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Metal–silicate partitioning of Pb at high pressures and temperatures: Implications for volatile loss and the timing of Earth's formation

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Pb is a moderately volatile to volatile, chalcophile, and slightly siderophile element, and therefore provides insights into volatile loss and the timing of volatile delivery to the Earth. However, the depletion of Pb in the bulk silicate Earth is due to both its volatility and its siderophility. Here we use laser-heated diamond anvil cells (LH-DACs) to measure the metal–silicate partitioning of Pb at conditions relevant to core formation on Earth (>40 GPa and >3500 K), to disentangle the effects of core formation and volatile loss on the distribution of Pb during Earth's accretion. We find that Pb partitioning is insensitive to pressure, but Pb becomes more siderophile with increasing temperature. The increasingly siderophile nature of Pb at high temperatures affects its sensitivity to the timing of Earth's core formation and accretion. Incorporating *N*-body simulation outputs into core formation models that include the Hf–W isotopic system and LH-DAC metal–silicate partitioning data on other moderately volatile elements, we can place constraints on the volatility trend of Earth's accreting material and the timing of Earth's formation.