A Geostatistical Framework to Predict Strontium Isotopes Variations in Bedrock and Rivers

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We develop a model to predict 87Sr/86Sr variations in bedrock and rivers and we apply the new model to predict 87Sr/86Sr of Alaska (AK) rivers. In the first step, we revisit the "bedrock model" [1] – predicting 87Sr/86Sr in bedrock – by including several new components and/or improvements including: 1) an independent siliciclastic sediment sub-model, 2) an explicit consideration of intra-unit 87Sr/86Sr variations, and 3) a fully-coupled assessment of spatial uncertainty. Tested against a compilation of 885 87Sr/86Sr analyses in igneous, metamorphic and sedimentary rocks over AK, the model significantly improves 87Sr/86Sr prediction accuracy in both igneous and sedimentary settings. In a second step, we develop a fully independent "Sr chemical weathering model" – predicting the spatial variations in the rate of Sr release – using multiple linear regression techniques. The model is calibrated on a compiled database of 339 analysis of dissolved Sr and 87Sr/86Sr in rivers of Northern latitudes. The best model predicts Sr release as a function of lithological proportions, permafrost cover and slope, and explains 64% of Sr concentration variations on an independent dataset of 61 rivers. We apply both the bedrock model and the Sr chemical weathering model to predict Sr concentration and 87Sr/86Sr in rivers of AK. The model explains 81% of the variance of 87Sr/86Sr in AK Rivers. This new flexible and cost-effective geostatistical framework to map 87Sr/86Sr at different scales in bedrock and water provides a baseline map for provenance studies and an interpretative tool to study the cycling of Sr at global scale.

[1] C.P. Bataille, G.J. Bowen, (2012) *Chem Geol* **39** 304-305