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Abstract

We have been exploring the idea that chondrules and chondrites formed in the regolith of asteroid-sized bodies made dynamic by the passage of gases from the interior. Such a process explains better than current ideas two of the chief properties of meteorites, their small deviations from solar Fe/Si and the abundance of chondrules. Variations in Fe/Si arise as a result of the separation of metal and silicates as gravity and aerodynamic drag sort the components by size and mass. Impact into a losely consolidated surface, new developments in chondrule chronology and regolith evolution, make the formation of chondrules by impact seem more viable than once thought. These ideas not only offer a new scenario for chondrite formation, but they have implications for asteroid studies. The proposed process is probably fairly rare, as it requires enough heat to dehydrate and mobilize the surface, but not enough to melt. Thus ordinary chondrites (i.e., unmelted dry surface) are probably rare and most asteroids are either igneous (i.e., once partially or fully melted) or CI/CM like (i.e., water-rich). Asteroid reflectance spectra, meteorite cosmic ray exposure ages, and induced thermoluminescence data for H chondrites, suggest that ordinary chondrites are coming from a very limited number of parent asteroids, such as 6 Hebe in the case of the H chondrites. Ordinary chondrites are overrepresented among terrestrial falls because only objects near resonances can send meteorites to Earth and because the earth's atmosphere screens all but the toughest meteorites. If these ideas have any merit, then there is no need to invoke space weathering or other devices to explain why asteroid surface compositions are so unlike the compositions of the major meteorite classes.