# Systematic biases in estimates of continental $^{87}Sr/^{86}Sr$ runoff

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Despite more than half a century of investigation of the marine strontium isotope ($^{87}Sr/^{86}Sr$) system, the community cannot agree on whether the flux and isotopic composition of continental runoff is sufficient to balance the marine Sr budget [1,2]. The largest disagreements lie in the flux and isotopic composition of continental runoff. To address this issue, we are studying potential biases in existing data. Our approach is premised on the observation that bedrock ages of drainage basins are positively correlated with the $^{87}Sr/^{86}Sr$ of runoff [3]. We use a GIS to quantify bedrock ages and lithologic composition of watersheds at the points of sampling and at the river mouths, and present a detailed analysis of rivers draining the West coast of North America.

Rivers draining this region fall into two categories: small to mid-sized watershed draining the geologically young western side of the Coast Mountains with young bedrock ages (e.g. ~76 Myr for the San Joaquin and Sacramento rivers), and large watersheds that break through the Coast Mountains and drain large segments of the geologically older continental interior (e.g. ~265 Myr for the Fraser and Columbia rivers). Sampling locations rarely coincide with river mouths and therefore tend to preferentially exclude younger bedrock. For instance, the $^{87}Sr/^{86}Sr$ reported for the Columbia River reflects drainage of only ~75% of the entire drainage basin area with a mean bedrock age of 306 Myr, ~40 Myr older than the mean bedrock age of the entire basin. Similar relationships are observed on the Fraser River. Large watersheds with older average bedrock ages are also over-represented in the riverine $^{87}Sr/^{86}Sr$ database. Both facts imply that average $^{87}Sr/^{86}Sr$ values for active margin drainages are biased towards more radiogenic $^{87}Sr/^{86}Sr$ values.

Quantifying the magnitude of this bias for global runoff will require a global analysis that also takes into account differences in Sr concentrations. Without such an analyses it is impossible to resolve the dispute. However, considering recent data for global submarine groundwater flux into the ocean [4] it is likely that the marine $^{87}Sr/^{86}Sr$ system is currently less out of balance than predicted [1].

[1] Vance *et al* 2009, Nature **458,** 493-496. [2] Allegre *et al* 2012, EPSL **292**, 51-56. [3] Peucker-Ehrenbrink *et al* 2010, G3 **11**, GC002869. [4] Beck *et al* 2013, GCA **117**, 33-52.