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Magnetic dynamos in accreting planetary bodies

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Laboratory measurements revealed ancient remanent magnetization in meteorites [1] indicating the activity of magnetic dynamos in the corresponding meteorite parent body. To study under which circumstances dynamo activity is possible, we use a new methodology to simulate the internal evolution of a planetary body during accretion and differentiation. Using the N-body code PKDGRAV [2] we simulate the accretion of planetary embryos from an initial annulus of several thousand planetesimals. The growth history of the largest resulting planetary embryo is used as an input for the thermomechanical 2D code I2ELVIS [3]. The thermomechanical model takes recent parametrizations of impact processes [4] and of the magnetic dynamo [5] into account.
It was pointed out that impacts can not only deposit heat deep into the target body, which is later buried by ejecta of further impacts [6], but also that impacts expose in the crater region originally deep-seated layers, thus cooling the interior [7]. This combination of impact effects becomes even more important when we consider that planetesimals of all masses contribute to planetary accretion. This leads occasionally to collisions between bodies with large ratios between impactor and target mass. Thus, all these processes can be expected to have a profound effect on the thermal evolution during the epoch of planetary accretion and may have implications for the magnetic dynamo activity.
Results show that late-formed planetesimals do not experience silicate melting and avoid thermal alteration, whereas in early-formed bodies accretion and iron core growth occur almost simultaneously and a highly variable magnetic dynamo can operate in the interior of these bodies.

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