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Fluid–rock interaction: Hydration, stress generation and mass transfer

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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 will be given from studies of the microstructures associated with hydration of granulites during the Caledonian Orogeny in the Bergen Arcs, Norway [1], from which a compelling case can be made for large fluid–rock ratios and significant mass transfer.

Reference:

[1] Centrella S et al. (2015) Lithos 236-237: 245-255