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**Geochemistry at the nanoscale**

Chemical and microbial weathering are natural processes of mineral alteration mediated by fluid and, in the case of microbial weathering, living organisms, results in the replacement of primary rock-forming minerals by more stable secondary ones. The rate of chemical weathering is determined by the chemistry and crystalline structure of primary mineral, composition and saturation state of the fluid, temperature and pressure. Weathering of aluminosilicate minerals is an intrinsically slow process. As far as the natural weathering process, the rates observed in the field are usually10-3000 times slower than those that predicted from laboratory experiments. Such a discrepancy is a direct evidence of mismatch conditions between these two, but, the difference in laboratory and geological time scales along with the complexity of the natural systems create some difficulties in studying of geochemical processes in the lab.

Chemical weathering of aluminosilicate minerals can be expressed as sequence of elemental chemical actions. **I.** Dissolution of primary mineral that involves the release of interstitial cations through ion exchange, adsorption – desorption reactions on the mineral-fluid interface, and hydrolytic degradation of intertetrahedra linkages, allowing the removal of hydrated alumina and silica species from crystal lattice. **II**. Nucleation and growth of a secondary phase, stable at the given condition. In many geological systems, the transport of dissolved Al(OH)3, Si(OH)4 species away from the surface of primary minerals is constrained by relatively slow fluid flow. Therefore, local oversaturation in respect to secondary phase may occur directly in the vicinity of the surface of the primary mineral causing the re-precipitation. In geological time scale, these dissolution-re-precipitation events have driven the genesis of sediments, soils and landscapes, determining soil fertility and composition of ground water.

In my lectures I will be discussing technologies for extraction of valuable metals and creating useful functional materials from the earth most abundant materials – silicates and alumosilicates, while focusing on energy efficient and not-expensive technologies based on ideas and knowledge from geochemistry and chemical engineering.