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Experimental high-pressure behavior of germanium during core-mantle differentiation

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The concentration of siderophile elements in the Earth's mantle is the consequence of planetary accretion and core-mantle differentiation. These elements were partitioned either between core-forming, iron-rich metallic phases and residual mantle-forming silicate. While the mantle abundances of several siderophile elements (Ni, Co, Cr, Mn, Mo, W, Zn) are resolvable with a single-stage core formation model, the concentration of Ge in the mantle cannot be reproduced by such a scenario. To resolve this discrepancy, several models have been proposed, such as 1) accretion under oxidizing conditions, 2) the significant role of light elements (S, C, Si, O) or 3) a late veneer providing such siderophile elements to the silicate reservoir. However, none of them in isolation can account for the estimated core/mantle concentrations. This is mainly due to the scarcity of germanium partitioning data between metal and silicate at high pressure within variable accretion conditions ($T - X - fO_2$).

Here we performed multi-anvil experiments to constrain the partitioning of germanium between metal and silicate at high pressure (5 – 10 – 15 GPa) and high temperature (1800 – 2000 °C). Variable amounts of S and C were added to the starting metal to investigate the peculiar role of light elements on germanium partitioning. In addition, a series of experiments has been performed with different Si amounts to to probe the role of oxygen fugacity on germanium behavior.

Together with previous experimental metal-silicate partitioning studies at low pressure, we build upon our new partition coefficient dataset to explore the conditions ($P - T - X - fO_2$) prevailing during the Earth's core-mantle differentiation.