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Preliminary Report on the Geophysical Survey at Tell el-Dab'a/Qantir in Spring 2009 and 2010*

The survey was undertaken in May in both 2009 and 2010, which is the best period of the year for such work in this area¹. As in previous years two methods were applied: magnetic and electrical resistivity.

1. Magnetic Method

As in previous years, two different kinds of instruments were used: two fluxgate gradiometers (FM256, Geoscan Research, England) operated by Tomasz Herbich and his team, and a caesium-magnetometer (SM-4/4G-special, Scintrex, Canada) operated by Christian Schweitzer, supported by Mohammed Mutwalli. The fluxgate gradiometer data were processed by interpolating them and in the case of Areas B and F by applying a low pass filter. The results are presented as greyscale maps of intermediate value ranges. A positive scale is applied, that is, the extreme negative values in the given value range correspond to white, while positive extreme ranges correspond to black.

2. Resistivity Method

Vertical electrical sounding (VES) was the method of choice, as was used in the 2008 season. This version of the electrical resistivity method permits observation of the stratigraphy, distinguishing layers by their electrical conductivity properties². A symmetrical Schlumberger array was

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¹ The survey of 2009 was partly financed by the Austrian Archaeological Institute and partly by the Austrian Science Fund project »Stadtentwicklung im Nildelta«. The survey of season 2010 was funded solely by the Austrian Archaeological Institute. The resistivity survey was done in cooperation with the Polish Academy of Sciences. Members of surveys 2009 and 2010: Irene Forstner-Müller, Tomasz Herbich, Christian Schweitzer, Michael Weißl; 2009: Anne-Catherine Escher, Astrid Hassler, Dawid Świąch, Artur Buszek and Szymon Zdziebłowski (both Institute of Archaeology, Jagiellonian University in Kraków); 2010: Michał Kurzyk (Institute of Archaeology, Jagiellonian University in Kraków), Krzysztof Kiersnowski (Institute of Archaeology, University of Warsaw), Robert Ryndziejewicz (Institute of Archaeology, Maria Skłodowska-Curie University in Lublin). – The surveying and mapping was done by Michael Weißl who also provided the digital maps.

² I. Forstner-Mueller – T. Herbich – C. Schweitzer – M. Weissl, Preliminary report on the geophysical survey at Tell el-Dab'a in spring 2008, *AegLev* 18, 2008, 100–106. The results for 2009 will be published in a summary report of the electrical resistivity prospection.

employed, the spacing of the AB probes being between 1.60 and 40 m³. Soundings were spaced 20 m apart (occasionally 30 m, shown on the map localizing sounding points). The soundings were made with an ADA-05 apparatus by Elmes. The results were presented as apparent resistivity pseudo-sections. The vertical element of the pseudo-sections (corresponding to the AB/2 spacings) uses the logarithmic scale, which emphasizes the resistivity changes in layers near the surface.

Investigated areas (Fig. 1):

1. the area of Khata‘na, between the canals to the south of the village (Area A)
2. the area around Ezzawin (Area B, F, G, H)
3. south of Tell el-Dab‘a (Area C and D)
4. west of the modern water tower on the site of the future museum (Area E)
5. east of Ezzawin and south of Tell el-Dab‘a (Area I) to verify the extent of the gezira
6. the gezira west of Ziz (Area J)
7. the area between ‘Ezbet Machali and ‘Ezbet Mehesin, in order to map the paleogeographic landscape (Area K)
8. the area of the ›Tell‹ at Tell el-Dab‘a (Area L)

3. Magnetic Survey Results

Area B and F (Ezzawin) (Figs. 1–3)

The shape and arrangement of the anomalies leave no doubt that they are a reflection of compact urban architecture with a clearly defined southern border and a less evident but still traceable northern border. Long anomalies of uniform value, from 2–6 m wide and from 20–200 m long, correspond to streets. Negative anomalies correspond in most cases to the walls of buildings. The layout is sufficiently distinct for the plan of the settlement to be reconstructed on this basis. The main axes are formed by two streets: the western one between the southwestern corner of square N5 and F8, running SSW-NNE, and the eastern one between the southwestern corner of N8 and the northeastern corner of H13 (Fig. 3). The length of the observed section of the western street is approximately 200 m and it is quite likely that it ran further north to the edge of the settlement, that is, to the northern edge of square E9. The street is made up of two straight sections. The northern section is shifted by 4 m, that is, about the width of the street, to the west; this point is clearly visible on the map in the southern part of square H7, at the intersection with the transverse street. The eastern street, which is slightly wider (6 m in places, e.g. in L11), follows an arc; the change in the direction of the street can be observed between L11 and K12. The main streets determine the layout of the architecture which is arranged along side streets going off the main street always at a right angle. The anomalies corresponding to these side streets on the western side of the west street are easier to trace: between the northeastern part of F3 and the southern part of G7, the northeastern corner of H5 and the southern part of H7, in J5, and in L5. Side streets off the eastern street can be discerned between the southern part of K12 and M14, between L11 and N12, and in I11. Streets parallel to the main street can be observed between the northern part of I4 and the northeastern corner of H5. The non-parallel character of the main streets and the change in the direction of the eastern street results in three different orientations of the architecture in this area. The layout of the settlement along the western fringes of the surveyed area, west of the line between squares D4 and R4, is less distinct. Two short sections of streets can be discerned: a narrow East-West street in the southern parts of I2 and I3 and a slightly wider one, curving somewhat along a North-South line, between the southwestern corner of E3 and the northern part of D2.

³ The distances between current probes AB and potential probes MN is given in Forstner-Mueller et al. (note 2) 103.

Streets to the southeast of the main eastern street end in a very distinct linear anomaly bordering the settlement on the south; it can be seen between T1 and M14. Its interpretation is difficult without archaeological testing as it could reflect an ancient wall protecting the settled area from the floodplain, or a modern road, for example, completely concealed under cultivated land, or even a mud-filled canal. Either of the latter two possibilities is suggested by the parallel course of this anomaly with regard to an existing modern road between the canal and the village of Ez-zawin⁴.

The distribution of magnetic field intensity values to the south of the linear anomaly, which delimits the area of archaeological structures, indicates an uninhabited area. The arrangement of the anomaly leaves no doubt as to the alluvial character of the ground, possibly a floodplain. Extensive anomalies interpreted as mud excavation pits are observed in squares S7–S8, R7; squares R6, R7 and P8 contain small oval anomalies, which may be a reflection of small pits. Anomalies with a high range of values (up to 25–30 nT), recorded in the southeastern corner of R5 and in P8, may reflect structures formed from heavily burned material (kilns [?]).

Consequently, the interpretation of the rectangular anomalies characterized by raised values of magnetic field intensity at the southern edge of the settlement needs to be verified (e.g., in M13). These anomalies have the same orientation as the neighboring anomalies corresponding to building walls. Some of these anomalies could be reflections of structures filled with material different from the surroundings, as suggested by the definitely higher magnetic values (burning, ashes [?]). Analogous anomalies were registered in areas with evident traces of architecture, for example, in M9, L11, and M12. From their nature, at least some of the rectangular anomalies could reflect graves, an interpretation further confirmed by surface finds from this sector – many small objects found by local villagers, which were obviously once part of grave furnishings. The archaeological significance of this area can also be deduced from the fact that the owner of the field, presumably aware of what the ground conceals in this area, made every effort to hinder the survey. The extensive anomalies with distinct edges, analogous to anomalies discovered previously on the northeastern side of Khata'na and in the northern part of F2, could be interpreted as places where mud was excavated.

The northern extent of the settlement is not as clearly mapped by the magnetic survey as the southern edge and the clarity of the magnetic image weakens gradually. The map distinguishes anomalies corresponding to walls in line with the edges of squares D1–D8 in the western part of the area and the line between G9 and G13 in the eastern part. North of the line there are some blurred shapes corresponding to structures filling a belt of land approximately 20 m wide at the center and 40–50 m wide at the extreme edges. The arching line from square A5, running across the northern edge of E9–E10 to C15, marks the border beyond which there are no structures. The blurred magnetic image could mean that the remains were washed out by water. A similar blurring of the image has been observed to the south of the palace complex in area F/II⁵. It should be noted that the image of these remains becomes blurred on the same contour line as that determined by Josef Dorner for the ground level in ancient times. It would mean that the structures in the two areas were destroyed by the same event or process.

At the northern end the prospection in 2010 joined the area surveyed in 2008 to the east of Khata'na (and east of the canal) where no traces of settlement could be found⁶, but where architecture was expected based on the results generated by the survey to the south of Khata'na, on a narrow belt of land between canals. The magnetic map shows evident remains of buildings there

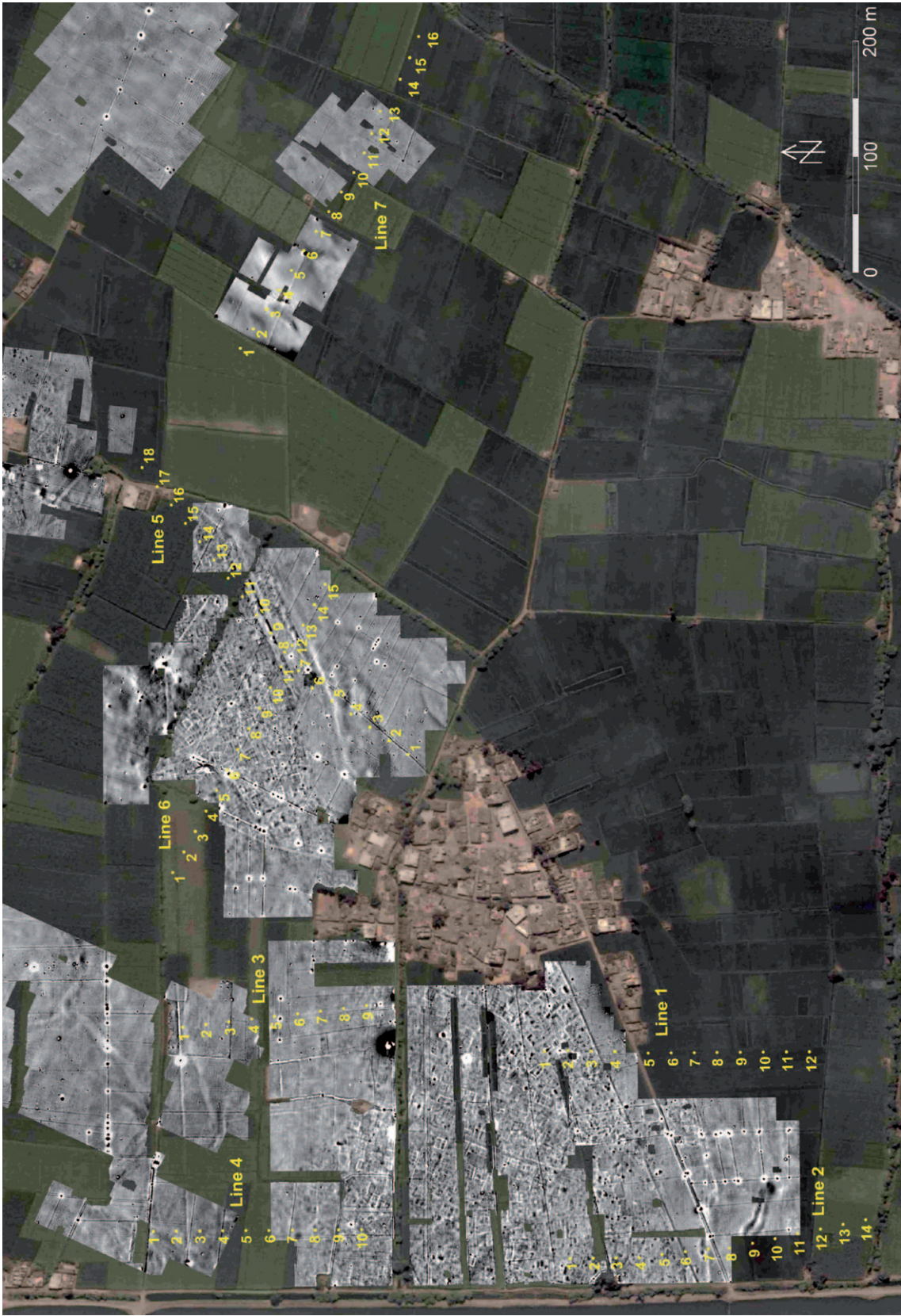
⁴ Forstner-Mueller et al. (note 2) 3.

⁵ M. Bietak – I. Forster-Mueller – T. Herbig, Discovery of a new palatial complex in Tell el-Dab'a in the Delta: geophysical survey and preliminary archaeological verification, in: Z. A. Hawass – J. Richards (eds.), *The Archaeology and Art of Ancient Egypt. Essays in Honor of David B. O'Connor*, *Annales du Service des Antiquités de l'Égypte* 36, 2007, I, 144.

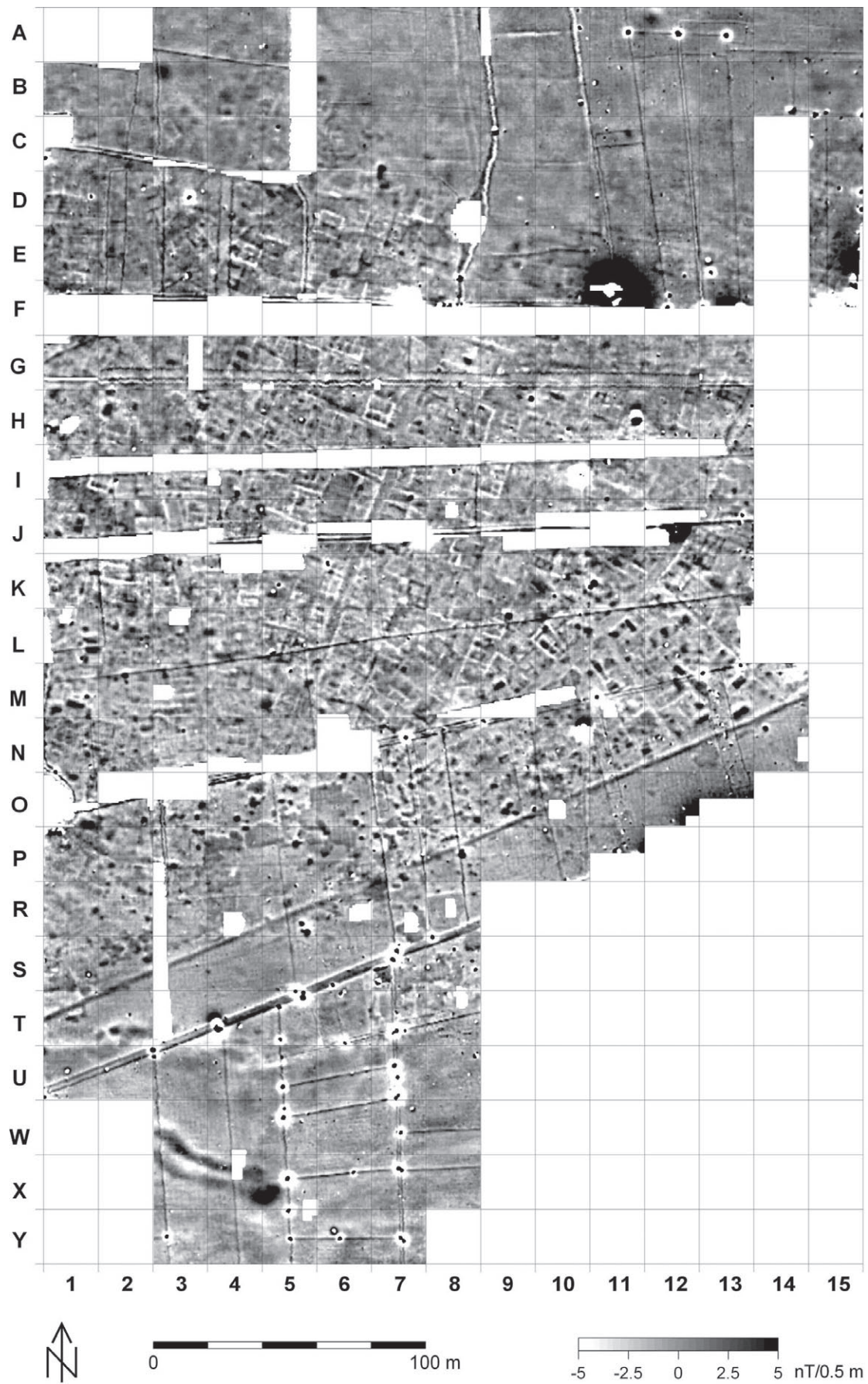
⁶ Forstner-Mueller et al. (note 2) 93–97 fig. 7.



1 Overall map of Tell el-Dab'a, magnetic map and satellite image



2 Ezzawin, magnetic map and satellite image, VES-measurement lines in yellow dots



3 Area B and F, Ezzawin, magnetic map

oriented in much the same way as the structures discovered to the north of Khata'na during the prospection in 2007⁷.

Area G and H (Ezzawin) (Figs. 1. 2. 4)

Magnetic investigation to the northeast of Ezzawin (Area G and H, Fig. 1) was aimed at localizing potential settlement within the limits of the *gezira* discovered during Josef Dorner's research⁸. The idea to map this area magnetically was triggered by the results of the electrical resistivity survey (see below). The investigations in 2009 to the south and south-east of Khata'na showed that the Nile bordered the settlement to the west and south. To the east, the modern architecture of the village of Ezzawin obscures the eastern border of the ancient site. Nonetheless, the prospection in Area G has revealed some information in this respect.

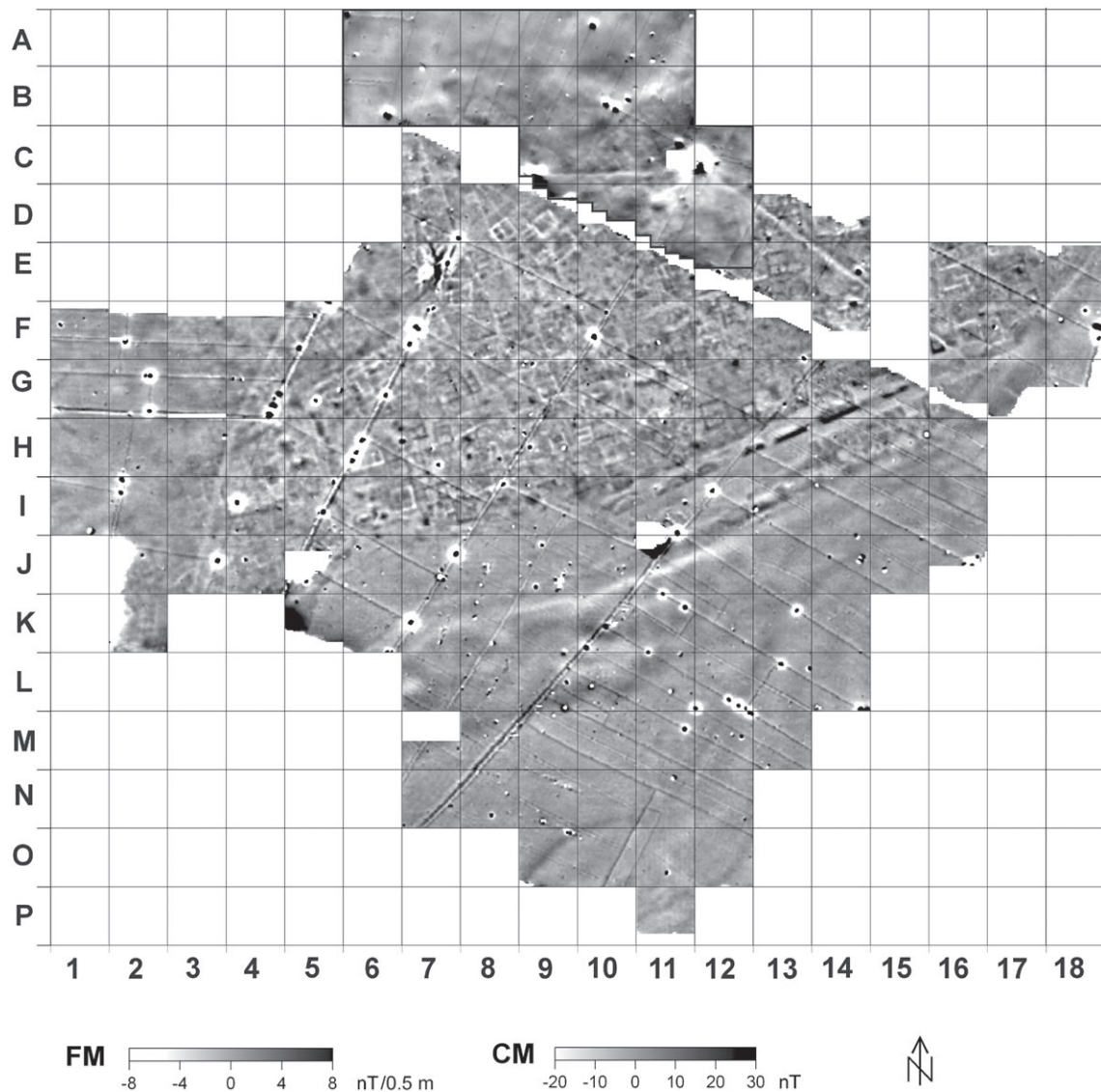
As in Area F, the complex of anomalies in the northern part of the map reflects a compact architectural district (Fig. 4). Most of the anomalies are also of negative values. The settlement is generally oriented SWW-NEE and NNW-SSE, but neighboring buildings all tend to follow slightly different alignments, varying by a few degrees. The architecture seems to be slightly different in character from that of Area F: none of the magnetic anomalies can be interpreted as streets constituting axes for the architecture. Only narrow alleys of different lengths can be discerned on the magnetic map, and these usually follow a slightly curved alignment. The longest of these alleys can be seen between the southwestern corner of square H6 and the center of square F12. A number of anomalies correspond to streets perpendicular to the street described above, between the middle of square C7 and the northeastern corner of G8, between the northwestern corner of D8 and the eastern part of G9, and the northwestern corner of E10 and the eastern edge of G10.

Investigations did not cover the northwestern part of the settlement which lay outside the area chosen for prospection. The mapping using a caesium magnetometer identified the northern extent of the architecture which curves towards the north between squares B7 and B11. The continuation of this line to the southwest could not be mapped this season because of the crops growing in this area. Measurements at the western edge of the area suggest that this border ran most probably between squares C6 and E3, because anomalies reflecting remains of architecture are present in C7 and F3. The western edge of the settlement, south of squares F3 and F4, is washed out. The map shows that architecture discovered in Area G can be associated with that in Area F, the link being a belt of land approximately 70 m wide, the northwestern edge of which can be observed in squares I1 and I2 and the southeastern edge in J5 and K5. To the southwest, further measurements were impossible because of the modern buildings of Ezzawin.

The southern and southeastern fringes of the settled area show up very distinctly on the map. The border runs between the northwestern corner of square J6 through the center of squares I9–I10 and further along a straight line to F17, where it turns to the northeast. A belt approximately 30 m thick at its widest, characterized by unusually stable values of the earth's magnetic field intensity, runs along the border to the south (between the middle of I10 and that of H13). East of H13 this belt narrows to approximately 15 m. The character of the anomalies to the south of this belt is proof that this area was once under water. It thus seems that the anomalies recorded to the southeast of the settlement could reflect harbor installations: the stable-value belt would correspond to a hardened waterfront surface and the narrowing (evidently cut off on the south side) to a place where the boats would have docked. The interpretation of this narrowing belt of stable values as a waterfront is also suggested by a marked southward projection in the southeastern part of G15. Assuming this is indeed a levee, then the belt of disturbances from 25–40 m wide that can

⁷ I. Forstner-Mueller – T. Herbig – W. Mueller – C. Schweitzer – M. Weissl, *Geophysical survey 2007 at Tell el-Dab'a*, *AegLev* 17, 2007, 97–99 fig. 1.

⁸ J. Dorner, *Die Topographie von Piramesse*, *AegLev* 9, 1999, 77–83.



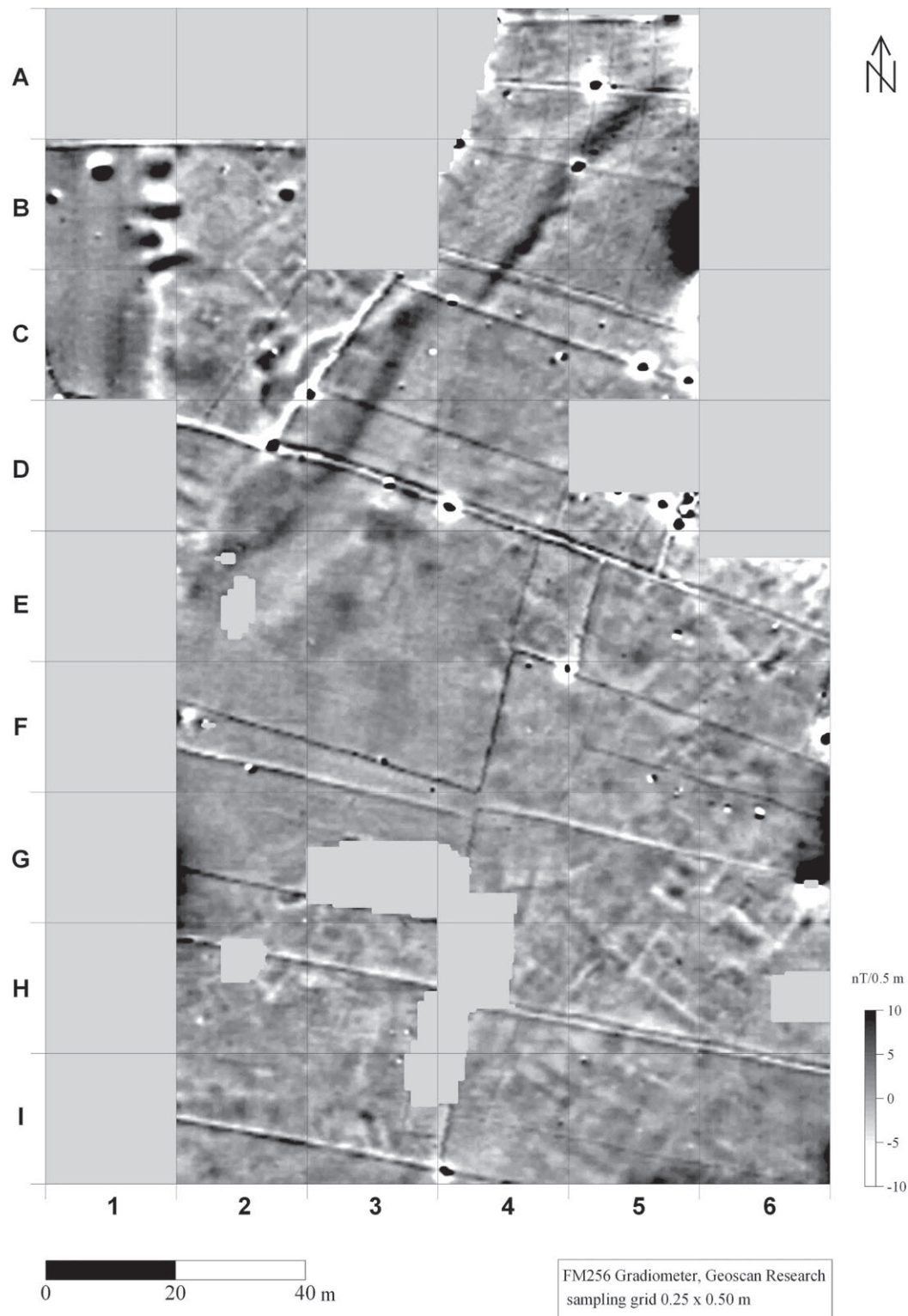
4 Area G and H, Ezzawin, magnetic map. FM: fluxgate gradiometer; CM: caesium magnetometer

be seen south of the belt of stable values, between L7 and I15, can be interpreted as an area where the floodplain was dredged in order to create a place for docking boats.

Two linear anomalies in the northeastern (between the southern part of C12 and G17) and western (between the northwestern corner of F5 and J3) parts of the surveyed area do not seem to be of ancient date. They have no connection with the remains of ancient architecture, and could correspond to filled canals of fairly modern date.

Area A (Khata'na) (Figs. 1. 5)

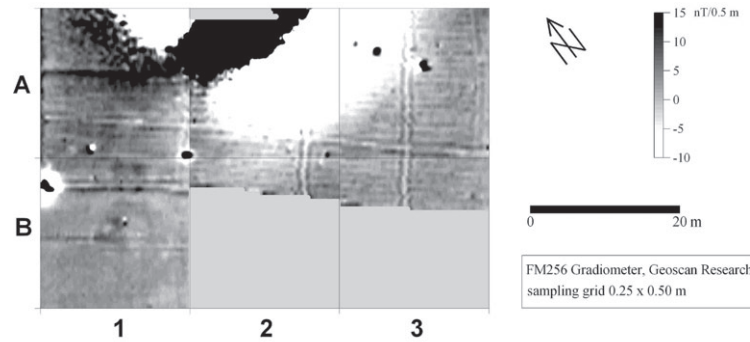
The survey in Area A revealed the presence of architecture in the form of linear anomalies in a rectilinear arrangement, obviously corresponding to buildings. These can be observed in the southeastern part of the surveyed area and close to the northwestern corner. These anomalies are characterized by magnetic field intensity values lowered with respect to the surroundings. The distinctness of the anomaly in some parts of the map even permits a reconstruction of the dimensions of particular rooms, especially in squares G5–I5. The building alignment matches the orientation of architectural complexes recorded during the prospection to the north of Khata'na, in 'Ezbet Helmi and in Area F/II.



5 Area A, Khata'na, magnetic map

The survey also showed the position of the ancient Nile river bed; its edge runs along the eastern border of squares B1 and C1.

Long anomalies cutting across the surveyed area along a southwest-northeast line, observable between E2 and A5, find no reflection in ground surface features. They must correspond to some sort of extensive earthworks.



6 Area E, modern water tower, magnetic map

Area E (Figs. 1. 6)

An analysis of results from this area is severely compromised by the strong disturbance caused by a concrete water tower. Where the magnetic image is undisturbed by the said modern structure there are only two features of possible anthropogenic origin: two small oval diameters (just 2 m in diameter) seen by the northeastern edge of B1. They can be interpreted as pits.

Area J (Ziz) (Figs. 1. 7)

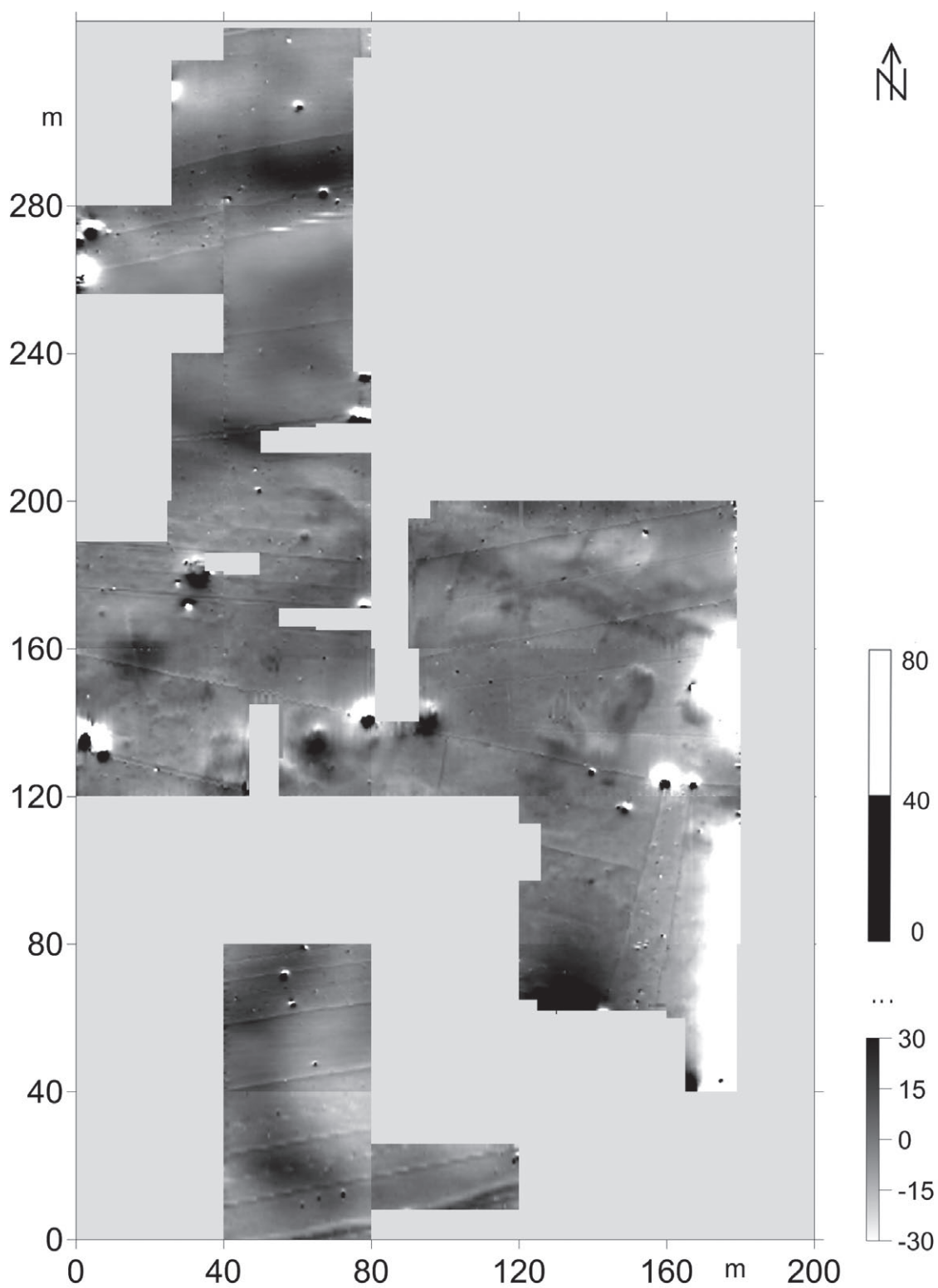
The area west of Ziz was investigated by a magnetometer test survey in an area of 320 m by 180 m. The gezira widens to the east and has a long narrow extension from east to west with a pronounced northern shoreline, separating it from a floodplain with deep river channels (dark stripes). This part was obviously not inhabited. There are no signs of rectangular shaped or linear structures which might indicate the presence of houses, walls, roads, etc. The round, oval and elongated dark patches are interpreted as areas where sandy material from the gezira has been taken recently or in older times and afterwards refilled with clay and mud. Although the area was not inhabited, the small island or peninsula has been intensively used, perhaps for agriculture. In comparison to the quiet and undisturbed floodplain area its surface is full of footprints and marks of human activity.

Area K (between ‘Ezbet Machali and ‘Ezbet Mehesin) (Figs. 1. 8)

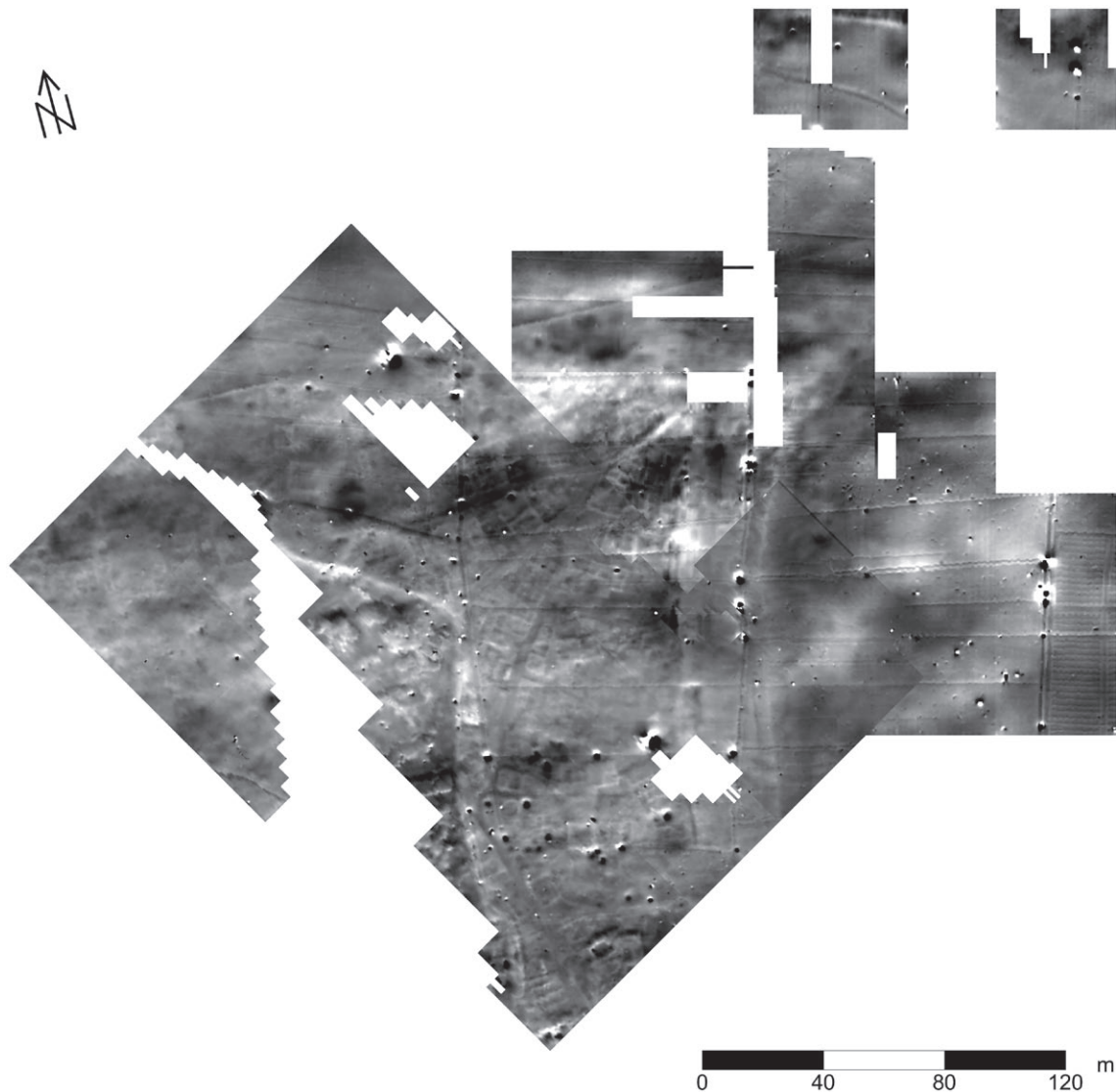
The recent magnetometer survey in this area was hampered by flooded rice fields south of Machali⁹, and therefore a gap of some 30–40m had to be left in this part. To the south, dark stripes reveal deeper river channels with deposited mud layers, whilst to the north the land was settled. The configuration of the shore lines is not clear. Due to the short distance between the higher land and the flood plain and its fluvial environment, a distinct, well defined shoreline to the gezira with a steep edge is to be expected.

Northeast of ‘Ezbet Mehesin the floodplain stretches towards the northeast as an area of shallow water. The settled area extends to the west of the shoreline, north of the modern village, bounded by a straight line to the north and a slightly curved line to the east. In areas beyond those lines surface soil of higher magnetization has been taken away along with the remnants of old houses. This causes a light and more homogeneous image in the magnetogram. Faint signals of

⁹ For earlier surveys s. Forstner-Mueller et al. (note 2) 97 fig. 9–11.



7 Area J, 'Ezbet Ziz, magnetic map



8 Area K, between 'Ezbet Machali and 'Ezbet Mehesin, magnetic map

rectangular structures in this light-coloured area indicate that the old settlement extended further to the north and to the east by some 30 m in each direction.

Area L (The ›Tell‹ of Tell el-Dab'a) (Figs. 1. 9)

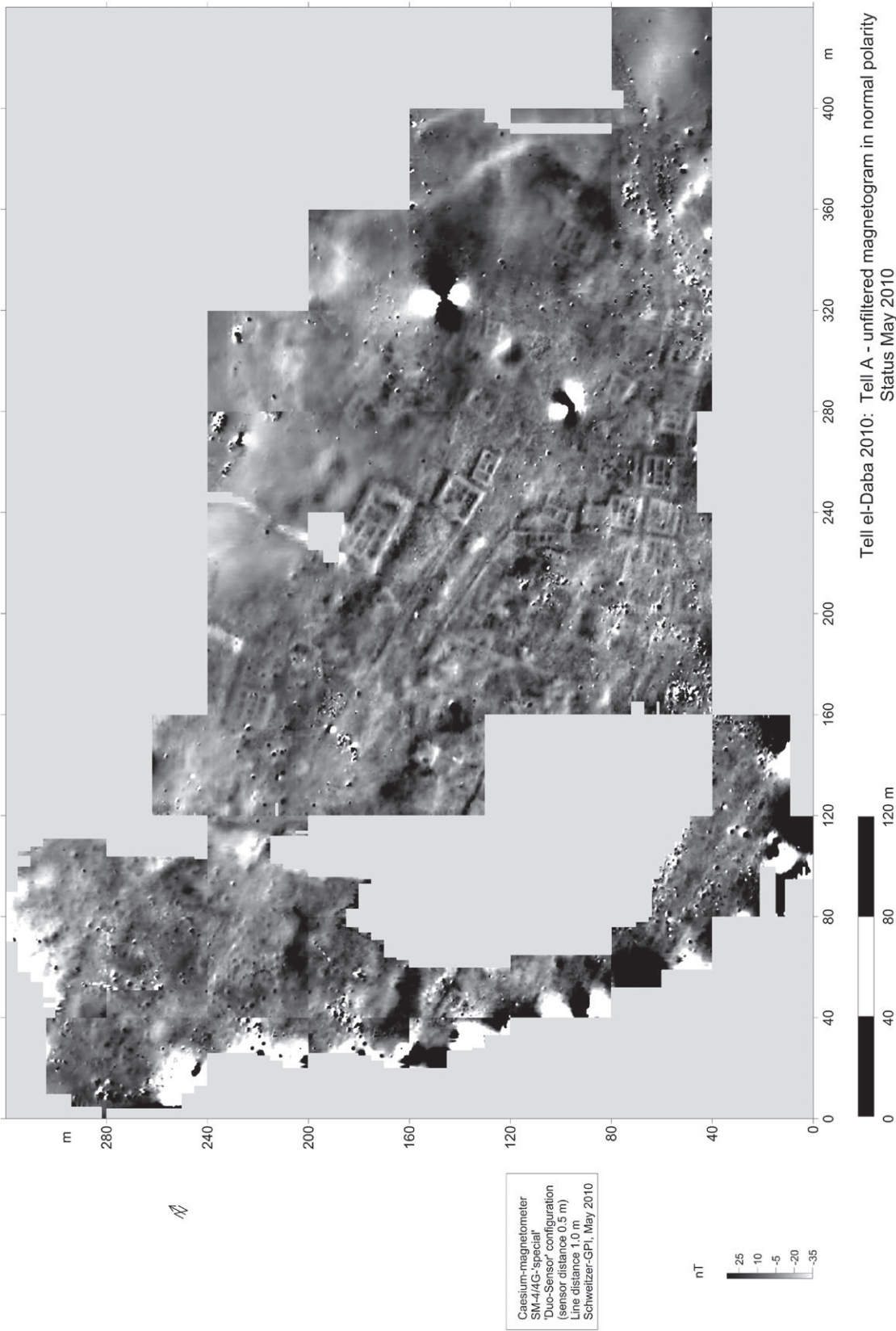
Intensive agricultural activity in the 19th and 20th century A.D. removed most of the actual Tell, which was much more extensive even at the end of the 19th century¹⁰. The remaining mound of Tell el-Dab'a covers an area of approximately 500 m in diameter and still rises up to 7–8 m above the surrounding farmland.

The magnetometer survey has shown that massive structures from the Late Period cover the eastern part of the Tell¹¹.

Inside the area of the Sutekh-temple and in the most elevated northwestern area of the Tell, dark anomalies, most probably pits, show up in the magnetic image. They are 0.8–1.0 m in dia-

¹⁰ F. L. L. Griffith, *The Antiquities of Tell el Yahudiyeh*, EEF Excavation Memoirs 7 (London 1890) 56–57.

¹¹ I. Forstner-Müller – W. Müller, *Neueste Ergebnisse des Magnetometersurveys während der Frühjahrskampagne 2006 in Tell el- Dab'a /Qantir*, AegLev 16, 2006, 79–81 fig. 2.



9 Area L, Tell A, magnetic map

meter and are filled with dark soil. They might be interpreted as tree-pits such as were excavated in 1985¹².

Not all archaeological features could be mapped using caesium magnetometry. The mudbrick walls of an excavated Late Period house¹³ lie directly below the surface. Thus the conditions seem to be almost ideal for showing up in the magnetic image. However this is not the case, and no structures are visible. Perhaps the contrast in magnetization between the walls and the surrounding mudbrick debris is insufficient. Magnetic susceptibility measurements carried out during the next excavation season may help to clarify the geophysical background.

The Tell extends to the south as a less elevated mound. The area is completely covered by the modern village which prevents any further geophysical prospection. The surrounding lowlands have been investigated using auger drilling and magnetometry in few areas. These show that there is a narrow transition zone from the mound to the area of water, F3. The gezira of Ezzawin to the south was separated from Tell A by a water channel as confirmed by VES profiling.

Depression north of the Tell (Fig. 10)

North of the Tell a depressed area can be distinguished which already existed in antiquity¹⁴. The shoreline of this depression can be traced on the magnetogram. It spread northward almost as far as the modern east-west trending path leading from 'Ezbet Rushdi to the north of the Islamic cemetery. To the south the shoreline emerges as a dark curved line, full of dark curved stripes and dark and light borders. Some structures close to the waterside are visible. These features are probably caused by refilling activities to gain additional land. In the east a transition zone from shallow water to the landside is visible. Settlement structures can be discerned close to the waterside. The western shoreline runs east of the Islamic cemetery. The depression extends about 300–400 m north-south and 200 m east-west and was certainly part of the Nile river system. A connection to the Pelusiac branch was assumed via a channel or shallow water-filled depression running west-north-west and east-south-east¹⁵. Therefore the area was scrutinized for the presence of an ancient waterway starting from the northern side of the Islamic cemetery and continuing westwards towards an area slightly north of 'Ezbet Helmi. This area shows a densely inhabited landscape full of buildings of many types, but no evidence of an old river system such as lagoons, channels or other elements. From the geophysical point of view, an ancient waterway probably did not exist in this area and the link to the Pelusiac branch should be searched for elsewhere. A possible location could be in the area now mostly covered by the modern village of 'Ezbet Rushdi. A narrow channel could have existed to the north, crossing the modern road through Rushdi to the Didamun channel and joining the Pelusiac branch at a point now covered by the village. To the southeast the lake was most likely connected to the F3-branch by a channel which passed the eastern edge of the Tell¹⁶.

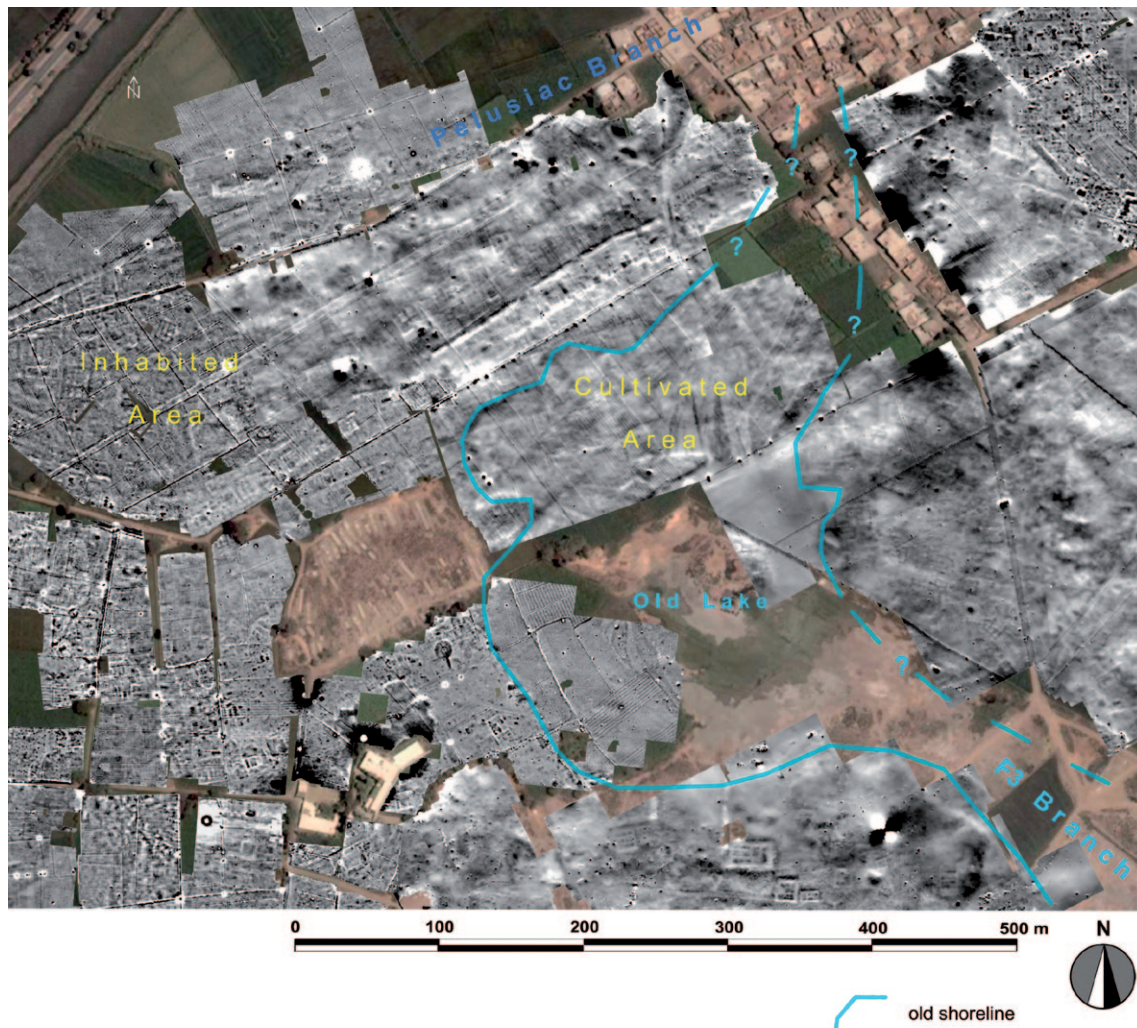
¹² M. Bietak, Ein altägyptischer Weingarten in einem Tempelbezirk (Tell el-Dab'a 1. März bis 10 Juni 1985), *Anz-Wien* 122, 1986, 267–278.

¹³ M. Lehmann, Vorbericht über die Grabungstätigkeiten der Herbstkampagne 2009 im Areal A/II von Tell el-Dab'a, *AegLev* 20 (in print).

¹⁴ J. Dorner (unpublished); H. Tronchère, Approche paléoenvironnementale de deux sites archéologiques dans le delta du Nil, Avaris et la branche Pélusiaque, Taposiris et le lac Mariout (unpubl. Diss. University of Lyon 2010) 160–175.

¹⁵ s. still recently M. Bietak, Houses, Palaces and Development of Social Structure in Avaris, in: M. Bietak – E. Czerny – I. Forstner-Müller (eds.), *Cities and Urbanism in Egypt. Papers from a Workshop in November 2006 at the Austrian Academy of Sciences, Denkschriften der Gesamtakademie* 60 = *ÖAIKairo* 35 (Vienna 2010) fig. 9 a–d.

¹⁶ The resistivity survey is part of the »Resistivity method in reconstructing the historical landscape of the Tell el-Dab'a area« project, carried out by the Austrian Archaeological Institute in Cairo and the Institute of Archaeology and Ethnology PAN in Warsaw within the framework of a cooperative agreement. A complete publication of resistivity results (with geoelectrical cross-sections) will be a subject of another publication.



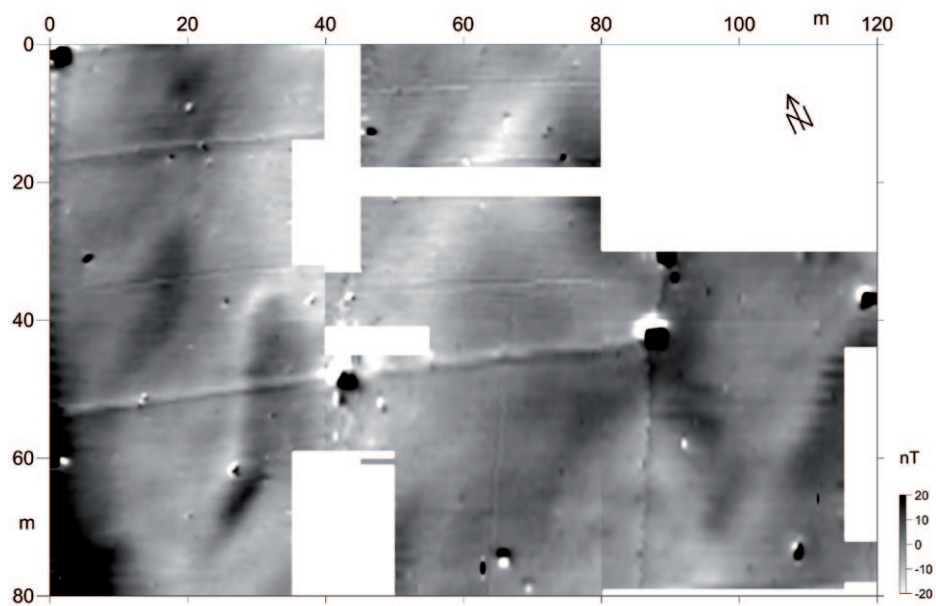
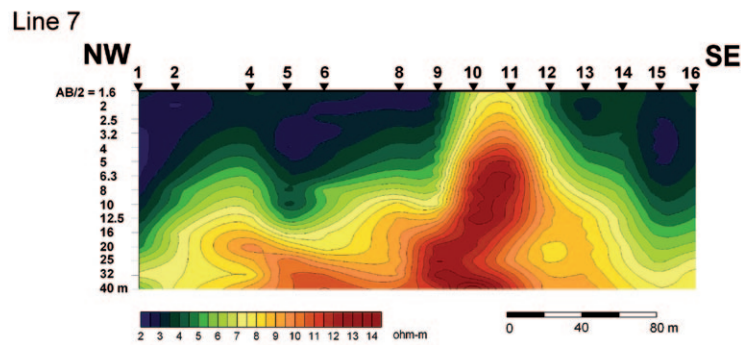
10 Reconstruction of the paleo-river system

4. Resistivity Survey Results

The electrical resistivity prospection in 2010 (Fig. 2) was integrated with the magnetic survey. Investigation in Area B, carried out following the magnetic survey, was intended to confirm the border between the floodplain and the settled area revealed in the resistivity image. In Area F the objective was to determine the hypothetical northern extent of archaeological structures, to be verified in the course of future magnetic mapping. Prospection in Area G was focused on verifying the extent of the gezira and determining whether the area could have been settled in antiquity. The objective of research in Area I was much the same: the profiles covered part of the gezira which had not been mapped magnetically. The magnetic surveying in Area I, which was carried out using a caesium magnetometer, was aimed at determining the nature of disturbances observed using the electrical resistivity method.

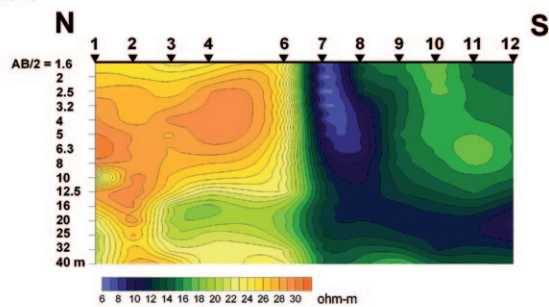
Area B and F (Figs. 1. 2. 12. 13)

Altogether 45 vertical electrical soundings were taken along four lines, to the south and north of the area surveyed using the magnetic method (Fig. 2). The apparent resistivity pseudo-sections along lines 1 and 2 in Area B demonstrate a clear division of the area into two zones: one zone

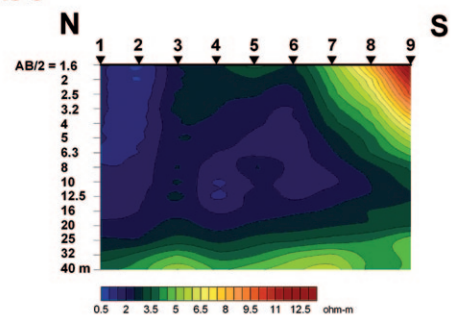


11 Area D and I, VES-pseudosection and magnetic map

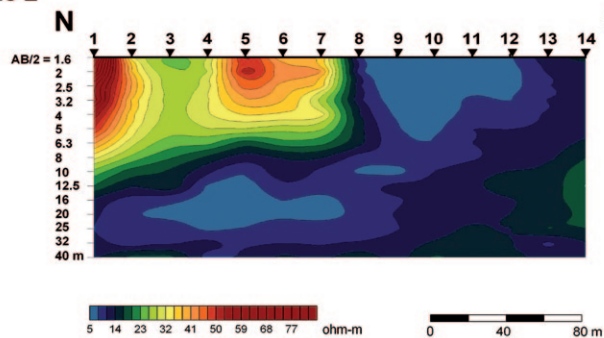
Line 1



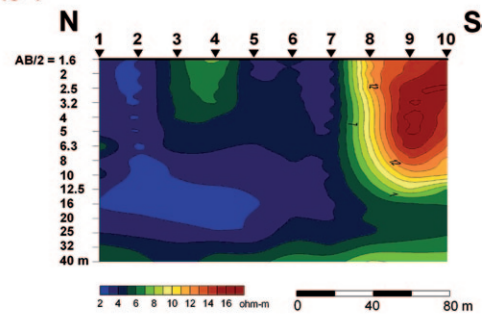
Line 3



Line 2



Line 4



12 Area B, VES-pseudosection

13 Area F, VES-pseudosection

with higher-resistivity forms to the north and another one with lowered-resistivity forms to the south (Fig. 12). The separation of the zones on line 1 is visible between soundings 6 and 7, and on line 2 between soundings 7 and 8. This border is also reflected on the magnetic map: the lower-resistivity zone corresponds to a magnetic image typical of the floodplain and the higher-resistivity one to magnetic images of architecture and also the 30-to-50 m wide belt bordering the inhabited area on the south side. This suggests that the high resistivity is due most likely to the presence of the *gezira* (that is, sand characterized by raised resistivity) rather than a cultural layer. High resistivity in surface layers (reaching 80 ohm-m) on line 2 may be connected with the raised resistivity of a cultural layer (an effect observed in the prospection carried out in 2008¹⁷).

The division into higher- and lower-resistivity zones is also evident on pseudo-sections along lines 3 and 4 in Area F (Fig. 13), made prior to the magnetic prospection. The results indicate that the northern border of the inhabited area (or *gezira*), which is characterized by higher resistivity, should be expected in soundings 7 and 8. Magnetic surveying confirmed this expectation (Fig. 2): on both lines the border line between zones corresponds approximately to the edge of the inhabited area characterized by washed-out features.

Area G (Figs. 1. 2. 14)

The soundings, 33 in all, were carried out on the *gezira* already known from Josef Dorner's survey¹⁸. They followed two intersecting lines (Fig. 2). In both pseudo-sections there is an evident cut-off between a higher-resistivity zone amidst lower-resistivity features. On line 5 this zone can be seen between soundings 5 and 15, and on line 6 between 3 and 13 (Fig. 14). In both zones there is a resistivity zone exceeding 20 ohm-m on the higher resistivity sections; previous experience has demonstrated this kind of result to reflect the presence of a cultural layer. A comparison of the results obtained from the pseudosections and the magnetic mapping indicates that on line 6 the inhabited area is reflected by the borders of the higher-resistivity zone. The results on line 5 suggest that the northwestern edge of the inhabited area is situated between soundings 15 and 16, outside the limits of the magnetically surveyed area.

Zones of the highest resistivity in the surface layer (seen on line 5 at soundings 6–9 and on line 6 at soundings 11 and 12) correspond to a belt of stable magnetic values observed on the magnetic map between the floodplain and the inhabited area (Fig. 4). This supports the idea that the belt was actually a waterfront covered by a layer of sand, characterized by high resistivity values.

Area C, D and I (Figs. 1. 2. 11)

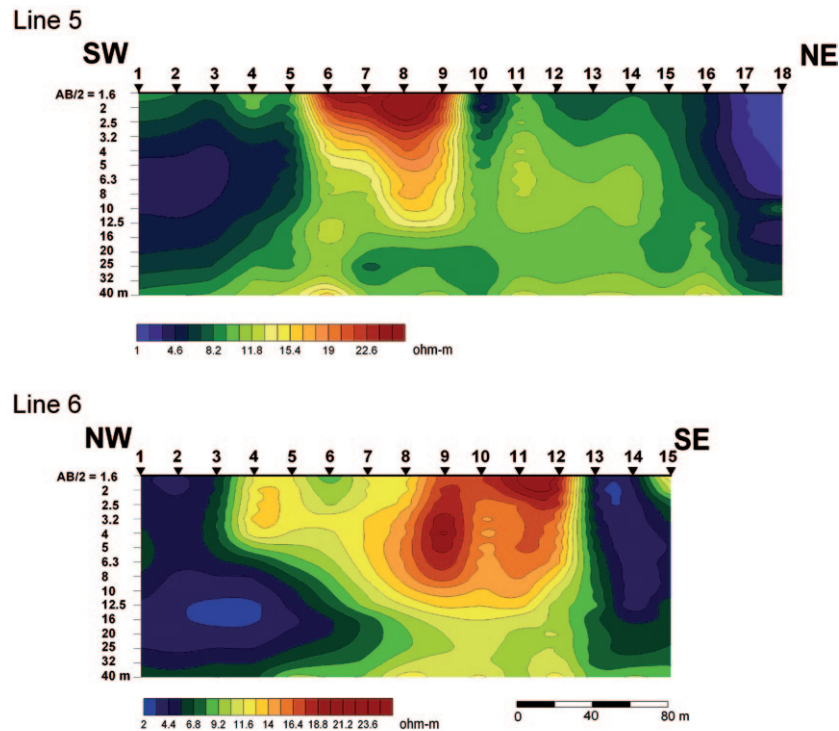
It was hoped that a survey to the east of Ezzawin and south of Tell el-Dab'a would verify the extent of the *gezira*. Magnetic surveying of part of the *gezira* in 2009 (Area C and D) had demonstrated no traces of any kind of architecture. In this area 16 soundings were made on a NWW-SEE and WNW-ESE line intersecting the alleged *gezira* (Area I) (Figs. 1. 2). The pseudo-section shows a predominance of lower-resistivity features in the surface layer (Fig. 11). Higher-resistivity forms appear at a deeper level. The arrangement of magnetic anomalies shows that the *gezira* (that is, the higher-resistivity forms in deeper layers) was not inhabited. This remains in agreement with the results of magnetic survey.

Sama'na

The *gezira* from *Sama'na* was the most elevated hill in the surrounding area.

¹⁷ Forstner-Mueller et al. (note 2) 100–106.

¹⁸ J. Dorner, unpublished.



14 Area G, VES-pseudosection

In the vicinity of the village remains of the 18th and 19th dynasty are known: these are a well with an inscription of Ramses II which was built of reused blocks from the Amarna period¹⁹, part of a lintel bearing the name of Paser, a vizier of Seti I and Ramses II²⁰ which was reused in a modern house, a fayence vase bearing the names of Haremhab and Mutnedjmet²¹, faience tiles from a cemetery²², and reused blocks with inscriptions of Ramses II from a modern well found in spring 2010. A field survey by Irene Forstner-Müller, Pamela Rose and Michael Weißl has shown that due to the flattening of the area the remains of ancient settlements have been totally removed and it is of no use to investigate this part of the area.

Conclusions

Magnetic survey has uncovered yet another inhabited area on the site of Tell el-Dab'a in the vicinity of the modern village of Ezzawin. The assemblage from fieldwalking the area suggests a date in the Second Intermediate Period. Therefore the area of Ezzawin can be designated as part of the southern suburban area of the Second Intermediate period town of Avaris. In addition, the magnetic map gives an idea of the layout as well as the extent of the western part of the suburban settlement. Similar data were obtained from the magnetic prospection of the eastern part. The magnetic map has also revealed an image of waterfront installations which can be interpreted as a possible levee.

¹⁹ L. Habachi, Khata'na-Qantîr: Importance, ASAE 52, 1954, 481–482.

²⁰ Habachi (note 19) 479–480; L. Habachi, Tell el-Dab'a I. Tell el-Dab'a and Qantîr. The Site and its Connection with Avaris and Pi-Ramesse. Aus dem Nachlaß herausgegeben von E. M. Engel unter der Mitarbeit von P. Janosi und C. Mlinar, Denkschriften der Gesamtakademie 23 = ÖAIKairo 2 (Vienna 2001) 38. 186–187 Cat. 52 pl. 18 A.

²¹ Habachi (note 20) 47 Cat. 152 pl. 49 A.

²² Habachi (note 19) 488.

Integration of magnetic mapping and the results of VES soundings have proved very useful. In Area F, the soundings suggested a zone in which the northern limits of ancient architecture could be anticipated, and confirmed the extent of the gezira to the south that was detected in the magnetic survey. In turn, the results of soundings made in Area G prompted a magnetic survey, which had not been planned, leading to the discovery of the eastern part of the settlement.

The assumption that a link existed between the natural depression and the Pelusiac branch of the Nile could not be confirmed from magnetometry in that area²³. This canal/waterway, if it existed, has to be searched for elsewhere else, possibly to the north and perhaps beneath the village of ‘Ezbet Rushdi.

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²³ s. above.