Thermodynamics of Lower Mantle Minerals

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There is a general consensus that the Earth's lower mantle is mostly composed of (Mg,Fe)SiO_3 perovskite (Mg-Pv) and (Mg,Fe)O ferropericlase (Fp). Knowledge of the chemical and physical properties of these minerals is, therefore, essential for understanding the structure and dynamics of the lower mantle.

In this work, we performed a new compression study of Mg-perovskite ($MgSiO_3$) and periclase (MgO) phases synthesized at variable conditions of the Earth's lower mantle by using pure Mg_2SiO_4 as a starting material. In our experiments a Double-sided Laser-Heated Diamond Anvil Cell at the ESRF – ID27 (Grenoble) was used up to 100 GPa and 3000 K. The equation of state (EOS) at various conditions of *P* and *T* for Mg-Pv and Fp were obtained by integrating the available experimental data into a single P-V-T EOS to constrain the elastic parameters (bulk modulus, densities, etc …) under conditions of the Earth's lower mantle, which provides a basis for evaluating the compositional models of the Earth's lower mantle.

In this study, we will also combine our new results and the existing data in the literature to discuss and compare the combined effects of Fe and/or Al on the EOS of both phases and the chemical constraints that we can obtain from such comparisons. Finally, we will discuss our results on the light of the most recent studies on the melting curves of the lowermost Earth's mantle and the stabilization of the ultra-low velocity zones associated with partial melting at the core-mantle boundary [*e.g.* 1-3].

[1] Andrault *et al*. (2012) *Nature* **487**, 354-357. [2] Andrault *et al*. (2011) *EPSL* **304**, 251-259. [3] Fiquet *et al*. (2010) *Science* **329**, 1516-1518.

C and O isotope compositions of the Matongo carbonatite (Burundi) : new insights into alteration and REE mineralization processes

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The Matongo carbonatite intrusion is part of the Neoproterozoic Upper Ruvubu alkaline plutonic complex (URAPC), located in Burundi along the western branch of the East African Rift. This alkaline complex, which also comprises feldspathoidal syenites, diorites, quartz-bearing syenites and granites, emplaced around 750 Ma [1].

Most of the oxygen and carbon isotope compositions obtained on the several carbonatitic facies are typical of carbonatites: the $\delta^{18}O$ values are between 7.2 and 8.5‰ (vs. SMOW), the $\delta^{13}C$ value are between -4.7 and -5.4‰ (vs. PDB). These values correspond to the magmatic signature of the intrusion. Some samples show a significant increase in the $\delta^{18}O$ value, between 11 and 20‰, with an extreme value of 21.6‰. Rare Earth Element fractionation is visible in the most isotopically altered samples, which points to mobilization of these elements. The site of re-deposition of the leached elements may well be found in distal hydrothermal veins, which contain albite, calcite, apatite and REE-fluorocarbonates. The Matongo carbonatite thus appears as a complete metallogenic hydrothermal system where both the source and sinks of REE are identified.

[1] Tack et al. (1996), In Petrology and geochemistry of magmatic suites of rocks in the continental and oceanic crusts. A volume dedicated to J. Michot (Demaiffe, ed.), ULB-MRAC, Brussels, **219-226**, 91-114.

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