Melting during planetary formation

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Different pressure and temperature conditions for core formation and element partitioning during planetary formation likely explain the differences between the interiors of the terrestrial planets. These pressure and temperature conditions are directly related to the amount and depth of melting due to planetary impacts. To model the compositional evolution of the inner planets, estimates of the amount of melting and the pressure at the bottom of the melt pool are required.

In this study, the amount and depth of melting are determined for the impacts that result from different N-body accretion models with different initial size distributions for the planetary embryos and planetesimals. Because of the large number of impacts, a parametrised model is used for these calculations.

The crystallisation time of the resulting magma oceans is also estimated, to determine whether the next impact occurs in the molten magma ocean or on a solid surface. The results of these calculations depend strongly on whether a dense atmosphere is present that significantly slows the cooling rate of the magma ocean.