Uncertainty factors in weathering estimates using the depletion method

JOHAN STENDAHL[1]

[1]Department of Soil and Environment, Swedish University of Agricultural Sciences, Box 7014 SLU, 750 07 Uppsala, Sweden (*correspondence: johan.stendahl@slu.se)

The depletion method [1] with e.g. Zr as conservative element is frequently used to estimate mass loss of more easily weathered elements in soil profiles. It quantifies field weathering rates that otherwise often relies on modeling of slow processes that are difficult to validate [2]. Although the principle of the depletion method is straightforward, the methodology involves expert judgements that introduce uncertainties. For example, the reference depth below which the weathering per definition ceases needs to be defined. An interfering factor is also the natural stochastic variation of the chemical measurements, particularly for Zr that is present in low concentrations. The lack of a standardized methodology make synthesis of published results difficult. In this study an objective approach is applied to determine the reference depth and to cope with stochastic variation. A set of intensively sampled forest soil profiles developed in non-stratified glacial till were used in the evaluation. Estimates were made of total weathering rates, weathering intensity by depth and the depth of the weathering front for Ca, Mg Na, and K. The importance of the choice of reference depth varied among the profiles. When using least-square fitted segmented models to quantify chemical gradients of Ca, Mg Na, K and Zr in the profiles, more robust outcomes were obtained. The correlation between weathering rates estimated by the depletion method and by process oriented modeling were higher for Ca and Mg than for K and Na.

[1] Brimhall & Dietrich (1987) *Geoch. Cosmoch. Acta* **51**, 567-587. [2] Stendahl et al. (2013) *Geoderma* **211-212**, 65-74.