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Mapping the strontium isotope distribution in northern Australia

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Strontium isotopes ($^{87}Sr/^{86}Sr$) are useful in the earth sciences (e.g., recognising geological provinces, studying geological processes) as well in archaeological (e.g., informing on past human migrations), palaeontological/ecological (e.g., investigating extinct and extant taxa's dietary range and migrations) and forensic (e.g., validating the origin of drinks and foodstuffs) sciences. Recently, Geoscience Australia and the University of Wollongong have teamed up to determine $^{87}Sr/^{86}Sr$ ratios in fluvial sediments selected from the low-density National Geochemical Survey of Australia (www.ga.gov.au/ngsa). The initial study targeted the northern parts of the Northern Territory and Queensland in Australia. The samples were taken from a depth of ~60-80 cm depth in floodplain deposits at or near the outlet of large catchments (drainage basins). A coarse grain-size fraction (<2 mm) was air-dried, sieved, milled then digested (hydrofluoric acid + nitric acid followed by aqua regia) to release total strontium. Preliminary results demonstrate a wide range of strontium isotopic values ($0.7048 < ^{87}Sr/^{86}Sr < 1.0330$) over the survey area, reflecting a large diversity of source rock lithologies, geological processes and bedrock ages. Spatial distribution of $^{87}Sr/^{86}Sr$ shows coherent (multi-point anomalies and gradients), large-scale (>100 km) patterns that appears to be consistent, in many places, with surface geology, regolith/soil type and/or nearby outcropping bedrock. For instance, the extensive black clay soils of the Barkly Tableland define a >500 km-long northwest-southeast trending low anomaly ($^{87}Sr/^{86}Sr < 0.7182$). Where carbonate or mafic igneous rocks dominate, a low to moderate strontium isotope signature is observed. In proximity to the outcropping Proterozoic metamorphic provinces of the Tennant, McArthur, Murphy and Mount Isa geological regions, high $^{87}Sr/^{86}Sr$ values (> 0.7655) are observed. A potential link between mineralisation and elevated $^{87}Sr/^{86}Sr$ values in these regions needs to be investigated in greater detail. Our results to-date indicate that incorporating soil/regolith strontium isotopes in regional, exploratory geoscience investigations can help identify basement rock types under (shallow) cover, constrain surface processes (e.g., weathering, dispersion), and, potentially, recognise components of mineral systems. Furthermore, the resulting strontium isoscape can also be utilised in archaeological, paleontological and ecological studies that aim to investigate past and modern animal (including humans) dietary habits and migrations.