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Core Formation in Terrestrial Planets by Negative Diapirism

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The presence of metallic cores in several terrestrial planets has been confirmed by various types of direct and indirect observations. Geochemical constraints on core formation provided by Hf/W systematics suggests it is a relatively fast process which may have been completed within less than 100 Myrs for planets such as the Earth or Mars. In addition, the overabundance of siderophile elements in the Earth's mantle suggests that metal silicate equilibration occurred during core formation processes.

We investigate dynamically the timing and metal-silicate equilibration processes during core formation by negative diapirism. Using numerical modeling, we follow the sinking of iron-rich diapirs through a viscous silicate mantle, in 3D axisymmetric geometry. Shear heating as well as several viscous rheologies are considered and we carried a parameter study where we vary quantities such as the Rayleigh number, the dissipation number and the radius of the iron diapir. Scaling laws are derived and subsequently used to investigate the ability of negative diapirism to explain core formation in Terrestrial planets within the timing and metal-silicate equilibration constraints provided by geochemistry and mineral physics.