Do rare earth elements (REE) trace pedogenic processes of podzolization?

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Podzols cover approximately 4% of the earth's land surface. They can form rapidly and result from the combination of two main pedogenic processes: (1) weathering in the surface eluvial (E) horizon; (2) downward transfer of dissolved organic matter (OM) and mobile Al and Fe, and their accumulation deeper in the illuvial (B) horizon. Consequently, podzols offer a natural laboratory to study the impact of pedogenic processes on the REE behavior. Here we investigate whether REE can trace podzol formation, by assessing the REE signature along five pedons, aged from 120 to 530 years, in a Cambisol-Podzol chronosequence located in the Cox Bay of Vancouver Island (BC).

Total REE content in topsoil decreases with increasing pedon age. In each pedon, it increases at depth. Total REE content is strongly correlated with the total reserve in bases, a weathering index ($r = 0.896$). Our results corroborate previous ones showing that weathering accounts for major REE loss from parent material. Furthermore, we observe a preferential removal of Medium-REE (MREE) in the surface E horizon. That specific signature has been proposed by several authors as a diagnostic fingerprint of the involvement of OM in the solubilization process.

No systematic accumulation of REE is observed in the B illuvial horizons, wherever OM and Al/Fe oxides accumulate, despite of the well-known affinity of REE for these components. An explanation could be the transfer of aqueous REE-organic complexes to the groundwater. Mass balance calculation shows a similar evolution of chemical depletion values for REE and total Al and Si along the chronosequence. As a conclusion, we may question the efficience of REE to trace the podzolization process.