

CHEMICAL ANALYSIS OF ARCHAEOLOGICAL MATERIAL UNDERWATER BY LASER-INDUCED BREAKDOWN SPECTROSCOPY

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Nowadays, one of the most important areas of interest in archeology is the characterization of the submersed cultural heritage. Mediterranean Sea is rich in archaeological findings due to storms, accidents and naval battles since prehistoric times. Chemical analysis of submerged materials is an extremely valuable source of information on the origin and precedence of the wrecks, and also the raw materials employed during the manufacturing of the objects found in these sites. Sometimes extracting the archeological material from the marine environment is not practical due to the size of the sample, or is not permitted by the legislation or preservation practices. In these cases, the in-situ analysis turns into the only alternative. The versatility of laser-induced breakdown spectroscopy (LIBS) has been successfully tested in oceanography [1]. Advantages such as rapid and in situ analysis with no sample preparation make LIBS a suitable alternative for field measurements. Laser Laboratory of the University of Malaga is evaluating the capability of stand-off LIBS (ST-LIBS) for seafloor exploration (2000-3000 meters deep). Several experiments including the transmission of laser radiation through water or the influence of the range of analysis over LIBS signal, has been performed in laboratory inside a water tank. Preliminary results are quite satisfactory and suggests the possibility of integrating LIBS technology in a remotely operated vehicle (ROV) for geological/mineralogical exploration, cultural heritage investigation and/or the inspection of oil and gas pipelines in the seafloor, among others.

[1] S. Guirado, F.J. Fortes, V. Lazic and J.J. Laserna, *Spectrochim. Acta Part B* 74-75 (2012) 137.