Marine $^{87}Sr/^{86}Sr$ record mirrors the evolving upper continental crust

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Prior the discovery of hydrothermal vents in 1977 temporal variations in the marine $^{87}Sr/^{86}Sr$ were generally thought to reflect changes in the composition of the continental crust [1]. Since 1977 the marine $^{87}Sr/^{86}Sr$ record generally has been interpreted as two-component mixture of radiogenic continental and unradiogenic hydrothermal fluxes of Sr to seawater (e.g. [2]).

We have quantitatively investigated the relationship between riverine $^{87}Sr/^{86}Sr$ and the geologic makeup of drainage basins. We find striking positive correlations between dissolved riverine $^{87}Sr/^{86}Sr$ and average bedrock ages in the Fraser and Mississippi river basins. These findings point to a predominant geologic control of riverine $^{87}Sr/^{86}Sr$. A global analysis of bedrock geology indicates that sediments and volcanic rocks are generally young (average ages of 246±42 and 331±55 Myr, respectively) whereas plutonic and metamorphic rocks are much older (1745±248 Myr). A GIS analysis of 19 large-scale drainage basins that cover the entire non-glaciated Earth surface, combined with a Sr isotope database for 112 rivers draining these basins reveals a positive correlation between bedrock age (or lithology) and dissolved $^{87}Sr/^{86}Sr$. This confirms that the relationships found in individual drainage basins are characteristic for large-scale drainage basins in general.

One endmemeber interpretation of the marine $^{87}Sr/^{86}Sr$ record casts temporal variations in the marine $^{87}Sr/^{86}Sr$ as variations in the average bedrock age (or lithology) of the continental crust. Ill-constrained temporal variations of unradiogenic hydrothermal fluxes to the ocean are, for now, neglected. Such an analysis indicates that the eroding crust has undergone progressive rejuvenation from the early Cambrian to the Late-Mid Jurassic, followed by only minor changes until the trend reversed in the Eocene. Interestingly, the Paleozoic and Mesozoic trend broadly resembles temporal variations in the makeup of the continental bedrock as reconstructed by Ronov and his coworkers [3] and quantitatively evaluated by Bluth & Kump[4].

References

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