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A decade of diamond anvil cell metal-silicate partitioning experiments: what have we learned ?

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Metal-silicate phase equilibrium experiments have been carried out for over 4 decades to try and understand, constrain, and quantify the nature and degree of chemical interactions between the mantles and cores of terrestrial planets and planetary bodies (moons and asteroids). These investigations have been carried out under limited P-T ranges, compatible with traditional experimental apparatuses such as 1-atm furnaces, piston-cylinder and multi-anvil presses.

The last decade has witnessed the inception and establishment of similar phase equilibrium experiments carried out in the laser-heated diamond anvil cell (LHDAC), opening up the field of investigation to significantly higher P-T, directly relevant to deep planetary interiors.

We will review some of the findings obtained through LHDAC metal-silicate experiments, and show how they either confirmed some of the results obtained at lower pressure prior to their advent, or revealed new processes that were otherwise unexpected on the basis of prior experiments. We will show that experiments carried out in the LHDAC are in agreement and continuity with results obtained at lower P-T, and that there is no inter-laboratory or inter-technical discrepancy.

We will then talk about siderophile trace-element partitioning and what those experimental constraints allow us to say about the formation of Earth's core 4.5 Gyr ago and about the environment there. I will also address the solubility of lithophile major elements (*i.e.* the major rock-forming components of Earth's mantle) in core-forming metal, and its subsequent evolution during secular core cooling.

Finally, we will show a few implications of these phase equilibria and partitioning studies on the composition and evolution of Earth's and Mars' core. Without spoiling the suspense, we will defend the hypothesis that Earth's core is mostly an oxygen-rich (let's not get carried away: certainly, less than 5 wt%) iron-nickel alloy, and that we cannot (and neither should we) rule out small amounts of Si and S (probably on the order of ~2 wt%). We will also propose why we believe Mars' core must contains less sulphur than previously thought, probably in the 10 wt% range rather than 15-20 wt% as proposed in earlier studies.