EXPLOSIVE DISPERSAL OF HYDRATED ASTEROIDS BY IMPACTS AS A MECHANISM TO PRODUCE INTERPLANETARY DUST. K. Tomeoka[1], K. Kiriyama[1], K. Nakamura[1], Y. Yamahana[1] and T. Sekine[2], [1] Department of Earth and Planetary Sciences, Faculty of Science, Kobe University, Nada, Kobe 657-8501, Japan. [2] National Institute for Materials Science, Tsukuba 305-0044, Japan. <tomeoka@kobe-u.ac.jp>

Dust particles collected on the Earth's surface (micrometeorites) are similar in chemistry and mineralogy to the matrix of hydrated, porous CI and CM chondrites [e.g., 1-3]. However, such meteorites comprise only 2.8% of recovered falls. This large difference in relative abundances has been attributed to ‘filtering’ by the Earth’s atmosphere [4], that is, the CI-CM chondrites are so friable that they are preferentially fragmented and destroyed during atmospheric entry.

We have performed a series of shock-recovery experiments on the Murchison CM and Allende CV chondrites. Both meteorites contain major volume fractions of porous matrix, but the matrix of Murchison is hydrated (~12 wt% H_2O), whereas the matrix of Allende is anhydrous. The Murchison samples were shocked at peak pressures from 4 to 49 GPa [5], and the Allende samples were shocked at peak pressures from 27 to 49 GPa.

SEM observations reveal that the matrix of Murchison shocked at 26-30 GPa exhibits very noticeable changes. Narrow, subparallel fractures (1-50 µm wide) form at high density in directions roughly perpendicular to the compression axis, reducing the sample into minute particles. The fractures increase with increasing pressure and extend throughout the matrix at 30 GPa. At 21-35 GPa, local melts occur in the matrix and increase in amount with pressure. In contrast, the matrix of Allende does not exhibit such fractures even at 37 GPa. High-density fractures form at 41 GPa but only in ~10 vol% of the matrix. The matrices of both meteorites are totally melted at 49 GPa.

The sudden increase of fractures in the matrix of Murchison shocked at ~25 GPa was probably caused by an increase of expansive force upon release of the pressure. The local melting at 21-35 GPa indicates that shock heating also increases dramatically, simultaneously with the comminution. The heating must cause dehydration of hydrous minerals and evaporation of H_2O, and as a result, contribute to generation of great expansive force.

We suggest that if hydrated porous asteroids are shocked at pressures higher than 25 GPa, the shocked materials would be densely comminuted and/or melted, and the comminuted and melted particles would be explosively dispersed as dust into interplanetary space. In the case of anhydrous asteroids, much higher shock pressures would be required to comminute shocked materials, and dispersion of the particles would be less effective. As a result of these differences in shock response, CI-CM-like materials would become the predominant kind of dust particles produced by mutual collisions of asteroids. Therefore, we suggest that the different relative abundances of hydrated material in micrometeorites and meteorites are established before contact with the Earth’s atmosphere.

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