CONSTRAINING NEBULAR MAGNETIC FIELDS IN THE OUTER SOLAR SYSTEM FROM CO CHONDRITES

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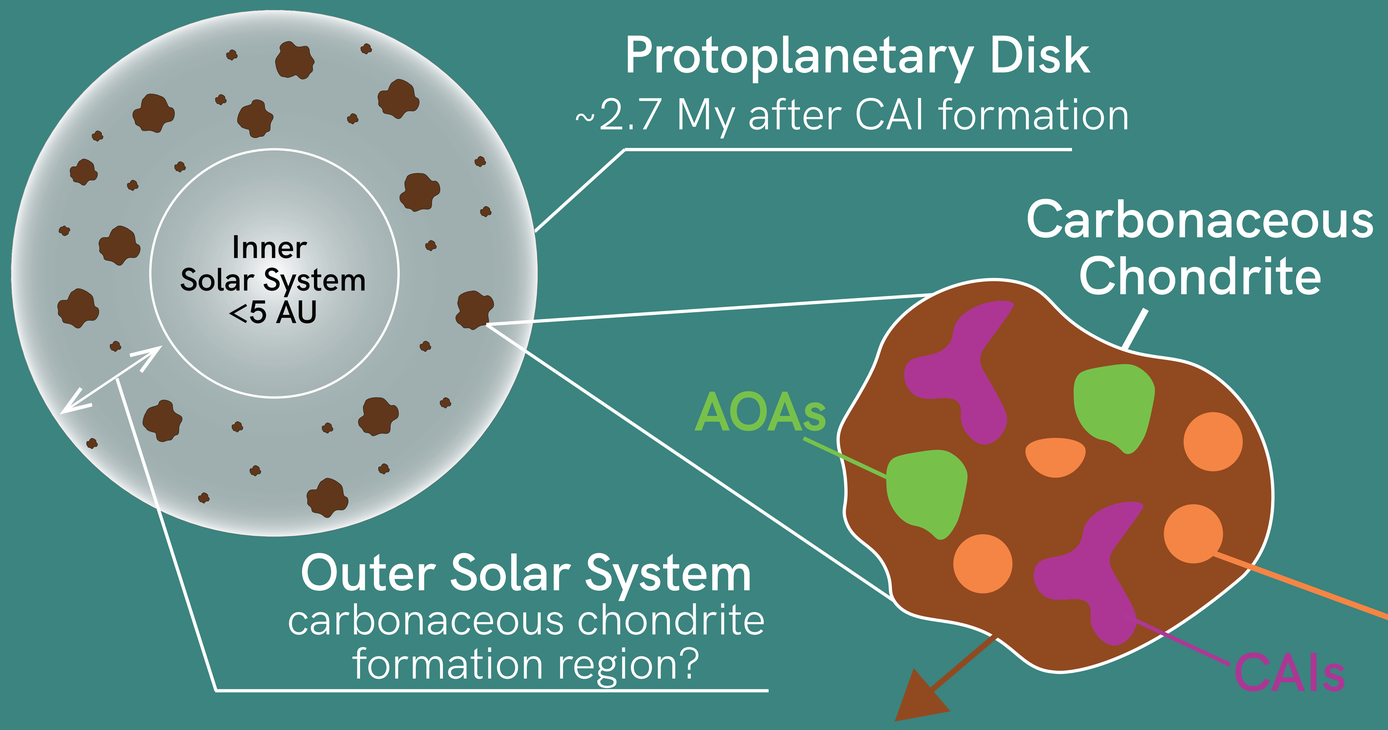
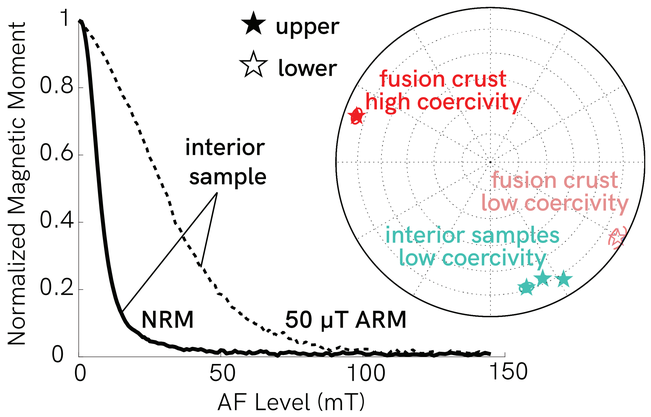


Motivation: it has long been theorized that magnetic fields in the solar nebula powered stellar accretion and disk evolution. Because such fields are currently inaccessible to astronomical observations, we can establish their existence and intensities by measuring the paleomagnetism of meteorites.

Implications: our preliminary analyses find no evidence for ancient magnetic fields recorded by CO chondrites, which implies that the solar nebula had dissipated by ~5 My after CAI formation, consistent with Wang et al. (2017). Additionally, the CO chondrite parent body did not seem to have an active dynamo by ~5 My.
Our future work will help constrain the CO chondrite paleofield.

Records of the Solar Nebula in CO meteorites

Bulk samples (matrix + inclusions) of ALH 77307 (CO3.0) record magnetic history > 5 My after CAI formation.

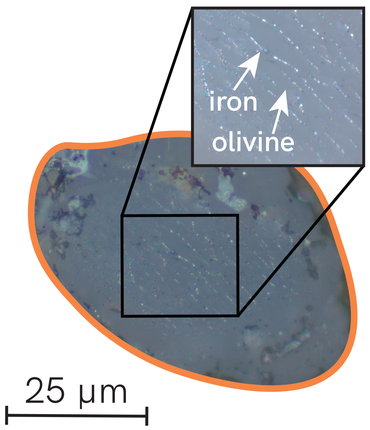


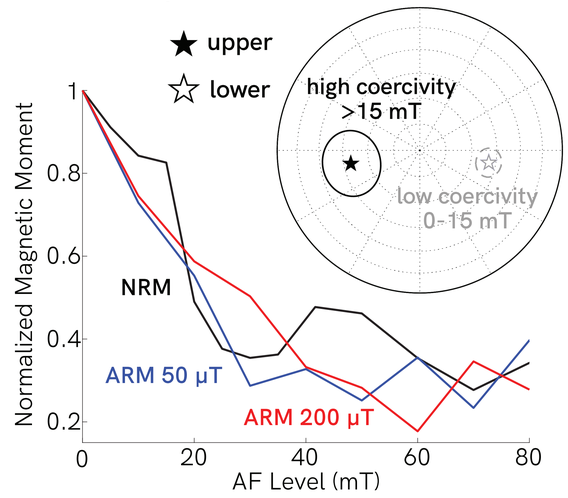
Above: alternating field demagnetization of NRM and of laboratory-induced 50 μT ARM for a bulk sample.

- CO chondrite matrices contain magnetite with high fidelity recording properties.
- Fusion crust is magnetized in different direction from interior samples, indicating meteorite retains preterrestrial magnetic record.
- A low coercivity component (0-30 mT) found in interior samples, records an Earth-strength field (~135 μT) and is secondary in origin.
- The high coercivity range (>30 mT) in interior samples is essentially unmagnetized (formed in a paleofield < 2 μT).

The time-averaged magnetic field as recorded by CO chondrites at ~5 My after CAI formation was < 2 μT.

Dusty olivine chondrules may provide magnetic records up to ~2.5 My after CAI formation.





Left: reflected light microscope image of a dusty olivine chondrule, an excellent magnetic carrier, from NWA 11751 (CO3.05).
Right: initial results from alternating field demagnetization of natural remanent magnetization (NRM) and of 50 and 200 μT anhysteretic remanent magnetizations (ARM) for dusty olivine chondrule from DOM 08006 (CO3.0).

CO chondrules may record 50-200 μT instantaneous nebular field at ~2.5 My after CAI formation.