High precision $^{87}Sr/^{86}Sr$ measurements on foraminifera from the equatorial Pacific and Indian oceans: The search for climate related seawater $^{87}Sr/^{86}Sr$ cycles

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Introduction

A long term increase in the $^{87}Sr/^{86}Sr$ ratio of seawater is well established (Hodell *et al.*, 1990). High frequency variation about this long term trend might be expected due to changes in continental weathering rates between interglacial and glacial times. Two recent studies have reported such variation (Dia *et al.*, 1992, Clemens *et al.*, 1993) (see Fig. 1). These results have important implications, but remain controversial as the variations are < 40ppm and are close to the analytical precision of the measurements.

The aim of this study is to test the accuracy of these published results. We present very high precision $^{87}Sr/^{86}Sr$ ratio measurements from cores V28-238 (equatorial Pacific) and ODP site 758 (Ninety East Ridge, Indian Ocean) - those investigated in the previous studies. By increasing the precision of the measurements the small variations involved should be clearly resolvable.

Analytical details

Samples containing ~30 *P. obliquiloculata* individuals were handpicked. Previous work suggests that there is no interspecies $^{87}Sr/^{86}Sr$ variation (Henderson *et al.* 1993) but for some key ages *G. menardii* samples were also picked. Samples were gently crushed and ultrasonically cleaned once in methanol and 4 times in ultrapure water before Sr separation using Sr-spec resin. Sr was analysed by dynamic multi-collection on a VG 354 mass spectrometer. External precision was assessed by repeated analyses of NBS standard 987.82 beads run over a period of 14 months average 0.710233 ± 0.000009 (2s.d.) (equivalent to 13ppm).

Equatorial Pacific samples (V28-238)

19 samples ranging from present day to 340ka in age were chosen to include the largest range in values seen by Dia *et al.* and to sample interglacial and glacial periods. At the level of precision reported here these samples approximate to a linear increase in $^{87}Sr/^{86}Sr$ indistinguishable from that of Hodell *et al.* (see Fig 1d).

Indian Ocean samples (ODP 758)

Samples were selected from the last 35ka as this period is of most palaeoceanographic interest and as Clemens *et al.* report shifts in $^{87}Sr/^{86}Sr$ of up to 40ppm in this interval. Samples were also selected from the interval 330–365ka as this period contains a large (37ppm) shift in the data of Clemens *et al.* which is also seen in their thoroughly cleaned samples.

Within each period no significant variation in $^{87}Sr/^{86}Sr$ is seen (see Fig. 2). The standard deviation of the sample ratios within each period is the same as that for the standards run with those samples, suggesting that any variations are due to noise rather than a geological signal.

Conclusions

We have measured $^{87}Sr/^{86}Sr$ ratios in samples previously measured by Dia *et al* and Clemens *et al.* to a precision of 13ppm. These new measurements do not support the idea that high frequency, climate related, variations in the seawater $^{87}Sr/^{86}Sr$ ratio exist at greater than a few ppm.

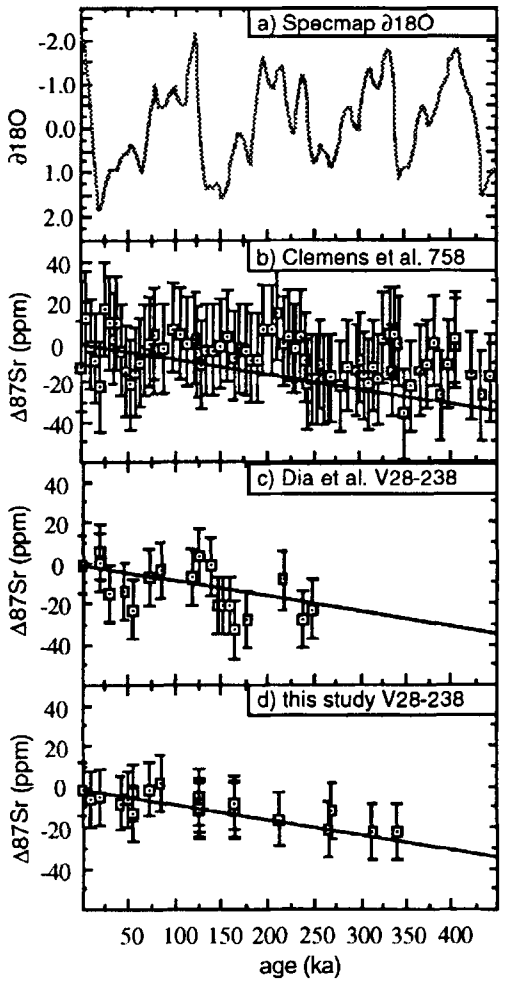

FIG. 1. a) Specmap $\delta^{18}O$ curve; b)-d) Comparison of Sr isotope ratios from - b) Clemens *et al.* (1993), c)Dia *et al.* (1992), d) this study. All error bars are reported 2 sigma errors. The line drawn through each data set is the long term trend in seawater Sr isotope composition from Hodell *et al.* (1990). All Sr data are adjusted to an NBS 987 value of 0.710233. ΔSr87 (ppm) = $((^{87}Sr/^{86}Sr)_{sample}/0.709158)-1) \times 10^6$.

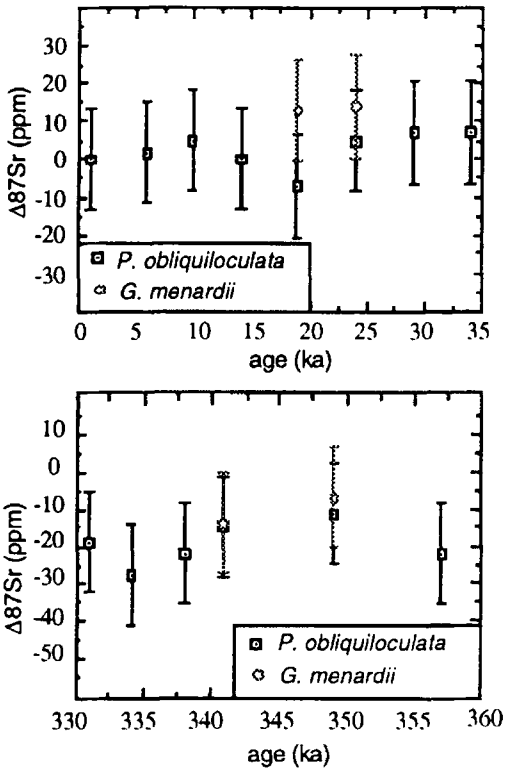

FIG. 2. High precision Sr isotope results from ODP site 758. The time intervals were selected to investigate some of the larger shifts reported by Clemens *et al.* At the precision reported here, no significant variation between these samples is resolved.

References

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