Weathering stoichiometry: A critical factor to estimate soil acidification rate $

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Soil acidification is widespread in the world. However, how to accurately estimate current soil acidification rate is still a hard scientific problem because of soil acid-buffering mechanism. To explore a new method to accurately estimate soil acidification, a forested watershed with acid deposition, located in subtropical area, China, was selected. The input and output of proton (H^+) and related elements from the watershed had been monitored for three years. The soils sampled from the watershed were eluted exchangeable base cations (K, Na, Ca, Mg), then leached by simulated acid rain to obtain the weathering stoichiometric relation of base cations to Si (BC:Si).

The net input of H^+ from both wet and dry deposition was about 1395 mol ha^{-1} yr^{-1} in the watershed, including directly from acid rain, transformations from nitrogen and sulfur. However, the runoff water was neutral, meaning that soil consumed all H^+. The specific adsorptions of extraneous SO_4^{2-} in soil produced OH^- and consumed H^+ about 93 mol ha^{-1} yr^{-1}. The remained H^+ in soil was consumed by cation exchange and mineral weathering. The leached experiment of acid rain showed that BC:Si was 1:1 during the soil mineral weathering. Based on BC:Si and the net output of base cation and Si in the watershed, we found that weathering consumed 1068 mol ha^{-1} yr^{-1} H^+, about two times more than the estimation in previous study based on plagioclase weathering[1]. The H^+ consumed by cation exchange only took up one fifth of total H^+ input. The soil acidification rate was 234 mol ha^{-1} yr^{-1}.

The method of estimating soil acidification rate based on weathering stoichiometric relation of BC:Si is very effective. This study illustrates that previous methods only using input H^+ and leaching of base cations highly overestimated soil acidification rate.

[1] Yang et al. (2013) *Chem.Geol.* **337-338**, 30-37.

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