RIVER ARCHAEOLOGY – A NEW FIELD OF RESEARCH

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The beginning of underwater archaeology dates back to the turn of the 19th-20th century Underwater archaeology became a real scientific discipline by the diffusion of autonomous diving equipment, and the work of pioneers (such as J.-Y. Cousteau, G. Bass). However these researches concentrated on marine archaeology. Even the UNESCO convention on the Underwater Cultural Heritage (2001) concentrates on marine archaeology, and only mentions the cultural heritage found in rivers and lakes.

The physical conditions of the rivers are different from that of the seas: the visibility is close to zero, the current is strong, and the depth is only a few meters. It means that the methods and technologies of marine archaeology are not applicable automatically. The role of new technologies in river archaeology is to reduce the handicap caused by the unfavourable environmental conditions.

It is possible to distinguish two groups in the technologies. The first group consists of technologies for surveying. There are a number of methods of different aims and costs. They range from the mapping of the environment to detection of buried objects. The problem of underwater documentation of finds and excavations is fundamental and needs further research.

Systematic underwater survey of rivers began in France in the 1960's, but only on a small scale. The most important among these is the work of L. Bonnamour in the Saône River (Bonnamour 2000). From the 90's the Departement des Recherches Subaquatiques et Sous-marins began the large scale surveys of the French rivers. We should highlight the Rhône, the Sein, the Saône and especially the Charente rivers (Bonnamour ed. 2000 and Dumont 2003, 2005 with further notes). The National Office of Cultural Heritage of Hungary organised an underwater archaeological research programme in 2002. We carried out surveys, geophysical prospections in the Danube, Tisza, Dráva and Rába rivers (Tóth 2002, 2004, 2005, Kérdő-Tóth 2003). In 2004 the European Fluvial Heritage programme began with Hungarian, French and Slovenian co-operation. The aim of the programme was to exchange methods, information and experiences.

The use of aerial photos and satellite technologies is spread in archaeology. In river archaeology they are useful to detect ancient river-beds, roads and bridges/ferries. In the case of the Dráva river (**Fig. 1**.) in the area of Barcs the ancient meanders, river branches are clearly visible on satellite images. Mapping these features and combination of observations with data related to underwater sites (logboats and wrecks) and archaeological maps place the sites to their paleo-environmental context.

In the case of the Dráva ship-sites it is clearly visible, that we find the underwater sites in the areas, where the modern river bed is identical, cuts or meets ancient river branches (**Fig. 2**.).

Bathymetric survey is a combination of GPS, depth measuring and cartography (Bonin 2000). The isometric mapping of the river bed could help to find shallows, artificial moles, and dams. Shallows are potential archaeological sites, because they were used to cross rivers (fords), the fast currents were used by water mills and fisheries. Bathymetric survey of the Charente river near Taillebourg (Charente-Maritime, France) found three shoals, or shallows in the environment of known archaeological finds (**Fig. 3**.). The detailed underwater survey of these areas highlighted the potentiality of these formations: a huge amount of artefacts and structures was found. Wooden posts and stone weights are evidences for fishing. A number of logboats, parts of plank-built ships, medieval weapons were also found. A further advantage of this technology is the relatively low cost and easy data-processing. The method is not able to produce high-resolution images, so it is not applicable to detect small objects, or obtain detailed images.

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Figure 1.

Satellite image of the Drava-plain near Barcs. The ancient river beds are clearly visible. (Google Earth)

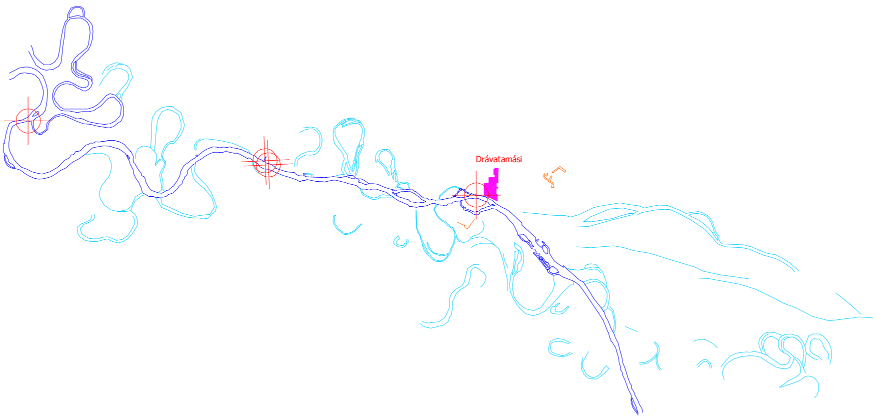

Figure 2.

AutoCAD interpretation of the satellite images in the environment of Barcs. Red points represents ship and boat finds

Sonar systems are often used in marine environment from the late '60-s (Bass 1968). Sonar (Sound Navigation And Ranging) is using the echo of sound waves, transmitted in fan-shaped beams from a moving vehicle. The echo sounds reflects the topography of the sea-bed and the computer processing of the returning waves results the image of the bottom. The system consists of a "towfish", a cable and a computer. The key characteristic of sonar is the resolution, which reflects to the frequency of the device. Marine sonar however, is not able to make images in shallow water. The new high resolution side-scan sonar (900-1200 MHz) makes good images in rivers. It makes detailed images of underwater objects (**Fig. 4**.). The problem of using this technology is that in the case of underwater vegetation-cover or intense sedimentation (tree-chunks) it is not possible to see the river bottom. Naturally the sonar is not able to make difference between a modern object and an archaeological site. Objects of small surface and low elevation (eroded wooden posts) causes problems. The sonar is a useful tool for detecting large areas during short time, but only in the case of "open" river bed. The other application area is the mapping of known composite sites (shipwreck, group of ships, walls). New, high quality fish-radar can also produce realistic images of the river-bed. We used a Humminbird 987 commercial radar in the Danube at Budapest and the Dráva at Drávatamási. At both places we could identify ships and boats (**Fig. 5**.).

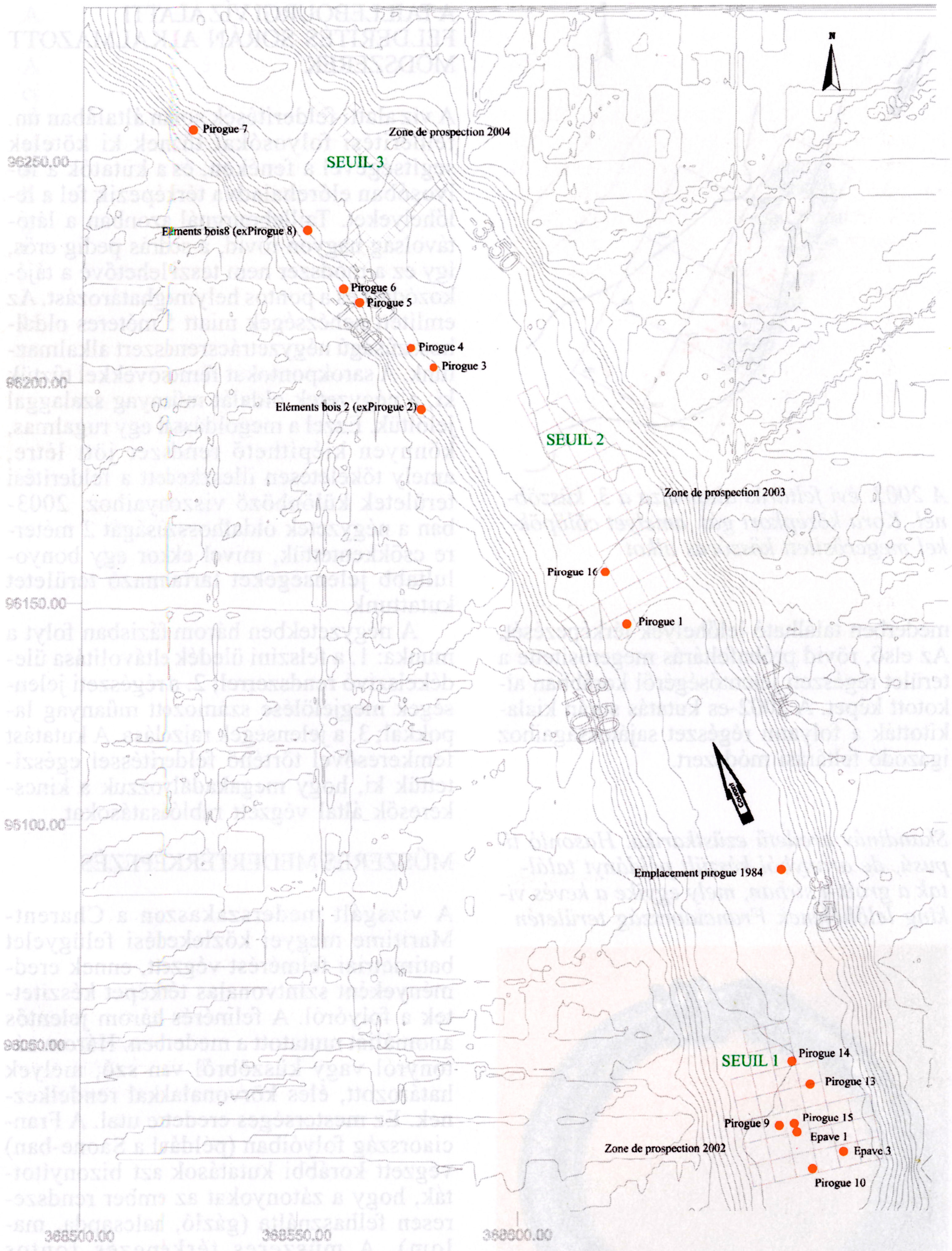

Figure 3.

Bathymetric map of the Charente river with the finds of underwater surveys, near Taillebourg (France). (courtesy A. Dumont, J.-F. Mariotti)

Seismic radar waves penetrate into the sediments. Echo sounds reflect the anomalies of sedimentation, so it is possible detecting covered structures. By the use of differentiated GPS, or constant teodolite positioning, it is possible to combine the sections made by the device (**Fig. 6.**) and create isometric or 3D images of the river-bed (**Fig. 7.**). According to our experience this is the most useful technology in instrumental survey. In the case of the Tisza at Szeged the ruins of the medieval fortification wall and the North-Eastern Tower were clearly visible on the 3D image as mounds on the river-bed. These structures stood on the right bank of the river, but they were washed over in the late 17th century. Near these structures smaller mounds were found in the river-port area, near the quay. The cross section one of them suggests artificial origin (**Fig. 8**.). Underwater survey proved, that they are shipwrecks. One of these (on fig. 7.) is a mid-19th century flat-bottomed river cargo ship, found in upside-down position.

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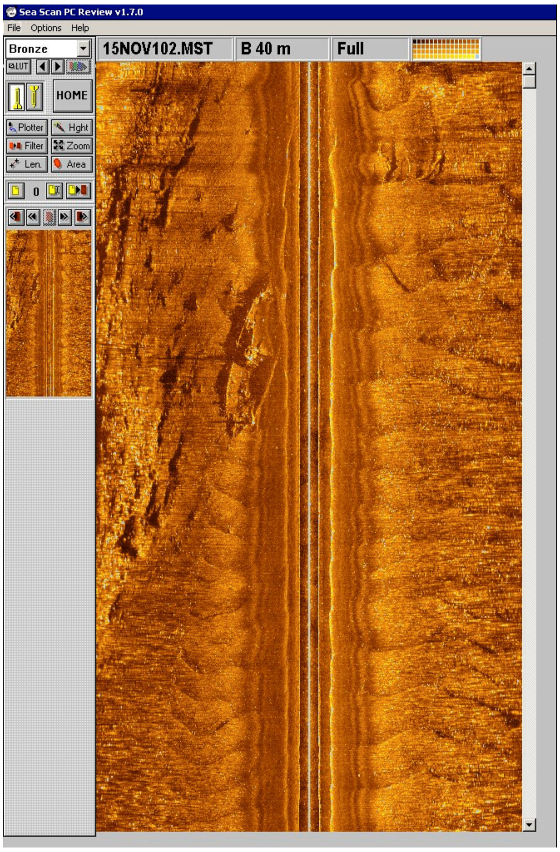

Figure 4.

Side-scan sonar image of a modern ship, Wörthersee, Austria. (courtesy C. Dworsky)

Figure 5.

Sunken boats in the Danube, near Budapest. Image produced by a Hummingbird 987 fish-radar, by L. Czakó.

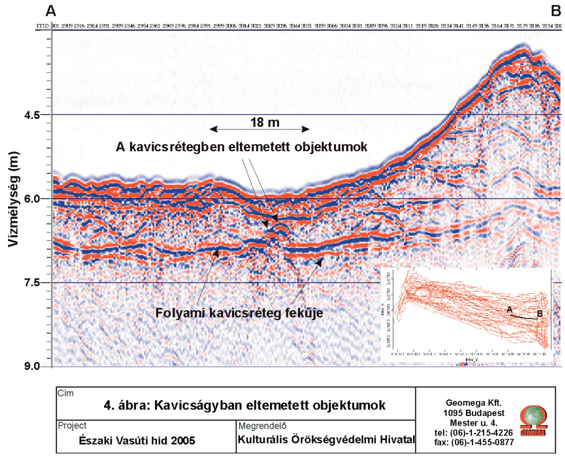

Figure 6.

A section of the Danube at Budapest, near Aquincum. An object making anomalous reflection in the sedimentation. (Geomega Ltd.)

The radar image depicts correctly the flat bottom and the curved contour of the bow/stem. This example presents that these survey technologies are useful to detect "anomalies", but the personal presence (dive) of an underwater archaeologist is necessary to identify an archaeological site.

In case of underwater survey and excavation the main problem is the orientation, the positioning of the site and the finds. The modern documentation tools of the archaeological research like GPS, laser technologies are not applicable under water. Archaeologists use hand measuring, but the scarce visibility makes it a very slow and difficult process. The SHARP (Sonic High Accuracy Ranging and Processing System) was invented in 1984 by M. Wilcox (USA). The method is based on ultrasonic technology (Shomette 1997). A grid of ultrasonic transceivers is implanted around the site, the diver emits short ultrasonic signs from a portable transceiver (used as a pen, **Fig. 9**.). The position of the "pen" is calculated from the signs detected by the fixed transceivers (all of these instruments are connected to a computer by cable). The first field tests demonstrated, that the range of the device is over 100 m, and the accuracy is 1-2 cm. This technology is used mainly in the positioning of ROV-s (Remote Operated Vehicles), but evidently useful in the documentation of underwater sites, because the accuracy and the speed is much better than by traditional hand measuring.

According to our experience a combination of sonar (or a fish-radar) and underwater survey is a fast, effective and economic solution for the mapping of underwater sites in river environment. We used these methods for the documentation of the logboat site in the Drava river (25 logboats has been found during the first campaign). In some cases, when the sediment formation is important, seismic radar is needed to detect covered structures.

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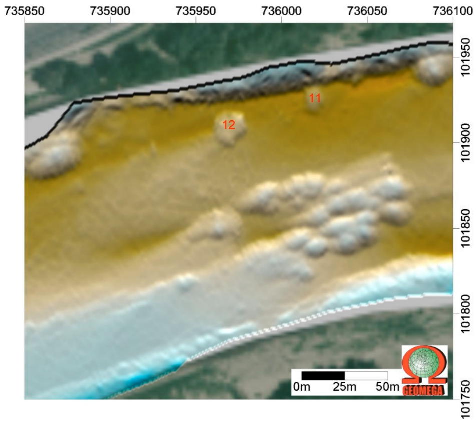
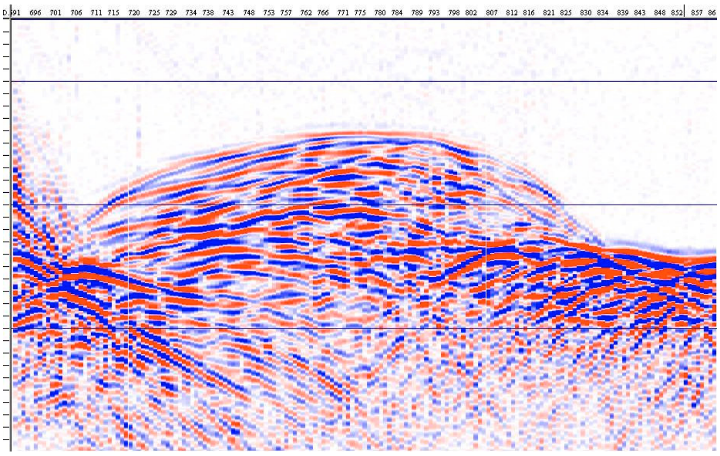


Figure 7.

D model of the Tisza river at Szeged. The mounds correspond to underwater ruins and shipwrecks. (Geomega Ltd.)



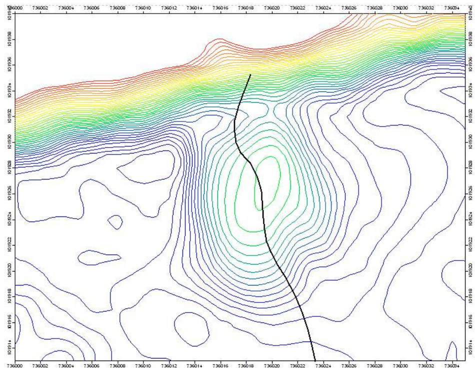


Figure 8.

Longitudial section of an anomalous mound in the Tisza at Szeged, the contour of the upside-down wreck is clearly visible. (Geomega Ltd.)

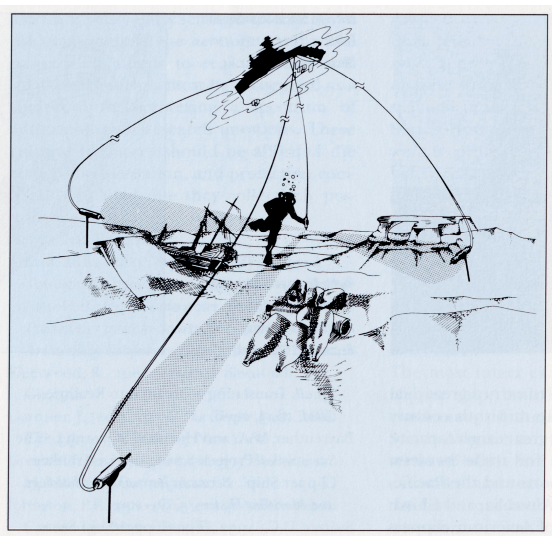


Figure 9. Sketch illustrating the working method of SHARPS system. (after Shomette 1997).

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