[EE] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS03]Small Bodies in the Solar System: Current Understanding and Future Prospects

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Wed. May 23, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)
In this session, we welcome presentations regarding small bodies in the Solar System from a variety of approaches (i.e., laboratory experiments, observations, explorations, theoretical modeling, and sample analyses). Especially this year, the Hayabusa2 spacecraft is about to rendezvous with its mission target (Ryugu, C-type asteroid), and ready to make remote-sensing observations for acquiring detailed information of the primordial body. Taking account of the situation, we aim to organize our current understanding of these primordial bodies and further discussing future prospects in this research field.

[PPS03-P21]Chondrule Formation by Lightning in Dust-Rich Environment

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Chondrules are spherical objects found in chondritic meteorites. They are thought be formed in the early solar system: precursor particles were heated to be molten, became spherical due to the surface tension, and cooled to solidify. Their heating and cooling conditions are inferred from various studies. Also, their formation environment is supposed to be dust-rich, so that the vapor pressure of volatile elements becomes high enough to prevent their evaporation. Formation mechanisms for chondrules include the shock-wave heating, the planetesimal collisions, the lightning, and so on, but debates on the origin have not settled yet. In this study, we explore a possibility that lightning in a dust-rich region forms chondrules.

In a previous study on the chondrule formation by lightning, the temperature evolution of a precursor particle was examined theoretically. It turned out that the heated particle cooled rapidly because the radiation from the particle flows efficiently in an optically thin environment, and the calculated cooling rates were inconsistent with observationally inferred values, which are in a range from 1 K/hour to 1000 K/hour. If the particle is in a dust-rich region, however, the radiation energy transfer is hindered, so the cooling rate of the particle may become low enough. It is worth noting that lightning is likely to take place in some dust-rich regions. The dust-to-gas mass ratio there is supposed to be 100 or more. And those dust-rich regions may be generated by the streaming instability and/or the gravitational instability, which may lead to the formation of planetesimals, as a natural consequence of the dust evolution in the solar nebula.

So, we examined the temperature evolution of particles in various dusty environments, and found that cooling rates of particles consistent with speculated values can be realized if the spatial dust density is higher than 10^{-7} g cm^{-3}. This density is so high that the region is gravitationally unstable. It implies that chondrules may be formed in gravitationally contracting planetesimals.