abstract

THE ACCRETION & EARLY DIFFERENTIATION OF THE EARTH

The currently accepted model of planetary formation is that the cloud and dust surrounding the young sun accreted in about 10^4a to form 10 km size planetesimals. Gravitational interactions and collisions between planetesimals progressed to generate a few tens of moon to Mars-sized planetary embryos in ~1 Ma. Earth grew from these embryos through a succession of impacts, culminating in the moon-forming giant impact. The energies of impact, combined with the energy of radioactive decay means that the growing Earth would have frequently been covered by a thick molten layer, a “Magma Ocean” which assisted in differentiation.

Apart from the insight provided by these models, the principal evidence for the earliest history of the Earth comes from the chemical and isotopic compositions of the silicate mantle and crust, collectively called the “Bulk Silicate Earth” (BSE). BSE is depleted in siderophile (iron-loving) elements such as Ni, Co, Au and Pt relative to undifferentiated meteorites because these elements were partitioned into the core. How they partitioned provides a wealth of information about the state of the early Earth. There are also isotopic differences between silicate Earth and meteorites which can be used to constrain the timescales of accretion, the timing of the moon-forming impact and the changing composition of the Earth as it grew from smaller bodies. The aim of this talk is to draw together these disparate data into a coherent view of the first 150 Ma of Earth history.

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