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An exploratory study on streamlining lab and analytical protocols for labile 87Sr/86Sr determination in emerging applications

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The uses of radiogenic Sr isotope ratios—87Sr/86Sr—in and deriving from soils are extensive, namely because large-scale characterization of 87Sr/86Sr of surface materials allows us to determine where geological units reside both individually and in relation to one another, at the surface and below. This extends to the labile 87Sr/86Sr fraction, i.e. that which is implicated in soil-water-life interactions. While 87Sr/86Sr signatures have historically been used in conventional applications such as ore geology, this tool is now also used across a great many applications that rely on large-scale characterization of the labile fraction, namely provenance work in archaeology, modern forensics, food security and sustainable practices. Moreover, advances in both mass spectrometry and geochemical databasing have made it more viable to develop large-scale 87Sr/86Sr maps (isoscapes). This involves hundreds to thousands of datapoints and is the cumulative result of often months to years of lab and analytical time.

This research arena has already experienced rapid expansion, commercial use, and enhanced public awareness, and yet critical to all the above and further adoption of such applications are high-throughput end-to-end techniques for the determination of labile 87Sr/86Sr to harmonize our ability to meet research demands. This exposes a great need for streamlined lab and analytical protocols for labile 87Sr/86Sr determination in all the applications mentioned herein, as well as those not yet realized.

Here, we have selected soil samples from three international locales—Australia, Jordan and Cambodia—wherein we have determined bulk 87Sr/86Sr spanning from 0.703 to 0.722. From this cohort, we have quantified labile 87Sr/86Sr signatures by both conventional leaching (e.g. ammonium acetate), and by a novel streamlined technique that extracts labile Sr using mineral acid media, followed by rapid Sr purification and isotopic analyses. Reproducibility, comparisons, and trends between bulk, conventional and streamlined 87Sr/86Sr signatures will be detailed, as well as any caveats identified.