

Multimedia Technology in Cartography as a tool for Archaeology

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Abstract. The aim of this research is to develop new methods of co-operation between cartographers and archaeologists by applying the latest developments in instrumentation, surveying methodology and information management. The proposal is based on two approaches. Firstly, to provide the archaeologist with precise digital maps and networks applicable to any excavation by applying GPS, and integrating this into the national and international co-ordinate systems. In order to represent archaeological phenomena in a geographical area, it will be necessary to link these nets to the national or international geodesy. Our project analyses the accuracy and possibilities of the methodology. The aim of the second approach is to investigate the design and to create mapping documents that contain the archaeological information in two different formats: a digital format for multimedia interactive applications and hard copies for general use.

Keywords: Survey methodology, cartography and archaeology.

1 Introduction

The research project we are working on has its origins in the excavation work by the archaeological team of the Ancient History Department of the Universidad Autónoma de Madrid. They are the main excavators of the site of Tuqueibah in the United Arab Emirates. A settlement has been found at this site dating to 2000 bc. which would challenge the established theories of nomadism in this area. It is one of the first settlements on a trade route from India to the towns of Petra and Alexandria, along which many products important in that period were transported.

This research and the historical reconstruction in that geographical area, required plans of the settlement and the surrounding fields, in order to discover new ways of excavating and to experiment with electrical resistivity techniques as well as with ground penetrating radar. We have had to choose between several different scales to analyse the kind of detail required, and to familiarize ourselves with the archaeologists' way of sketching, and their way of excavating. We were thus part of a multidisciplinary team with the aim of obtaining cartography.

For our survey, we placed four marked control points. The data were obtained with a Leica TC 1610 station. The work in the field was done by using triangulation and trilateration with mutual and simultaneous visual control of the atmospheric refraction. We began with a scale of 1/100 of the site, and the altimetric details were converted to contour lines at every 10 centimetres.

Often an investigation is initiated by some facts arousing our suspicion or curiosity, which then lead us to find more data about the matter. In our case we were inspired by the thought: Is this all that we, specialists in cartography, surveying and geodesy, can offer archaeology?

We have spent three years on this investigation and have another five years ahead of us, as a new agreement of collaboration is soon to be signed. We can count on strong moral help from the archaeological world and we have great hopes that we will be able to realize our aim: to show all archaeologists the great possibilities of our technology available to them.

Our project is called the Sharjah Project: Landscape, Geodesy, Surveying, and Cartography in Archaeology.

Our work includes documentation of the general location of the sites and excavation areas, to analyse the archaeological systems, and to improve the processing of information. In this paper we will show two important points of view.

2 Cartographic Mapping

Our aim is to give the archaeological teams accurate cartographical documents to use. We want to show them how digital cartography can become the basis of their information gathering. We have met with archaeologists and technicians of the excavation teams who can do the basic surveying of a site for which they do not require specially qualified staff. They use basic surveying methods for short distances, and they are also familiar with total stations. But when the area is large, they encounter problems when they want to show the relationship between different sites, which would help them in the historic reconstruction of the period.

In order to solve this problem, we decided in 1997 to establish micro-nets in the excavation areas in the Yebel Buhaish mountains and to link these to the ones in Tuqueibah, using GPS technology (figs. 1 and 2).

A large part of our work consists in preparing the campaigns for unknown fieldwork. The general design of the project is made in Madrid, but it is in the Emirates where we are really confronted with the dimensions of the work and where we develop new solutions for the tasks in hand. We of course have our basic working

methods but at the same time we must resolve any problems which may arise during the campaign. It is, for instance, necessary to collect a great number of data which provide us with enough redundancy to have confidence in the results.



Fig. 1. The Leica TC 1610 total station



Fig. 2. GPS in the field

As we have mentioned earlier, there are two aspects to our work, the first of which is to supply accurate cartographic material to the archaeological teams. In this line we have made documents at scales of 1/50, 1/100 and 1/500, in 3D representation. Following are some images from Recopolis, in Spain, which will illustrate our methodology (figs 3 and 4).

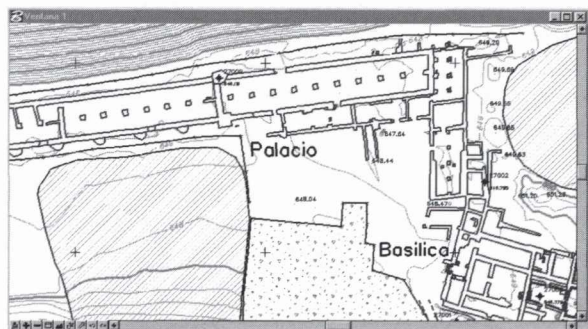


Fig. 3. Palace and church in Recopolis, Spain

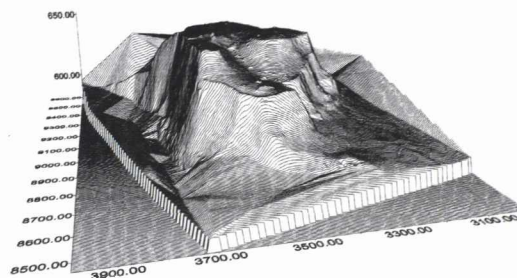


Fig. 4. 3D representation Recopolis, Spain

We also process the cartography to generate maps of the general lay-out and apply these to archaeological area of Al-Madam. At the moment we are working on one main map of the Emirate of Sharjah which should enable us to enlarge the area of site in the next campaign. The original documentation was given to us by the Department of Culture and Information, and consists of 8 maps of 0.8 x 3.20 metres in UTM projection at a scale of 1/25000 feet, equal to 1/6250 in metres. This documentation dates from 1992. The origin of the heights is sea level in Dubai, and the whole area lies in zone 40.

By digitizing the maps, we have obtained a topographic map of the Al-Madam area at a scale of 1/50,000. On this we have projected the archaeological sites and the graves, using the coordinates of the control points which were obtained by GPS in the 1997 campaign (fig. 5).

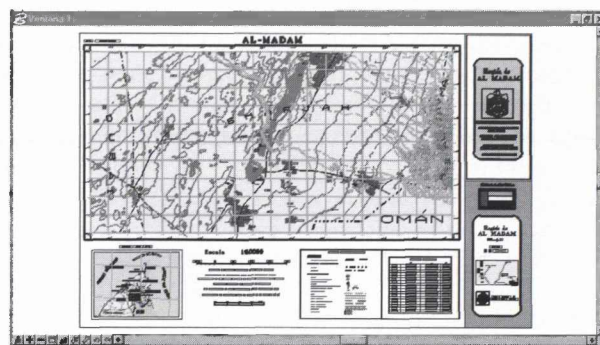


Fig. 5. Topographic map of the Al-Madam area, Sharjah

In 1998 we took the data into the field for a comparison with the real situation and to make any necessary updates. The first aim of the survey in the field was to get the right interpretation of the drawn details. The area of the map covers a surface of 40 x 20 kilometres. In the United Arab Emirates we were surprised by the speed with which geographical changes take place, and by the fact that details which for us were a constant, were no longer there. The geography is shown here as a dynamic science to which the cartographers with their modern technology could have much to offer (fig. 6).

We must be prepared to interpret and show all the morphological information through our cartography.

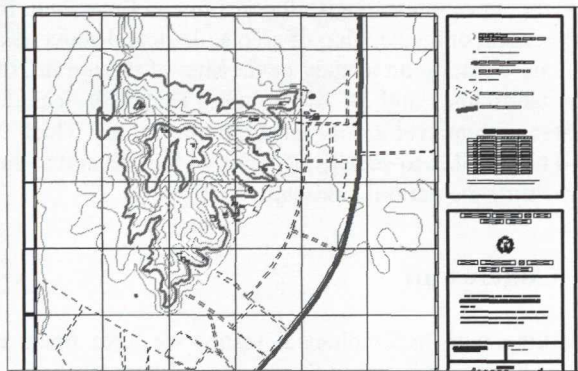


Fig. 6. An example of a topographic map

3 Cartography as an aid to the general public

We hope to create cartographic models which could help in the dissemination of archaeological information. When the cartographical maps are finished, we would like to work on the design of symbols and all other components of a map or plan. This new document has two aims, depending on the format of the output:

- on paper: as data to be circulated in museums and documentation centres.
- in a digital format: to be used as experimental games on computers as a basis for multimedia applications.

An example of our aim is shown in the figure below. We are trying to make maps which show both the sites and the Archaeological Museum of Sharjah. The data which were used to make these maps come from the Atlas of the Emirate of Sharjah, from photographs taken in situ, from images on the Internet and from tourist information supplied by the Emirate and its Embassy in Spain (fig. 7).



Fig. 7. Archaeological and cultural map of Sharjah

On the tourist maps of Sharjah (fig 8) are included three-dimensional images of buildings which have a

certain cultural historical interest. These and other images which could improve the cartography, should make the document more attractive to the general public.

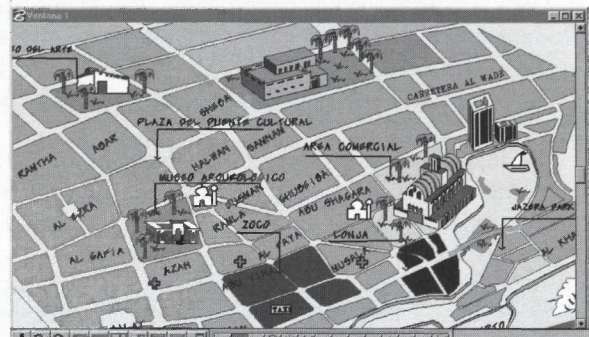


Fig. 8. Tourist map of the city of Sharjah

Through cartographic processing we want to recover the informative and valuable typology of the old cartography with modern technologies and thus create new designs.

The cartographic models of dissemination have two main archaeological elements:

- the sites
- and the objects located on these sites

For a detailed description of the archaeological objects, we are comparing the results obtained photogrammetrically and as a photographic representation. For the photogrammetric method, we have used non-metric cameras and have obtained three-dimensional views with millimetre accuracy of the details. The non-metric cameras were less expensive but they required more control points. This methodology has been applied to a part of a column from the 18th century in Spain, as an illustration.

By photogrammetry, we took points and lines generating triangles with program MGE Terrain Analyst of Intergraph. We assigned textures and illuminations with Microstation, and finally we created as an example a three-dimensional anaglifque view with Render Stereo 3D, which allowed us to observe the volume with special glasses. In addition, we have made a film, from one previously defined trajectory with Microstation 3D, and have included it in the multimedia application.

For a description of the architectural structures of the sites, we are using classic surveying methods and photogrammetric technology. We are already applying this process in our local project on the site of Recopolis in Guadalajara, Spain:

- To obtain one virtual model of the Church of Recopolis,
- To create a three-dimensional model of the archaeological ruins of a palace and its surroundings by topographic techniques.

In our general design of the cartographic model, we have also taken into consideration the possibilities which the Internet offers. Nowadays many people are using the Internet, and it provides a good opportunity to offer new products such as cartographic documents. As an example, we have created a model consisting of one webpage with text, images, graphics and links. With this approach we think that cartography will enter the 21st century.

The maps consist of images in which are defined some active areas associated to links. If the icon is placed over one of these areas, a concrete page will be supplied by the server. The regular references and links will make the navigation system easier for the public. We are showing that access to the maps is made by clicking on icons (images in GIF format) which will show an index of all the information that can be accessed. We have also tried to make the webpage exciting for anybody interested in the geographical area shown. We think that with this webpage we will be able to transmit archaeological data, and information on the sites and the museums of Sharjah, by taking advantage of the sources of actual cartographic technology, mixed with the opportunities the Internet provides.

Another focus of our research is the link between the environment and archaeology. We are taking part in the teams of development and environmental control investigation, which are involved in every territorial intervention.

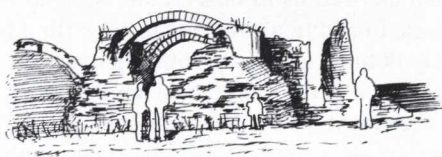
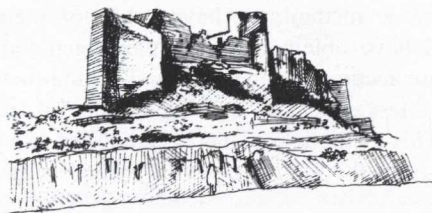


Fig. 9. The palace and church of Recopolis, Spain

We are in the process of preparing a design for the site of Recopolis (Spain) (fig. 9) for which also a thematic scheme is applied, with a main cartography to a scale of 1/1000, showing the application of the concept of an archaeological environmental park. The idea is to show the spread of cultural traditions and the way of life of a

settlement in relation to its direct surroundings. This way the landscape, relief, flora and fauna of the place may be more interesting to the visitors and may help in the general understanding of archaeological discoveries. We are working on a study of the site, of the terrain, of the landscape, and of the routes. That will include routes with arrival and departure points, along which it will be possible to see the elements of the site and at the same time the natural landscape.

4 Conclusion

Working with archaeological teams, we have found a clear difference between the manner of investigation in experimental sciences and the technology used by the humanities. For an engineer it is possible to study, analyse and improve the technology and methodology but these are not usually applied to another subject, especially not archaeology.

Our aim is not remain surveyors or cartography specialists at the beginning of an excavation but to create ways of supplying a general treatment of the cartographic documents of the discovered elements. The subject of our study is the archaeology and the object is the application of the Geodesy, Surveying, and Landscape and Cartography technologies. We are talking about remote sensing, photogrammetry, gravimetry, all kinds of surveying techniques, cartographic design, application of GIS to the information, geodesy, application of GPS, basic sketching, and lastly drawing and editing. We are certain that with all these we can make a contribution to archaeology.

Acknowledgements

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