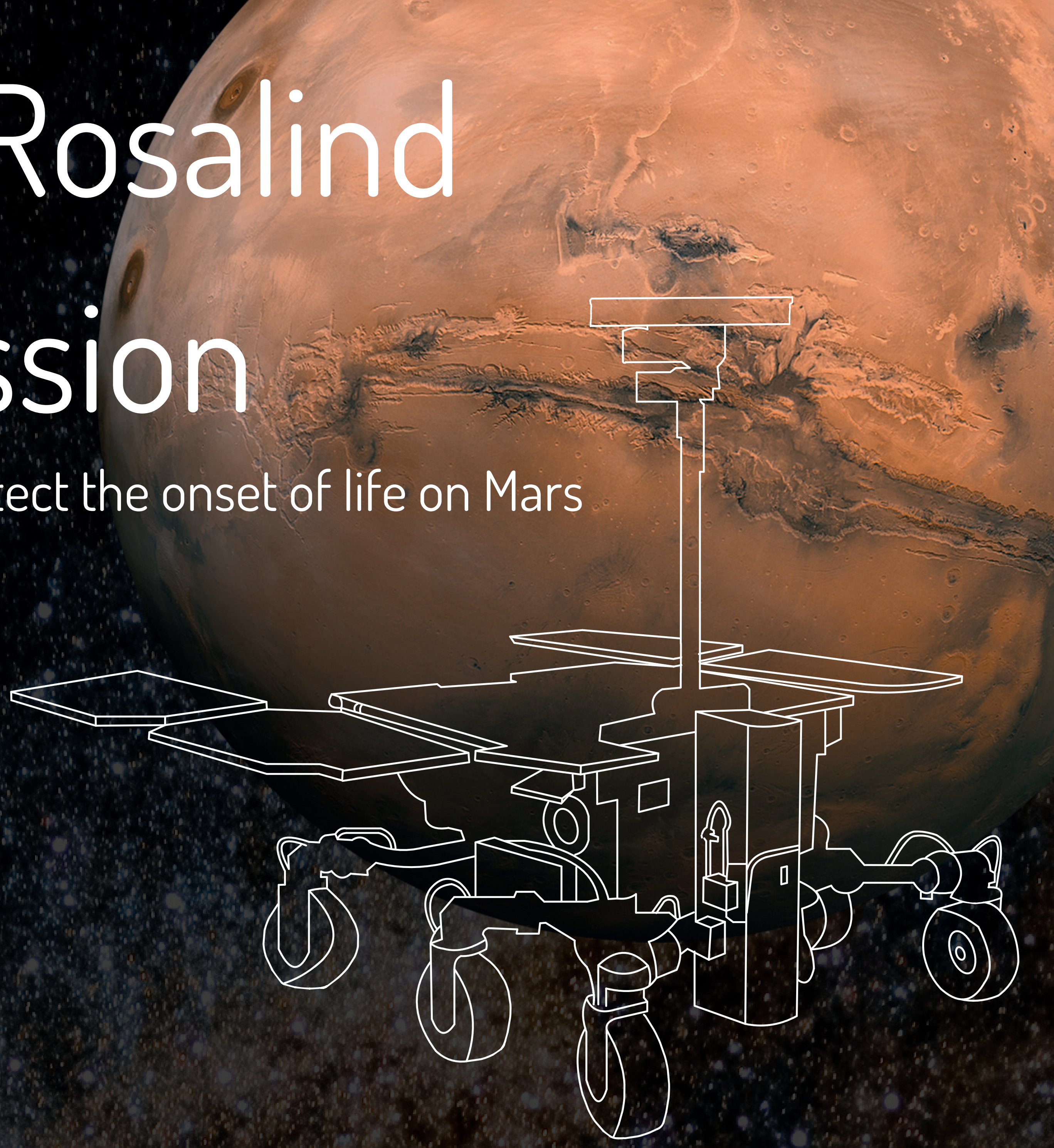
REVIEW POSTER

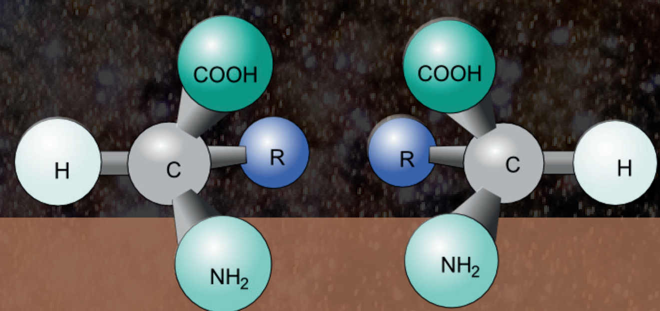
ESA's ExoMars Rosalind Franklin mission

Using chirality of molecules as a proxy to detect the onset of life on Mars



ABSTRACT

The concept of chirality of a molecule can be used to determine if the molecule's origin is based on a biological process that we call life. Whether life or life-like biology was present on Mars is still subject to intensive current research. In the near future, ESA's ExoMars Rosalind Franklin Rover is planned to carry, amongst other, the MOMA instrument suitable to detect the chiral property of molecules and thus contribute to the question of whether Mars once hosted life early on in its history. This review poster will describe a part of ESA's ExoMars program, the MOMA instrument and what chirality means for life on Earth.



CHIRALITY - A BIOSIGNATURE

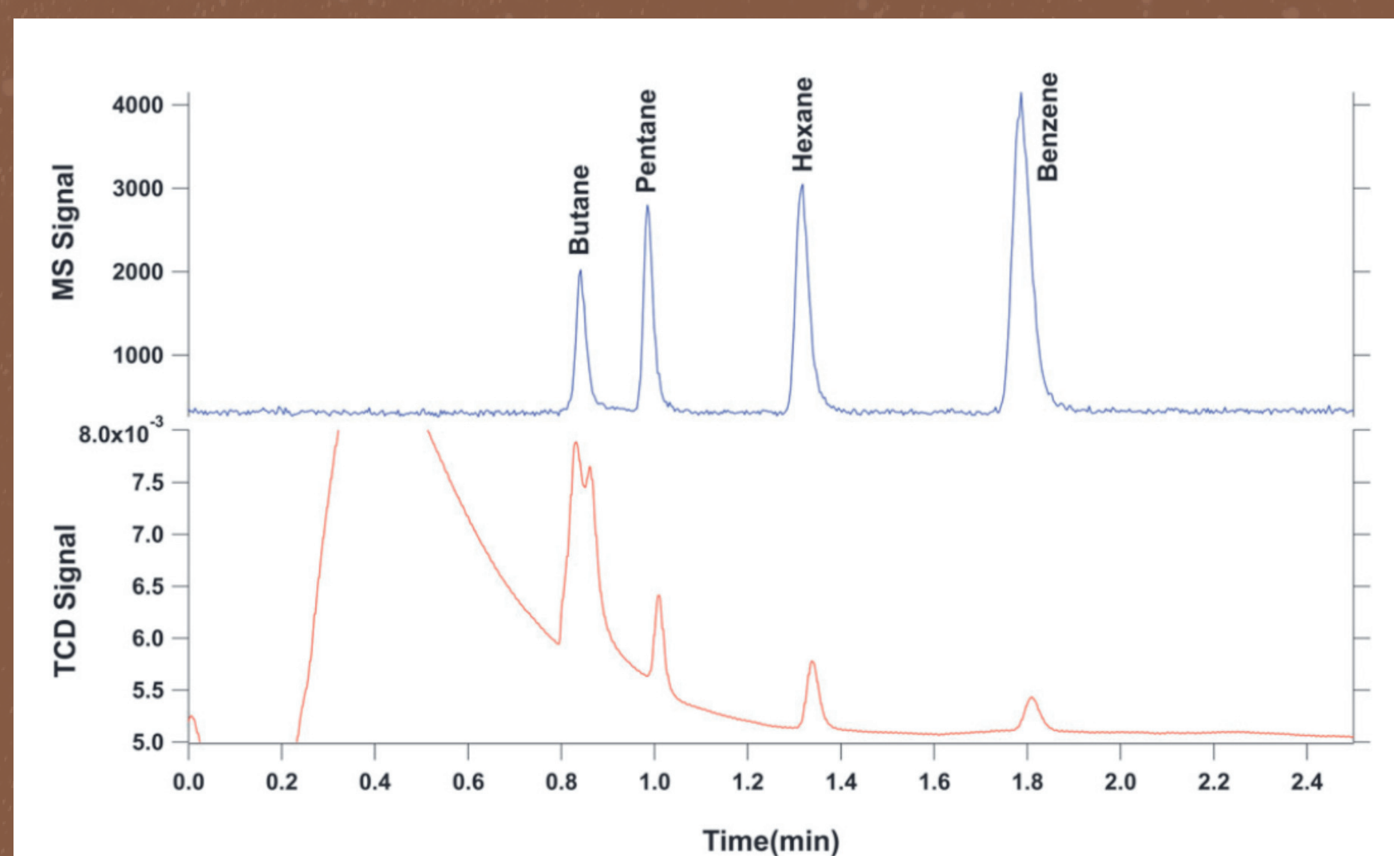
- A unique property in organic compounds that can be used to differentiate between biological or non-biological sources.
- Biological homochirality, more specific the use of L-amino acids in proteins and D-ribose and D-deoxyribose in nucleic acids, coenzymes is considered to be essential for life or an early product of it.
- Most life on earth utilizes L-amino acids and D-sugars and detecting an excess of one chiral form in extraterrestrial environments may indicate, along with other supporting evidence the presence of life. (Anon, Chirality and stereoisomers, (2023))

THE ROSALIND FRANKLIN ROVER AND THE ONBOARD MOMA INSTRUMENT

- Goal: The Mars Organic Molecule Analyzer (MOMA) searches for signs of past or present life on Mars.
- MOMA analyzes a variety of organic compounds in drill samples collected from up to 2 meters below the Martian surface.
- MOMA is a two stage instrument composed of a gas chromatograph (GC) and a mass spectrometer (MS).
- MOMA separates, detects and characterizes key complex organic compounds, along with other relevant measurements of organic and inorganic inventories. (Goesmann et al. 2017)

GCMS COUPLING CAMPAIGNS

- To demonstrate the functionality of the GCMS experiment, the two independent instruments was coupled and their performance characterized as a single unit.
- In this experiment, volatile compounds contained in a gas mixture (butane, pentane, hexane, and benzene, 1000ppm each) were used as calibrant standard and the mass spectrometer signal and the TCD (Thermal Conductivity Detector (GC detector)) signal was detected.
- Along with other experiments it was concluded that the demonstration of the GCMS coupling campaign was succesfull. (Goesmann et al. 2017)



Separation of volatile compounds (butane, pentane, hexane, and benzene). The chromatogram obtained shows good separation of the four compounds injected in both the MS (above) and TCD (below) signals. The double peak observed on the TCD signal at a retention time of 0.85 min is due to the presence of air, which is not observed by the MS as it is below its mass range.

Conference presentation: "Are We a Unique Species on a Unique Planet?", July 30th to August 2nd, 2024, Centre for ExoLife Sciences (CELS), Copenhagen, Denmark: (https://cels.nbi.ku.dk/english/conference-cels/)

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References: Goesmann et al. (2017); DOI: 10.1089/ast.2016.1551 - Rosalind Franklin Rover Illustration credit: Natalie Ansbjerg, SDU - Anon, Chirality and stereoisomers, (2023) https://chem.libretexts.org/@go/page/795/visited 23/07/2024

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