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Magnetic study of CM chondrites

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The study of the paleomagnetism of carbonaceous chondrites can lead to an estimate of the magnetic fields present in the early solar system. CM chondrites contain abundant magnetite formed during aqueous alteration on their parent body, and have not been heated after that, making them interesting targets for paleomagnetism.
We performed a detailed and comparative magnetic study (paleomagnetism and rock magnetism) of three CM chondrites: Paris, Cold Bokkeveled and Murchison. These three meteorites cover a wide range of aqueous alteration, with increasing alteration from Paris [1] to Murchison to Cold Bokkeveld [2].
Paris is a unique CM chondrite significantly less aqueously altered than other CM chondrites. Our magnetic data show that in contrast with other CM, Paris meteorite contains abundant FeNi metal (of nebular origin) together with magnetite and pyrrhotite (of asteroidal origin).
Paleomagnetic results of Paris show that unfortunately the meteorite has been exposed to a strong artificial magnetic field (magnet), precluding the study of the natural magnetization (of possible nebular origin) carried by FeNi. However, a high-coercivity magnetization carried by pyrrhotite is still preserved in the meteorite. It is homogeneous in direction and intensity at the scale of the meteorite. We interpret this high-coercivity magnetization as a pre-terrestrial chemical remanent magnetization acquired on the parent body in a field of a few μT. Our preliminary results on Murchison also evidenced an stable and homogeneous magnetization in the meteorite. Therefore a long-lasting stable magnetizing field seems necessary to account for the paleomagnetism of both meteorites.
Because crystallization of pyrrhotite and magnetite occurred several Myr after the formation of the parent body [3] (i.e. after possible existence of strong solar and nebular magnetic field), the magnetizing field was most probably created on the parent body.
In view of its intensity, the most plausible origin for the magnetizing field is an internally generated dynamo field. This would imply that the parent body of CM chondrites was partially differentiated with a convecting metallic core. Such process has recently been proposed for the parent body of CV chondrites [4, 5].

[1] Zanda et al., 2010. Meteoritics Planetary Sci., 45, 222-222. [2] Rubin et al., 2007. Geo. et Cosmo. Acta, 71, 2361-2382 [3] Krot et al., 2005. UCRL-BOOK-217207 [4] Carporzen et al., 2011. Proc. National Acad. Sci., 108, 6386-6389. [5] Elkins-Tanton et al., 2011. Earth Planet . Sci. Lett., 305, 1-10.