Imperial College London

DEPARTMENT OF EARTH SCIENCE AND ENGINEERING

The volatile fingerprints of life – a new method to indicate the biological or non-biological sources of gas

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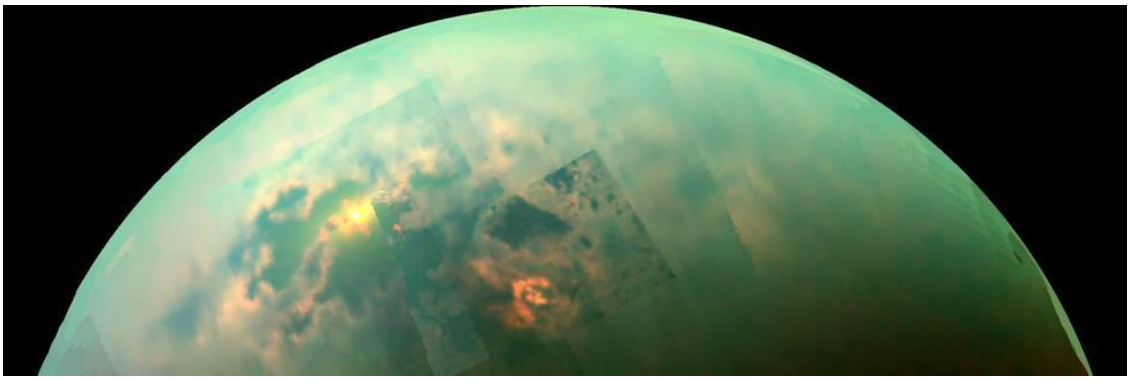

The Methane seas of Titan (Credits: NASA/JPL/Univ. Arizona/Univ. Idaho).

Hydrocarbon gases are common in the Cosmos and the geosphere. The biological or non-biological source of hydrocarbon gases is often the subject of debate, the intensity of which depends on the location of the hydrocarbon gas and the amount of information available to settle any uncertainty. Unfortunately, hydrocarbon gases can be relatively information poor compounds. Their small size makes their molecular architecture undiagnostic of source. Patterns of gases with different numbers of carbon atoms do provide some information but the most information rich part of these compounds is within the atoms themselves.

The carbon atoms that make up the skeleton of hydrocarbons contain two stable isotopes, carbon-12 and carbon-13. The lighter carbon isotope is more reactive than its heavier counterpart and takes part in reactions more readily. The preferential incorporation of the lighter carbon isotope in reaction product leads to isotope fractionation and can reveal synthetic mechanisms. Non-biological hydrocarbons generally reveal an increase in carbon-12 with carbon number in accord with the kinetically controlled synthesis of higher molecular weight homologues from simpler precursors. By contrast the thermal cracking of high molecular weight biologically-derived hydrocarbons produces the opposite trend where a decrease in carbon-12 with carbon number is observed.

This project will explore the possibility that adsorption and desorption of gases can produce isotopic compositions and patterns in hydrocarbon gases that would normally be associated with life. At Imperial College London we have developed a custom-built desorption cell into

which powders or plugs of representative samples can be loaded. Known volumes and compositions of gas can be introduced and adsorbed onto the contents and then released by depressurization. Measurement of the gas recovered from the desorption cell is performed using coupled online gas chromatography – flame ionising detector (GC-FID) and online gas chromatography – isotope ratio mass spectrometry (GC-C-IRMS) systems to study molecular weight and stable carbon isotopic fractionation respectively.

The results of the project will have implications for the evolution of volatiles and atmospheres in the early solar system, the recognition of gases from any life on Mars and theories of abiotic formation of petroleum deposits on Earth.

*The **world's only** online desorption cell-gas chromatography-combustion-isotope ratio mass spectrometry system at Imperial College London.*

The research will use equipment in the Imperial College Organic Geochemistry Laboratories (right). 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.

- 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/.