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Silica biogeochemistry in grasslands of mid-continent North America

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There is a substantial body of evidence that suggests that plants may transform silica into more stable or labile forms, thus acting as potential sources or sinks of silica. Estimates of soil weathering rates need to include the influence of biogenic silica in “dampening” primary silicate weathering, which in turn influence evaluations of paleoclimate. We were interested in quantifying variability in the modern biogeochemical cycle of silica in grassland ecosystems to identify the possible effects of plant type and production on the silica pools and fluxes during soil development. To further quantify biological cycling of silica, we present the initial results of state factor (bioclimo- and chronosequences), constituent mass balance, and geochemical analyses of soil and biogenic silica to quantify the role of plants in regulating the biogeochemistry of silica in temperate grassland ecosystems of the mid-continent of North America.

Isotopic analyses of soils and biogenic minerals in tropical ecosystems have shown that δ^{30}Si values within the soil profiles exhibit a strong differentiation between a more biologically influenced layer (<30 cm depth), and the less biologically active deeper layer (30 – 100 cm depth). The more negative δ^{30}Si values found in the upper 5 cm is likely due to the greater quantities of recycled biogenic silica in the form of opal phytoliths.

The grassland ecosystems we studied have shown considerable variation in biogenic silica production and storage as a function of age and bioclimatic conditions. In general Holocene aged soils of temperate grassland ecosystems have a net accumulation of silica while soils of Pleistocene age have experienced a net loss of silica; however, all grassland systems accumulate biogenic silica. Shortgrass steppe ecosystems have the greatest accumulations of biogenic silica in soil and the lowest silica storage in biomass, whereas the tallgrass systems have greatest biomass silica and lowest biogenic silica accumulation in soil. Our paper will integrate pedological and geochemical characterization to provide a synthetic treatment of the potential role of grassland ecosystems in the mobilization and storage of silica worldwide.

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The source of calcium in wet atmospheric deposits: Ca-Sr isotopes evidence

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The understanding of base cation nutrients behaviours and origins in watersheds is necessary to determine the recovery of a watershed from environmental disturbances such as acid rain. Thus, the identification of the Ca origin in wet atmospheric deposits is important for environmental studies since it is a dominant acid neutralising cation and also an important nutrient.

Here we present the first Calcium isotope ratios of rain and snow samples from northeastern and southern locations (France, Switzerland, Luxembourg, California and Japan). The data indicate that the global Ca isotopic composition range of the studied samples, with a maximal range of 0.8 ‰ is limited, similar to the variability of natural waters [1, 2] and must be linked to mass fractionation processes. No difference can be observed in the Ca isotopic composition or origin of rain and snow.

The data point to a carbonated origin. Nevertheless, in a silicated-forested watershed (Vosges mountains, France), the Ca isotopic composition of rainwater indicate that, at a local scale, during storm events, the rainwater becomes admixed with throughfall solution, which is a mixing product of Ca from dissolved atmospheric dust particles and leave excretions. Consequently, in a forested watershed, the Ca contribution from the canopy is very important for the neutralisation of acid rain and of the corresponding soil system. Thus, in contrast to Sr isotopes, Ca isotopes are adapted tools to trace processes occurring in the biosphere.

References

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