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Nonexchangeable H isotope ratios of soil organic matter across different ecoregions in Argentina

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$\delta^2H_{n(nonexchangeable)}$ analyses of bulk soil organic matter (SOM) are analytically challenging because they require separation of organic matter (OM) and mineral matrix and isotopic equilibration of exchangeable H (Sauer et al. 2009, Ruppenthal et al. 2010). However, isolation of SOM for δ^2H_n analysis is necessary in order to avoid ambiguities in the interpretation of soil δ^2H_n, which constitutes a mixed signal of δ^2H_n of SOM and δ^2H_n of pedogenic clay minerals. For the first time, we were able to determine δ^2H_n values of pure SOM, isolated from 53 topsoil samples from 18 sampling sites along a 2500-km north to south transect from the Argentinean Pampas to the Patagonian Steppe. We demineralized soil samples with a new hydrofluoric acid (HF) demineralization technique optimized for high OM recovery and water-steam equilibrated the SOM concentrates prior to δ^2H measurement.

Spiking of demineralization reagents with deuterated water had no effect on δ^2H_n values (-96 to -119‰ for demineralization with deuterated reagents vs. -92 to -117‰ for conventional demineralization), proving the suitability of HF treatment for preparation of SOM concentrates for δ^2H_n analyses. Standard deviation of independently demineralized and equilibrated replicate samples was below 4‰ indicating very good reproducibility of both HF demineralization and H isotope equilibration.

δ^2H_n of SOM varied between -71 and -161 ‰ and showed a close relationship to modelled annual average δ^2H of local precipitation at the sampling sites (δ^2H_{nSOM}=1.18 $\delta^2H_{precipitation}-41$, r=0.97, p<0.0001). This result was unexpected because of the large variation of vegetation, soil type and climatic conditions along the sampling transect. The very robust relationship suggests that δ^2H_n of bulk SOM can be predicted solely from modelled δ^2H of local precipitation and that effects such as enrichment of ^2H in soil and leaf water in arid regions, physiological effects in plants or possible isotope fractionation during SOM decomposition do only marginally affect δ^2H_n of bulk SOM. Analysis of δ^2H_n of SOM could therefore help to reliably constrain the geographical origin of soil samples and, with an extened database, offer the perspective to model a SOM δ^2H_n isoscape from the Global Network of Isotopes in Precipitation (GNIP) δ^2H data.

References

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- Sauer et al. 2009 *Rapid Commun. Mass Spectrom.* 23, 949-956