# Experimental constrains on an MgO-driven geodynamo

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Exsolution of MgO has been proposed to drive an early geodynamo[1]. Experimental studies, however, have drawn distinct conclusions how effective the MgO exsolution is[2,3]. While all studies suggest that significant amount of Mg can be dissolved in Earth's core, the amount of MgO exsolved out of the Earth's core during cooling remains an open question. This critically hinges on the temperature dependence of MgO exsolution, which is still poorly constrained[3,4]. Here we show high pressure and high temperature experiments (3.5-8 GPa and and ~2000 K) containing Fe alloy with a large range of O content (0.3-13 wt.%). Those experiments allow us to better constrain the temperature dependence of Mg partitioning between iron-rich liquid and silicate melt. Our results show that Mg partitioning is weakly dependent on temperature, while confirming its strong dependence on oxygen content in iron-rich liquids. Consequently, MgO exolution is limited, and can only drive an early geodynamo if the core is cooling rapidly. However, this would be not consistent with Earth's thermal budget. Therefore, a substantial heat source is still required to drive an early, likely thermal geodynamo.

[1] O'Rourke and D. J. Stevenson, Nature **529**, 387 (2016).
[2] Badro et al., Nature **536**, 326 (2016).
[3] Du et al., Geophysical Research Letters **44**, 11 (2017).
[4] Badro et al., Geophysical Research Letters **45**, 13 (2018).