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DETERMINATION OF TRACE TOXIC ELEMENTS IN PLANT SAMPLES BY ICP-MS AND GF-AAS

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Abstract

Geochemical surveys involving collection and characterization of rock, soil/sediment, water and plant samples constitute an integral part of the uranium exploration programme. Plant samples need to be analysed for uranium and several other trace elements like arsenic, selenium, lead etc. Analyses of plants also render important information in agricultural, toxicological and environmental investigations since plants are very significant links in the trophic chain. In order to evaluate, minimize, and avoid adverse effect of toxic metals in ecosystems, one has to monitor their distribution, accumulation and dispersion in different types of vegetation. Hence, there is a constant need for development/ improvement of analytical methods for the accurate and precise determination of such toxic elements in plant samples. In the present work, Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and Graphite Furnace-Atomic Absorption Spectrometry(GF-AAS) have been applied to the determination of lead (Pb), arsenic(As) and cadmium(Cd) in plant samples using two different sample decomposition procedures, one employing dry digestion route and another using a microwave assisted digestion route. Plant samples (bark, seed, husk, leaves) collected from areas in/around potential uranium deposits like Chitrial, Gogi and Rohil were brought into the solution using both a dry digestion method and a microwave assisted digestion method. The amount of major elements constituting the plant samples were then determined. The plant samples analyzed showed the presence of aluminium (31-1281 μg/g), calcium (230 – 31230 μg/g), iron (121 – 2073 μg/g), magnesium (520 -4066 μg/g), manganese (8 -139 μg/g), titanium (<0.1 – 25 μg/g), sodium (110 - 4780 μg/g) and potassium (0.32 – 1.64 %) from μg/g (ppm) to percentage levels. Studies were also carried out using spiked samples to assess the extent of recovery/loss of these elements from plant samples by both methods. Quantitative recoveries were obtained for As, Cd and Pb by both methods with spiked samples. The sample dissolution parameters were optimized to achieve quantitative recovery of elements from the real samples by both methods. Since the metals have to be determined at very low/trace levels in samples analysed, highly sensitive instrumental techniques, i.e ICP-MS and GF-AAS were utilized for their determination and the results obtained compared. The plants analyzed showed Cd in the range of 0.04 -0.38 μg/g, Pb in the range of 0.4 – 8 μg/g and As in the range of 0.6 – 2.4 μg/g.

Keywords: ICP-MS, GF-AAS, Plants, Geochemical surveys, Uranium, Trace, Toxic elements, Arsenic, Cadmium.