Making Mercury's Core with Light Elements

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Recent results obtained from the MErcury **S**urface, Space ENvironment, GEochemistry, and Ranging spacecraft showed the surface of Mercury has low FeO abundances (<2 wt%) and high S abundances (~4 wt%) [1], suggesting the fO_2 of Mercury's surface materials is somewhere between 3 to 7 $\log_{10}$ units below the IW buffer [2]. The highly reducing nature of Mercury has resulted in a relatively thin mantle and a large core that has the potential to exhibit an exotic composition in comparison to the other terrestrial planets. This exotic composition may extend to include light elements (e.g., Si, C, S). Furthermore, [3] has argued for a possible primary floatation crust on Mercury composed of graphite, which may require a core that is C-saturated. In order to investigate mercurian core compositions, we conducted piston cylinder experiments at 1 GPa, from 1300 °C to 1700 °C, using a range of starting compositions consisting of various Si-Fe metal mixtures (Si_5Fe_{95}, $Si_{10}Fe_{90}$, $Si_{22}Fe_{78}$, and $Si_{35}Fe_{65}$). All metals were loaded into graphite capsules used to ensure C-saturation during the duration of each experimental run. Our experiments show that Fe-Si metallic alloys exclude carbon relative to more Fe-rich metal. This exclusion of carbon commences within the range of 5 to 10 wt% Si. These results indicate that if Mercury has a Si-rich core (having more than ~5 wt% silicon), it would have saturated in carbon at low C abundances allowing for the possible formation of a graphite floatation crust as suggested by [3]. These results have important implications for the thermal and magmatic evolution of Mercury. **References**: [1] Nittler, L.R. *et al.*, (2011) *Science* [2] McCubbin, F.M. et al., (2012) *GRL*. [3] Vander Kaaden, K.E. and McCubbin, F.M. (2015) *JGR-Planets.*