

The influence of multi-modal collisional outcomes on bulk composition and Hf/W isotopic systematics.

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The late stages of planetary accretion involved stochastic, large collisions. Many of these collisions likely resulted in hit-and-run events or erosion of existing bodies' crusts or mantles. Our work is an initial investigation into the effects of late-stage accretion on the bulk chemistry and isotopic characteristics of the resulting planets when multiple modes of collision are included. The model is composed of two parts: (1) an N-body accretion code which tracks the orbital and collisional evolution of the terrestrial bodies, including hit-and-run and fragmentation events and (2) a post-processing step which evolves the chemistry in light of radioactive decay and impact-related mixing and partial equilibration. The collisional outcomes are determined by the velocity, angle, mass ratio, and total mass of the impact.

For both bulk chemistry and isotopic chemistry, diversity increases as final mass decreases. This behavior is similar to that observed in our solar system in terms of both bulk and isotopic chemistry. This is the first time that such a concordance has been achieved, suggesting that multiple collision types during the late stage of planetary accretion was strongly influential on the chemical composition of the planets.