



## Why Mineral Interfaces Matter

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While it is obvious that reactions between a mineral and an aqueous solution take place at the mineral-fluid interface it is only relatively recently that high spatial resolution studies have demonstrated how the local structure of the mineral surface and the chemical composition of the fluid at the interface control both the short-range and the long-range consequences of mineral-fluid interaction.

Long-range consequences of fluid-mineral interaction control element cycles in the earth, the formation of ore-deposits, the chemical composition of the oceans through weathering of rocks and hence climate changes. Although weathering is clearly related to mineral dissolution, to what extent do experimentally measured dissolution rates of minerals help to understand weathering, especially weathering mechanisms?

This question is related to the short-range, local reactions that take place when a mineral, that is not stable in the fluid, begins to dissolve. In this case the fluid composition at the interface will become supersaturated with respect to a different phase or phases. This may be a different composition of the same mineral e.g. a Ca-rich feldspar dissolving in a Na-rich solution results in a fluid at the interface which may be supersaturated with respect to an Na-rich feldspar. Alternatively, the interfacial fluid could be supersaturated with respect to a different mineral e.g. an Na-rich zeolite, depending on the temperature. Numerous experiments have shown that the precipitation of a more stable phase at the mineral-fluid interface results in a coupling between the dissolution and the precipitation, and the replacement of one mineral by another.

This process separates the short-range mechanisms which depend only on the composition of the interfacial solution, and the long-range consequences that depend on the composition of the residual fluid released from the reacting parent mineral. Typically such residual fluids may carry metal ions tens to hundreds of kilometres from the initial reaction site to form ore deposits.

The coupling of dissolution and precipitation has important consequences for all reactions between fluids and rocks and understanding this coupling has applications well beyond mineralogy, for example, in developing new methods of materials synthesis, for carbon removal from the atmosphere and for safe storage of nuclear waste.