Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.26876

Calibration of K-richterite in the Deep Earth Water Model (DEW) – a key for understanding mantle metasomatism

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Deep Earth fluids play a significant role in shaping the geochemical environment of the upper mantle. Hydrous minerals, such as K-richterite (a potassic-rich amphibole) and phlogopite in mantle xenoliths, are key evidence of metasomatic processes. Investigating the formation of such K-rich metasomatic xenoliths enhances our understanding of the involvement of fluids in the sub-continental lithospheric mantle (SCLM). However, the thermodynamic properties of K-richterite are poorly known. Here, we used published metasomatic HP-HT experiments in the system peridotite+H_2O±CO_2 that include K-richterite as a stable phase [1, 2] to calibrate the thermodynamic properties of this amphibole. For example, at 5.0 GPa and 1,000°C, we have retrieved the standard free energy of K-richterite based on a Deep Earth Water model of the equilibrium peridotitic assemblage and the measured fluid composition. Such values, together with estimates of the standard entropy, heat capacity, and volume of K-richterite, will enable the inclusion of K-richterite in predictive models of metasomatism. In turn, this will facilitate investigations of the effect of the fluid-to-rock ratio on metasomatised peridotites and deepen our understanding of metasomatic processes in the SCLM, including the role of K-rich fluids during diamond formation.

[1] Meltzer & Kessel (2022), *Geochimica et Cosmochimica Acta.* 328, 103-119

[2] Meltzer & Kessel (2023), *Geochimica et Cosmochimica Acta.* 350, 28-45