SEISMIC ACOUSTIC RESEARCH APPLICATIONS ON THE ARCHEOLOGICAL SITES IN SUBMERSIBLE ZONES

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Abstract. In Romania, geophysical methods are normally used to estimate the distribution of cultural relics, before digging. Objects of archeological interest are usually located within a few meters of the surface. The equipment belongs to the seismic –acoustic reflexion systems category and it is generally employed for the detailed investigation of the submersible sediment structure. A great contrast of acoustic impedance and therefore a correct identification of reflexion occur when in the sediment mass there are some bodies with acoustic impedance thoroughly different from that of the sediments, like in the case of the archeological buildings.

Keywords: acoustic impedance, vertical resolution, frequency modulation, ancient cities

INTRODUCTION

Some of the oldest fortress-type settlements are Greek colonies in Dobrogea, really considered the most ancient cities in Romania (*e.g.* Argamum, Histria, Tomis, and so on). In the last flourished period of the Roman Dobrogea, between the 4^{th} – 7^{th} centuries A. D., the fortifications along the Danube were strengthened, and other fortresses were built inside (*e.g.* Ulmetum, Argamum, Petra). The last fortress is considered the first antique settlement in our country, as it was mentioned by an antic literary source (Barnea 1976).

In Romania, geophysical methods are normally used to estimate the distribution of cultural relics, before digging. Objects of archeological interest are usually located within a few meters distance from the surface.

Seismic–acoustic research was made with specific equipment ("X-Star Full Spectrum Sub-bottom Profiler") which works with frequency modulation in the range of 2-16 Hz. The vertical resolution of this system is better than 1 decimeter.

The research has been performed in turbo mode with 12 emissions of signal/sec. In order to reach the archeological research objectives (identification of some, presumably 1 meter wide walls).

Data have been recorded on thermic paper as depth sections on which the GPS format position information have been noted. The location where the measurements were taken has been noted. That location has been performed with a Global Positioning System, Sercel type – NR. 109 GPS.

METHOD

The equipment utilized belongs to the seismic-acoustic reflexion systems category and is regularly used to investigate in detail the submersible sediment structure. In a vehicle, pulled by the boat with the collecting data system, there is the seismic source. This produces the mechanical acoustic waves which excite the medium. Beside the source, there are the receptions elements (hydrophones group) which catch the compression wave reflected by the interfaces from the analyzed medium. Those interfaces separate domains with different acoustic impedances. The catched signal is counted and processed in order to be graphically represented as seismic acoustic sections of reflexion. Those sections follow the structure of the acoustic impedance contrasts of the analyzed medium. The method is based on the reflexion capacity of the interfaces separated by different granulometer types which form marine, fluvial and other type of sediment mass.

The physical parameters which condition the identification of interfaces in the seismic acoustic sections of reflexion are the contrast of physical properties, namely, the speed of the mechanical waves used to excite the sediments, as well as the density of the mass crossed by the mechanical waves produced by the seismic acoustic source.

A great contrast of acoustic impedance and therefore a correct identification of reflexion occur when in the sediment mass there are some bodies with acoustic impedance thoroughly different from that of the sediments, like in the case of the archeological buildings.

In the archeological submersible the vertical resolution (1/4 of the average length wave of the seismic – acoustic used source) of the used equipment is sufficient enough (that is, a minimal high of 10 cm of a submersible wall).

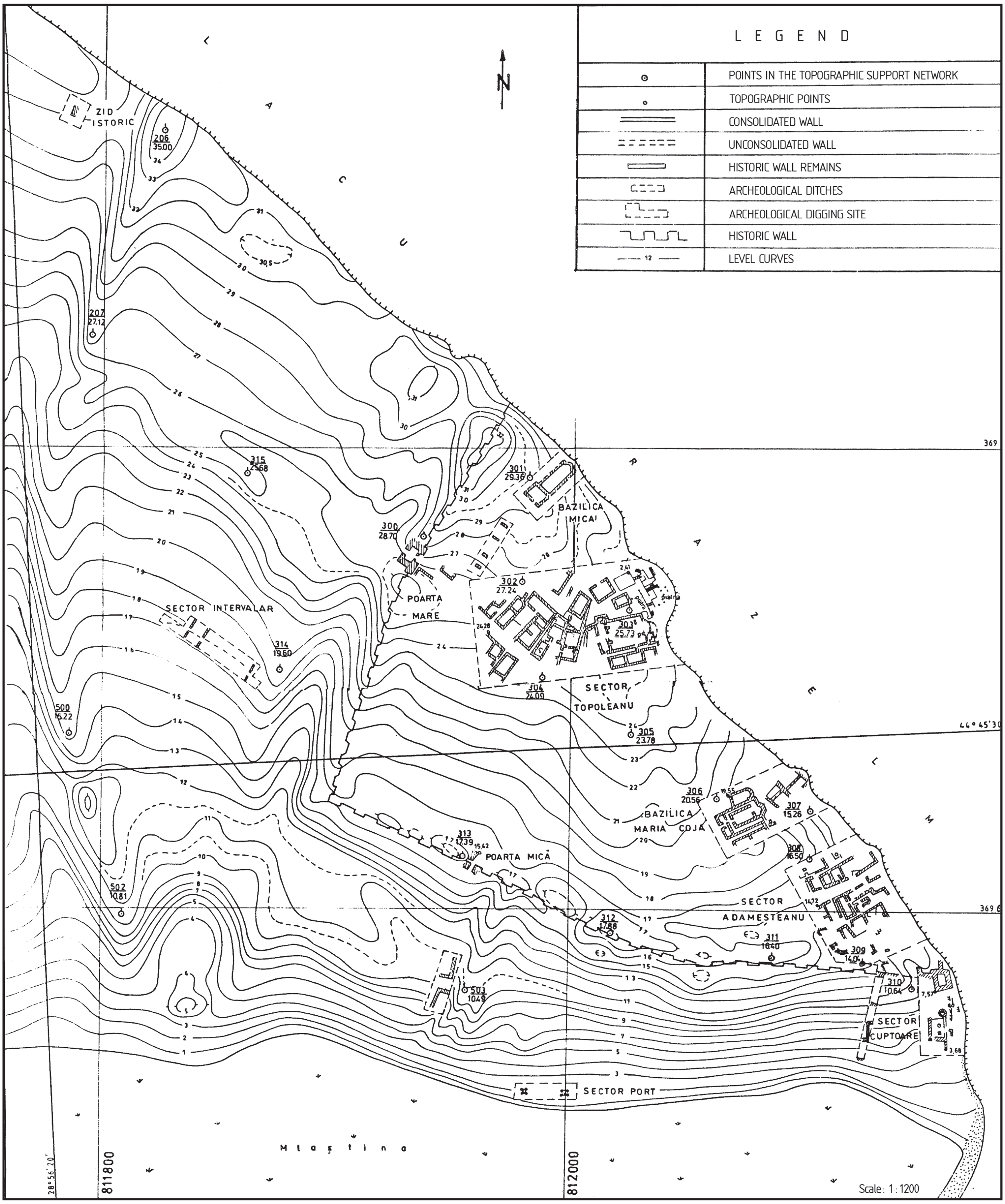

Fig. 1 The topo-plane of Argamum archeological site (*acc. to* M. Malageanu)

METHODOLOGY

The approximate length of the defense wall along the Dolosman promontory cliff is 315 m (Fig. 1).

Seismic acoustic works have been projected in order to perform profiles parallel to the coastline in the Argamum fortress zone, at an equidistance less than 10 m, which renders possible the interception of some probable ancient buildings inside the Razelm Lake (Fig. 2).

The configuration of the Dolosman promontory cliff indicates past and present erosion of this. In the Figure 3 is a reconstruction of this unchanged configuration. A first element isolated on seismic acoustic sections is presented in the Figures 4 and 5; this element could represent a part of some antique building which resisted erosion.

CONCLUSIONS

The interpretative elements identified on seismic acoustic registered sections can represent parts of small dimensions of some antique buildings which resisted erosion, but which do not evidently group themselves in the coherent elements to suggest the presence of some antique complexes.

The seismic acoustic works were prospected to be made in the form of some profiles almost parallel to the coastline in the zone of Argamum fortress, at a distance smaller than 10m, in order to find possible antique submersible buildings in the Razelm Lake.

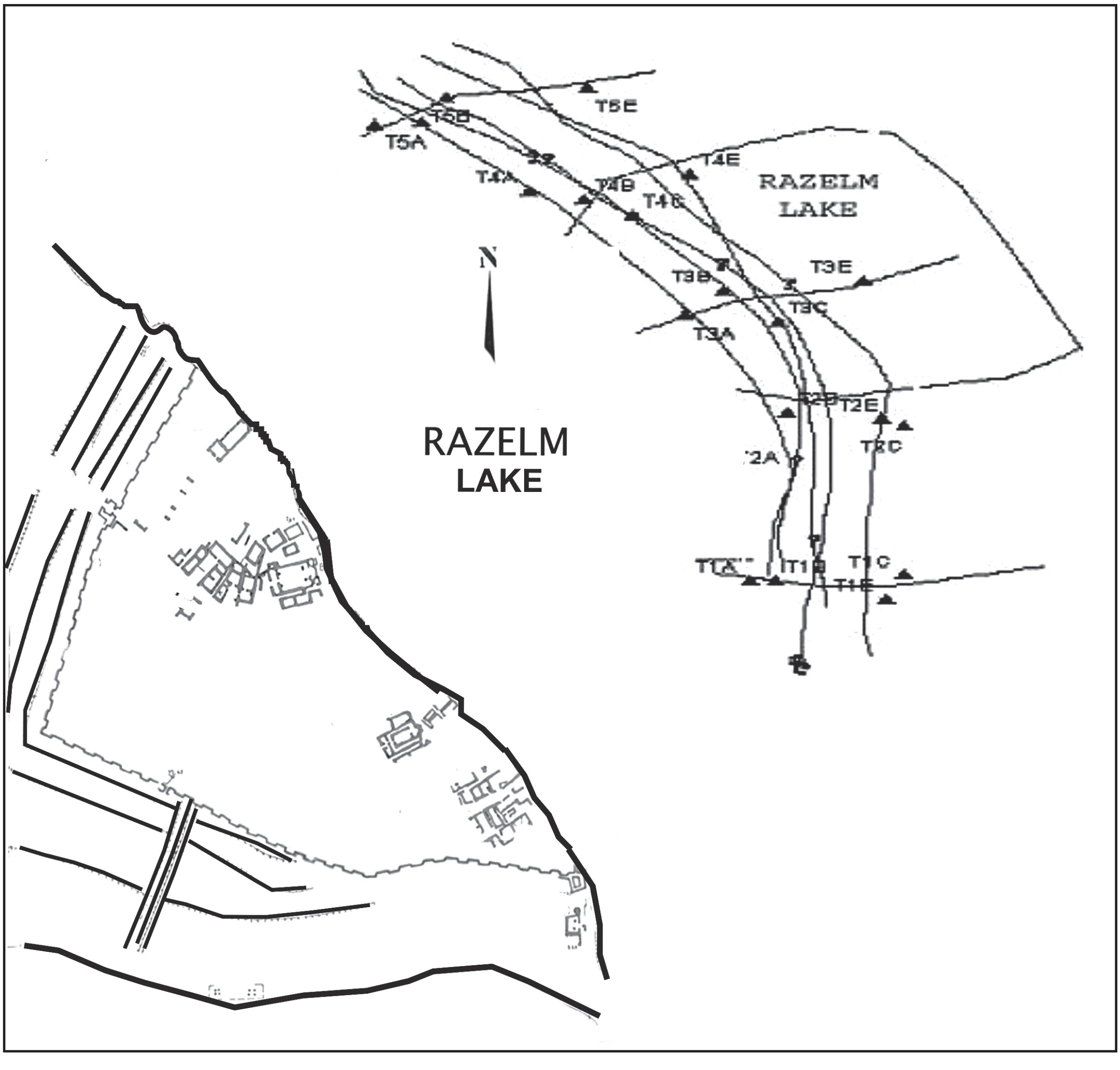

Fig. 2 The plane of seismic acoustic profiles and the interpretative elements

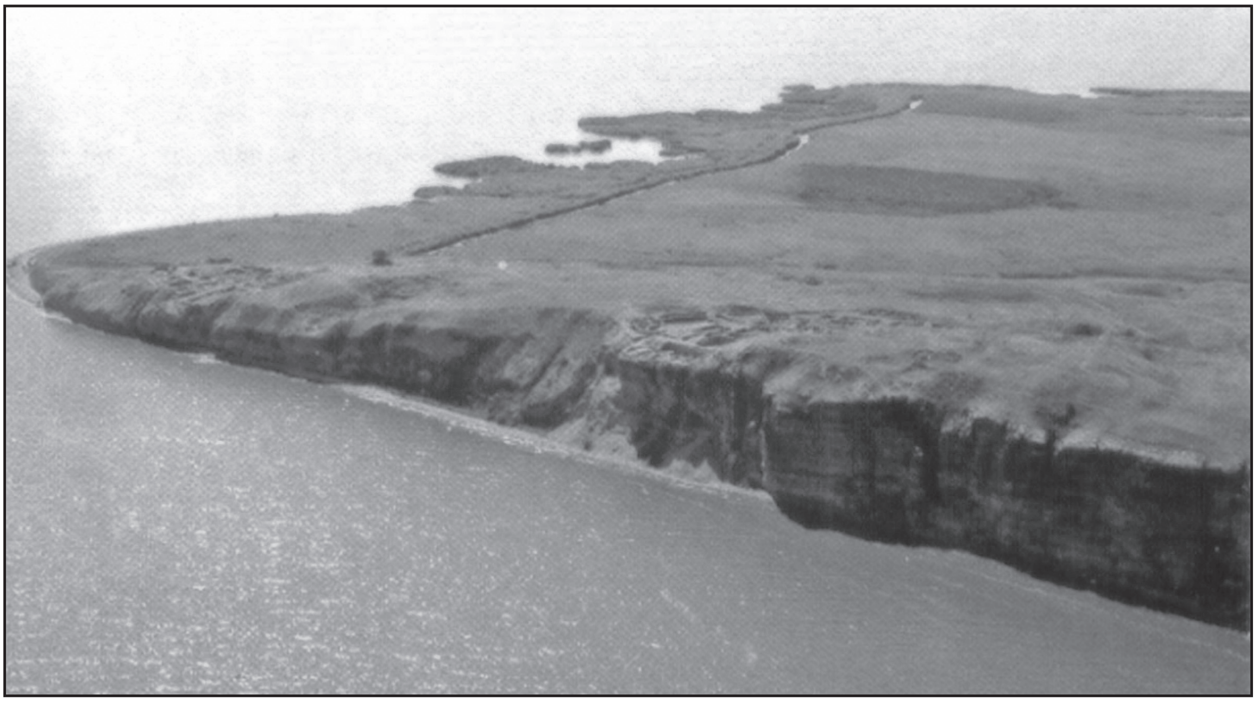

Fig. 3 Dolosman Cliff – aerial photo taken from North

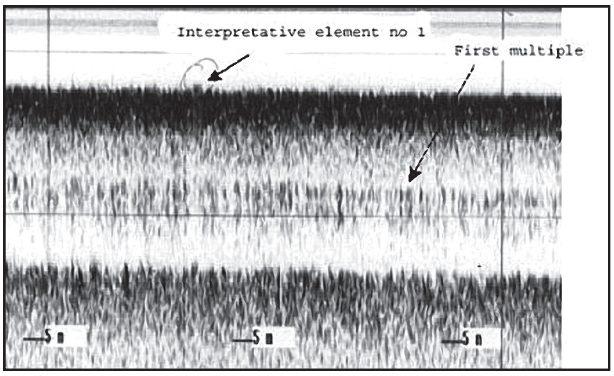

Fig. 4

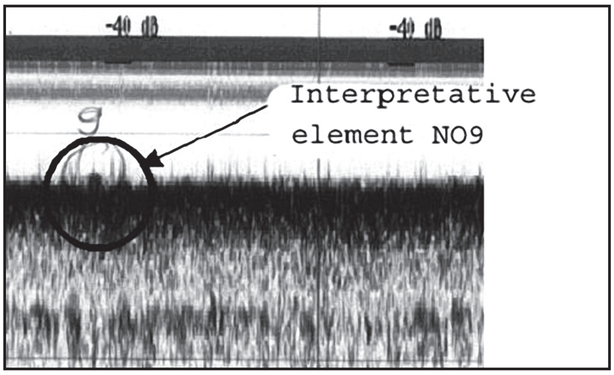

Fig. 5

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