

Under what conditions is weathering maximized?

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According to Edmond and Huh [1] current global weathering rates are at a kinetic minimum due to a low atmospheric CO₂ content. It is hypothesized that this minimum in atmospheric CO₂ has been reached through a recent high consumption of CO₂ by enhanced silicate weathering due to tectonic uplift of the Himalayas [2]. To determine a range of possible global silicate weathering rates, we need to characterize the role of the processes, which control global spatial variability of weathering rates and to pinpoint conditions under which weathering is maximized or minimized.

Here, the concept of a dynamic model of soil genesis and associated rock weathering rates is presented and tested globally in order to find conditions under which weathering is maximized. In the model formulation the state of the soil system, i.e. temperature, water balance, depth, composition and CO₂ partial pressure, determines the outflow of weathered elements to rivers and ultimately the ocean. This allows us to quantify and model the influence of climate, uplift, erosion, soil age, and the direct and indirect effects of vegetation on silicate weathering rates.

The geographic variation of weathering rates and soil state can be examined and possible maximum weathering regimes recognized through a set of sensitivity simulations of weathering output to variability in vegetation, uplift and erosion. The outcome of such a set of experiments is presented and discussed.

[1] Edmond & Huh (2003) *Earth Planet Sc. Lett.* **216**, 125-139. [2] Raymo *et al.* (1988) *Geology* **16**, 649-653.

Constraining the ³⁶Cl/Cl ratio of seawater and its sources

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AMS Analysis of ³⁶Cl/Cl ratio of Seawater

Cosmogenic ³⁶Cl found in seawater is produced via spallation of atmospheric ⁴⁰Ar [1] and neutron capture of secondary cosmic-ray neutrons by dissolved ³⁵Cl [2]. The long residence time of chloride in the ocean and relatively long half life of ³⁶Cl compared to the oceanic mixing time should result in a homogenous ³⁶Cl/Cl ratio throughout the ocean.

Until recently, attempts to measure the ³⁶Cl/Cl ratio were unsuccessful due to insufficient analytic sensitivity. Modern AMS technology now allows us to measure ³⁶Cl/Cl ratios down to values close to 10⁻¹⁶ [3]. We have recently analyzed seven seawater samples from the Pacific and five commercially available NaCl salt samples at the ANU 14UD Pelletron. The average ³⁶Cl/Cl ratio of our seawater samples was 7.6 +/- 1.6 x 10⁻¹⁶, and the blanks averaged 0.5 +/- 0.4 x 10⁻¹⁶.

Discussion of Results

Preliminary calculations to determine how well this value correlates with expected atmospheric and oceanic sub-aqueous production indicate a discrepancy. Using values calculated by Masarik & Beer [1], estimated contribution to the ³⁶Cl/Cl ratio of seawater from atmospheric production is 2.9 x 10⁻¹⁶. Using the neutron flux values in seawater calculated by O'Brien [4], the contribution to the ³⁶Cl/Cl ratio via neutron capture by ³⁵Cl is estimated to be ~1.0 x 10⁻¹⁶. These two primary sources of ³⁶Cl sum up to a ratio of ~3.9 x 10⁻¹⁶. Future work will focus on identifying and quantifying the source of this discrepancy.

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[1] Masarik & Beer (1999) *Journal of Geophysical Research*, 12099-13012. [2] Bentley, Phillips & Davis (1986) In: Fritz & Fontes (eds). Elsevier, Amsterdam, Netherlands. [3] Galindo-Uribarri *et al.* (2007) *Nuclear Instruments and Methods B*, pp.123-130 [4] O'Brien *et al.* (1978) *Journal of Geophysical Research*, 114-120.