Nitrogen mobility in freshwater peat

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Peatlands cover less than 5 % of the Earth's land surface, yet they store as much as 15 % of the world's soil N, and 30 % of the world's soil C. Vile et al. [1] have recently reported that ^{210}Pb dated peat in pristine high-latitude bogs contains 20 times more N than could be explained by inputs of atmospheric N. Vile et al. [1] have suggested that the "excess" N in peat is a result of *in-situ* N_2 fixation from cyanobacteria, a process that has been largely overlooked. It is unclear whether in N-polluted areas, where N is not a limiting nutrient, the symbiosis between *Sphagnum* and N-fixing microorganisms is lost. Still, it appears that a major gap in the global biogeochemical cycling of N has been identified.

Here we report a field experiment that might provide an insight into the retention of atmogenic N in peat. We hypothesized that vertical N profiles in peat do not directly reflect historical trends in N deposition and that N is mobile after its burial in peat. We selected two Central European peat bogs, differing in present-day atmospheric N inputs by a factor of 2, and collected 10 peat cores per site. Trends in N deposition since the beginning of the Industrial Revolution have been extremely well documented in the area [2]. The more polluted site VJ exhibited a clear-cut N concentration peak in layers dating from 1950. The less polluted site CB showed a N concentration minimum in layers dating from 1940. In actual fact, the atmospheric N input increased smoothly until 1980, and dropped thereafter [2]. We suggest that N in peat profiles does not record past N deposition levels. We conducted an 18-month reciprocal peat transplant experiment between VJ and CB, using 5 cores as transplants and 5 cores as controls per site. At the end of the experiment, at both sites, bulk N to a depth of 10 cm changed its δ^{15}N value by 3 per mil, converging to that of the host site. Again, the bulk N isotope change indicated a measurable degree of N mobility in peat.

[1] Vile et al. (2011) *Proceedings of AGU Annual Meeting*, San Francisco, December 2011.
[2] Kopacek et al. (2011) *Global Biogeochem. Cycles* 25, GB2017.

Development of a process-based chemical weathering model with consideration of the effective surface area

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Feedback mechanism between climate and chemical weathering is one of the most important aspects of the Earth system. Despite a significant number of studies for understanding the rate of chemical weathering quantitatively by observational, experimental, and numerical methods, the global chemical weathering rate has not been estimated straightforwardly owing to a significant discrepancy between field and laboratory studies. The discrepancy may be explained as a sum effect of several phenomena such as increase in surface roughness with time and difference in reaction affinities between natural and experimental conditions [1].

We are developing a process-based chemical weathering model to study behaviours of the geochemical cycle system in response to changes in modern- and palaeo-environment. This model is similar to “WITCH” model [2], but the originality of our approach lies on integration of simple soil physics (i.e. heat and moisture transport) and consideration of soil biological activity in the weathering model. The model has been applied to different small (< 10 km^2) watersheds such as Strengbach in France and Lac Clair in Canada to verify the model to reproduce major ion concentrations of modern streams. We introduced a free parameter which represents a ratio of field-scale weathering rate to mineralogical dissolution rate to fit the results to the observational data. Sensitivity analyses show that riverine ionic concentrations of base cations are well reproduced from the model only by tuning this parameter alone. We interpret that this parameter may represent the erosional effect which, in turn, controls the age of the weathering environment. That is, the time dependency of silicate weathering [1] can explain the difference in this parameter. The obtained parameter is also comparable with the ratio of the effective surface area to the BET surface area estimated in previous studies.

Our results imply that the chemical weathering process can be modelled by considering the difference in the effective surface area controlled by lithology and erosion.

[1] White & Brantley (2003) *Chem. Geol.* **202**, 479-506. [2] Goddéris *et al.* (2006) *Geochim. Cosmochim. Acta* **70**, 1128-1147.