

## ***Interactive comment on “Weathering rates in Swedish forest soils” by Cecilia Akselsson et al.***

### **Anonymous Referee #2**

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#### General Comments

The estimation of weathering rates under field conditions is one of the least constrained exercises in biogeochemical research. Yet weathering is crucial to acid-base chemistry and the supply of mineral nutrients to terrestrial (and aquatic) ecosystems. The wide variety of methods available to estimate weathering rates is itself a testimony to our profound lack of clarity regarding the quantification of the key factors and processes. This paper, part of a series of related papers, attempts to bring together weathering flux estimates from a large number of sites in Sweden, made using several estimation methods. The strength of the paper lies in the large number of sites studied and the thoughtful review of the key uncertainties in the various methods of estimation. It is somewhat hard to evaluate this paper without reading the other papers in the proposed series, but it is clear that, together, these represent a comprehensive state-of-the-science assessment of weathering research, at least in the Scandinavian context.

It is very exciting to see the fruits of the QWARTS project coming to the publication stage.

### Specific Comments

1a. The consistency of the weathering rates estimated by different methods at the same sites in this study was remarkable. Older studies frequently reported one or two order of magnitude differences in estimates of weathering by depletion versus budgets. The paper discusses the fact that those older studies were done when acid rain was at its peak, but it is true that precipitation is still highly acidic relative to pristine conditions. Have weathering rates changed substantially in the last 30 years, or were the differences always muted in Swedish soils?

1b. Following up on the previous comment, have the authors tried plotting the estimated weathering rates against one another? For example, PROFILE vs. Depletion, etc.? Perhaps this is in one of the other papers in the series?

2. Given the spatial coverage of the sites in this study, I was surprised by the narrow range of estimated weathering rates - for example, in Figures 2 and 3. Were carbonate sites avoided? Were there other selection criteria for the study sites?

3. When comparing weathering rates to harvesting removals, what rotation length was assumed to calculate a  $\text{meq/m}^2/\text{yr}$  value? Perhaps I just missed it, but I could not find it.

4. An awful lot of confidence is placed in this paper in modeling approaches in general and in the PROFILE/ForSAFE family of models in particular. They are good models conceptually and they produce results that appear to track the results from other methods (but see comment 1b above). The problem is that there are no "measured" values of weathering flux to use to validate these (or any) weathering models. So, just as budget-based approaches may be contaminated by non-weathering fluxes like net losses from exchange sites, and depletion approaches may suffer from invalid as-

assumptions, model results almost certainly contain a host of errors. This is addressed somewhat in the paper. Depletion methods and budget methods are based on field observations and data. With all their flaws, they are, at least in my view, fundamentally stronger than model results. To compare them as equivalent approaches is problematic.

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