

In field analysis of aqueous environmental samples using transportable EDXRF: methodological developments for remote areas

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On-site analytical programs at remote contaminated sites confer a number of advantages over traditional methods. First, rapid feedback on the level of contamination of site materials can ensure full compliance with regulators while minimising the amount of clean fill moved or treated unnecessarily. Second, because on-site programs can be less expensive, it is possible to perform more analyses, with the same budget, than might be possible by sending samples off-site to external laboratories.

Transportable energy-dispersive X-ray fluorescence (EDXRF) is one such tool recently adopted for on-site characterisation studies. Traditionally used for the analysis of soils, sediments and solids, the addition of aqueous samples (such as surface water, soil water and TCLP leachates) would help to characterise the mobility of metal and metalloid contaminants in the environment.

Transportable EDXRF spectrometers typically have method detection limits (MDLs) for metals in waters of ~1-10 mg/L, whereas environmental guidelines for many dissolved metals and metalloids are often less than 1 mg/L. If it were possible to lower the MDLs for the analysis of waters using EDXRF, then only one analytical tool may be sufficient for remote areas, increasing program flexibility and reducing the amount of equipment that needs to be purchased, calibrated, maintained, transported, and operated by trained personnel. Here, we report a reliable field protocol for aqueous metals and metalloids which effectively lowers the MDL via a preconcentration step.

We present experimental data where ion exchange resins have been used to concentrate metals and metalloids, from 10-500 µg/L, to greater than the MDL. The method has been optimised for field use, with a number of parameters, including sample flow rate, volume of resin, volume of eluent, and resin form, adjusted to maximise analytical speed and accuracy. Two case studies will be presented, where the method has been successfully applied to surface waters at a remote contaminated site in Australia, and to TCLP extracts derived from a landfill located in Antarctica. Finally, we will discuss future developments of this technique, where dried droplets of aqueous samples may also be used to effectively lower the MDL to the µg/L range.