Three-Dimensional Shapes of Cosmic Spherules: Deformation of Dust Particles Molten in the Earth Atmosphere

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Observations have found that there are both oblate and prolate shapes in the cosmic spherules [1, 2]. The ram pressure, the surface tension, and the centrifugal force acting on the particles deform the shape when they are molten. Thus, it seems natural to consider that the variation of the observed cosmic spherule shapes may originate from the shape of dust particles when they solidified. In this study, we numerically solve the equation of motion and the energy equation of dust particles entering the Earth atmosphere [3], and calculate the ram pressure and the centrifugal force acting on the molten dust particles. Then we evaluate the magnitude of deformation of dust particles using analytic solutions for the shape of molten particles [4, 5]. On the other hand, we measure the 3-D shapes, chemical composition, and structure of cosmic spherules collected from Antarctica ice. Then we estimate liquidus temperature of natural cosmic spherules [6]. Finally, we compare the results of calculations with observations.

We can see our numerical results consistent with measurements. The differences between oblate and prolate shapes are derived from whether samples are rotating or not while they are molten. And, the differences of the liquidus temperature among natural cosmic spherules generate the variety of deformation.

References

[1] Tsuchiyama, A. *et al*. (2004) WCPD 9033-9034.
[2] Doi, M. *et al.* (2008) *LPS* **XXXIX** 1548-1549.
[3] Love, S. G. and Brownlee, D. E. (1991) *Icarus* **89** 26-43.
[4] Sekiya, M. *et al*. (2003) *Prog. Theor. Phys.* **109**, 717-728.
[5] Miura, H. *et al*. (2008) *Icarus* **197** 269-281.
[6] Hewins R.H. *et al.* (1990) *Meteoritics* **25** 309-318