# The behaviour of Mg and Li isotopes during the dissolution and precipitation of silicate minerals

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The stable isotopes of lithium and magnesium are fractionated during weathering processes, with retention of the light isotope of lithium ($^{6}$Li) and the heavy isotope of magnesium ($^{26}$Mg) in secondary minerals [1, 2]. This has direct consequences for the isotopic composition of groundwater and river waters, and so influences the chemical composition of seawater.

Because of the importance of primary mineral dissolution and secondary mineral formation on the chemistry of natural waters it is advantageous to be able to quantify their effects. However this is difficult to do because natural systems are extremely complicated. The advantage of experimental studies is that a system can be constructed that is very simple with variables such as pH kept constant, enabling the isotope behaviour to be more easily understood.

In this study we have investigated the behaviour of Li and Mg isotopes during the dissolution of forsterite and basalt glass at far-from and close-to equilibrium conditions. Preliminary results show that during the dissolution of forsterite there is no fractionation of Li isotopes, but under close-to equilibrium conditions the $\delta^{7}$Li value of the fluid phase shifts to higher values. These results, together with changing solution stoichiometry, support the idea that the precipitation of secondary minerals causes preferential removal of $^{6}$Li from the fluid phase.

These results, together with further analyses, will help to show how both isotopes behave during mineral dissolution and precipitation and help to quantify the isotopic effects of these processes. Ultimately this can be applied to further our understanding of their behaviour in the natural weathering environment.

[1] Huh *et al.* (1998) *Geochim. Cosmochim. Acta* **62**, 2039-2051. [2] Tipper *et al.* (2006) *EPSL* **247**(3-4) 267-279.

# Half a million years of coherent dust flux variations in the tropical Pacific and Antarctica

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Dust plays a critical role in the Earth's climate system, both directly by affecting the radiation budget of the atmosphere and indirectly by influencing the biological uptake of $CO_2$ by the oceans and the exchange of radiatively active gases with the atmosphere. While ice core studies have characterized climate-related changes in dust fluxes to Polar Regions on seasonal to glacial timescales, dust fluxes at lower latitudes, where changes may have important impacts on marine biogeochemistry, surface radiation, and the hydrological cycle, are less well constrained.

We present a reconstruction of aeolian dust fluxes from inter-hemispheric sources to three sites across the Equatorial Pacific Ocean over the past five glacial cycles [1]. We use $^{232}$Th as a geochemical proxy for dust in sediments and $^{4}$He/$^{232}$Th as provenance indicator.

The three dust records, spanning 6000 miles across the tropical Pacific, bear remarkable correlations with global ice volume and with the Antarctic dust flux record. Coherent changes in dust fluxes from polar to tropical latitudes suggest that processes regulating dust generation have a consistent relationship to global climate variability across widespread source regions. We provide a comparison of our observations and recent dust models. Using our results as benchmark, we show that model dust fluxes in this region have improved over the past decade, but the zonal gradient in recent models is reverse of that seen in the data, indicating areas for further improvement.

[1] Winckler *et al.* (2008) *Science* **320**, 93-96, doi, 10.1126/science.1150595