# Probing Earth's volatile past with Sr isotopes

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Introduction: The application of the $^{87}Rb$-$^{87}Sr$ chronometer to determine the timing of volatile addition to the Earth requires an accurate estimation of Earth's initial $^{87}Sr/^{86}Sr$ ratio. In this study, primitive $^{87}Sr/^{86}Sr$ ratios were measured in Archaean barites. They provide an upper limit for the Archaean mantle from which an initial $^{87}Sr/^{86}Sr$ for Earth can be calculated using a multi-stage Sr evolution model. This value provides constraints on Earth's precursor material and its early volatile depletion history.

Samples and Methods: Nine barites were analysed; two from the Dresser formation, Pilbara (3.49 Ga) Australia and seven from Barberton (3.26-3.23 Ga) South Africa. Ion exchange chromatography was used for Sr separation and isotopic analyses were performed by TIMS at ETH Zürich. Five-hundred ng of Sr were loaded onto rhenium filaments and run with a signal intensity of 20V on $^{88}Sr$. Eleven replicate measurements of USGS BCR-2 give an external reproducibility of 17 ppm.

Results and Discussion: Of all barites, the Dresser sample DB2 yielded the most primitive $^{87}Sr/^{86}Sr$ ratio (0.700546 ± 0.000008 (2SE), corrected for in situ $^{87}Rb$ decay). It lies on the depleted mantle trend defined by other barites from the Dresser formation [2] and Neoarchaean pyroxenes [3]. Our model predicts an initial terrestrial $^{87}Sr/^{86}Sr$ ratio of 0.69954 ± 0.00001 at 4.47 Ga, supporting results of [2]. Assuming a terrestrial accretion period of 80-100 Ma, this indicates terrestrial precursor materials with average Rb/Sr ratios of ~ 0.4. The Barberton barites lie on a steeper $^{87}Sr/^{86}Sr$ evolution, indicating their sampling of an Archaean reservoir with higher time-integrated Rb/Sr. Possible explanations invoke distinct enriched mantle reservoirs or weathering of the Archaean continent [4]. Differences in $^{87}Sr/^{86}Sr$ ratios between primary and detrital barite from the same bed translate to tens of millions of years, reflecting the complex and varied origin of the barite.

[1] Heinrichs & Reimer (1977) *Economic Geology* **72**, 1426-1441. [2] McCulloch (1994) *Earth Planet. Sci. Lett.* **126**, 1-13. [3] Machado et al., (1986) *GCA* **50**, 2335-2348. [4] Roerdink et al. (2015) *Goldschmidt Abstracts* **#2663**.