Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.8158

Earth's wild years

SIMONE MARCHI

Southwest Research Institute

Presenting Author: marchi@boulder.swri.edu

Little is known about the Earth's first billion years. We can surmise that, once the Earth was fully formed about 4.5 Ga, its subsequent evolution was governed by complex geophysical processes. The Earth, however, was not in isolation from the rest of the Solar System, and these processes were strongly modulated by interplanetary collisions for hundreds of million years. Recent advances in Solar System formation models coupled with terrestrial geochemical data hint at a prominent role of collisions in shaping the Earth's Hadean and early Archean evolution (4.5-3.5 Ga). An emerging possibility is that the Earth's earliest evolution was a random walk, in which each large-scale collision changed the evolutionary trajectory of the planet. In this view, an hypothetical collisionless Earth-like planet could have evolved to become very different from our Earth. The effects of collisions are particularly severe for near-surface environments (crust, atmosphere). So, it follows that prebiotic processes, habitability, and formation of early life must have taken place under the influence, and perhaps be the result of, collisional processes.

In this talk, I will review current understanding of the 4.5-3.5 Ga collisional evolution of the Earth. I will then outline how early collisions could have been a primary driver for the evolution of the Earth's earliest crust and atmosphere, highlighting both their positive and negative effects for prebiotic chemistry and habitability.