

Approaches to estimating chemical weathering rates in soils

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Introduction

While the loss of soils by physical erosion has been a major scientific focus over the last century, the rate of soil formation from the earth's protolith is currently an emerging topic for investigation. The quantification of soil production has important ramifications in terms of the neutralization of acidic deposition, carbon sequestration, nutrient cycling and CO₂ drawdown. Often remediation strategies are dependent on the relative rates of soil weathering [1]. This paper discusses a number of approaches for characterizing natural weathering rates based on mineral, element and isotope distributions in soil profiles using differing levels of computational complexity and the availability of field information.

Discussion

Soil weathering is commonly considered in two very different temporal scales, geologic time over which changes in mineral composition occur and contemporary time over which solutes move through the soil column.

Quantification of both geologic and contemporary scale weathering can be developed from parallel perspectives involving weathering rates, gradients and velocities shown in Fig. 1 [2].

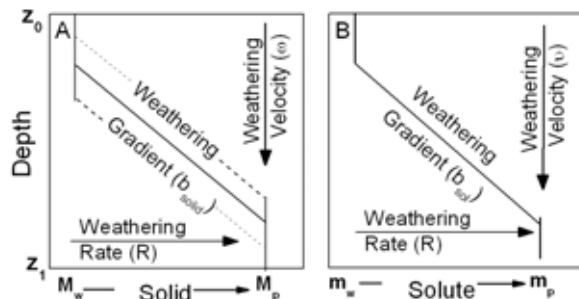


Figure 1: Schematic of solid and solute soil profiles.

A number of approaches, involving geometric and numerical analyses, spreadsheet computation and reactive transport codes, which derive the above parameters from field-based soil studies, are discussed.

- [1] Drever and Clow (1995) *Rev. Mineral.* **31**, 463-481.
 [2] White (2004) *Treatise of Geochem.* **3**, 133-169.

Chemical interactions in rainfall/shallow soil pore water in coastal watersheds

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Introduction

Characterizing precipitation inputs is critical in achieving chemical mass balances in watersheds. This goal is made significantly more difficult in coastal environments which are often subjected to strong aerosol and orographic gradients. This paper reports the results of an ongoing study of precipitation-soil water interactions for a series of sites along a transect 0.1 to 8 kms from the Pacific Ocean near Santa Cruz, California.

Results

Data indicate complex interactions between coastal aerosols, which, depending on chemical species, are dependent on differing marine and terrestrial sources. Elemental ratios in Fig. 1 indicate that although Na/Cl and Mg/Cl are indicative of sea spray, we found that Ca/Cl and SO₄/Cl are in excess, indicating other sources which are dependent on precipitation intensity, and as documented by the NOAA HYSPLIT atmospheric model, on storm direction and progress.

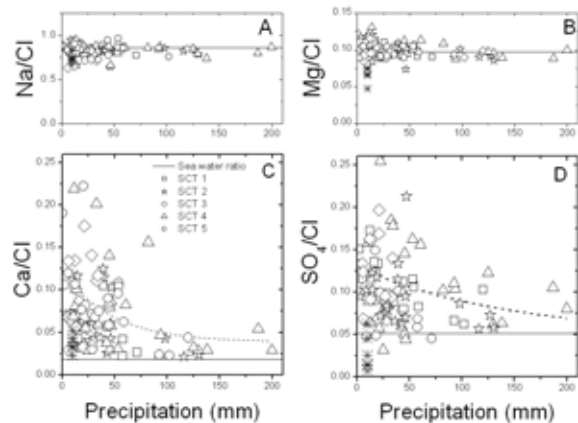


Figure 1: Elemental ratios as functions of storm intensity.

Precipitation, infiltrated into shallow pore waters undergo complex interactions involving biological cycling and chemical weathering. These processes are traced using a number of techniques including ⁴⁴Ca/⁴⁰Ca and ⁸⁷Sr/⁸⁶Sr.