The Dynamics of Core Formation in Terrestrial Planets by Negative Diapirism: Timescales, Heat Distribution and Metal-Silicate Equilibration

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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 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. We carried a parameter study in which shear heating as well as several viscous rheologies were considered and systematically varied. General scaling laws are derived for the diapir sinking velocity as well as for the heat distribution. These scaling laws are 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.

Different types of hydrochemical stratification in the acidic mine pit lakes of the Iberian Pyrite Belt

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Meromixis in pit lakes of the Iberian Pyrite Belt

Many acidic pit lakes formed in the abandoned mines of the IPB during the last decades are *meromictic*, showing a bottom, anoxic water body (called *monimolimnion*) which is permanently isolated from the rest of the water column, and an upper, oxygenic *mixolimnion* that periodically circulates.

Results and Discussion

On-going research in pit lakes of the IPB has revealed different types of perennial hydrochemical stratification, which ranges from a simple model with two internally homogeneous layers separated by a well defined *chemocline*, to a more complex, multi-layer model that display numerous steep salinity gradients and different strata with continuously increasing dissolved solids content with depth (Figure 1).

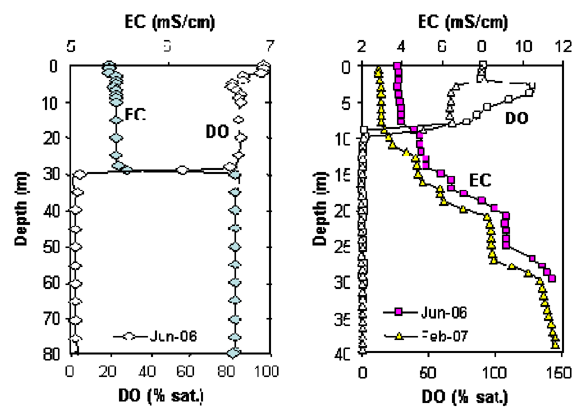

Figure 1: Vertical profiles of electric conductivity (EC) and dissolved oxygen (DO) in the pit lakes of San Telmo (left) and Cueva de la Mora (right).

These different models of chemical stratification do not correlate with the age of the pit lakes (15-100 years), their relative depths (13-45%) or the geometry of their pit basins. It is hypothesized that the different vertical trends are the result of the interplay between different types of processes, including (i) physical mixing (e.g., wind-induced advection, heat-driven convection) in the *mixolimnion*, (ii) geochemical and microbiological reactions (bacterial oxidation of Fe(II), photoreduction of Fe(III), precipitation of Fe(III) phases, metal sorption) in the *mixolimnion*, (iii) bacterial reduction of Fe(III) and SO_4^{2-} coupled with fermentation in "*reactive*" lake bottoms (water/sediment interfaces), (iv) groundwater input at depth, and (v) warm salt-laden water descending into the basin along the pit contours.