Abstract

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 aftershock 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 that are relevant for the early stage of Earth's accretion. We monitor changes in the Hugoniot equation of the melts when changes in the composition of the major elements occur; an increasing Mg/Si ratio increases the compaction of the material during the shock. The Hugoniot equation provides realistic PT conditions that the bodies experience as a result of impacts during accretion. 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 an important impact on our view of the early degassing of primordial reservoirs and volatile distribution in the early solar system.

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Reference

[1] Analyzing Melts and Fluids from Ab Initio Molecular Dynamics Simulations with the UMD Package, Razvan Caracas, Anais Kobsch, Natalia V. Solomatova, Zhi Li, Francois Soubiran, and Jean-Alexis Hernandez Journal of Visualized Experiments, 175 (2021)