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Evidence for interfacial dissolution-precipitation during low-temperature mineral weathering

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The dissolution of most common multicomponent minerals and glasses is typically "incongruent" as shown by the nonstoichiometric release of the solid phase components. This frequently results in the formation of so-called surface leached layers. The mechanism of this process has been a recurrent subject of research and debate over the past two decades, due to its relevance to a wide range of natural and technological processes, as well as being crucial in defining rate laws for mineral reactions. Here we report experimental, in situ nanoscale observations that confirm the formation of a cation depleted layer at the mineral-solution interface during dissolution of multicomponent minerals at acidic pH. Our in situ Atomic Force Microscopy studies of the dissolution of wollastonite, $CaSiO_3$, and dolomite, $Ca0.5Mg0.5CO_3$, combined with compositional analysis of reaction products, provide, for the first time, clear direct experimental evidence that cation-depleted (i.e. leached) layers are formed in a tight interface-coupled two step process: stoichiometric dissolution of the pristine mineral surfaces and subsequent precipitation of a secondary phase from a supersaturated boundary layer of fluid in contact with the mineral surface. Such a mechanism presents a new paradigm that differs from the concept of preferential leaching of cations, as postulated by most currently accepted incongruent dissolution models.

References

Ruiz Agudo, E; Putnis, CV; Rodríguez Navarro, C and Putnis, A. (2012) Mechanism of leached layer formation during chemical weathering of silicate minerals. Geology, 40, 947-950 Urosevic, M; Rodríguez Navarro,C; Putnis, CV; Cardell, C; Putnis, A and Ruiz Agudo, E (2012) In situ nanoscale observations of the dissolution of [10-14] dolomite cleavage surfaces. Geochimica et Cosmochimica Acta, 80, 1-13