

PIXE-PIGE, XRF, and Avaatech XRF Core Scanner of lake sediments: an inter-laboratory comparison

M. EL OUAHABI^{1,6}, G. CHENE^{2,3}, A. BECKERS⁴, S. OPITZ¹, A. DEVELLE⁵, D. STRIVAY^{2,3}, J. VANDER AUWERA⁶, A. HUBERT-FERRARI⁴

¹University of Cologne, Department of Geography, Germany

²University of Liège, Institut de Physique Nucléaire Atomique et de Spectroscopie (IPNAS), Department of Physics, Belgium

³University of Liège, Centre Européen d'Archéométrie (CEA), Department of Physics, Belgium

⁴University of Liege, Department of Geography, Belgium

⁵EDYTEM, UMR CNRS University of Savoie/Grenoble-Alpes, F-73376 Le Bourget du Lac, France

⁶University of Liege, Department of Geology, Belgium

ABSTRACT

PIXE-PIGE, XRF, and Avaatech XRF Core Scanner are very effective techniques in geology for lake sediments investigations. In this work an inter-laboratory comparison of the analysis of humid and dried (with and without linking powder) samples collected on Amik lake, the location of Roman ancient city Antioch, in the south of Turkey with these techniques is presented. PIXE-PIGE measurements were performed on the “Arkeo” beam line of the University of Liège AVF-Cyclotron. A 3 MeV proton beam was used in external beam mode under Helium flux. Both low energy and high energy X-ray as well as Gamma rays were collected with a classic PIXE-PIGE detection set-up. The same set of samples was also analyzed by X-Ray Fluorescence spectrometry using several set-ups, in particular, a laboratory and a portable XRF in Liège and an Avaatech's XRF core scanner in Chambéry. Semi-quantitative analysis was obtained by recording X-ray spectrum of major and trace elements above 500 ppm and use of geological referenced materials.

The results obtained on the different set-ups are in good agreement for all analysed samples. The presence of a linking powder does not affect the measure on the dried samples. However, the measures from wet and dry samples differ significantly. For the humid samples, the peak intensities of the minor elements are lower than dry samples. It may be related to the texture and the grain-size of the dried sediments after the loss of water content.

The aim of this work was also to compare PIXE-PIGE, XRF, and Avaatech's XRF Core Scanner capabilities for lake sediments core analysis with the set-ups routinely in use in the three laboratories, to determine the best combination of techniques and sample preparation protocol to be applied for lake sediments core samples and main elements of interest for each specific technique. Results and comparison of detection limits of the three techniques will be provided for all the measured elements.