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Understanding Prehistoric Landscapes – Understanding Early Sedentism

Körtik Tepe in Southeastern Turkey as a Key-Site

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Living by the water

Körtik Tepe (37°48'51.90" N, 40°59'02" E) is located at the confluence of the Batman Greek and the Tigris River in Southeastern Turkey. It was once blessed with a panoply of natural resources thanks to a rich and reliable water supply. Even prior to the Holocene a hunter-gatherer-fisher community established a permanent settlement in this favourable landscape.[1] However, in our days, the proximity of the site to water poses more of a threat than a blessing: Körtik is one of the prehistoric sites which will be inundated by the rising waters of the Ilisu Dam reservoir in 2013/2014 (**Fig. 1**). The site was discovered during survey work in 1989, though at this time its exact cultural affiliation and eco-historical importance was unclear. Only during rescue excavations did the potential of this site become evident. These investigations began in 2000 and were concluded in October 2012; they were directed by Vecihi Özkaya and Aytaç Coşkun from the Dicle University of Diyarbakır, under the auspices of the Diyarbakır Museum and with the permission of the Ministry of Culture and Tourism[2].

Fig. 1 Projected extention of the Ilisu Dam Reservoir. Modified after NZZaS 23.11.2008.

Transcending Thresholds

Chronological analyses show that settlement activities at Körtik Tepe began at least during the Younger Dryas and lasted until the early Holocene. The chronology of the site is based on a stratified sequence of ^{14}C-data ranging between 10400 – 9250 cal BC.[1,3] Continuous occupation is evidenced by multilayered floors within the houses, burials beneath the floors and a huge amount of heavy stone tools, such as grinders, mullers and mortars, and hundreds of stone vessels.[2] As such, Körtik Tepe provides invaluable information on social developments during a period of abrupt climate change; additionally, it is the first and only site to have so far produced well stratified proxies for the reconstruction of local ecological changes. It is also one of the rare sites where the transition to a sedentary lifestyle of a hunter-fisher-gatherer population can be observed. Yet, in order to better comprehend sedentarisation processes, it is paramount that we access information relating to (pre-)historic landscapes, including the types of environments preferred by foraging communities.

Bioarchives for the reconstruction of prehistoric landscapes

Charcoal and seed remains provide first evidence for ecological changes at the transition from the Younger Dryas to the Early Holocene. At this time, the characteristic steppe-like environment changed to an (open) oak park woodland with a wide spectrum of resources such as almonds, pistachios and wild cereals.[1,4] Riverine plants were present during both periods and aquatic resources probably played an important role for the nutrition of the Körtik Tepe people.[5] Pollen cores taken in 2012, geo-electric measurements, as well as geological and isotopic analyses of teeth and fish bones, are planned to support the reconstruction of the local environment. The first laboratory tests of one core show rather good pollen preservation in the lower part of the core between 350 and 200 cm depth. For these deepest sediments, studies indicate a landscape with open woodland dominated by oak and light demanding trees and shrubs. In the upper most sample at ca. 200 cm depth the arboreal pollen signal is weaker and it seems that the landscape became rather open. Radiocarbon dating is still in process, so we are currently unable to attribute the pollen assemblages to certain periods.

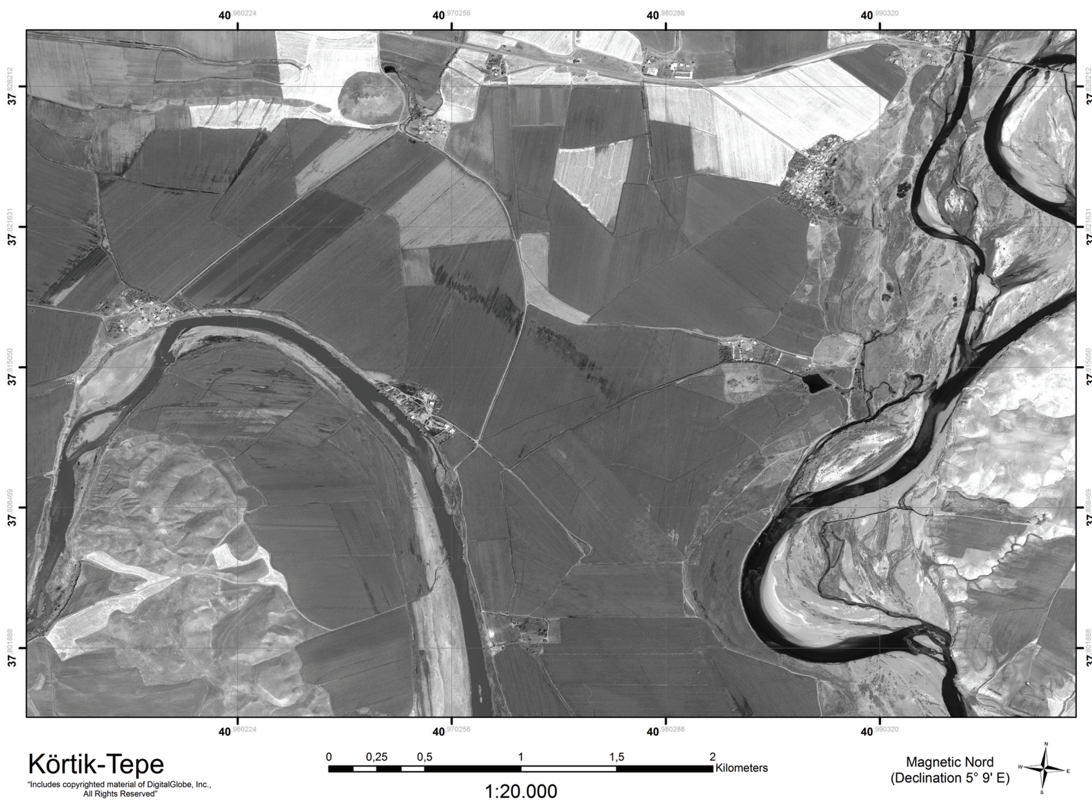

Fig. 2 Alluvial fans are visible south of the site in the satellite image.

For all radiocarbon data:
http://www.exoriente.org/associated_projects/ppnd.php

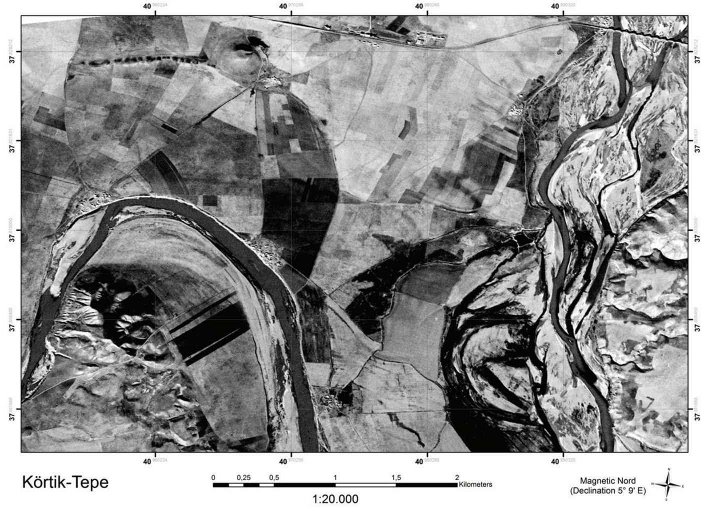

Fig. 3 In the historic Corona satellite image of 1968 meanders of the Batman Creek extend much further west.

Views from Space…

Remote sensing can support the reconstruction of ancient landscapes. Although results of earth observation will not provide absolute chronological data, traces of ancient water bodies or topographic anomalies can be detected from space. It is a convenient and inexpensive means of gaining a rapid overview of a site's environment or even that of a whole region. The refinement of the geometrical resolution of optical sensors during the last years means that even small structures such as walls and crop marks can be detected.

High-resolution Satellite Imagery

Data from two very high resolution satellite sensors, WorldView1 and GeoEye, were acquired. The former was chosen due to the very high radiometric resolution and the broad spectral range, while the latter was used to create a normalized differenced vegetation index (NDVI). Digital elevation models (SRTM-C, SRTM-X, and ASTER-GDEM) were used to study topographic structures and to perform orthorectification of satellite imagery. Multispectral Landsat 5 Thematic Mapper data were included in the geographic information system. We also georeferenced 4 images of the Keyhole Missions KH-4a and KH-4b („Corona Program").

Changing Landscapes

Fig. 2 shows the location of Körtik Tepe at the confluence of the Batman Greek (east) and the Tigris River (south). Northwest of the site is another tell, Gre Dimse, the main occupation of which is dated to the Iron Age. Some interesting features are clearly visible on the GeoEye satellite image. About 100 m south of Körtik Tepe alluvial fans can be traced as soil anomalies in the modern fields. In an image from the espionage satellite Keyhole 4b (Corona) taken in 1968 (**Fig. 3**), meanders of the Batman Creek can be seen to extend much further west than today. This historic satellite image also indicates a water course to the southeast of the artificial channel which springs from the small pond northeast of the site. More importantly, in this same image (and in several other images produced during the Keyhole-Mission) there can be observed an ancient channel of the Tigris River (*"Altarm 1"*), visible as a crescent-shaped soil anomaly in the left part of the image. At some time (as yet undetermined), Gre Dimse formed the apex of this ancient water course. However, additional evidence (see below) suggests that during the occupation of the tell the river was about 400 m further to the south. West of Gre Dimse a narrow ridge, which extends in a west-east direction, could demarcate the cut bank of the earlier river course. This old river course can still be seen today as a shallow depression in the ASTER-GDEM elevation model **(Fig. 4)**. Further images, among them a very high resolution image of the World-View 1 satellite **(Fig. 5)**, also suggest that the ancient river bed was cut by a later course further south. This more recent course (*"Altarm 2"*) was not crescent-shaped, but extended further east, transecting the *"Altarm 1"* in the middle of its eastern bow. It is still visible as an area of enhanced humidity in the 7-4-2 band combination of the Landsat 5 images (here „Global Land Survey 2010" data, **Fig. 6**). If we extend this anomaly in a southeasterly direction, we see that the confluence of the River Tigris and the Batman Creek was probably located a mere 200 m southeast of Körtik Tepe.

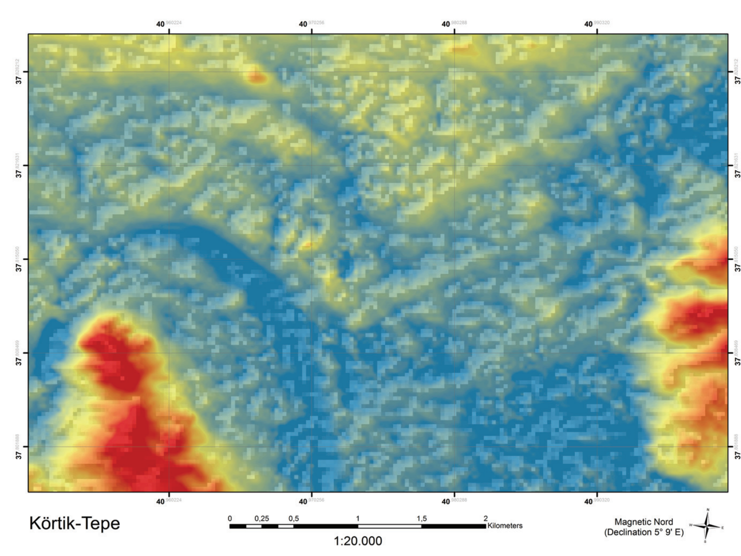

Fig. 4 ASTER-GDEM elevation model.

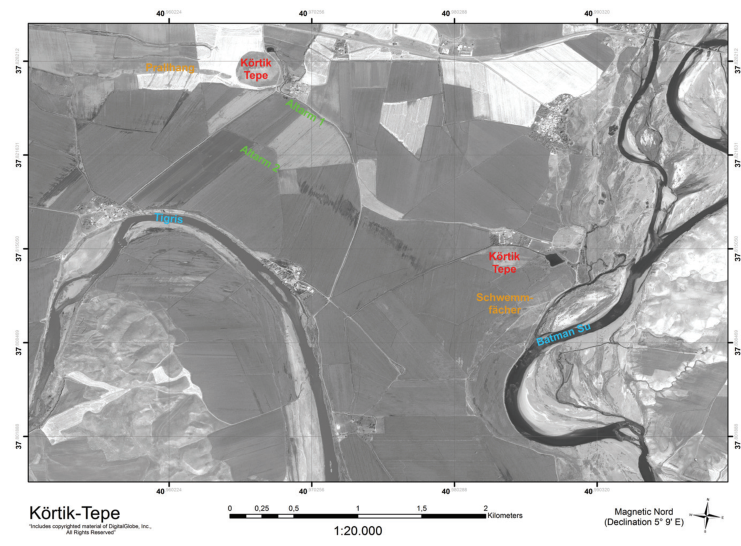

Fig. 5 High resolution image of WorldView 1.

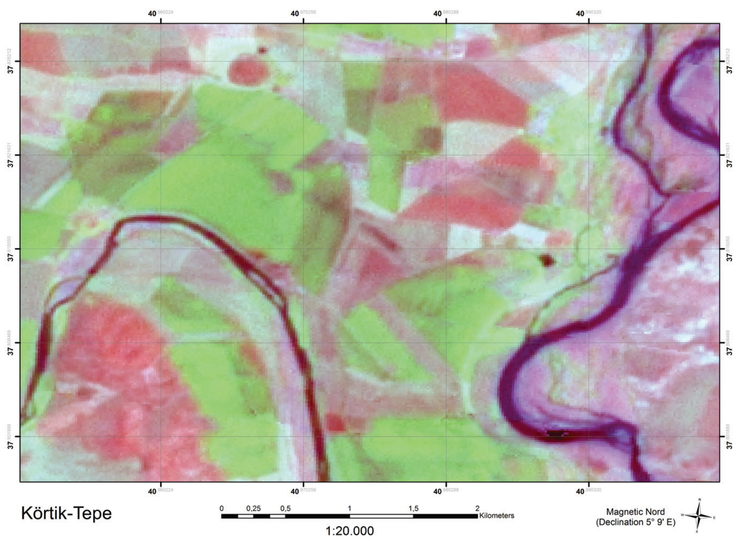

Fig. 6 Areas of enhanced humidity south of Gre Dimse.

„Down by the Riversides"…?

It can be suggested that Körtik Tepe was once located much closer to the confluence of the River Tigris and the Batman Creek, probably on some kind of peninsula **(Fig. 7)**. This hypothesis is corroborated by the shape of the southern border of the tell (see "Geoelectric Depth Section"). Therefore, the Epipalaeolithic settlers chose a location on a shallow ridge between the two rivers; the surrounding environment would have offered not only a wide spectrum of resources, but would also have been easy to defend. This hypothesis has to be tested by additional analyses, especially by drillings to determine the dating of the anomalies visible in the satellite imagery. Concerning remote sensing, further high resolution interferometric TanDEM-X elevation models are planned.

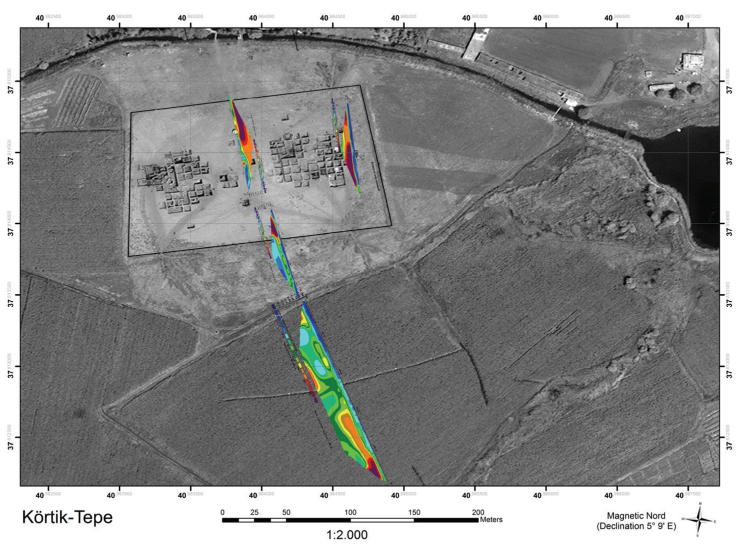

Fig. 7 Positions of geoeletric depth sections.

... Views from the Underworld

Geoelectric is a geophysical method that applies electrical current to examine subsurface earth material. The geoelectric equipment consists of metallic electrodes that are driven into the ground, a power source providing electric current, a resistivity metre and an operation unit that controls the measurement. Multi-Electrode-Geoelectric employ a line of multiple and constantly spaced electrodes. Electric current is sent into the ground and the potential difference between electrodes is measured and converted in electric resistivity [Ω*m].
The vertical investigation depth and the final data resolution vary according to the spacing of the electrodes. After data processing with an inversion program the final output of a measurement is a vertical section of subsurface electric resistivity. Since different earth materials (e.g. clay and gravel) differ in their electric properties it is possible to detect structures and material changes in the subsurface.

Geoelectric Depth Sections

At Körtik Tepe we performed a Multi-Electrode-Geoelectric survey with a Lippmann 4-Point-Light 10W earth resistivity metre controlled by GeoTest software (Rauen, A.). The data were processed with the Inversion program Res2DInv by Geotomo Software. For all measurements 40 electrodes were arranged long a north-south line with a spacing of 2 m.

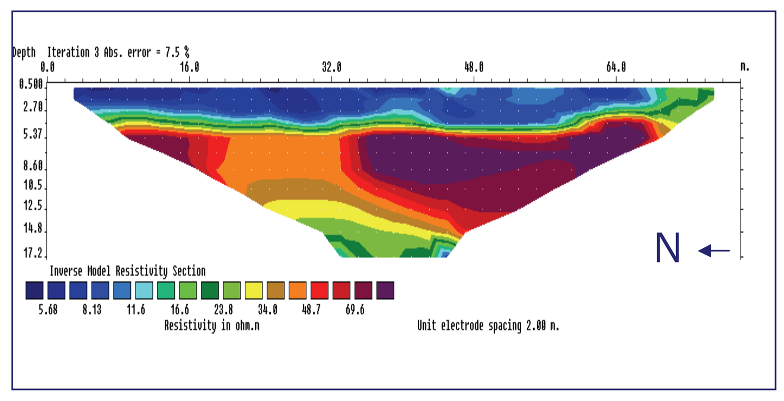

Fig. 8 Vertical section from depth profiling in the eastern part of the tell.

The profile of the supposed eastern border of the tell (**Fig. 8**) shows two, more or less, homogenous sediment layers. In the upper part of the section, very low electric resistivity values up to a distance of approximately 70 m dominate. The low values are likely due to high clay content of the material. In about 3 m depth there is a distinct change to higher electric resistivity values. The horizontal layout of the lower layers is astonishing and might hint at alluvial sedimentation. The suggested relatively abrupt change of sediment types from fine to more gravel rich material is supported by the visual impressions from nearby excavated trenches.
Fig. 9 shows a profile measured in the centre of the tell. Similar to the section in fig. 8 a two-layered structure is visible. From approximately 32 m sediments with low electric resistivity are indicated by bluish colours. In contrast to the section in fig. 8 the low electric resistivity values reach down to greater depth. High resistivity values appear at circa 5.5 m depth to about 40 m distance and are shown as reddish and purplish colours. Between 52 and 58 m an anomaly of 3-4 m depth can be observed. This is caused by open and fresh refilled excavation trenches. Overall, the profile shows a subsurface which slopes downwards in a north-south direction, starting with a slight depression at 32 m and continuing as a quite steep slope from 48m, and eventually leading into a rather deep depression filled with low resistive sediments. The original inclination of the slope was probably steeper, especially if the available topographic data of the modern tell is considered. According to stratigraphic observations, the bottom of the depression might correlate with the natural soil encountered below the Epipalaeolithic settlement (at a depth of 4.50 +/-0.5 m from the zero-point of the excavation). It must be emphasised that the scales of the colour spectrum in the graphs have not been standardised. Values at the eastern border of the tell are generally lower than in the middle and at the southern border (cf. **Figs. 9 and 10**).
The section from the southern border (**Fig. 10**) shows the transition between exposed tell and the surrounding area. Similar to the sections in figs. 8 and 9 the upper part has low resistivity values. Up to ~24 m high resistivity values appear beginning at a depth of ~ 2.5 m, implying a change in sediments at this location.
The results of the geoelectric survey at Körtik Tepe show distinct variations in electric resistivity in the subsurface of the tell. Highest values were measured at the southern edge of the tell, where the transition from fine grained, possibly alluvial sediments, to sediments with high resistivity is well documented. According to the results from the section in the middle of the tell the surface, at the time when the first foraging communities settled there, was probably a low mound which sloped upwards to the north. In order to correlate the resistivity values with certain types of sediment it will be necessary to compare these results with the geomorphological analyses and stratigraphic documentation. The southern depression, visible in the third section, might be correlated with the core drilling which was taken in 2012.

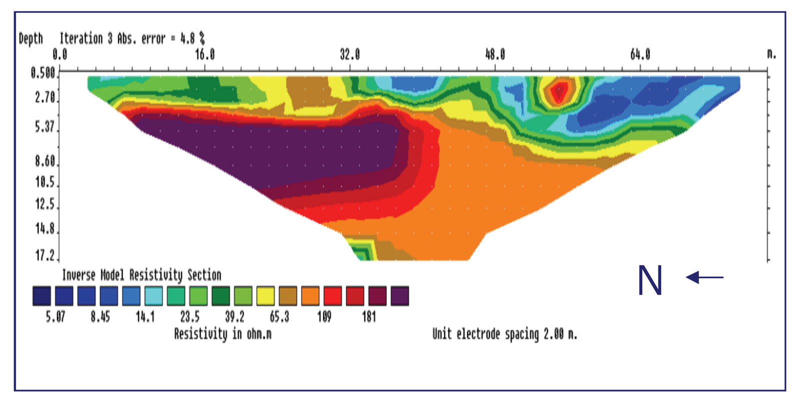

Fig. 9 Vertical section obtained by depth profiling at the centre of the tell.

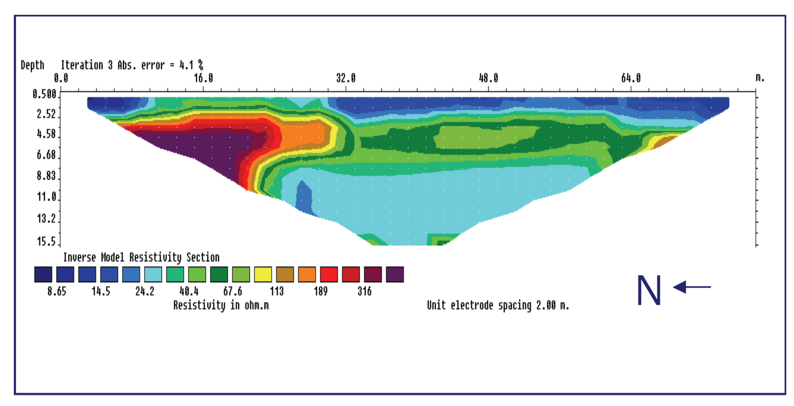

Fig. 10 Vertical section obtained by depth profiling at the southern edge of the tell.

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