



## **The role of volatiles ( $\text{H}_2\text{O}$ , $\text{CO}_2$ ) in the mantle incipient melting captured by a multi-component model**

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The link between volatiles and mantle melting has so far been illuminated by experiments revealing punctually, at a given P-T condition and under a specific chemical system, properties such as solubility laws, redox equilibria, and phase equilibria. The aim of this work is to establish a multi-component model describing the Gibbs free energy of melt produced by mantle incipient melting in presence of  $\text{CO}_2$ - $\text{H}_2\text{O}$ : that is carbonatite-carbonated melt, basanites and  $\text{H}_2\text{O}$ - $\text{CO}_2$ -rich basalts. Near solidus melts are dominated by carbonate-rich compositions, evolving towards basaltic compositions at higher temperatures. However, this carbonate-silicate transition is complex, abrupt, and dependent on temperature, pressure and the chemical composition of the system. The actual objective is to take advantage of a large existing experimental database by developing a multi-component model: crystal-liquid, liquid-liquid, redox and fluid-liquid equilibria (more than 500 data points). We established a parameterization of the mixing properties allowing the Gibbs free energy of multi-component hydrated carbonated melts to be described. Using the Margules formalism, this parameterization is calibrated in the P-T range 1-10 GPa and 900-1800°C.

The model appears as a powerful tool to address the debated topic of mantle melting in the upper mantle from the 410 km discontinuity to the LAB. Under the oceanic ridge, the bottom of the Low Velocity Zone is identified by seismic data in the oceanic mantle about 160 km and rises towards the surface with the lithosphere cooling. These observations correlate with the abrupt compositional transition between a  $\text{H}_2\text{O}$ -rich carbonatitic melt and a carbonated silicate melt as shown by our present model.