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Highly sensitive method for determination of 90Sr in large-volume groundwater samples using pixel detectors

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This work describes a newly developed method for determination the specific activity of ⁹⁰Sr in large-volume groundwater samples in which a high concentration of sodium, calcium and magnesium can be expected. This method is based on separation of strontium from other cations which increase the thickness of target sample, and radionuclides, especially beta emitters.

In the groundwater sample, the concentrations of Ca, Mg and Sr are determined by OES. Depending on the concentration of natural occurring strontium, the sample volume between 30 and 50 L is analysed. If the concentration of naturally occurring strontium is low, the sample volume will be 50 L and stable strontium is added to the sample to give 30 mg of strontium in the whole sample. Stable strontium is used as a carrier and yield monitor.

This method consist of two main phases: separation of the strontium and 90Sr activity determination. The separation consists of five steps. The first step is the pre-treatment and mineralization of the insoluble fraction of the sample. The sample is then concentrated by carbonates precipitation, followed by pre-separation on a strongly acidic cation exchanger (Dowex® 50w x8 100–200 mesh) by EDTA solution. The main separation of strontium is performed using Sr resin. The final step is the preparation of the sample for measurement. After 26 days secular equilibrium of the 90Sr and 90Y is achieved and samples are measured using pixel detector in a shielded chamber. The evaluation of the measured data is performed using an algorithm written in python. Using this procedure a detection limit lowered by one order of magnitude (0,1 mBq per sample) in comparison with conventional method used in NRPI can be obtained.

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