

## **Contribution of geophysics to research on city planning in the ancient and classical Near East**

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The study of ancient city planning in archaeology requires information over wide surfaces to understand the main characteristics of urban layout and the spatial organization of the social, cultural, economic and political city networks and their evolution through time. Until recently, our knowledge of the cities of the ancient Near East was based mainly on huge excavations carried out during the first half of the 20th century. These excavations revealed significant parts of different city quarters, as in Dura-Europos (Rostovtzeff 1938) and Ugarit (Yon 1997) in Syria, but they were also often poorly documented in terms of keeping proper records of the stratigraphy and excessively approximate periodization of the different phases of occupation. Excavations in past decades have produced more efficient data, partly making up for the shortage of data from the old missions. But meticulous excavations of this kind cannot be applied over big areas, making the study of the urban situation problematic.

The development and evolution of geophysical tools appeared like an ideal way of exploration to acquire new data and to 'dust' the information from old excavations. For more than twenty years different geophysical methods have been used to retrieve occasionally very impressive results

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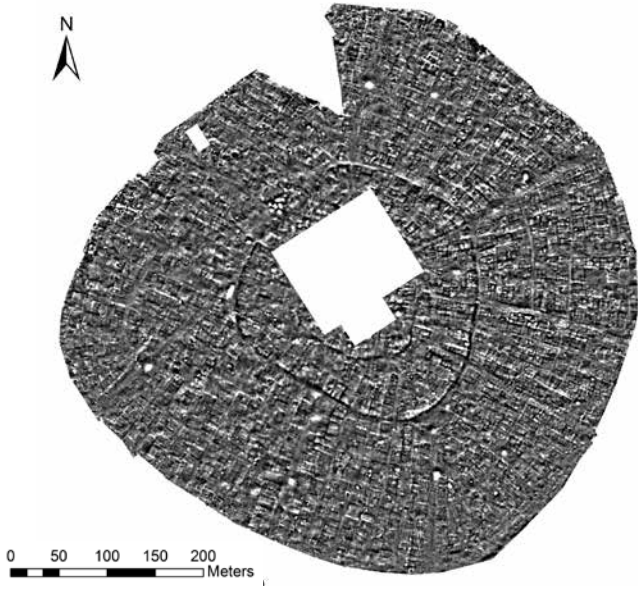


Fig. 1. Example of radio-concentric city planning; magnetic map of the Early Bronze Age site of Tell Sh'airat (Syria) (scale white/black -10/+10 nT/m)

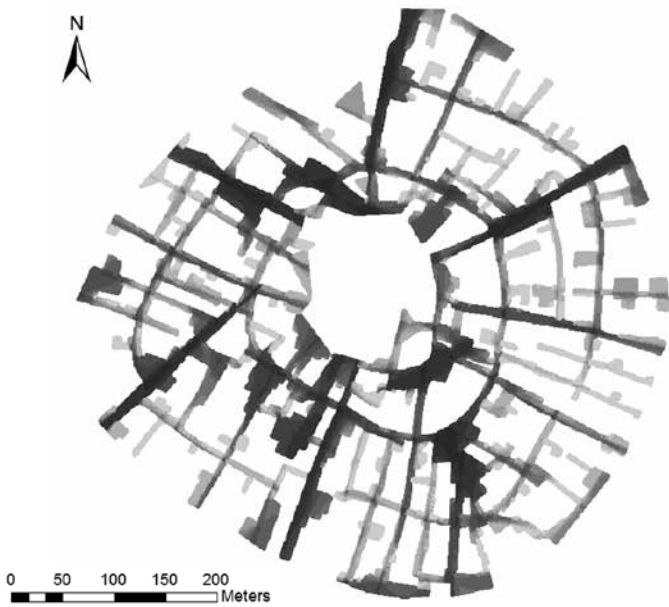


Fig. 2. Visibility Graph Analysis of the street network at Tell Sh'airat (Syria) (scale min white/max black)



Fig. 3. Example of orthogonal city planning: magnetic map on the site of Apamea on the Euphrates (Turkey) (scale white/black  $-10/+10$  nT/m)

about the spatial organization of the ancient cities. In the Near East, this has touched on two periods representing significant phases of urbanisation of the region: firstly, the Early Bronze Age with the development of circular cities in Northern Syria and at the limits of the arid margins to the west, known as the second urban revolution of the region (Akkermans *et al.* 2002), and secondly, the Hellenistic period after Alexander's conquest, with the diffusion of an orthogonal city-planning model inspired by the Hippodamian plan, which had appeared in Asia Minor in the 5th century BC (Martin 1974). Impressive results have been obtained on numerous sites like Tell Chuera (Meyer 2010), Tell al-Rawda (Gondet and Castel 2004) for the Early Bronze Age or Apamea (Gaborit *et al.* 1999), Dura-Europos (Benech 2007), Cyrrhus (Abdul Massih *et al.* 2009), Palmyra (Becker and Fassbinder 2001) concerning the Hellenistic foundations. These geophysical maps have undoubtedly changed the perception of these cities and have helped to contextualise the old excavations in the overall spatial organisation of the urban layout. They have also changed archaeological excavation strategies to locate more precisely forthcoming digging projects designed to confirm and understand what the geophysical maps have revealed.

However, all these geophysical surveys have also generated substantial documentation of city planning, which is far too big to be properly explored and validated by excavations. Essentially, specific tools of analysis need to be developed for documentation that may not necessarily be validated by archaeological digging (Johnson 2013). The question is, therefore, to what extent these surveys have actually changed our knowledge of different models of city planning and

whether there are new research methods, inaccessible to the traditional approach of excavations or field survey, that can be developed specifically in agreement with the nature of the geophysical data. For instance, different protocols of spatial analysis have been applied for this purpose, depending mostly on the quality of the geophysical data (Paliou 2014) and they have brought variable results in different geographical areas and historical contexts.

For almost twenty years now, the use of the space syntax tools has met with a growing interest in archaeological studies, particularly with regard to domestic space (Brusco 2004; Grahame 1997; Westgate 2007). This kind of analysis, based on a visual perception of space, was particularly adapted to the nature of the geophysical data, but Spacial Syntax has also proved a powerful tool for the study of street networks, once they are clearly traced on a geophysical map, emphasizing street hierarchies deriving from their spatial accessibility (Benech 2010). The “more traditional” methods of space analysis are also a viable tool for the study of the evolution of historic towns (Arnaud 2008), allowing the evolution of the cadastral plan to be studied. Tools of this kind highlight the main steps of the evolution of analysis of city planning based on a 2D map.

In the case of the Ancient Near Eastern cities, it is interesting to review the situation concerning the progress in our knowledge of city planning from the Bronze Age to the Classical cities and to evaluate the contribution of the geophysical survey in this domain.

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