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Stable Sr isotopic variability in Godavari River basin, India: implications for surface processes and reservoir mixing

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Understanding the chemistry of dissolved constituents of rivers is critical to constrain a variety of Earth surface processes that play major role in modulating global elemental cycles. Stable Sr isotopes have emerged as a new tool to better understand low-temperature surface processes. Here we present new stable Sr isotope data from a large silicate-draining river basin of southern India and discuss possible implications. Water samples were collected from the Godavari River near Rajahmundry (~ 65 Km from the coast), Andhra Pradesh during monsoon (wet) and non-monsoon (dry) months of 2015-16. The dissolved cation concentrations were measured using an ICP-MS at the Centre for Earth Sciences, Indian Institute of Science and the external precision was better than ± 5 %. The radiogenic ($^{87}Sr/^{86}Sr$) and stable Sr ($\delta^{88/86}Sr$) isotopic measurements were carried out using established protocols[1,2] using a TIMS at Centre for Earth Sciences, Indian Institute of Science. External precisions (2SD) for radiogenic and stable Sr isotope measurements were better than ± 15 ppm and ± 0.024 ‰ based on multiple measurements of NIST SRM-987 standard. The dissolved Sr content in the river water samples varied between 0.55 - 1.53 µmol/L. Radiogenic $^{87}Sr/^{86}Sr$ ranged between 0.714249 - 0.719358 while the $\delta^{88/86}Sr$ varied between 0.174 - 0.640 ‰. The average $\delta^{88/86}Sr$ of Godavari river is estimated at 0.327 ± 0.226 ‰ (2SD, N = 18) which matches with global average $\delta^{88/86}Sr$ of world rivers. When compared with the $^{87}Sr/^{86}Sr$ data the samples essentially overlapped with the bulk silicate earth estimates underscoring the dominance of congruent weathering of surrounding lithologies. Although a distinct seasonal trend was lacking, the heaviest $\delta^{88/86}Sr$ values were observed mostly in the dry seasons which suggests mixing with a fractionated reservoir such as the local groundwater, specifically when contributions from seawater was minimal.

[1] Banerjee et al. (2016) Chemical Geology 440,124-138.

[2] Ganguly and Chakrabarti (2022) Journal of Analytical Atomic Spectrometry 37(10),1961-1971.