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Artificial cosmic spherules produced by heating and quenching experiments

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Micrometeorites (MMs) are extraterrestrial fine particles derived from asteroids and comets and continuously falling to the Earth. Depending on their velocity, mass and entry angle, micrometeorites have undergone various degrees of heating during the atmospheric entry within a few seconds. This heating lead to significant textural, mineralogical and chemical modifications to MMs. The MMs larger them 70 micron meters in diameter show variously melted textures. In particular, completely melted micrometeorites are known as cosmic spherules. Cosmic spherules have experienced large degrees of melting of primary phases during atmospheric entry, and form molten droplets. In this study, we carried out rapid heating and quenching experiments on fine particles of three kinds of meteorites (CV, CM and H chondrite) to reproduce cosmic spherules by atmospheric entry.

The run products of meteorites as starting materials show quite analogous textures to cosmic spherules including porphyritic olivine and barred olivine. The most of molten particles show spherical shape due to surface tension of the silicate melt. The outside shape of the particles is various depending on melt fraction of the particle. We successfully reproduced artificial cosmic spherules with remarkably analogous textures to natural ones. We can compare textural variations of cosmic spherules to run products and possible precursors of cosmic spherules. Analogy of the run products to cosmic spherules can be applied from textural, mineralogical and chemical modifications during atmospheric entry to estimate abundance of the interplanetary fine particles in the vicinity of the Earth’s orbit.

Keywords: micrometeorite, carbonaceous chondrite, H chondrite, atmospheric heating, cosmic spherule