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Titel
Base metal budgets of a small catchment in a tropical montane forest in South Ecuador

Abstract
In a tropical montane rain forest in south Ecuador, the alkali and earth alkali metals Ca, Mg, K, and Na are supplied by weathering of the parent substrate consisting of phyllites and metasandstones and by atmospheric inputs. Phases of acid deposition are interrupted by alkalinization through episodic basic dust deposition. Although the biological productivity of most terrestrial ecosystems is thought to be N- and/or P-limited, there is increasing evidence that the essential plant nutrients K, Na, Mg and Ca can also limit biological functioning.

We quantified biological and geochemical contributions to base metal fluxes and set up a metal budget of a ca. 9.1-ha large catchment from 1998 to 2013. The catchment is characterized by a high annual interception loss (28–50 %) and a low contribution of stem flow to throughfall. Mean total annual soil input (throughfall + stemflow + litterfall) was 13800 ± 1500 mg m^{-2} (Ca, mean ± SD), 19000 ± 1510 (K), 4690 ± 619 (Mg) and 846 ± 592 (Na) of which 22 ± 6 % (Ca), 45 ± 16 (K), 39 ± 10 (Mg) and 84 ± 33 (Na) were leached to soil horizons below the organic layer. The three nutrient metals Ca, K and Mg were thus to a large part retained in the biotic part of the catchment.

The canopy budget of K was consistently and most pronouncedly negative. The canopy budgets of Ca and Mg were closely correlated and in most years negative, while the budget of Na was consistently positive, indicating net retention of this element in the canopy. The mineral soil retained 79–94 % of Ca, K and Mg, while Na was net released from the mineral soil.

The size of mainly biologically controlled aboveground fluxes of Ca, K and Mg was 1-2 orders of magnitude larger than that of mainly geochemically controlled fluxes which are driven by sorption to soil and weathering. Annual net hydrological fluxes (bulk deposition – stream flow) were –66 ± 278 mg m^{-2} (Ca), 361 ± 421 (K), –188 ± 159 (Mg) and –1700 ± 587 (Na). If estimated dry deposition was included, the system accumulated 86 kg Ca $ha^{-1}$and 199 kg K ha^{-1}, had a nearly balanced budget of Mg (+0.3 kg ha^{-1}) and lost 56 kg of Na ha^{-1} in the last 15 years. The strongest driver of all budgets was the input flux into the various compartments.