

Fluid-rock interaction: Revisiting the problem of mineral replacement and density change in open and closed systems

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At temperatures and pressures where hydrous minerals are stable, the interaction between aqueous fluids and dry rocks leads to hydration and carbonation reactions that in most cases reduce the rock density. How a density change can be accommodated during the replacement of one mineral assemblage by another is a critical issue and the debate on whether metamorphism and metasomatism preserves rock volume has been discussed for over a century. The consequences of hydration reactions may be stress generation, rock fracturing and mass loss to the fluid, depending on whether the system is “open” or “closed” and on what spatial scale. The problem will be discussed in terms of the possible feedbacks between stress generation, fracturing and deformation, and mass loss. Examples [1] will be given from studies of the hydration of granulites during the Caledonian Orogeny in the Bergen Arcs, Norway from which a compelling case can be made for large fluid-rock ratios and significant mass transfer.

[1] Centrella S., Austrheim H. and Putnis A. Coupled mass transfer through a fluid phase and volume preservation during hydration of granulite: An example from the Bergen Arcs, Norway. *Lithos*, 236,237, 245-255 (2015)