EGU22-3367
https://doi.org/10.5194/egusphere-egu22-3367
EGU General Assembly 2022

Melting relations of carbonates and trace element partitioning between carbonates and carbonate liquid in the Earth's upper mantle

Melanie J. Sieber[1,2], Max Wilke[2], Marcus Oelze[2,3], Oona Appelt[2], Franziska D.H. Wilke[2], and Monika Koch-Müller[2]

[1]University of Potsdam, Germany
[2]German Research Centre for Geoscience (GFZ), Potsdam, Germany
[3]Bundesanstalt für Materialprüfung und -forschung (BAM), Berlin, Germany

We examined the supra-solidus phase relations of the $CaCO_3$-$MgCO_3$ system and established trace element partition coefficient between carbonates and carbonate melt by conducting high pressure (6 and 9 GPa) and temperature (1300-1800 °C) experiments with a rocking multi-anvil press. It is well known that the major element composition of initial melts derived from low-degree partial melting of the carbonated mantle strongly depends on the melting relations of carbonates (e.g. 1, 2 and reference therein). Understanding the melting relations in the $CaCO_3$-$MgCO_3$ system is thus fundamental in assessing low-degree partial melting of the carbonated mantle. We show here to which extent the trace element signature of a pure carbonate melt can be used as a proxy for the trace element signature of mantle-derived CO_2-rich melts such as kimberlites.

Our results support that, in the absence of water, Ca-Mg-carbonates are thermally stable along geothermal gradients typical at subduction zones. Except for compositions close to the endmembers (~$Mg_{0\text{-}0.1}Ca_{1\text{-}0.9}CO_3$; $Ca_{0\text{-}0.1}Mg_{1\text{-}0.9}CO_3$), Ca-Mg-carbonates will partially (to completely) melt beneath mid￿ocean ridges and in plume settings. Ca-Mg-carbonates melt incongruently to dolomitic melt and periclase above 1450 °C and 9 GPa making the $CaCO_3$-$MgCO_3$ a (pseudo-) ternary system as the number of components increases. Further, our results show that the rare earth element signature of a dolomitic melt in equilibrium with magnesite is similar to those of Group I kimberlites, namely that HREE are depleted relative to primitive mantle signatures. This implies that dolomite-magnesite solid solutions might be useful to approximate melting relations and melt compositions of low-degree partial melting of the carbonated mantle.

References

1 Yaxley, Ghosh, Kiseeva, Mallik, Spandler, Thomson, and Walter, *CO_2-Rich Melts in Earth*, in *Deep Carbon: Past to Present*, Orcutt, Daniel, and Dasgupta, Editors. 2019, Cambridge University Press: Cambridge. p. 129-162.

2 Dasgupta and Hirschmann, *The deep carbon cycle and melting in Earth's interior.* Earth and Planetary Science Letters, 2010. 298 (1-2): p. 1-13.