Variations in the strontium isotope composition of seawater during the Quaternary

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Variations in chemical weathering of the continents over glacial-interglacial timescales have been proposed to account for the long-term rise in $^{87}Sr/^{86}Sr$ over the Quaternary, and the apparent imbalance of Sr in the oceans at the present-day [1]. Recent high-precision data for planktic foraminifera from ODP Site 758 in the north-east Indidan ocean show no resolvable variation in $^{87}Sr/^{86}Sr$ through the last glacial maximum at the uncertainty of ±4.9 ppm (2SD) or less [2]. These data cannot accommodate a short-term weathering pulse during deglaciation, although a diffuse pulse accompanying protracted ice sheet retreat is permissible. However, variations through other glacial cycles (particularly those associated with significant climate change) and the long-term evolution of $^{87}Sr/^{86}Sr$ during the past 2.5 Myr, remain poorly constrained.

This study presents very high precision $^{87}Sr/^{86}Sr$ data for modern seawater and foraminifera from ODP sites 758 and 647 (in the Labrador Sea) through a number of glacial cycles over the past 2.5 Myr. The Sr isotope compositions of modern seawater from the Atlantic, Pacific and Indian Oceans are indistinguishable from one another at the ±4.1 ppm (2SD) precision of this study. The $^{87}Sr/^{86}Sr$ seawater record preserved by planktic foraminifera through the last four glacial terminations also shows no resolvable variation, limiting the response of seawater to variations in the chemical weathering flux and/or composition to ±4.1 ppm or less. Calculations suggest that a variation of ±12% around the steady-state weathering flux can be accommodated by these uncertainties, consistent with independent estimates for variations in weathering over glacial timescales (e.g. [3]), but still sufficient to account for the longer-term rise in $^{87}Sr/^{86}Sr$ of ~60 ppm Ma^{-1}, determined here, over the quaternary [1].

[1] Vance et al., 2009 *Nature* **458**, 493-496 [2] Mokadem et al., 2015 *EPSL* **415**, 111-120 [3] Munhoven, 2002, *Glob. Planet. Change* **33**, 155–176.