ID de Contribution: **6**

Type: **Poster**

The very shocking behavior of chondrite: an impacting study

mercredi 27 mars 2024 13:51 (1 minute)

Large impacts dominated the accretion during the early solar system. They contribute to the heating, melting, and sometimes vaporization of the impact bodies. Quantifying the frequency of the different resulting structures'aftershocks is a key point in understanding the evolution of the protoplanetary disk. In this study, we work on the behavior of early Earth-like materials under shocks.

We performed ab initio molecular dynamics simulations using the VASP6 package. The post-processing analysis was done with the UMD package [1].

We compare the Hugoniot equations of the state of realistic multi-component silicate systems under different shock conditions. We choose different compositions which are relevant for the early stage of Earth's accretion. We monitor changes in the Hugoniot equation of the melts when the initial density and temperature of the shocked material change. However, changes in the composition of the major elements do not affect the Hugoniot. The Hugoniot equation provides realistic PT conditions that the bodies experience as a result of impacts during accretion. Using thermodynamic integration methods we compute the entropy produced during a shock and the liquid-vapor dome of the pyrolite in the entropy against temperature phase space. Those hugoniots in the entropy-temperature diagram give us a precise criterion to estimate if an impact leads to partial vaporization. Thanks to our results, we can build new scenarios about the physical states of proto-planets and planetary bodies during the early stages of solar system formation. The characterization of the physical state of the protoplanetary disk may have a significant impact on our view of the early degassing of primordial reservoirs and volatile distribution in the early solar system.

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Classification de Session: Pitch Session

Classification de thématique: Earth and Environment Sciences: Geophysics