Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18697

# Origin of volatiles in rocky bodies – an iron meteorite story

**DAMANVEER S GREWAL** AND PAUL D ASIMOW
California Institute of Technology
Presenting Author: dgrewal@caltech.edu

Unravelling the origin of life-essential volatiles like nitrogen (N) and carbon (C) in Earth and other rocky planets requires constraints on their inventories in the first-formed planetesimals. Our current understanding of this problem is built on chondrites. However, the first planetesimals inherited an important short-lived radionuclide, $^{26}$Al, which had a tremendous effect on their geophysical and geochemical evolution. Thermal models predict that the heat released during $^{26}$Al decay resulted in planetesimals having differentiated interiors overlain by undifferentiated crusts. Paleomagnetic data suggests that many groups of chondrites originated from the surficial layers of differentiated planetesimals. Though these surficial layers escaped melting, their N and C elemental abundances and isotopic ratios were affected by aqueous alteration and thermal metamorphism. Therefore, using chondrites as direct proxies for the bulk volatile inventories of the first planetesimals is impractical.

Iron meteorites can be used as an alternative approach to solve this problem. Magmatic iron meteorites are the remnants of the metallic cores of the first planetesimals. The siderophile character of N and C led to most of the N and C being segregated into the cores of differentiated planetesimals. Therefore, the N and C contents as well as isotopic ratios in iron meteorites can be used to yield confident estimates of their quantities in the complete parent bodies of iron meteorites. High-pressure, high-temperature experiments are combined with iron meteorite data to accomplish this. Solid metal-liquid metal partitioning experiments provide a basis for reconstructing the N and C compositions of the cores. Then, in turn, liquid metal-liquid silicate partitioning data support reconstruction of the bulk N and C abundances and isotopic compositions of the earliest planetesimals. These results will be used to shed new light on our understanding of the origin of N and C in the rocky bodies of the solar system.