
FORMATION OF CHONDrites IN A THICK DYNAMIC REGOLITH. S. Huang, D. W. G. Sears, and P. H. Benoit, Cosmochemistry Group, University of Arkansas, Fayetteville AR 72701, USA.

In a companion abstract we have proposed that chondrules formed as the products of energetic impacts in a very thick dynamic dust layer of an accreting asteroidal object and that the various chondrule groups, and that chondrite classes formed by variations in the number and intensity of impacts [1]. We here argue that in such a dust layer there was probably a steady flow of volatiles and that on accretion conditions may have resembled those of a fluidized bed in which density and size sorting produced the metal-silicate fractionation and chondrule size distributions observed among the chondrules.

The existence of a temporary atmosphere is suggested by the elemental and isotopic abundance patterns observed in chondrules [2–4]. The atmosphere may have been transient, but was probably transient, consisting of water and other volatiles from the parent body most probably produced during accretion and chondrule formation [5]. It seems unlikely that such an atmosphere would be cosmic in composition and there are experimental reasons for suspecting that the H:O ratio was many orders of magnitude below cosmic [6] and the PAHs was much higher than expected for gases of cosmic composition [7]. The requirements for minimal fluidization are determined by equating the upward drag force of the escaping volatiles (which is dependent on the Reynolds’s number, Re) to that of the particles and the downward gravitational force on the particles [8]

\[
\frac{1.72R^2}{c^0} = 150(k-\varepsilon)\lambda \frac{d^2}{c^0}\left(\frac{\rho_v}{\rho_s} - 1\right),
\]

where \( \rho_v \) is the density of the gas (typically 100 g/m³), and \( \rho_s \) is the density of the particles (typically 1000 g/m³), \( \lambda \) is the size of the particles (typically 100 μm), \( d \) is the diameter of the particles, \( k \) is the viscosity of the gas (typically 1.8 x 10⁻⁵ poise), and \( \varepsilon \) is the acceleration due to gravity. We calculate that most asteroides smaller than a few hundred kilometers should be capable of producing a sufficiently high flow rate of volatiles to produce fluidization.