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Low-Z TXRF spectrometer: a new strategy for the quantification of light elements in clays

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Clay minerals are a very important constituent of soils which influence several bulk properties such as water retention and cation exchange capacity. Moreover, they are used in many environmental fields (i.e. landfill isolation, water depuration, soil remediation, etc) due to their properties and capability to adsorb potentially toxic elements and pollutant. Both in soil science and environmental studies the full characterization of the clay fraction should be performed for the whole comprehension of the soil behavior and/or for the assessment of remediation strategies. Together with mineralogical and physical investigations, chemical analysis of clays is a crucial step in their study and characterization. Elemental analysis is usually performed by ICP-AES, ICP-MS, after complete mineralization of the sample, or by EDXRF and WDXRF, using 1 - 5 g of material. However, in some soils the clay fraction is not very abundant and the procurement of the suitable quantity of sample can led to very high time-consuming sedimentation procedure. Also in sorption studies, where a very few amount of sample is usually tested, the procurement of the suitable amount of clay sample can be a problem. Total-reflection X-ray fluorescence spectroscopy proved to be a valuable method for the analysis of these very small samples. A method for the elemental analysis of clays using TXRF was already developed [1] but light elements like Na and Mg could not be quantified due to the limitations of commercially available spectrometers for the analysis of light elements. However, the quantification of these two elements is very important for an exhaustive chemical characterization of aluminosilicates.

For this reason, in the present work, a new strategy for the analysis of light elements in clays is presented. The study was carried out using a Low-Z TXRF spectrometer [2] equipped with a Cr source (30 kV, 10 mA), an Atominstitut TXRF Vacuum Chamber (1 mbar), a W/C multilayer monochromator and a SDD with an ultrathin Si₃N₄ window [3]. A set of six different aluminosilicate-rock reference materials was used for calibration and other three reference materials were used for validation. Samples were prepared as suspension using Ag as internal standard. In this way, all the elements from F to Ti were detected and quantified with good accuracy (80 - 120%). Moreover, Fe was also quantified using L α lines. The obtained results will be discussed on both the analytical and applicative point of view, with the aim of identifying the best equipment and condition for a full elemental characterization of aluminosilicates.