HANDHELD X-RAY FLUORESCENCE SPECTROMETRY FOR RAPID IDENTIFICATION OF PLANETARY BASALTS PARENTAGE.

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Introduction: Fifty-five achondrites from the National History Museum of London, Museo del Cielo e della Terra of San Giovanni in Persiceto (Bologna) and from a private collection were analysed with a handheld XRF spectrometer (HHXRF). The aim of the work was to test the effectiveness of the HHXRF in the determination of their bulk chemical composition and thus their planetary parentage based on key element ratios (mainly Fe/Mn/Ti/Ca). This methodology could be a valuable and practical tool in meteoritics and for curatorial purposes. The reasons for the significant success of HHXRF [1] include (i) portability of the instrument, (ii) the easy handling of the operating system, (iii) minimal sample preparation (iv) rapid, non-destructive field analyses with remarkable reproducibility and low detection limits for elements heavier than Mg.

Methodology: The meteorites chosen for HHXRF analysis, including mostly basalt suites from the Moon, Mars and Vesta, were analyzed with a NITON XL3t GOLDD+ XRF spectrometer (50 kV, 200 µA, 2W). Analyses were carried out on flat surfaces, mostly sawn-surfaces. In order to test accuracy and precision of the instrument, a range of thirty-seven GeoPT geological reference materials have been selected and analyzed using factory-set calibrations. We used rock powders mounted and pressed in a standard X-ray sample cups. Furthermore, in order to test the effects of sample preparation on the precision and accuracy of the method, a set of thirty-nine terrestrial rock slabs of known composition have been analyzed as 'in-house' standards. This procedure has been also used to calculate correction factors in order to calibrate the full range of elemental concentrations of interest for meteorite analysis.

Results: The results suggest that HHXRF is well suited for analysis of silicate rocks and that factory-set calibration is effective in determination of many elements with good accuracy and precision. The best results were obtained for key elements used for the classification of planetary basalts such as Fe, Mn, Ti, Ca and K. In fact, the calibration curve constructed for these elements has a mean R^2 value of 0.97. The exceptions are P, Mg and Al. Comparative planetary mineralogy studies [2] show that elemental signatures in minerals from planetary basalts record planetary parentage. This study demonstrates that, in general, the Fe/Mn ratio obtained by HHXRF bulk analysis on achondrite meteorites could be used for a preliminary and quick determination of the parentage of planetary basalts.

References: [1] Potts P.J. and West M. 2008 Portable X-ray fluorescence spectrometry – capabilities for in situ analysis. *Royal Society of Chemistry Publishing (Cambridge, UK)*, 291pp. [2] Papike J.J et al. 2003 Determination of planetary basalts parentage: A simple technique using the electron microprobe. *American Mineralogist,* 88, 469-472.

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