Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12416

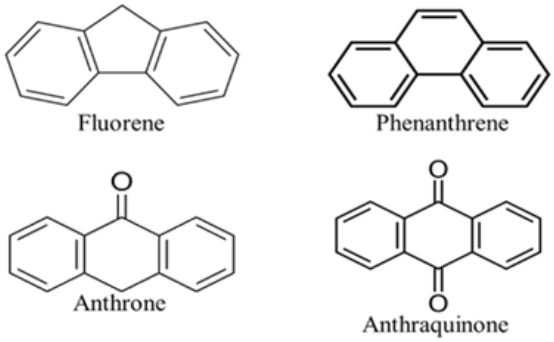
Polycyclic Aromatic Hydrocarbons in Simulated Subsurface Martian Mineral Matrices

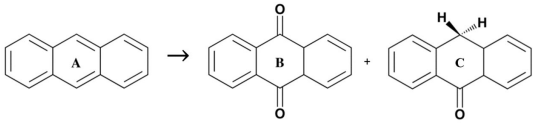
CHRISTINE ROSE WARD[1], DR. ARDITH D. BRAVENEC, PHD[2] AND TIMOTHY J WARD[1]

[1]Millsaps College

[2]University of Washington

Presenting Author: wardcr@millsaps.edu





Evidence for previous life on Mars may be provided by biomolecules. Biomolecules of interest include polycyclic aromatic hydrocarbons (PAHs) (Fig. 1). Although PAHs can occur abiotically, identifying abundances of specific PAHs can be indicative of a biological origin. PAHs are highly stabilized aromatic structures resistant to heat and pressure that may be able to withstand the high pressures and temperatures inherent to Martian burial environments, including metamorphic, diagenetic, and impact processes. Due to the largely inhospitable surface environment of Mars, potential biosignatures likely reside in the subsurface [1].

Past subsurface hydrothermal systems and mineral matrices might be key as minerals and fluid environments could confine and protect biomolecules. However, certain fluid and mineral environments are destructive to biomolecules as they include acidic and oxidative stressors [2].

To investigate the preservation potential of PAHs in simulated Martian conditions, four minerals were selected as the starting materials. Selected PAHs were added to the minerals, and the mineral/PAH samples were subject to four fluid environments: 25 % NaCl in H_2O, 5 % Fe_2O_3 in H_2O, 2 pH solution of HCl in H_2O, and an anhydrous environment. The resulting samples were held constant at 150 °C for 200 hours in a heating furnace. Following an extraction protocol, samples were analyzed by gas chromatography – mass spectrometry to identify the presence of the PAHs and their degradation products.

Preservation potential varied significantly between the PAHs in the simulated conditions. A number of degradation and oxidation pathways were identified (Fig. 2). Much of the preservation potential results were within theoretical estimates, however, several experiments provided unexpected outcomes.

References:

[1] Benner, S. A., Devine, K. G., Matveeva, L. N., Powell, D. H., 2000, The missing organic molecules on Mars. *Proc. Natl. Acad. Sci. U.S.A.,* 97, 2425-2430.

[2] Gil-Lozano, C., Fairén, A. G., Muñoz-Iglesias, V., Fernández-Sampedro, M., Prieto-Ballesteros, O., Gago-Duport, L., Losa-Adams, E., Carrizo, D., Bishop, J. L., Fornaro, T., Mateo-Martí, E., 2020, Constraining the preservation of organic compounds in Mars analog nontronites after exposure to acid and alkaline fluids. *Sci. Rep*., 10.