



## **Chemical weathering of minerals and corrosion of glasses- evidence for the same mechanism: coupled interfacial dissolution-precipitation**

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Here we present solid-state data based on the laboratory alteration of several silicate minerals (1) and a borosilicate glass (2) in aqueous solutions at temperatures up to 50 °C. Several high spatial and mass resolution techniques were used to measure the nano- or subnanoscale chemistry and structure of the ubiquitous surface altered layers that form during the chemical alteration process. The thickness of the layers depends on reaction time, the chemistry and structure of the parent phase, and the chemical and physical properties of the solvent fluid. In all cases, the structural interface between the altered surface layers and the pristine, parent phase is very sharp and well defined, as measured by HRTEM. The surface layers are also chemically distinct with respect to the parent phase, being in particular enriched in hydrated amorphous silica, but also containing minor concentrations of cations derived from the primary phase. In addition, certain cations (present as oxide or oxy-hydroxides) are enriched in the surface altered layers. In all cases, the chemical gradients of all cations, be they network formers or charge compensating interstitials, display nm-sharp chemical gradient widths at the boundary with the pristine phase (based on EFTEM, EEL spectrum imaging, STEM-HAADF, APT). Very importantly, the chemical and structural interfaces are always spatially commensurate. The strong similarity of these nanoscale measurements for both minerals and glasses is strong evidence that there is a unique process controlling chemical alteration: coupled interfacial dissolution-precipitation. This has many important implications, in particular it may signify that many aqueous alteration processes commonly attributed to diffusion-control are in reality controlled by coupled chemical reactions.

Refs:

1. Hellmann, R. et al. Unifying natural and laboratory chemical weathering with interfacial dissolution-precipitation: A study based on the nanometer-scale chemistry of fluid-silicate interfaces. *Chem. Geol.* 294-295, 203-216 (2012).
2. Hellmann, R. et al. Nanometre-scale evidence for interfacial dissolution-precipitation control of silicate glass corrosion. *Nature Materials*, 14 (2015).