Eclogitisation of dry and impermeable granulite by fluid flow with reaction-induced porosity: Insights from hydro-chemical modelling

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Résumé

Eclogitisation is a major metamorphic process of continental subduction zones, where transformation of dry lower crustal rocks into eclogites seem to correlate with seismogenic events. Eclogitisation can occur at high pressure during hydration of granulite, but the physical processes controlling the hydration of dry, impermeable granulite remain poorly understood. Here, we present a new fully coupled hydro-chemical model of a non-deforming porous rock which undergoes metamorphic reactions in response to fluid pressure variations. Conservation equations for total and solid mass are solved, and fluid and solid densities are calculated with look-up tables computed from models relying on equilibrium thermodynamics. Our model shows that a fluid pressure pulse generates a pressure gradient that causes densification when the pressure required for eclogitisation is reached. The reaction generates porosity and subsequent porous fluid flow into the initially non-porous impermeable granulite. This process lasts as long as the pressure pulse is maintained, but high pressure within eclogite can persist for a longer time. The hydration front propagates tens of centimetres into the granulite in the order of weeks to months. Reactive hydration of impermeable granulite is possible because its solid density is smaller than that of eclogite.

Mots-Clés: Eclogitisation, hydration front, reaction, induced porosity, hydro, chemical modelling

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