The effect of pressure, temperature and composition on physical rock properties

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Many geological models assume average and constant densities for any section of the crust and the mantle. However, we can show that this is an oversimplification since rock densities depend significantly on composition, temperature and pressure. Using the program Perple_X [1], we systematically calculate phase diagrams for pelitic, basaltic and felsic rock compositions and quantify the effect of pressure, temperature and composition on physical rock properties, especially densities and seismic velocities. Using Perple_X has the advantage that it is internally thermodynamically consistent, and physical rock properties can be calculated at all desired P-T conditions without any extrapolation. Phase transitions can cause significant changes in density and seismic velocity in a rock due to the formation of much denser and compact minerals. In addition to temperature and pressure, the rock composition also plays an important role to when those phase transitions occur.

In order to correctly model geodynamic processes such as crustal delamination, it is necessary to know the exact density and rheology of the crust and the underlying mantle. Since phase transitions can also significantly influence the rheology of a rock, it is essential to model temperature and pressure changes, densities and petrological changes simultaneously and to understand coupled geological processes.

[1] Connolly & Petrini (2002) *J. Metamorphic Petrology* **20**, 697-709.

Detection of sub-micro scale highly siderophile element nugget in kimberlite by synchrotron radiation X-ray fluorescence analysis

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To know where and how the highly siderophile elements (HSEs), in the earth exist is a key for understanding the Earth's formation processes and subsequent chemical evolution of the mantle. Sulfide minerals and more recently HSE nuggets which are micro-scale size can be explained for whole-rock HSE abundances in some peridotite samples (e.g. [1, 2]) and it implies that such HSE micronuggets could influence the behavior of HSEs in the mantle [3]. However, the studies of HSEs in magma phase are not much investigated because of the low concentration of HSEs. Kimberlites are derived from deep mantle and have relatively high HSE abundances. In this study, we report the existence of HSE micronuggets in kimberlite by microbeam X-ray fluorescence mapping using synchrotron radiation X-ray at SPring-8, Japan. We found a few grains of HSE nuggets in sub-micron scale in a section of fresh kimberlite from Greenland. A HSE sub-micronugget exists on the mineral boundary between olivines. This suggests that the HSEs distribute inhomogeneous in magmatic rocks similar to in the peridotites [3].

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