Geophysical Research Abstracts
Vol. 16, EGU2014-6965-1, 2014
EGU General Assembly 2014

Stable isotopes as indicators for long term soil degradation

Katrin Meusburger, Franz Conen, and Christine Alewell
University of Basel, Environmental Geosciences, Basel, Switzerland (katrin.meusburger@unibas.ch)

We summarize the results of several studies that explored the suitability of stable isotope as indicators for soil degradation. Two approaches to indicate soil degradation were tested. The first one aims to identify soil erosion in hill slope transects from uplands (erosion source, oxic soils) to adjacent wetlands (erosion sink, anoxic soils) as it often occurs in mountain environments. The second aims at identifying long-term disturbance of oxic soils through decreasing correlations between δ^{13}C and soil organic carbon (SOC), δ^{15}N and N content, and δ^{15}N and C:N ratio.
Following the first approach, different stable isotope signatures can be expected for uplands and adjacent wetland soils. In our study, δ^{13}C of SOC in wetland soils was with -28.3 $\pm$ 0.6 ‰lighter than those of upland soils (-26.6 $\pm$ 0.6 ‰). Soil erosion is indicated by intermediate δ^{13}C values (-27.5 $\pm$ 0.5 ‰) of the wetland soil. Analogue oxic upland soils and wetlands not affected by soil erosion also differed in δ^{18}O values. The upper horizons (0–10 cm) of upland soils had a mean δ^{18}O between 5 and 15 ‰, while δ^{18}O signatures of reference wetland soils varied between 15 and 20 ‰. Intermediate δ^{18}O values for wetland soils adjacent to an upland can consequently be interpreted as mixing of soil erosion material with the organic wetland soil.
Following the second approach, ‘stable’ landscape positions (reference sites), which are neither affected by erosion nor deposition are compared with disturbed sites. For undisturbed soils we expect that the enrichment of ^{15}N and ^{13}C with soil depth, due to fractionation during decomposition, goes in parallel with a decrease in N and SOC content. In the Swiss Alps, the soil profiles of the reference sites showed significant correlations between SOC content and its corresponding ^{13}C signature. In contrast, for the eroding sites this relationship was not significant. The usefulness of the stable carbon isotope signature as a qualitative indicator for soil disturbance could be confirmed for a mountain site in South Korea. For the Korean site, we could further show that the ^{15}N isotope signature can be used similarly for uncultivated sites. Further, δ^{15}N is functionally related to the C:N ratio. In unperturbed sites δ^{15}N values cover a relatively narrow range at any particular C:N ratio in soils within a large geographical region. Substantial loss, or gain of N, mostly results in the loss or gain of ^{15}N-depleted forms. The latter results in larger or smaller δ^{15}N values than usual at the observed C:N ratio and can serve as a soil disturbance indicator.