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Automated and streamlined strontium purification of aqueous samples for isotopic analyses

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Radiogenic strontium ($^{87}Sr/^{86}Sr$) is a powerful tool for characterising and differentiating water reservoirs (among many other applications). The development and improvement of MC-ICP-MS instrumentation has enhanced the analytical throughput of isotope ratio determination, however separation chemistry for element isolation/purification—needed to remove isobaric interferences—continues to occur largely *via* manual gravity-driven ion exchange chromatography (IEC), which generally cannot match instrument throughput. This has created a throughput gap that persists today and that encumbers the use and proliferation of isotope chemistry. This emphasises the need for rapid separation of Sr (and other elements), and of comprehensive, end-to-end high-throughput analytical workflows.

Here we have developed a workflow-optimised protocol for the isolation of Sr from water samples using automated ion chromatography (Thermo Fisher™ Dionex™ ICS-6000). The method has been designed to seamlessly integrate with common practices for water sample collection/treatment, and for subsequent isotopic analysis by MC-ICP-MS. This has been accomplished by developing the technique to accommodate sample introduction of water samples that have been filtered (standard 0.22-0.45 mm membranes) and mildly acidified with nitric acid, and by modulating the sample volume processed such that purified Sr fractions collected can be directly acidified and analysed by MC-ICP-MS (no dry-down, dilution, etc.), ultimately so that this can be done as a completely hyphenated and automated "hands-off" technique (IC-MC-ICP-MS).

Performance of the automated technique has been evaluated by comparing results with those from conventional IEC. A comparison of the $^{87}Sr/^{86}Sr$ values obtained through manual and automated chromatography shows a strong correlation (R^2 = 0.995) and high yields in both cases (slope = 1, concentrations checked by TQ-ICP-MS). Importantly, the automated technique can process 30-40 samples in a 24-hour sequence, providing higher throughput than manual techniques and matching that of modern instrumentation. Moreover, the automated approach enables separation of other cations relevant for isotopic characterization (Li, K, Mg, Rb, and Ca). Future work will focus on developing Li, K and Ca purification protocols from water samples, expanding sample media to [bio]apatite, serum and urine samples, and expanding the platform configuration to separate transition metals for isotopic analysis.