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Artificial micrometeorites from powdered Allende meteorite

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Micrometeorites (MMs) are extraterrestrial dust particles that have been captured by the Earth and are thought to be derived from asteroids and comets. Depending on their velocity, mass and entry angle, MMs have undergone various degrees of heating during their deceleration in the atmospheric entry within a few seconds. This heating may lead to significant textural, mineralogical and chemical modifications in MMs.

In this study, we carried out immediate heating and quenching experiments on fine particles to represent for atmospheric entry of MMs. The experimental system is reported by Isobe and Gondo (2012). We used powdered Allende meteorite (typical CV3 chondrite) with approximately 100 micron meters in diameter as the starting material.

The run products show analogues textures to MMs including scoriaceous, porphyritic olivine and dendritic magnetite. Fe sulfide occurs on melted particle surfaces. Immiscibility between sulfide melt and silicate melt may induce sulfide melt discharge from silicate melt. The surface distribution of iron sulfide in MMs has not been reported. Sulfide on MMs may be removed by abration in the upper atmosphere. This process may be constant source of sulfur species other than volcanic activity to the upper atmosphere. Maximum temperature and thermal history of particles were estimated from compositions of melt and minerals. Analogy of the run products to MMs are discussed on textural, mineralogical and chemical modifications during atmospheric entry.

Keywords: micrometeorite, heating / quenching experiment, Allende meteorite, atmospheric entry