Chondrite Formation by Turbulence and Shock in the Solar Nebula. J. A. Wood, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge MA 02138 USA, *jwood@cfa.harvard.edu.*

I have argued that shock waves in the gas are the most probable heat source for chondrite components in the solar nebula [1], and that turbulence is the mechanism which concentrated solid matter into chondrule precursors and chondrites [2]. Herein two important aspects of these chondrite-forming mechanisms are discussed.

1. Particle concentration by centrifugation from turbulent eddies is size-selective. [3] found that the process selects and concentrates chondrule-sized objects, an important discovery for meteoritics, but this leaves unexplained the aggregation of dust particles into chondrule precursors. This paper shows that the particle size selected by centrifugation is dependent upon gas pressure; thinner gas concentrates smaller particles. The (vertical) range of pressures in an infall-stage nebula is from ~3×10^{-5} bar at the midplane to ~6×10^{-8} bar near its surfaces. While chondrules can be concentrated near the midplane of the nebula, dust of ~10 μm radius is most efficiently concentrated near the disk surfaces.

2. Energetic shocks sometimes had the chance to interact with zones in which solid particles (of whatever dimension) had been concentrated by turbulence. Shock heating would have been particularly effective in these because the great density of particles inhibited the loss of heat by radiation. The time scale of chondrule cooling may have been set by the rate at which particle concentrations were ultimately dispersed by the changing pattern of turbulence, when they began to be able to radiate to the nebular background.

The mass of solids in a turbulence-concentrated zone may have been quite large (10^{11}-10^{13} kg), which would mean their acceleration and heating by a shock wave subtracted a significant amount of energy from the shock. If so, the particles first encountered by a shock would have been accelerated more than particles deeper in the concentration, which met shocked gas that had already been decelerated by its interaction with earlier particles. The farther into the concentration, the less particles were accelerated. The net effect would be to produce relative velocities among the shock-accelerated particles that tended to further collapse the cloud of particles along an axis parallel to the motion of the shock. Moreover, if the shock was most weakened and slowed where the particle concentration was densest, the shock front would have developed local curvature and a slight tendency to wrap around the particle cloud. The curvature would have imparted an inward component of motion to the particles accelerated, further concentrating and focussing them. This throwing-together of particles in an already highly concentrated medium may have been crucial to the onset of aggregation of chondrites, and of finer-grained aggregates that became chondrules and other structural components in chondrites.

[1] Wood J. A. (1996) *Meteoritics & P. S.* ***31***, 641-645. [2] Wood J. A. (1997) *LPSC* **XXVIII**, 1583-1584. [3] Cuzzi J. N. *et al.* (1996) in *Chondrules and the Protoplanetary Disk* (Eds. Hewins, Jones, Scott), Cambridge Univ. Press, 35-43.