ARPHA Conference Abstracts 6: e108199
doi: 10.3897/aca.6.e108199

Conference Abstract

N-Alkane Biosignatures in a High Arctic Mars Analogue Gossan Deposit

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Received: 18 Jun 2023 | Published: 16 Oct 2023

Citation: Aoid H, Léveillé R, Douglas P, Lemelin M, Williamson M-C (2023) N-Alkane Biosignatures in a High Arctic Mars Analogue Gossan Deposit. ARPHA Conference Abstracts 6: e108199.
https://doi.org/10.3897/aca.6.e108199

Abstract

If past life ever existed on Mars, what are the multiple ways it could have been preserved in the Martian geological record? This crucial question is becoming especially relevant the more we uncover about the planet's ancient wet history. Different acidic and sulfur rich analog environments have been proposed that are comparable to the alteration environments of iron oxides and sulfate minerals on Mars. However, some authors have hypothesized that these past Martian environments might have been cold and semi-dry, similar to polar regions on Earth. As part of the T-MARS team, we studied reactive gossans in the Canadian High Arctic, on Axel Heiberg Island, as an analog environment to similar deposits on Mars. We hypothesized that n-alkane lipids could potentially be an important form of molecular fossils entombed in varying mineral assemblages of sulphates, iron oxides, and phyllosilicates in Arctic gossans, because of their excellent preservation potential relative to most other forms of organic molecules. To determine the preservation potential of lipids in mineralogically varying acidic sulfur rich gossan deposits, this study extracted and quantified n-alkane biomarkers from three different Arctic gossans with gas chromatography–mass spectrometry (GC-MS). Total organic carbon, pH, and mineralogy were also determined. Organic matter was found to be very low in all samples (<1% wt.%). N-alkane analysis also revealed preserved even-over-odd distribution patterns in short chain n-alkanes, most likely from a microbial source, along with evidence for long-chain n-alkanes with odd-over-even distribution from higher plant sources. The presence of these

unique chemical biosignatures in low organic, highly acidic, and sulfur rich Mars analog gossans of varying maturity provides evidence that sulfur deposits linked to paleo hydrothermal systems on Mars can be promising targets for preserved organic biosignatures, specifically lipid n-alkanes. The significant diversity in biosignature patterns across samples of varying mineralogy, pH, and oxidation levels within each gossan suggests that n-alkane preservation varies on a small scale in these environments. These factors alone do not definitively account for the variability of n-alkane concentrations and distributions in this study, and additional investigations of these and other influencing factors are needed to determine which specific targets to choose for biosignature search on Mars in future space missions. This exploratory study provides novel insights into the lipid biosignature content in high Arctic Mars analogue gossan deposits.

Keywords

Mars-analog studies, lipids, n-alkanes, biosignatures, biomarkers, gossans

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Conflicts of interest

The authors have declared that no competing interests exist.