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P49 - Application of nondestructive analytical techniques to the study of Iron Gall inks

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The study of cultural heritage objects is a delicate issue that needs well defined experimental conditions when applying any analytical technique. When dealing with historical valuable documents it has to be taken into account many factors as for example the fragility of the pieces or their size, and so the use of non-destructive techniques are usually mandatory.
The use of an external proton beam is one of the best options to characterize them under the experimental conditions that safeguard the documents.
In this work, handwritten documents with iron gall inks were characterized by means of X-ray diffraction (XRD) and by ion beam (IBA) techniques using an external proton beam, mainly Rutherford backscattered spectrometry (RBS) and proton induced X-ray emission (PIXE) which were simultaneously recorded.
Through XRD analysis it was possible to identify the presence of different types of cellulose, anhydrite and calcite as part of the constitution of the paper. These analyses helped to understand and fit the RBS spectra obtained for paper and inked areas. However, it was not possible to obtain information about the ink composition neither by XRD or by RBS because of the low quantity of material in comparison with the compounds belonging to paper support. Another constraint in RBS is the impossibility of distinguishing between the Ca and Fe signals due to the close kinematic factor.
Yet, PIXE analysis provided the identification of the major elements in iron gall inks (Fe and S) and also the presence of trace elements, such as Cu, Zn, Sr or As, which made possible to differentiate inks, even in the same document [1]. Moreover, PIXE results revealed differences in terms of paper elemental composition between documents with the same date and place which suggests different manufacturing processes [2].

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[1] F. Lucarelli, Nucl. Instr. Meth. Phys. Rev. B., 109-110 (1996) 644
[2] R. Viegas et al., I. Journal Conserv. Sc. 4 (2013) 593.

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