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Mega-Sites' Impact on Central Mesopotamia. Archaeological and Multi-Temporal Cartographic Study of the Al-Mada'in Area

This paper presents the preliminary results of a study on the impact of ancient mega-sites on Central Iraq, focusing on the area of Al-Mada'in, one of the largest and most important complexes of ancient settlements in the world, as also witnessed by Greco-Roman, Chinese, Syriac, Middle-Persian and Arab sources.

1. Introduction

Starting from 1920, immediately after World War I, the use of Remote Sensing products and applications in archaeology increased even more and is today a common way for performing archaeological research and study. The digital revolution and wider use of very high resolution satellites starting from the 1990's, which allow to obtain images with high spatial resolution (up to 0.5 m) using data provided by commercial platforms (such as Quickbird, IKONOS, WorldView GeoEye, etc.), provide a phenomenal instrument for improving the knowledge of archaeological areas.

In this scenario, starting from recent remote sensed data, the purpose of this work was to collect and organize all the cartographic information available on the area of al-Mada'in, in Central Mesopotamia, one of the largest and most important complexes of ancient settlements in the world, as witnessed by Greco-Roman, Chinese, Syriac, Middle-Persian and Arab sources. We also aimed at generating a digital copy of each document, and implementing a geo-database referring all cartographic data in a common system, useful for conducting a multi-temporal study.

This study was performed by adding together non-conventional maps, recovered in archives or in literature (on site drawings, maps, etc.), with aerial data (Royal Air Force images) and the most used remote sensing platforms for archaeological research, such

as Corona (Philip et al. 2002; Castrianni et al. 2010; Casana/Cothren 2008), Quickbird¹ (Lasaponara/Masini 2006; Alexakis 2007), and World View (Scardozi 2009). After the image processing phases, all these data were photo interpreted for grounding hypothesis on the evolution of the selected area during the past centuries.

2. Historical Background

Since the foundation of Seleucia on the Tigris (at the very end of the 4th cent. BC), the area known at present as al-Mada'in – which precisely means <the cities> in Arabic – was the administrative, economic and cultural centre of the three great oriental empires alternating from the death of Alexander the Great until the Muslim conquest: the Seleucid, Arsacid and Sasanian empires.

The royal capitals founded there, Seleucia, Ctesiphon and Veh Ardashir, were the counterparts to Rome and Constantinople, and, during the centuries, even a number of other major towns were built in the same area (up to seven, according to Arab sources), even if most of them have not yet been located on the ground (Negro Ponzi 2005; Hauser 2007): of particular importance must have been Veh Ardashir, founded in AD 230 by the first Sasanian King of Kings, Ardashir I, and Veh Antioch-e Khusrau, founded in AD 540 by Khusrau I for the deported population of Roman Antioch. Further to the Muslim conquest, the cities lost their importance and declined in size, however their population dropped sharply only after al-Mansur had founded Baghdad early in the second half of the 8th cent. AD.

Muslim geographers continued to describe the area's most famous sights, the <White Palace> (Qasr al-Abyad) of the Sasanian Kings of Kings, and the vault ascribed to Khusrau Anushirwan (Taq-e Kisra), which is considered today one the major Sasanian achievements in architecture and one of the most famous monuments in Iraq (Al-Ali 1968–69).

The area of al-Mada'in extends for thousands of hectares about 30 km south of present-day Baghdad and its ancient cities (that can be actually defined as mega-sites in modern terms) shrank to villages only after a long time, having been abandoned one after the other and, sometimes, submerged by the floods of the river Tigris.

When historical research began, the location of the various cities within the area was uncertain and even today is still a matter of debate. Thus, at the beginning of the 19th century, Claudius James Rich could recognize that this was the area where Ctesiphon was founded

1 Quickbird ended its mission life in December 2014. The satellite has been in service for over 14 years, which is nearly three times its initial mission life, and has made an impressive contribution to the extensive knowledge of the world. Quickbird data, dating back to its launch, will remain available for purchase in the archives of the commercial companies that sell its products.

even if he couldn't locate it on the ground (Rich 1836: 404–405), while in 1908 and 1911 Ernst Herzfeld, who visited al-Mada'in after a Tigris flood, misunderstood the location of the ruins of Seleucia (Herzfeld 1920: 50).

3. Archaeological Research

Modern archaeological research in the area (Messina 2015), which immediately appeared outstandingly important for the study of ancient models of settlement in Central Iraq, started after two decades with two major projects.

The first one was the American excavation of the University of Michigan, the Kelsey Museum of Archaeology, Ann Arbor, and the Museums of Toledo and Cleveland, directed by Leroy Waterman, Clark Hopkins and Robert McDowell from 1927 to 1936 (Waterman 1931, 1933; Hopkins 1972), which investigated the mega-site extending south of Tell 'Umar, on the west bank of the Tigris, surely identified for the first time as Seleucia by the finding of seal impressions bearing official stamps of the city institutions in a private archive, inside one of the dwelling-blocks (McDowell 1935). This was followed by the first aerial survey of the area conducted by the Royal Air Force (RAF), which allowed the surveyors to acquire a set of aerial photos that are still a precious source of information.

The second was the German expedition of the Deutsche Orient-Gesellschaft (DOG), the Islamische Kunstabteilung, and the Metropolitan Museum NY, directed by Oscar Reuther in 1928–29 and 1931–32 (Reuther 1930), which investigated the round city crossed by the modern bed of the Tigris, and the areas of the Taq-e Kisra, Al-Ma'arid, and Umm al-Za'atir, further to the north on the east bank of the river. A survey was conducted by Walter Bachmann, who produced what are still considered as the two most important archaeological maps of the area (**figs. 1–2**) in historic archives (Meyer 1929: fig. 2; Reuther 1930: fig. 1).

To those, followed, after decades, the Italian survey of the west bank of the Tigris (Gullini 1966, 1967) and excavations at Seleucia and Veh Ardashir, held by the Centro Ricerche Archeologiche e Scavi di Torino per il Medio Oriente e l'Asia (Centro Scavi Torino) and the University of Torino under the direction of Giorgio Gullini from 1964 to 1976 and 1987 to 1989², which allowed to discover the most important public buildings of the Seleucid capital, such as the archives, the stoa and theatre (Messina 2006, 2010), and one of the workshop areas of the round city in front of Seleucia, surely identified as the Sasanian capital, Veh

2 Preliminary reports on the Italian excavations were published by G. Gullini, G. Graziosi, A. Invernizzi, M. Negro Ponzi, P. Schinaia, R. Venco Ricciardi and E. Valtz in the journal *«Mesopotamia»*, issues 1–12 (1966–1977) and 21, 23, 25 (1986, 1988, 1990). A synthesis was proposed both by Gullini 1966 and Invernizzi 1976. *«Mesopotamia»* indexes and complete bibliography are available on the website: www.centroscavitorino.it.

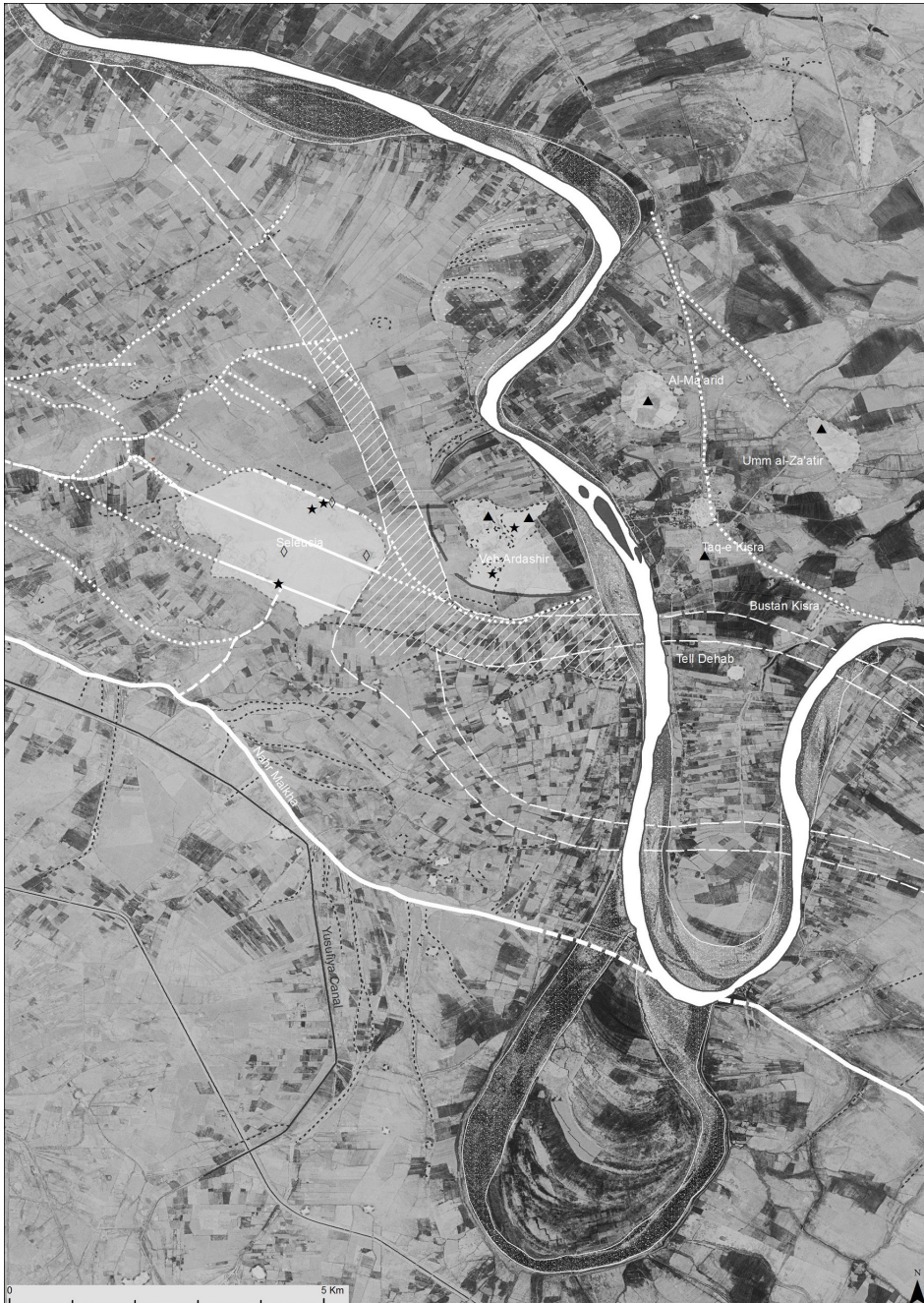


Fig. 1. Multi-temporal elaboration including Bachmann's 1928–29 map, 1969 Corona image and present interpretation. Triangles indicate German excavations, lozenge American excavations and stars Italian excavations. Continuous lines define degree 3 features, dotted lines degrees 2 and 1 features.



Fig. 2. Multi-temporal detail of the Seleucia and Veh-Ardashir's area, where Bachmann's 1928–29 map and 1969 Corona images are superimposed using RPCs approach.

Ardashir, by the finding of Ardashir I's coins below the foundations of the s.-c. «Artisans' Quarter» (Venco Ricciardi/Negro Ponzi 1985).

These field researches allow us to recognize at least three mega-sites, two on the west and one on the east bank of the Tigris (Seleucia, Veh Ardashir, and Asbanabr, or the s.-c. «Sasanian Ctesiphon», built around the Taq-e Kisra, but particularly further to the north), as well as to date the major phases of occupation of two of them (Seleucia and Veh Ardashir). Furthermore, a huge amount of data were collected that can be briefly summarized as follows:

- Seleucia was founded at the very end of the 4th cent. BC and progressively abandoned from the second half of the 2nd cent. AD, having been affected by Tigris floods, as attested by the way some of its collapsed monuments were partially re-used (at the end of the Sasanian period) and pillaged in the Islamic period, probably with the aim of re-using resulting materials during the foundation of Baghdad;
- Veh Ardashir was founded in the period of Ardashir I on the area of a cemetery dated to the 2nd cent. AD and covered by alluvial deposits resulting from river floods, having been reduced in size in the Islamic period, even if its occupation continued up to the 13th century in its central and most elevated part, in the area of Baruda;
- The large area on the east bank of the Tigris, including the Tak-e Kisra, Al-Ma'arid and Umm al-Za'atir can be interpreted as a mega-site of the late Sasanian period, in which urban spaces alternated with unbuilt areas or gardens. It is unknown if it grew on a more ancient site of the Parthian or preceding periods, but this is considered very probable by many scholars.

Subsequent ground surveys and landscape studies, such as those made by P. J. M. Fiey (1967a, 1967b), A. Oppenheimer (1983), G. Gullini (1966) and, more recently, M.M. Negro Ponzi (2005) and S. Hauser (2007), who particularly focused on the changing watercourse of the Tigris and the possible location of those sites still unidentified on the ground (such as Parthian Ctesiphon), were primarily based on the analysis of the abundant ancient literary sources and, particularly as far as topography is concerned, on the excellent work made by Walter Bachmann, which can be even more appreciated for its precision when compared with modern satellite imagery (**fig. 1**).

However, all these pioneering studies took into consideration the results of the American, German and Italian fieldworks only to a limited extent, sometimes neglecting excavation data. For instance, the fact that the Tigris changed its course two times from the Hellenistic to the late Sasanian period is postulated by many scholars particularly on the basis of the interpretation of some records in the Babylonian Talmud and Syriac Christian sources (Fiey 1967a: 37; Oppenheimer 1983: 233; Negro Ponzi 2005: fig. 7), notwithstanding that the trace of only one paleoriver was surveyed by Bachmann on the ground (Messina 2015: 103–104).

Moreover, the network of exhausted ancient canals, recognized by Bachmann, and still visible in aerial photos or satellite imagery, was not taken into consideration, with the only exception of the «Nahr Malkha», the famous royal canal that joined the Euphrates to the Tigris in ancient times.

4. Cartographic and Remote Sensed Data Organization

A multi-temporal approach was followed with the purpose of retracing the transformations of the area.

During the data acquisition the research was organized according to the following schema: first of all, an accurate bibliographic research was performed in order to collect all the published maps, such as those by Bachmann (Meyer 1929: fig. 2; Reuther 1930: fig. 1), Fiey (1967a: 37), Oppenheimer (1983: 233), Gullini (1966: pl. 1), and Negro Ponzi (2005: fig. 7); thus, the archive of the Centro Scavi Torino was analyzed in order to acquire all the available documentation concerning photogrammetric flights, topographic maps and remote sensed data; finally a complete web research finalized to find old images (Corona 1968–1969), digital elevation models (Aster and SRTM³), and recent remote sensing data – one archive's 2005 Quickbird image and two Word-View 2 images were purchased – was performed in order to acquire complete information on the area.

After the data acquisition, all information was harmonized in a GIS software for obtaining a complete cartographic geo-database: this is a fundamental support for remote archaeological analysis. Given that the harmonization of several spatial data could be performed only with a common system, a reference map was realized. For this purpose Quickbird scenes of the area were processed: first of all the Pansharpened⁴ image was realized, then, using the Rational Polynomial Coefficients approach (RPCs), the orthophoto was realized. The RPC model uses ratios of cubic polynomials to express the transformation from ground surface coordinates (latitude, longitude, elevation) to image coordinates (line, column) for the particular input image. The coefficients for the rational polynomial model are supplied in an auxiliary file with each RPC image kit. Using this approach, the use of a DEM (Digital Elevation Model) is also necessary for rectifying the image and obtaining an orthophoto of the area.

3 Shuttle Radar Topography Mission.

4 A pansharpened image is a colored high-resolution image derived from the merging of a panchromatic high-resolution and lower resolution multispectral image.

The Quickbird orthophoto was employed as reference map for all the other data. With the exception of the WorldView 2 image that was processed using the RPCs, all employed information for the multi-temporal analysis was processed using as reference the Quickbird orthophoto by means of traditional rubbersheeting procedures, implemented in the employed GIS software (ArcMap ESRI).

The achieved results supply a complete and updated geo-database of the area that was accurately analyzed for the evolution hypothesis reported in the next section.

The cartographic products implemented in the GIS were:

- Bachmann's maps (1928–29);
- Fiey's map (1967);
- Oppenheimer's map (1983);
- Gullini's map (1966);
- topographic map of Seleucia on the Tigris (1963–64) in the archives of the Centro Scavi Torino;
- RAF aerial images (1936) in the archives of the Centro Scavi Torino;
- Corona (1968–69);
- Quickbird (2005);
- WorldView 2 (2009–12).

As mentioned above, all these data were georeferenced using the Quickbird orthophoto. According to the international standard, the employed projection was the Universal Transverse Mercator (UTM): the analyzed area is in the fuse 38 North.

5. Data Interpretation and Hypothesis

Basing on the data available, an accurate photo- and bibliographic interpretation of the area was performed. The interpolation of topographical, surveyed, remote sensed, and archaeological data allowed us to verify the reliability of the traces recognized by us and other researchers, and propose the following classification:

- features identified by photo-interpretation, surveyed on the ground, and attested by excavation can be considered sure (degree 3);
- features identified by photo-interpretation and surveyed on the ground can be considered very probable (degree 2);
- features surveyed on the ground can be considered probable (degree 1);
- features identified only by photo-interpretation remain undetermined until they can be compared with other information (degree 0).

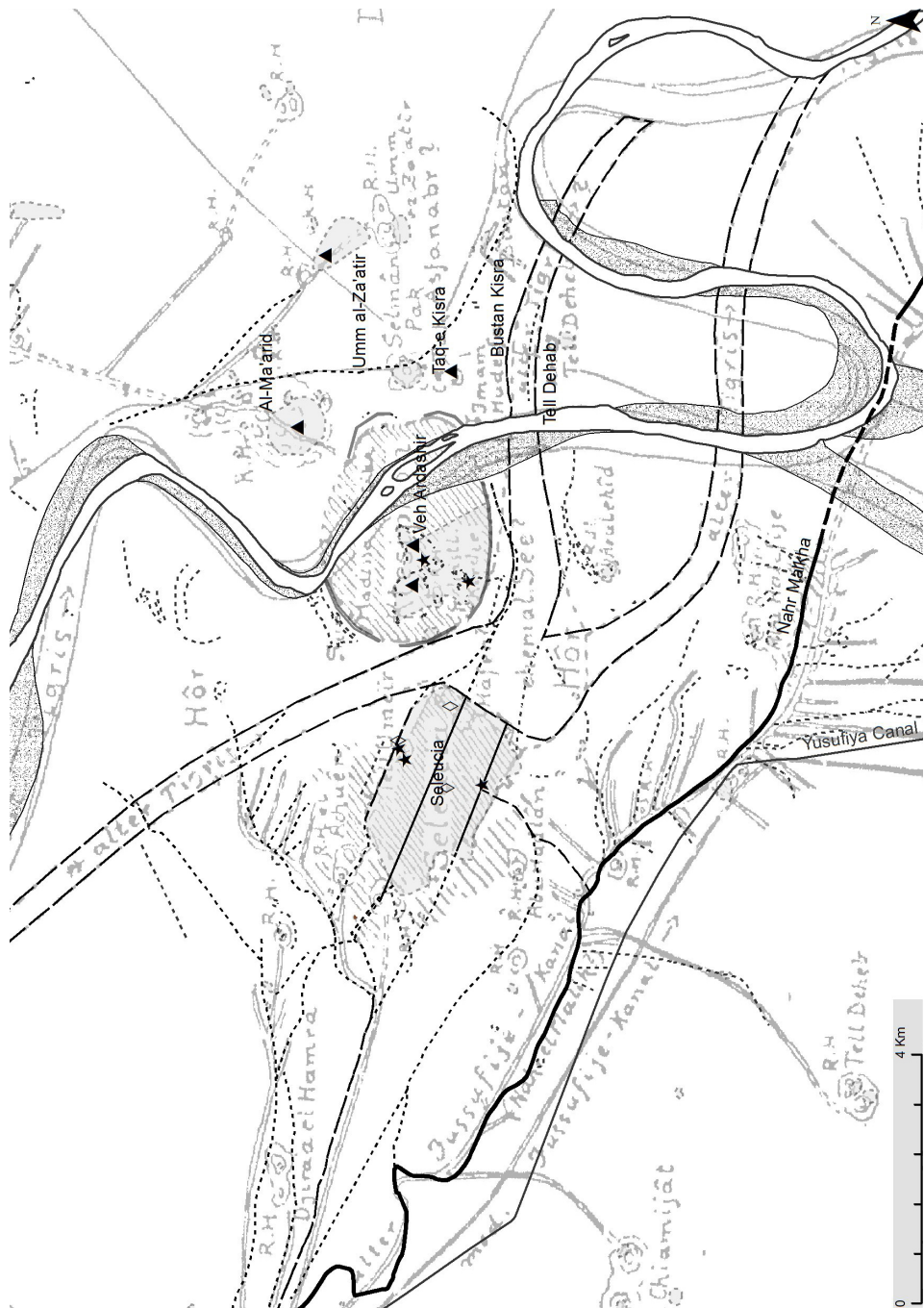


Fig. 3. Multi-temporal map elaborated fusing Bachmann's map and photo interpretation (see legend to fig. 1).

On the basis of the Bachmann's maps, RAF aerial photos, and World View 2 imagery, it seems for instance very probable that the Tigris flowed west of its present bed, closer to Seleucia, in the Hellenistic and early Parthian period (degree 2), for the branch of a paleoriver was not only surveyed on the ground by the German expedition in 1928, but also appears in 1937 aerial photos (**fig. 3**). Given that the date of this shifting is secured by the lifetime of Seleucia and no other paleorivers could be seen east of the present Tigris bed, the fact that it changed its course only one time since the late Parthian period, as supposed by Bachmann himself and confirmed by Gullini (1966: pl. 1), seems more probable than the hypothesis of a double shifting, exclusively based on the interpretation of some indirect literary sources. The maximum degree of reliability (degree 3) can be attributed to the phenomenon of progressive shifting of the three ancient canals clearly visible in maps, aerial photos or satellite images, which origin from a branch of the Nahr Malkha and run, from west to east, through the area in which Seleucia was founded (**figs. 1, 3**). Given that stratigraphic trenches were opened by the Italian expedition on each of the canals and that their course was surveyed and also detected by geomagnetic survey – the first conducted in the area in 1967, as far as we know (Lanza et al. 1972) – we can affirm that the south canal predates the foundation of the city, for it was artificially filled by layers of sediments with the purpose of transforming it into a large street, the central canal is contemporaneous to the city's lifetime, for its banks are in stratigraphic correlation with the urban layout, and the north canal, which is much more narrow than the others, was dug in the Islamic period, supposedly for irrigation, as the materials found in its deposit even 4 m below the present surface clearly attest (**fig. 4**).

The canals' progressive shifting, which passed unnoticed even in modern studies, must be related to human activity and is one of the results of the impact the foundation and decline of Seleucia had on the area.

Human activities were also devoted to the prevention of the Tigris floods and the control of the watertable's dynamics. Tigris floods have been repeatedly registered in modern and present times, having transformed the area into marshes (as witnessed by Ernst Herzfeld in 1911), caused the collapse of the left half of the Taq-e Kisra façade in 1888, and submerged cultivated fields many times. Floods can be postulated also in antiquity, however, for they caused the collapse of the theatre of Seleucia at the beginning of the 2nd cent. AD, originated the alluvial deposits that were reached by the Italian excavation below the foundations of Veh Ardashir in the second half of the 2nd cent. AD, and the ebb deposits on its south-east curtains in the 5th cent. AD.

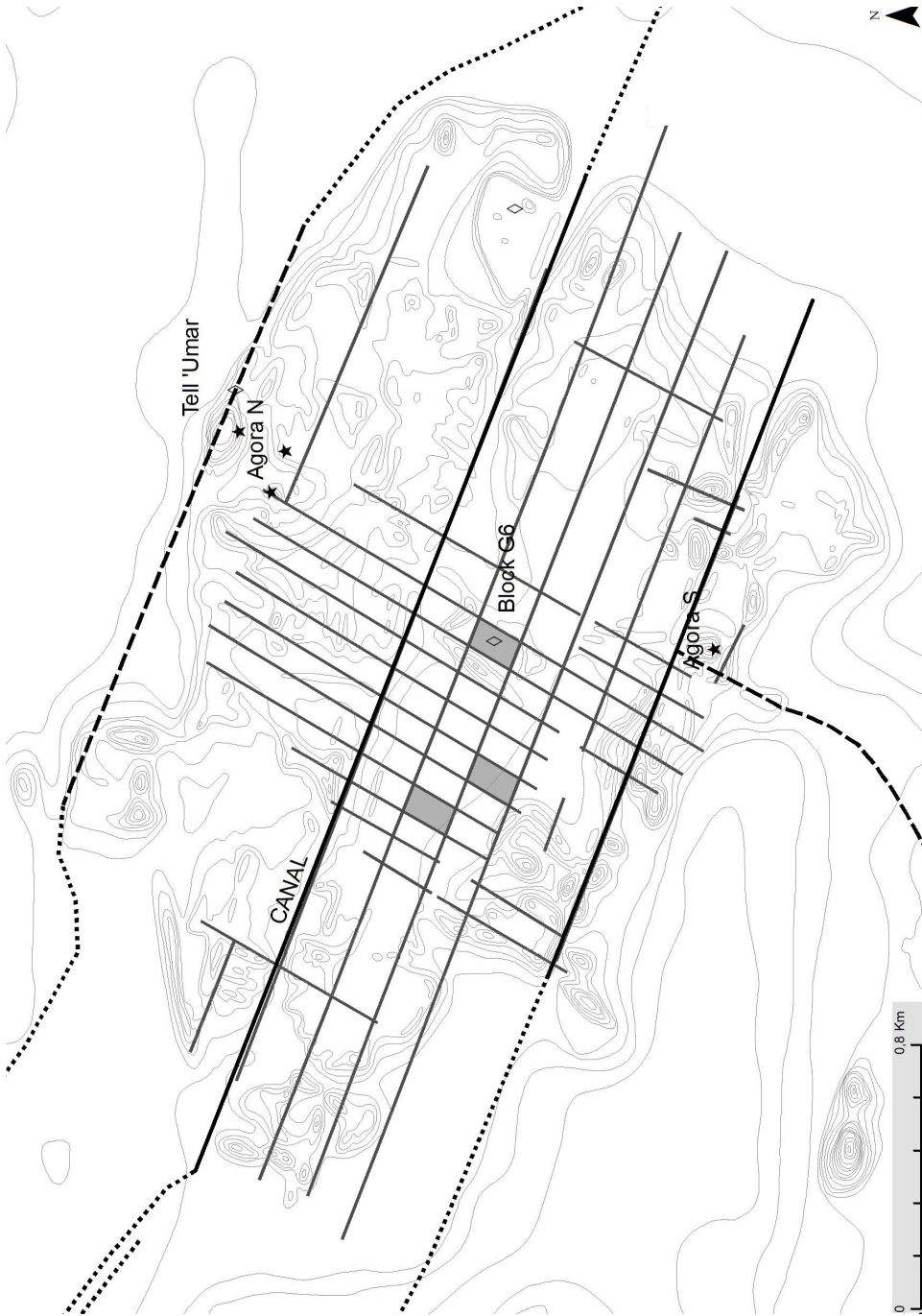


Fig. 4. Multi-temporal map of the area of Seleucia, including contours extracted from achieved topographic maps of the Italian expedition and interpretation (see legend to fig. 1).

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