

Destruction and melting of Hadean continent by Late Heavy Bombardment

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There are no rocks, which were made in Hadean Earth. In recent years, however, sedimentary rocks including zircons made in Hadean indicated the existence of some continental crusts in Hadean. So, how were the continental crusts to disappear? One hypothesis to solve this problem is destruction and/or melting of the crusts by the Late Heavy Bombardment (LHB), a concentration of impacts in last phase of Hadean. However, there are few quantitative studies so far.

We developed the expressions to deduce the effects of LHB to the Hadean crusts, and showed that the concentration of impacts could not destruct/melt the whole Hadean crust. We assumed the impact flux of based on the following three models: "Cataclysm" model, "Soft-Cataclysm" model, and "Standard" model.

First, we estimated the scale of LHB through the main asteroid belt's size-frequency distribution by the basins on the moon (Cataclysm model), results of numerical simulations (Soft-Cataclysm model), and cratering rates of the moon (Standard model). We approximated the main asteroid belt's size-frequency distribution estimated by observations as a power-law scaling, and gave some power indexes as a parameter. This parameter can change the effects of LHB widely. Then we estimated the sum of volume and area of craters made by LHB using the scaling law of cratering.

The result is that the LHB in any models had a chance to melt roughly same volume of the Hadean crusts, but could not cover the whole surface of the Earth by the craters. As the Hadean crusts are considered to be dotted on the surface, it would be impossible to melt the all dotted crusts by impacts. In conclusion, the Late Heavy Bombardment could not destruct/melt the whole Hadean crusts.

Keywords: Late Heavy Bombardment, Hadean, continental crust, asteroid, crater, impact