The Initial Thermal State of the Moon

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Abstract. The initial temperature profile of the Moon determines its subsequent geochemical and geophysical evolution. The crustal volume of the Moon and its lack of thrust faults limit the initial magma ocean depth to 250 - 1000 km. Previous estimates of the magma ocean depth after formation assume that a fraction of the accretional energy "h" is deposited in the interior of the moon during accretion. This fraction "h" is poorly constrained, and depends on the lunar accretion timescale and the sizes and velocities of impactors that form the Moon. Using numerical simulations of accretional impacts, we determine the fraction of impactor energy deposited in the lunar interior during accretion. We explore how the size, velocity, temperature, and angle of accretional impactors affect the fraction of energy deposited in the lunar interior. We estimate the initial temperature profile and magma ocean depth for a Moon accreting from a proto-lunar disk after a giant impact. We study how the initial magma ocean depth depends on the accretion timescale and distribution of objects impacting a growing Moon. Estimates of the initial magma ocean depth are compared to geophysical constraints to determine if the Moon's present state is consistent with the giant impact hypothesis.