II Data Collection and Analysis

A sample is ground up and loaded into a diamond anvil cell between two diamonds. Pressure is added onto the sample by tightening the screws.

III Preliminary Results

Rubidium microcline goes through a phase transition into Rubidium hollandite at high temperatures and pressures. The hollandite structure is metastable to ambient pressure, allowing for a detailed equation of state measurement at pressures of 0.15 GPa. A sample synthesized at ~15 GPa and ~2500 K was released in the diamond anvil cell with silicon oil for a quasi-hydrostatic pressure medium. The hollandite II structure is not quenchable to ambient pressure, and therefore the equation of state can only be inferred from synthesis experiments.

IV Discussion

- Unlike Rubidium hollandite, which has a tetragonal crystal structure, Rubidium microcline is triclinic, giving us six variables to solve for (lattices a, b and c; angles α, β and γ) instead of two (lattices a and c as in the case of hollandite) for every pressure state, allowing for a number of complications.
- The difficulty in picking out and assigning peaks to hkl's for the diffraction data of Rubidium microcline can be due to coarsely powdered samples.
- Analyses indicate that Rubidium is capable of being stored in deep mantle conditions, which would constrain the age of the Earth’s core. The similarity in observed phases between Potassium and Rubidium implies that these elements might be stored together in minor mineral phases in the Earth’s mantle.

V Future Expectations and Goals

- Add more X-ray diffraction data to the existing Rubidium hollandite data for higher pressures to help constrain the bulk modulus.
- Find the temperatures and pressures where phase transitions take place between Rubidium microcline, Rubidium hollandite I and II.
- Find the exact change in angles and lattice parameters with change of pressure for Rubidium hollandite II.
- Do more X-ray diffraction experiments for Rubidium microcline with finer powdered samples.
- Do similar analyses for KAlSi₃O₈.

VI References


The Stability of RbAlSi₃O₈ Under High Pressure Conditions

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I Abstract

Potassium and Rubidium are minor and trace elements of the Earth’s mantle, both of which have long-lived radioactive isotopes. ⁴₀K is a significant energy source that contributes to the convection of the mantle and outer core, while ⁸⁷⁷Rb is a geochronological tracer for long-lived mantle processes. In the Earth’s crust, K and Rb are stored in feldspar, KAlSi₃O₈, the most abundant mineral in the crust. The mineral host of K and Rb in the mantle is uncertain, with implications on reactivity of alkali metals with the Earth’s core. Sample preparation consisted of compressing RbAlSi₃O₈, Rubidium microcline (rubicline), under pressures of ~15 GPa (gigapascals) in a laser-heated diamond anvil cell (LH DAC). Synchrotron-based X-ray diffraction gives the structure and density at high pressures. The high-pressure structure of Rubidium microcline is similar to that of the high-pressure structure of feldspar, transforming to the hollandite structure at ~15 GPa, then to the hollandite II structure at ~25 GPa. Preliminary results yield the bulk modulus of Rubidium hollandite to be 210 (±10) GPa.

Rubidium microcline (rubicline) is capable of being stored in deep mantle conditions, which would constrain the age of the Earth’s core. The similarity in observed phases between Potassium and Rubidium implies that these elements might be stored together in minor mineral phases in the Earth’s mantle.