Organics discovered in Allan Hills Meteorite were generated from fluid and CO_2 interaction with rocks on early Mars

INTRODUCTION: The Allan Hills 84001 (ALH84001) martian meteorite was found in Antarctica in 1984. This meteorite has been dated to crystalize ~4.09 Gya but been modified by fluid ~3.6 Gya on Mars. This ancient martian sample provides valuable window into the potentially habitable environment on early Mars. Carbon has been found in ALH84001 but it is unclear about whether it was formed via (1) abiotic production through several planetary processes, (2) biological production from potential life on Mars, or (3) simply contamination from Earth. Steele et al. set out to investigate the identity, origin, and formation mechanisms of the organic carbon found in ALH84001.

METHODS: Two thin rock sections were extracted. Each rock foil has been characterized via nanoscale spectral, imaging, structural, and isotopic analysis.

RESULTS: The collection of minerals found in ALH84001 are similar to those in Earth-rocks that have undergone reactions with water (i.e., serpentinization) and CO_2 (i.e., carbonation). The structure of the minerals show evidences of aqueous and/or hydrothermal alteration. Organic carbon is associated with products of this alteration. Hydrogen isotope show the organics are Martian.

KEY TAKEAWAYS: (1) Results from this analysis are consistent with a Martian origin of the organic matter in ALH84001 because the hydrogen isotope signature is unique to Mars. (2) The organic carbon likely formed abiotically, from water-rock reactions. (3) These water-rock reactions shaped Mars's ancient environment and would have generated molecules important for the origin of any possible Martian life.

Steele, A., et al. "Organic synthesis associated with serpentinization and carbonation on early Mars." ***Science*** 375.6577 (**2022**): 172-177.

Illustration and text adapted from Steele et al. 2022 by Brook L. Nunn, Ziqin (Grace) Ni, & Trent Thomas @ ***NfoLD***