DEVELOPMENT OF A STANDARDISED SCREENING PROCEDURE FOR DIFFERENT SAMPLE MATRICES ENCOUNTERED DURING THE EVALUATION OF POTENTIALLY CONTAMINATED SITES IN AUSTRIA

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Upon the discovery of radioactivity at the end of the 19th century several factories and institutes in Austria started to produce and process radioactive materials due to Austria's proximity and access to the Joachimsthal uranium mines.[1][2] In a study carried out by the Austrian Agency for Health and Food Safety the premises of a former chemical factory were investigated. According to historical research the company, which was founded around 1890, used to process pitch blende residues (uranium ore residue) for the production of radium as well as monazite sands for the production of thorium and subsequent manufacturing of incandescent gas mantles.[3][4] The site of the factory was situated next to a river and nowadays serves as a recreational area. The radiological survey found elevated levels of radioactivity and upon detailed examination of the soil samples, elevated activity concentrations of thorium, uranium and cerium.

Using the results and experience gained from the above mentioned investigation we attempted to develop a standardised screening procedure to aid the evaluation of potentially contaminated sites in the future. With the help of a standardised screening strategy on-site measurements are carried out and a sampling strategy is developed. Samples are then analysed through a combination of gamma-spectroscopy and radiochemical methods for the determination of natural radio-nuclides such as Ra-226, Ra-228, Pb-210, Po-210 and uranium. Methods were evaluated for the different sample matrices expected to be encountered at relevant locations, such as mud, soil, sediments and water (clear water as well as water containing colloids and suspended matter). On the basis of all the obtained results the prediction of an exposure scenario is possible.

Laboratory tests were carried out on ashed and non-ashed soil samples applying microwave digestion as well as wet digestion. Sequential acid digestion was performed using concentrated HNO_3+H_2O_2, HCl and aqua regia followed by radio-chemical separation and analysis through liquid scintillation counting and ICP-MS. Satisfying chemical yields were achieved for the fractions digested with HNO_3+H_2O_2 and aqua regia. More tests need to be performed to optimise the chemical yield of radium after digestion with HCl. A comparison of preliminary results with a long-term gamma-spectroscopic measurement showed a good correlation between the activity concentrations of different natural radionuclides.

[1] Marie Sklodowska Curie – Radio-active Substances, Chemical News, 1904
[2] Roger F. Robison - Mining and Selling Radium and Uranium, Springer, 2014
[3] Maria Rentetzi - The U.S. Radium Industry, Springer, 2008
[4] Radioactivity – A History of a Mysterious Science, Oxford University Press, 2011