Long-term measurements of forest soil Ca and Mg decline with vegetation uptake and leaching

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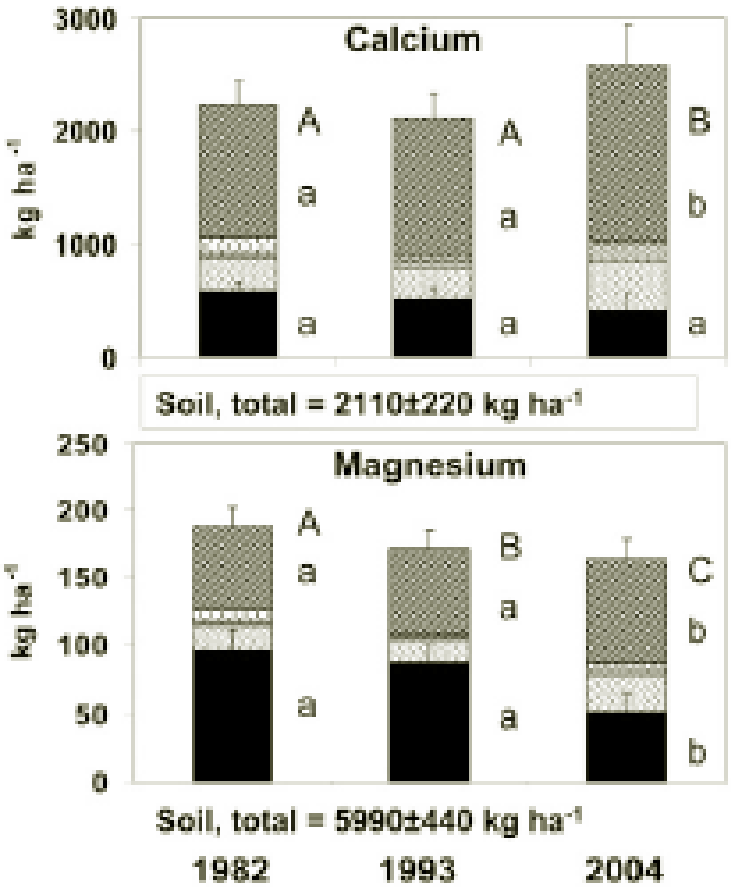
DOE/Office of Science/Biological & Environmental Research

- Repeated measurements of forest soil chemistry in 24 plots at 10-year intervals from 1972 to 2004 in Walker Branch Watershed show declines in exchangeable Ca^{2+} and Mg^{2+}.
- Decreases in soil Ca^{2+} were mostly attributed to Ca increases in biomass and detritus.
- Decreases in soil Mg^{2+} could only be attributed to leaching losses.
- In one of the 24 plots, exchangeable Ca^{2+} increased from decomposition of Ca-rich coarse woody debris from oak (*Quercus*) mortality.
- Long-term observations have endorsed long-term base cation changes in soil as a potentially important driver for vegetation change through time.



U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Long-term measurements of forest soil Ca and Mg decline with vegetation uptake and leaching*

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Decadal changes in soil exchangeable K^+, Ca^{2+}, and Mg^{2+} concentrations and contents from 1972 to 2004 in eight intensively monitored plots on Walker Branch Watershed were compared with estimates of increments or decrements in vegetation and detritus. The results from these eight plots compared favorably with those from a more extensive set from 24 soil sampling plots sampled in 1972 and 2004. Increases in exchangeable K^+ were noted between 1972 and 1982, but few changes were noted between 1982 and 2004 despite significant increments in vegetation and detritus and significant potential losses by leaching. Total K contents of soils in the 0- to 60-cm sampling depth were very large and a slight amount of weathering could have replenished the K^+ lost from exchanges sites. With one notable exception, exchangeable Ca^{2+} and Mg^{2+} concentrations and contents decreased continuously during the sampling period. Decreases in exchangeable Ca^{2+} could be attributed mostly to increments in biomass and detritus, whereas decreases in exchangeable Mg^{2+} could not and were attributed to leaching. The major exception to these patterns was in the case of exchangeable Ca^{2+}, where significant increases were noted in one plot and attributed to Ca release from the decomposition of Ca-rich coarse woody debris from oak (*Quercus* spp.) mortality. With minor exceptions, soils and changes in soils among the eight intensively sampled core plots were similar to those in a more extensive set of plots distributed across the watershed. This study shows that averaging among plots can mask significant and important spatial patterns in soil change that must be taken into account in assessing long-term trends.

* Johnson DW, Todd DE Jr, Trettin CF, Mulholland PJ (2008) Decadal changes in potassium, calcium, and magnesium in a deciduous forest soil. *Soil Science Society of America Journal* 72:1795-1805.

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