Magnesium isotopic fractionation in arid Hawaiian soils

KYLE D. TROSTLE[1*], LOUIS A. DERRY[2], NATHALIE VIGIER[3], OLIVER A. CHADWICK[4]

[1]Cornell University, Ithaca, USA, kdt42@cornell.edu (* presenting author)

[2]Cornell University, Ithaca, USA, lad9@cornell.edu

[3]CRPG, Nancy, France, nvigier@crpg.cnrs-nancy.fr

[4]UC Santa Barbara, Santa Barbara, USA, oac@geog.ucsb.edu

Sampling and Methods

Soil, streamwater, and parent material samples were taken from the arid leeward coast of the Kohala Volcano on the Big Island of Hawaii to investigate the fractionation of magnesium isotopes within the weathering environment. Soil samples were taken from both the Pololu (~350 ka) and Hawi (~170 ka) lava flows, and streamwaters were taken from streams under different discharge conditions. Soils were characterized on site and with x-ray diffraction techniques in order to determine horizonation and mineralogy. These samples were then processed via a sequential extraction to isolate carbonate, exchangeable, and soil organic matter fractions, and will be further processed to isolate noncrystalline phases, poorly crystalline phases, kaolin, and residual materials. Major element chemistry of these extractions was determined, and samples were processed according to an ion exchange method developed by Bolou-Bi et al. (2009) [1] in order to isolate monoelemental solutions of magnesium from each. These were run on a Thermo-Fisher Neptune multi-collector inductively coupled plasma mass spectrometer (MCICPMS) at the Centre de Recherches Petrographiques et Geochimiques (CRPG) in Nancy, France, using standard-sample bracketing techniques to determine δ^{26}Mg with respect to the standard DSM3.

Results and Conclusions

The δ^{26}Mg isotopic composition of soil carbonates (n=7) ranged considerably from -1.05 ± 0.32 per mil to -2.31 ± 0.16 per mil, whereas the magnesium isotopic composition of the exchangeable fraction (n=7) consistently averaged -1.12 ± 0.21 per mil, in both the Pololu (~350 ka) and Hawi (~170ka) soils. The variation in carbonate magnesium isotopic composition may be due to a variety of factors, including depth, age, and phase, but with only seven carbonate samples analyzed, further work is needed to confirm trends within the data. Both of the soil carbonate and exchangeable reserviors of magnesium, in both the Pololu and Hawi soils, are isotopically lighter than the primary sources of magnesium to Hawaiian soils, which include precipitation at a value of -0.8 per mil and basalt at -0.3 per mil [1]. The streamwaters (n=5) measured fall inbetween the isotopic values of precipitation and basalt, with an average value of -0.54 ± 0.20 per mil, although this consistency in magnesium isotopic composition within the streamwaters may be the result of groundwater influence. A magnesium budget for these soils has been created to interpret these findings.

[1] Bolou-Bi, Vigier, Brenot & Poszwa (2009) *Geostandards and Geoanalytical Research* **33**, 95-109.

The effects from soil mineralogy and groundwater acidity on *Lolium multiflorum* (ryegrass)

FANNY TRUONG[1,2*], KUMARI A. BISWAS[1,3], SHAGUN SINGH[1,4], BONNIE A.B. BLACKWELL[1,5*], AND JOEL I.B. BLICKSTEIN[1]

[1] RFK Science Research Institute, Glenwood Landing, NY, 11547

[2] fannytruong4@gmail.com (* presenting author)

[3] kumari.ananna.biswas2010@gmail.com

[4] s.singh_95@yahoo.com

[5] Dept of Chemistry, Williams College, Williamstown, MA, 01267 bonnie.a.b.blackwell@williams.edu (* presenting author)

Abstract

Acid rain reduces plant diversity, growth, and population size. Anthropogenic activities that release SO_2 and NO_x produce acid pre-cipitation, and cause to groundwater acidification. This experiment tested the ideal soil mixture for *Lolium multiflorum* (ryegrass), when exposed to low concentrations of acid rain. Using different mixtures of sphagnum peat moss, montmorillonite, and quartz sand, 21 different soils were created. For each, 48 *L. multiflorum* seeds were planted individually, and watered with an average of 10 mL/day of deionized water. Plants were grown in controled conditions under artificial light and were rotated regularly to ensure equal light intensity reaching each plant over a seven day period. On Day 19, each group was split in half, with one half continuing to receive 10 mL/d water, while the rest subsequently received 10 mL/d of 0.0001 M of H_2SO_4 at pH = 3.62. Plant heights were measured and health was monitored via leaf number and general appearance daily. After 35 days, biomass production was measured. Sprouting percentages, mean growth rates, and mean longevity were calculated for each group. In the absence of acid, the sprouting percentage is highest for soils with ≤ 20 vol% sand, ≤ 60 vol% peat moss, and ≤ 80 vol% montmorillanite, while the mean plant heights were tallest for soils with 40 vol% sand, 20 vol% peat moss, and 40 vol% montmorillanite after 35 days. If exposed to acid, the plants grew tallest in soils with 40 vol% peat moss and 60 vol% clay, but plant longevity was highest for soils with 20 vol% peat moss, 20-60 vol% sand and 20-60 vol% montmorillanite. Biomass production was highest for plants exposed to water when their soil averaged 20-40 vol% clay, but for plants exposed to acid, biomass production was highest if their soil had 40-60 vol% clay. Therefore, for ryegrass exposed to acid, growth will be improved, if clay concentrations in their soil are higher than for plants exposed to water alone. Nonetheless, pH of 3.62 did not dramatically affect potential growth for *L. multiflorum*. Thus, it might make a suitable species to use for reme-diation in areas with clay-rich soils and acidified groundwater. Future experiments will examine the ions leached from the soil under these conditions.

Figure 1. Mean plant heights on Day 35 for plants growing in the acidic groundwater (above) and in water lacking acid (below).