Abstract Submitted
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Direct measurement of the heat exchanges in a buoyancy driven two-phase flow; application to the planets core formation JEAN-BAPTISTE WACHEUL, MICHAEL LE BARS, IRPHE UMR 7342 CNRS, Aix-Marseille Univ and ECM, Marseille, France, ECOULEMENT TOURNANT ET GEOPHYSIQUE TEAM — Telluric planet formation involved the settling of large amounts of liquid iron coming from impacting planetesimals into a viscous magma ocean as deep as thousands of kilometers. During this "iron rain", the initial state of planets was mostly determined by exchanges of heat and elements between the two phases. Most models of planet formation simply assume that the metal rapidly equilibrated with the whole mantle. Here we report the results of experiments on which we performed measurements of the diffusive exchanges integrated during the fall, in addition to measuring the dynamical variables of the flow on high speed videos recordings. Using a balloon filled with liquid gallium alloy as an analogue for the iron core of the impactor and a viscous fluid as an analogue for the silicate magma, we were able to produce flows matching the dynamical regime of the geophysical inspiration. We find that the early representations of this flow as an iron "rain" is far from the experiments, both in terms of fluid mechanics and diffusive exchanges during the phase where most of the equilibration is accomplished. Indeed, the equilibration coefficient at a given depth depends both on the size of the metal diapir and on the viscosity of the ambient fluid, whereas the falling speed is only controlled by the size. Various scalings chosen in the literature for the diffusive exchanges, and we find good agreement with the hypothesis and scaling of a turbulent thermal.

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