Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02738, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02738
EGU General Assembly 2008

Oxygen three-isotope distributions in terrestrial carbonates, silicates and waters – Insights and inferences from high precision measurements and a 'mass-independent' fractionation process

M. F. Miller (1, 2)

(1) British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, United Kingdom (mfm@bas.ac.uk)

(2) Planetary and Space Sciences Research Institute, The Open University, Walton Hall, Milton Keynes MK7 6AA, United Kingdom

High precision measurements of oxygen three-isotope ratios in terrestrial silicates, waters and the fractionation of atmospheric O_2 during respiration, have demonstrated that the respective mass-dependent fractionation arrays are characterized by distinctive and reproducible slopes on the logarithmic form of the oxygen three-isotope plot. By re-examining data which demonstrated the generation of a mass-independent isotopic anomaly during carbonate thermal decomposition (under high vacuum conditions to minimize back-reaction), it is shown that – surprisingly – terrestrial carbonates appear to be in accord with the silicates line, rather than that of meteoric waters. Furthermore, the few published high precision measurements of both δ^{17}O and δ^{18}O in tropospheric CO_2 indicate that the oxygen three-isotope composition of this atmospheric constituent also fits on the carbonates fractionation array.

Small but significant departures from reference fractionation arrays may be indicative of unusual (but generally mass-dependent) processes. For example, terrestrial silicates which recrystallized under extreme P-T conditions ($>$ 700ºC and $\sim 3 \times 10^9$ Pa) plot on a distinctively steeper fractionation line than do other rock-forming silicates. Similarly, recently-published data indicate that the transition from snow firn to deeply

buried ice is also associated with a steeper fractionation line than that which characterizes meteoric waters (including polar precipitation). Several published studies have reported that the oxygen three-isotope relationship in meteoric waters, when characterized at very high levels of accuracy and precision, gives a fractionation array that is slightly offset (^{17}O-enriched) relative the VSMOW reference material. The extent to which this offset ($<$50 per meg) is a record of humidity conditions in the vapor source region, as has recently been proposed in the literature, or is simply a reflection of the fact that VSMOW is not a natural ocean water (but was prepared by distillation and mixing of different waters), is as yet unknown.