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Lagrangian approach of the mixing in a turbulent thermal, and implications for metal-silicate equilibrium during Earth's formation

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During the differentiation of terrestrial planets, the metal phase from the impactor core segregates from the silicate phase of the magma ocean. This buoyant mass forms a turbulent thermal and settles toward the proto-core. During this descent, thermal and chemical exchange occurs at the boundary between the metallic and silicate phases. Based on laboratory fluid dynamic experiments mimicking the settling of the metallic thermal turbulent, we develop a Lagrangian approach of the mixing from the experimental velocity field. We are able to track the evolution of the material elongated as lamellae by the turbulent stirring. We have characterised the elongation rate, the aggregation of lamellae, and the probability density function of the elongation and concentration, which are not accessible from direct measurements in the experiments. We have also investigated the effect of the Reynolds number and density ratio on these quantities. These results will allow us to develop a new predictive model of the mixing and chemical transfer in thermal turbulent to better understand the equilibrium between metals and silicates during the accretion of terrestrial planets.