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Magnetic records of planetary differentiation

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Several classes of chondritic and achondritic meteorites formed during the first stages of planetary evolution. These samples have the potential to record the early history of planetary differentiation and possibly even magnetic field generation in planetesimal cores. We have been conducting paleomagnetic analyses on angrites, which are among the oldest known pristine basaltic meteorites, and the CV carbonaceous chondrite Allende, which is traditionally thought to sample an undifferentiated body. We found that angrites record a past magnetic field of $\sim$10 microteslas on the angrite parent body extending from 4564 to at least 4558 million years ago. Allende, which acquired its magnetization over millions of years after accretion of the CV parent body, records fields of similar intensity. Because the angrite and Allende paleomagnetic records extend beyond the expected lifetime of the early circumstellar disk, these paleofields were probably generated internally on the parent bodies, possibly by early dynamos in rapidly formed metallic cores. In particular, the CV parent planetesimal may be a partially differentiated body with an unmelted, relic chondritic surface that was magnetized during metasomatism in the presence of an interior metallic core dynamo. Planetesimal core dynamos may have been widespread but short-lived phenomena in the early solar system.