else was observed in the section.

In GA44, however, some features were clearly visible (**Fig. B2.3a-b**). The soil reaches down to a depth of 0.35-0.95 m. Within this homogeneous soil material were a few large Sasanian pottery sherds (**§G1**). In the middle part of the eastern section, an accumulation of fine rounded pebbles was observed at a depth of around 1-1.5 m, corresponding to the presumed bed of the wadi. The surrounding sediment is homogeneous and consists of silty-to-clayey material, mixed with pebbles and larger cobbles. In the southern section, some larger cobbles and aggregations of pebbles were observed, largely resembling the general composition of the Bora Plain's underlying bedrock.

In GA45, several intriguing features were observed (**Fig. B2.4a-b**). On the top of this trench, there is a fine-earth sediment layer, around 0.8-2.2 m thick. In the eastern half of the northern section, some large cobbles crop out, possibly parts of archaeological structures. In the silty-clayey sediment below, three banks of fine pebbles, occasionally disturbed by larger cobbles, could be clearly distinguished. They appear in three layers, with the deeper ones further to the west (left). Probably all of the levels, and certainly the two lower ones, are connected to the wadi bed previously observed in trenches GA43 and GA44. In the lower eastern part of the northern section, some large accumulations of pottery were embedded in the sediment below the uppermost pebble bank. It is likely that GA45 is situated close to an intact building, as suggested by the magnetogram. Continuing to the narrow eastern section, some burned mud bricks (or very thick reddish pottery

20 Radner/Kreppner/Squitieri 2017, Fig. H2.

21 Kreppner *et al.* 2017.

Fig. B2.2a: Orthophoto of the northern section of the trench GA43. Created by Andrea Squitieri.

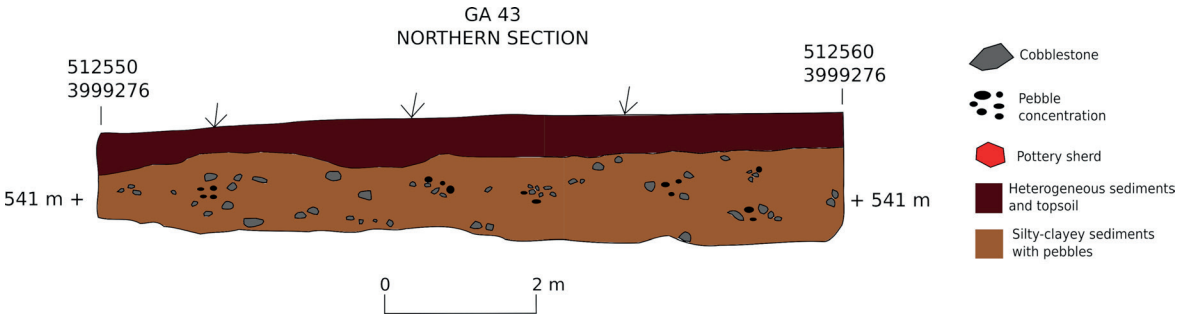

Fig. B2.2b: Section drawing of trench GA43. Field drawing by Cajetan Geiger; digitisation by Andrea Squitieri.

fragments) were documented; perhaps these belonged to a kiln or some other installation. These were also situated below a broader bank of pebbles. These remains reflect eroded materials that had come into the area of the ancient wadi. This shows clearly that some kind of stronger sedimentation process took place simultaneously with and following the occupation of this site. In the southern section, three different layers of a stronger fluvial-sedimentation regime could be differentiated, sometimes forming clay lenses within the pebble banks that may have been the remains of palaeo-channels, indicating changes in the wadi's course. Coarse and badly rounded cobbles were found in two of the upper layers. Pottery sherds were found throughout the layers.

The results from the geoarchaeological trenches GA43-GA45 indicate that a long-lived wadi existed just west of the Gird-i Bazar area with the modern chicken farm and that this wadi ran through the Dinka Settlement Complex towards the Lower Zab, from the northeast to the southwest (**Fig. B2.1**). This is evidenced by the pebbles in the silty/clay sediments of the trenches.

The evidence from the trenches further indicates that the wadi pre-existed any signs of occupation. It is therefore likely that this wadi existed prior to the Iron Age Dinka Settlement Complex and continued to exist for some time after this settlement had been abandoned. A few large Sasanian pottery sherds that were found in trench GA44 may indicate the presence of a nearby settlement during this period, or they may be connected to the use of the Sasanian-period cemetery at Gird-i Bazar. These sherds were found either above the wadi, or within its topmost layer, and either below, or within, the plough zone. This might indicate that while the wadi was active during the time of the Iron Age settlement, it had dried out around the Sasanian period (or later). However, on balance it is more likely that seasonal flooding led to the gradual erosion of architectural structures near the wadi, and that the tumbled remains, including some of the larger stones, are a reflection of this eroded architecture.

B2.2 Investigating the Lower Terrace

Gird-i Bazar and its environs are located on an ancient terrace near the Lower Zab, which we call the "Upper Terrace" (**Fig. B2.1**). Just below this main terrace on which the site lies are other, more recent Holocene terraces, with a larger terrace (dubbed the "Lower Terrace") south of Gird-i Bazar.

Six cores, ranging in depth from 1.5-5 meters (C15-C20), were placed just south of Gird-i Bazar. The area has some of the richest soils attested in the Bora Plain, demonstrated by current agricultural activity and recent irrigation. Very few artefacts were found in this area. The cores demonstrated the existence of overbank and alluvial fill deposits, alternating between clay, silt and some sandy sediments. The sediments are mostly devoid of rocks until bedrock is reached. According to the core samples,

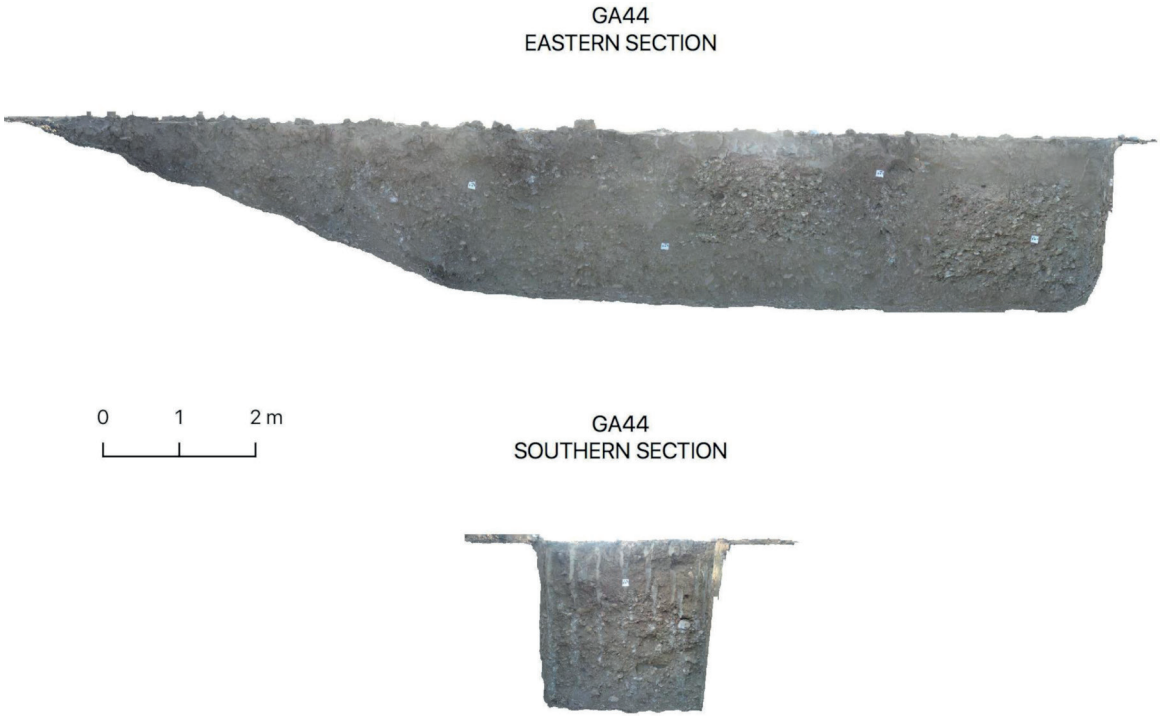

Fig. B2.3a: Orthophotos of the eastern and southern sections of the trench GA44. Created by Andrea Squitieri.

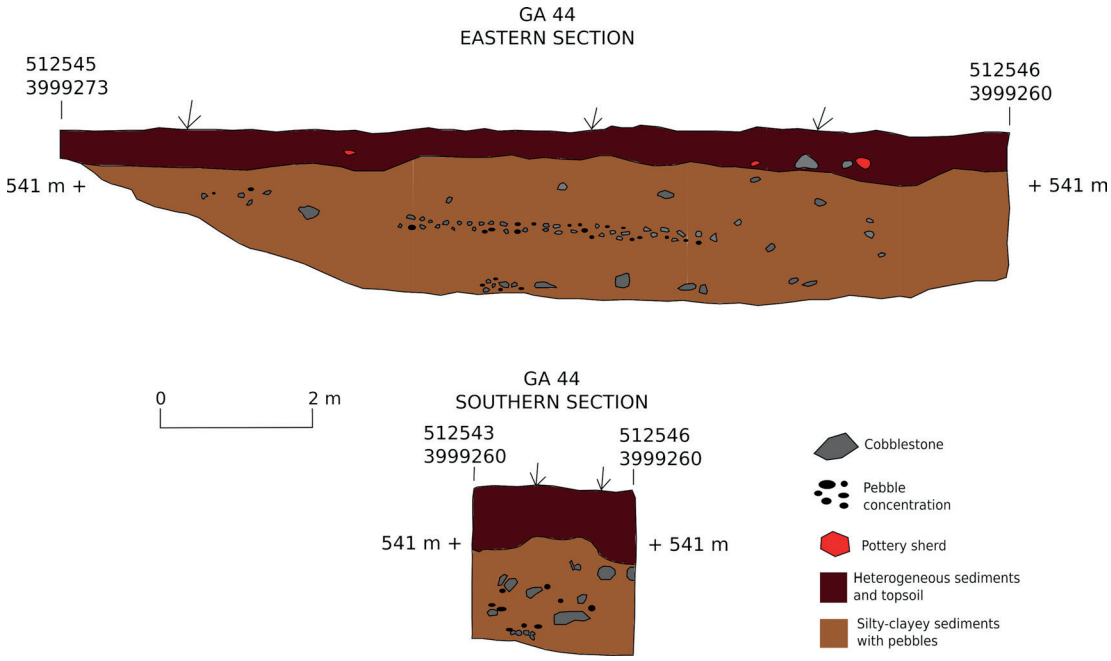

Fig. B2.3b: Section drawings of trench GA44. Field drawing by Cajetan Geiger; digitisation by Andrea Squitieri.

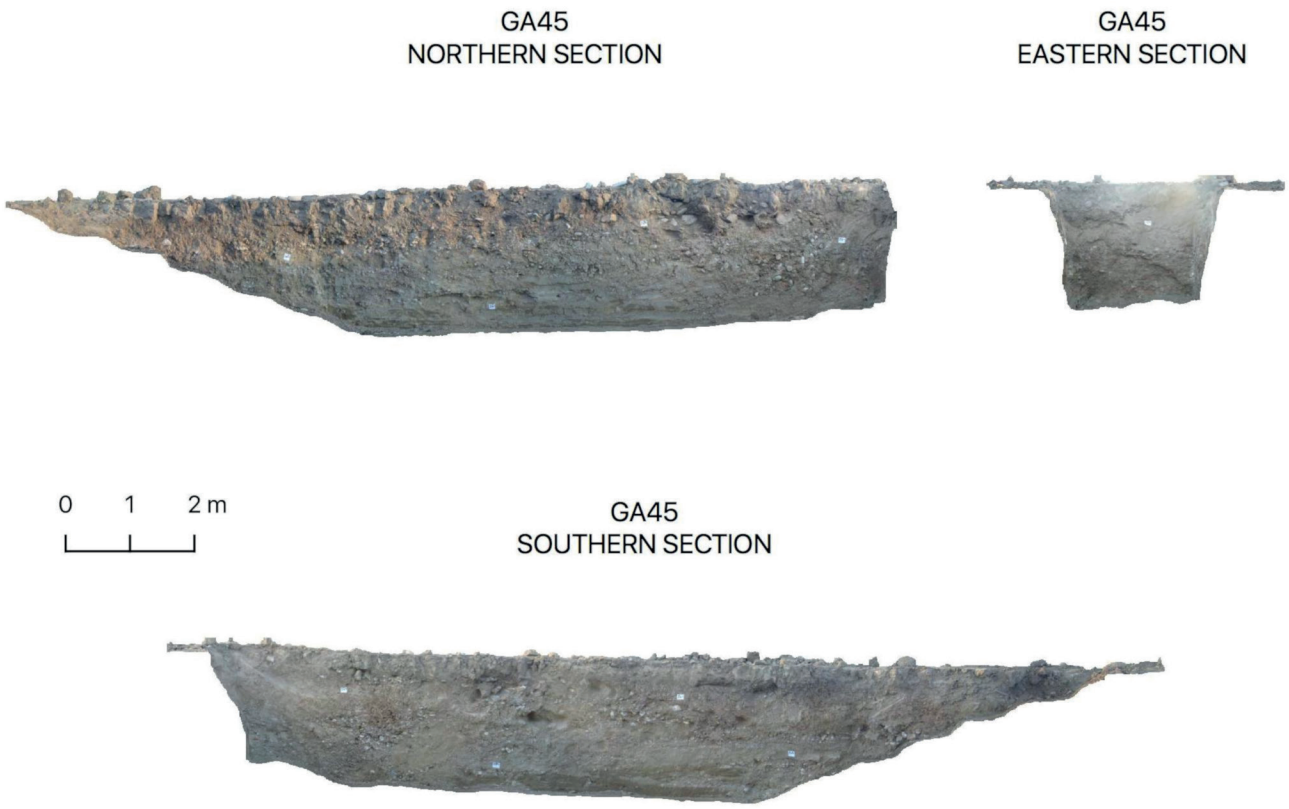

Fig. B2.4a: Orthophotos of the northern, southern and eastern sections of the trench GA45. Created by Andrea Squitieri.

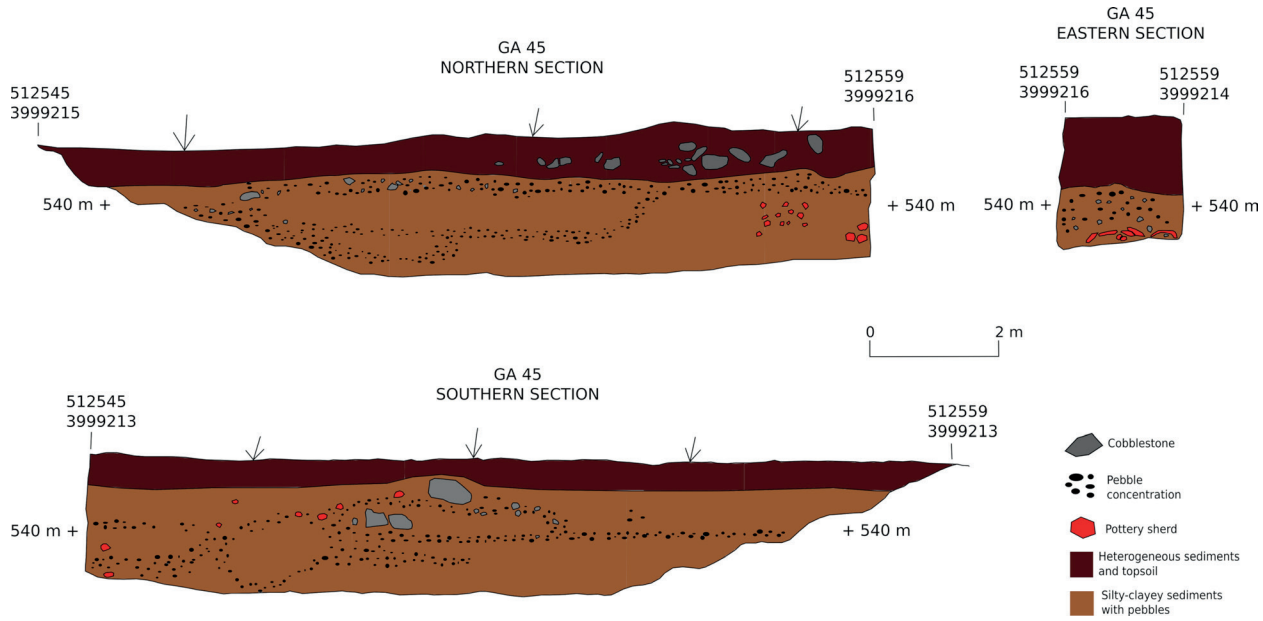

Fig. B2.4b: Section drawings of trench GA45. Field drawing by Cajetan Geiger; digitisation by Andrea Squitieri.

this bedrock is situated between 3.5-5 meters below the modern surface. The bedrock consists of small gravel.

The sand evidence is unknown at the level of the Upper Terrace where Gird-i Bazar is located, and this indicates that different fluvial deposits occurred in the Lower Terrace. Possibly, the core C17 could indicate a relict, more sandy formation that has largely been eroded but is still higher than other parts of the Lower Terrace. The sediments suggest not only more energetic fluvial activity than in the other areas of the Lower Terrace but also the presence of the Lower Zab in this area at some point in the past. The Lower Terrace, where Cores C15-C20 are located, may have been affected by more periodic flooding and was likely also submerged by the Lower Zab at different points in time.

The lack of archaeological materials suggests that the area may have been vulnerable to flooding, and that past inhabitants either avoided living in the area, or that any evidence of past occupation was eroded by the Lower Zab. Local informants reported that just west of the core C19, and in the direction of the river, the terrace was frequently flooded during the last fifty years and was even occasionally submerged by the Lower Zab. While it cannot be excluded that the Lower Terrace, from where Cores C15-C20 were taken, was partially settled as part of the Dinka Settlement Complex and that the evidence for this settlement was subsequently subject to erosion, the area may have been, even in the Iron Age, prone to flooding, and thus not subject to heavy occupation.

Dating the Lower Terraces might help further resolve the relationship between the settlement and the Lower Zab river. One core, C20, was taken specifically to be evaluated for OSL dating potential. This core was located on a relic alluvial channel, where channel scarring was evident on the available satellite imagery. If OSL dating is feasible, it may be possible to date the evolution of the Lower Terrace and better pinpoint the Lower Zab's relationship to the Dinka Settlement Complex.

It is possible that the Lower Terrace south of the Dinka Settlement Complex and closer to the Lower Zab was a relatively protected area, as the surrounding hills may have offered some protection from the river's fast flowing waters. This area could have served as a small harbour for shipping. Field-walking along the lowest terraces from the southwest to the southeast of the Dinka Settlement Complex and along the Lower Zab suggested that the ancient Lower Zab once cut through this area, which today contains river gravels and boulders.

B2.3 Spatial heterogeneity as indicated by the results of topsoil analysis

We analysed topsoil samples from the Dinka Settlement Complex to gain insight into the sedimentological differences, which can also reveal potential land-use patterns. We measured particle-size distribution, carbonate, carbon and nitrogen content, and the amount of phosphate within the soils and sediments. The results indicate some differences between the areas that might be related to sedimentation, but may also demonstrate differences in land-use (**Figs. B2.5-7**)[22].

The percentage of clay (< 2 µm) is particularly high in the soils of the north-western area, very low in the off-site sediments in the north, and rather low on the Lower Terrace in the south. The amount of sand is less variable, with pronounced peaks in the wadi sediments of the off-site area in the north and near the Lower Zab river on the elevated ridge on the Lower Terrace (C17). The latter might be a relic channel bar formed by sedimentation closer to the main river channel. The quantity of silt is higher at the edges of the Lower Terrace, near the channels or wadis (C16, C19) where flooding might occasionally occur; it is rather low in the central part where the ancient wadi (see above; **§B2.1**) was situated.

The distribution of particle sizes seems to be related mainly to the sedimentation history, and not to land-use. Also, carbonate contents show variations that are especially extreme in the soils of the Lower Terrace and the off-site samples, presumably due to the effect of precipitation of water from the wadis which is also used to irrigate the fields on the terraces. The high level of carbonates in the topsoil of C18 correlates to the carbonate contents in the excavated sediments of Gird-i-Bazar[23], but their source needs further investigation.

The levels of organic carbon (C_{org}) are highest in the north-eastern topsoils, which could be the result of land-use, as this could represent e.g. the residue of cropped plants. Phosphate levels often mirror the amount of organic carbon because organic matter can be a source of C_{org}. However, this is the case only with the topsoils of the excavation area DLT3; all other areas contain lower levels of phosphate. Some bone material was detected in core C13, which explains its high level of phosphate. The elevated levels of phosphates in DLT3, and partly also in the excavation area DLT2, are most likely related to materials connected to settlement activity. In the future, such

22 Core 8, taken in 2017 in our area (2), is included for reference. For this core see Eckmeier *et al.* 2018, 110 Fig. E3, 118.

23 Eckmeier *et al.* 2018.

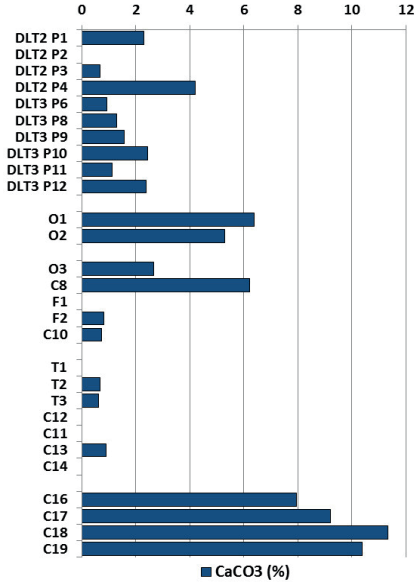

Fig. B2.5: Concentration of calcium carbonate from sampled areas in the Dinka Settlement Complex. Prepared by Eileen Eckmeier.

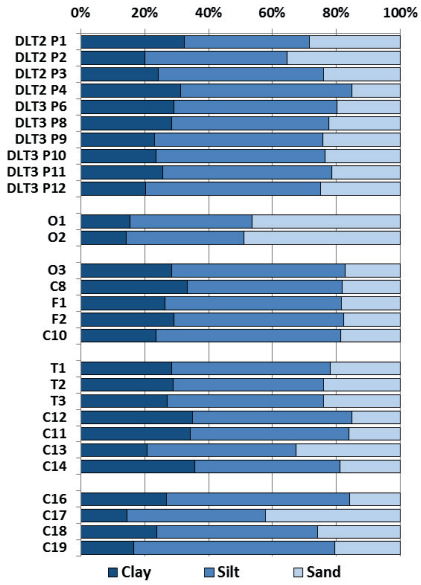

Fig. B2.6: Clay-silt-sand concentrations from sample areas in the Dinka Settlement Complex. Prepared by Eileen Eckmeier.

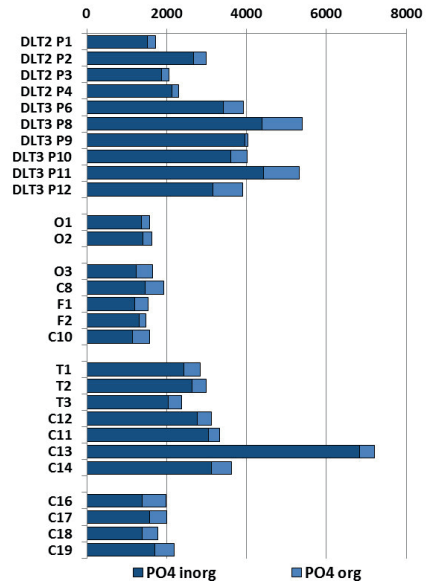

Fig. B2.7: Organic and inorganic phosphates. Prepared by Eileen Eckmeier.

phosphates could then be a good proxy for detecting the presence of settlement remains in other areas.

B2.4 General summary

In 2018, we were able to confirm that a large wadi/channel once ran through the Dinka Settlement Complex, cutting through the area just west of Gird-i Bazar. It likely existed before the Iron Age occupation of the Bora Plain and may have remained in place until the Sasanian or even later periods. This wadi would have been important to the Iron Age settlement as it provided a means for draining waste water away from the site and possibly also provided fresh water to the site. All drainage observed in the excavations at Gird-i Bazar points in the direction of the wadi, further supporting its usefulness for this purpose.

This wadi also affected the post-Iron Age site through erosion that potentially damaged structural remains between Gird-i Bazar and Qalat-i Dinka. To the south of the Dinka Settlement Complex and near the Lower Zab, a younger terrace is evident that was recently formed by alluvial activity, which may well have caused the erosion of part of the Dinka Settlement Complex. However, another possibility is that this Lower Terrace could have been part of the bed of the Lower Zab during the Iron Age occupation of the Dinka Settlement Complex, but confirmation of this awaits dating (using either OSL or radiocarbon methods). The area to the south of Gird-i Bazar, along the more recent Lower Terrace, would have been an ideal place for a small harbour during the Iron Age.