Imperial College London

DEPARTMENT OF EARTH SCIENCE AND ENGINEERING

Recognising Life in Samples Returned from Mars

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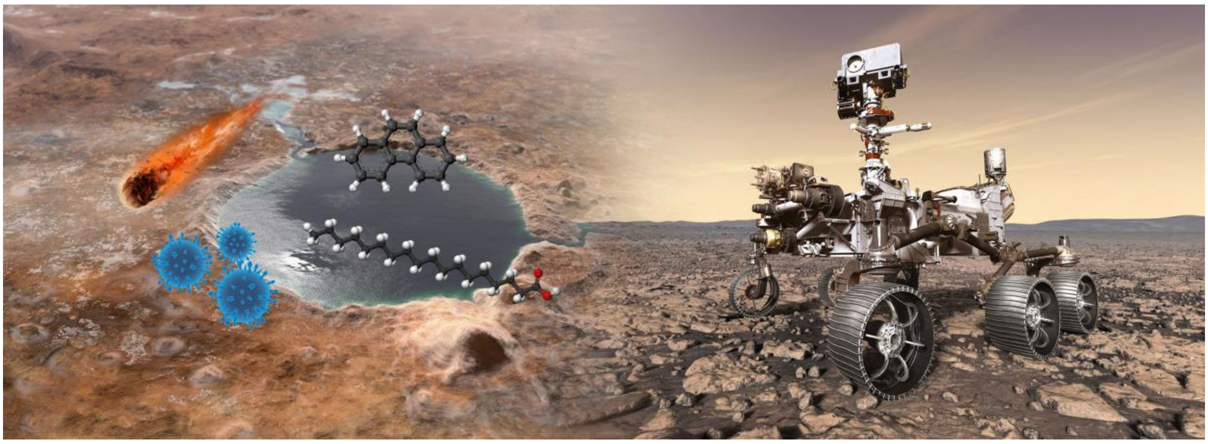

We are planning and waiting for the return of samples from Mars. The Mars 2020 Perseverance Rover is operating on the red planet and represents the first step in Mars Sample Return. The mission hopes to return samples that contain organic matter and potential evidence of past life. Yet, the organic compounds in samples returned from Mars may be affected by billions of years of radiation, reactions with the lake or subsurface water, the heat associated with burial, and/or interactions with chemically aggressive minerals and oxidants. This type of "secondary processing" on Mars will reduce our ability to distinguish organic compounds produced by life from those delivered by meteorites or generated in situ chemical reactions. New organic analytical techniques are needed that solve the problems of long-term storage on Mars and the loss of information it may cause.

Stable isotopes, measured by mass spectrometers, can reveal the source of carbon. The technique is used to great effect in geochemistry, forensic science and medical research. Stable isotope ratio measurements can extend to the level of individual compounds, a technique termed compound specific isotopic analysis (CSIA). The diagnostic capabilities of CSIA measurements have allowed terrestrial contamination in carbon-rich meteorites to be distinguished from indigenous extra-terrestrial compounds. Now, a next-generation method is available. At Imperial College London, stable carbon isotope ratio techniques have progressed from individual compounds to individual carbon atoms, to give position specific isotope analysis (PSIA). There are a multitude of potential arrangements of carbon isotopes in hydrocarbon structures and these arrangements can be used as unique biochemical and geochemical signatures to identify the sources of organic compounds. The

PSIA method is a system recently developed in the Imperial College Organic Geochemistry Laboratories (Figure 1). Very few of these systems exist globally and the application of this system to astrobiology and planetary science is an exciting step.

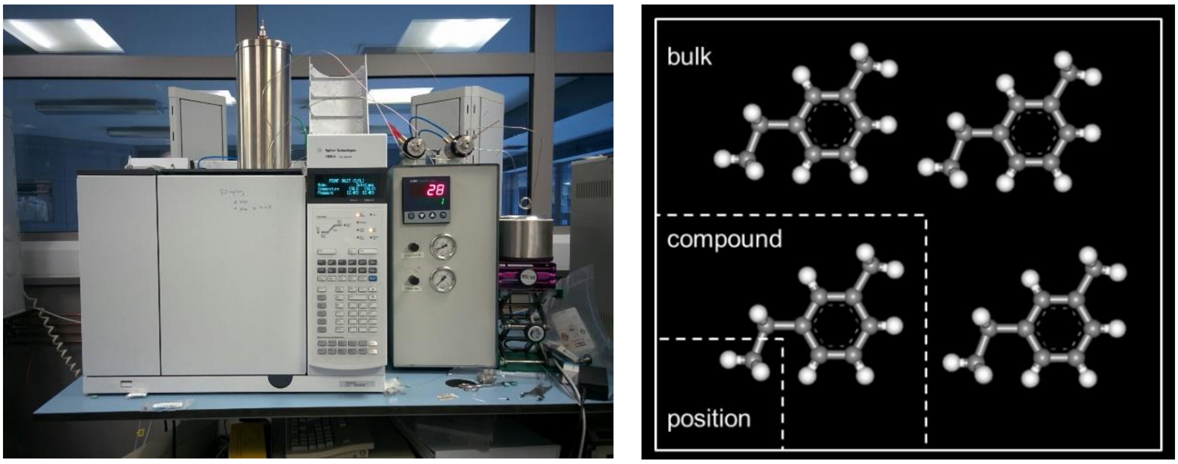

Figure 1. The PSIA system at Imperial College London (left panel) and the increased resolution provided by compound specific isotope analysis, or "CSIA" and the ultimate resolution provided by position specific isotope analysis, or "PSIA" (right panel).

The research will use a rage of equipment in the Imperial College Organic Geochemistry Laboratories. The work will use carbon-rich meteorite samples and samples from Mars analogue sites - locations on Earth that mimic conditions that may have been present in the history of Mars. Full training will be provided. The project would suit a candidate with enthusiasm for Planetary Science or Astrobiology and a background in Earth Science, Chemistry or a subject that develops similar skills. This is exciting opportunity for a student who would like to develop unique methods and skills ready for the return of samples from Mars.

If any successful applicant is eligible for a departmental STFC funded studentship, then this project would qualify for an enhanced CASE stipend. The industrial partner would be Protium who develop inlet and mass spectrometry systems.

- For more information contact: Professor Mark Sephton (m.a.sephton@imperial.ac.uk).
- Details of how to apply are at: https://www.imperial.ac.uk/study/pg/apply/how-to-apply/.
- Funding details can be found at: https://www.imperial.ac.uk/study/pg/fees-and-funding/scholarships/.