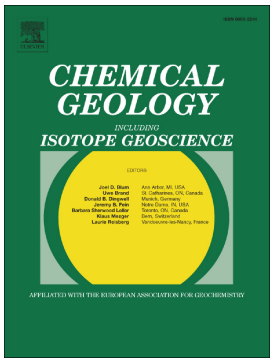
Accepted Manuscript



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PII: S0009-2541(18)30422-4
DOI: doi:10.1016/j.chemgeo.2018.08.025
Reference: CHEMGE 18889

To appear in: *Chemical Geology*

Received date: 10 December 2017
Revised date: 22 August 2018
Accepted date: 26 August 2018

Please cite this article as: Eric J. Bellefroid, Noah J. Planavsky, Nathaniel R. Miller, Uwe Brand, Chunjiang Wang , Case studies on the utility of sequential carbonate leaching for radiogenic strontium isotope analysis. Chemge (2018), doi:10.1016/j.chemgeo.2018.08.025

Case Studies on the Utility of Sequential Carbonate Leaching for Radiogenic Strontium Isotope Analysis

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ABSTRACT

Radiogenic strontium isotopes ($^{87}Sr/^{86}Sr$) have been extensively used as a tool to explore a diversity of Earth system problems, including long-term global weathering rates and global sequence correlation. Strontium isotopes are measured on a range of geological materials (e.g., calcite fossils, barites, limestone micrites), but whole-rock limestones are by far the most abundant of these materials within the geological record for paleo-seawater $^{87}Sr/^{86}Sr$ work. Whole-rock limestones, however, have a poor track record of recording primary seawater $^{87}Sr/^{86}Sr$ values. Alteration of the limestone during diagenesis and contamination from detrital aluminosilicate phases during carbonate extraction have been consistent problems. Various preparation and quality control methods have been applied to whole-rock $^{87}Sr/^{86}Sr$ work, yet there remains no consistent framework used to separate and identify both contamination and alteration simultaneously. The lack of consistent and systematic methods has made it difficult to gauge the accuracy and fidelity of much of the previously generated whole rock limestones $^{87}Sr/^{86}Sr$ data, especially for Precambrian sequences. Building on previous work, we explore a sequential leaching method designed to systematically isolate least-altered carbonate phases from detrital aluminosilicate Sr contamination and present several case studies that demonstrate the advantages of this approach. In the first case study, we use the Mid-Carboniferous Bird Spring Formation to empirically validate the accuracy of this sequential leaching method. Comparing least-altered sequentially leached whole-rock $^{87}Sr/^{86}Sr$ values with well-preserved calcite brachiopod $^{87}Sr/^{86}Sr$ values from the same section, we find near identical values. Following this first case, we studied the Neoproterozoic Dhaiqa Formation and the mid-Proterozoic Jixian Group and Muskwa Assemblage to outline a framework for identifying least-altered leachate fractions in Proterozoic carbonate samples. As a whole, we find that with this method it is possible to better identify whole-rock samples primary or least-altered carbonate fractions, and better account for alteration, providing a means to back-calculate a samples primary and least-altered marine $^{87}Sr/^{86}Sr$ value.

Keywords: carbonate extraction, dissolution method, Precambrian, chemostratigraphy, Sr Isotope