

Element mobilization resulting from mineral replacement reactions

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When minerals are out of equilibrium with aqueous fluids, reactions take place in an attempt to reach a new equilibrium. Commonly in the Earth, dissolution at a mineral-fluid interface initiates a coupled reaction involving dissolution and precipitation⁸. This is a ubiquitous reaction during rock alteration processes. When rock-forming minerals such as feldspars, olivine, pyroxenes are in contact with aqueous fluids (typically NaCl-rich) resultant new phases are formed and elements present in the parent mineral are released to the fluid and therefore mobilized for transport elsewhere. This has been shown in a number of systems such as the albitization of feldspars⁹, when a Ca-bearing plagioclase is replaced by albite (NaAlSi₃O₈). However during this reaction not only is Ca released to the fluid but other minor elements, such as Mg, Pb, rare earth elements, amongst others, are almost totally mobilized and removed in solution. This interface-coupled dissolution-precipitation reaction has many implications for the redistribution of elements in the crust of the Earth¹⁰. It is also of note that albitization often occurs in areas of high mineralization, such as in the Curnamona Province in S. Australia (Au-Cu and Ag-Pb-Zn deposits) and the Bamble District of S. Norway. Atomic force microscopy (AFM) has been used to image these reactions at a nanoscale, especially at the calcite-fluid interface, such as the formation of apatite from phosphate-bearing solutions, and the sequestration of toxic elements, including, Se and As.

⁸Ruiz-Agudo E., Putnis C.V., Putnis A. (2014) *Chemical Geology*, 383, 132-146. ⁹Hövelmann J., Putnis A., Geisler T., Schmidt B.C., Golla-Schindler U. (2010) *Contrib. Min. and Pet.* 159, 43-59. ¹⁰Putnis C.V. and Ruiz-Agudo E. (2013) *Elements*, 9, 177-182.