Characterising the Transfer of Biomarkers within the Phobos-Mars System

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How can material be transported from Mars to Phobos?

- Martian ejecta ascends through atmosphere undergoing aerodynamic heating.
- Martian ejecta spreads upwards towards the orbit of Phobos.
- Ascending martian ejecta intersects Phobos’ orbital path impacting Phobos’ sub-Mars hemisphere.
- Phobos sweeps up ascending martian ejecta in Phobos’ orbital path.
- Martian ejecta loses energy and disperses covering a larger area of Phobos’ orbit and begins to descend.
- Descending martian ejecta intersects Phobos’ orbit again impacting Phobos’ anti-Mars hemisphere.

CHARACTERISING THE TRANSFER OF BIOMARKERS WITHIN THE PHOBOS-MARS SYSTEM.

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Could there be martian biomarkers on Phobos?

- Phobos itself is not considered habitable [1]
- However, its proximity to Mars and short orbital period have led to the hypothesis that:
  Large impacts into Mars could eject material, containing biomarkers remnant from past life, that could deposit onto Phobos [2-4].
- Therefore, biomarkers could potentially exist on the surface of Phobos and be sampled by future sample-return missions like MMX [5,6]

What about organic contamination in the Light-Gas Gun?

- Within the light gas gun unwanted carbon-based material can act as contamination.
- Samples from throughout the gun (as) will undergo organic characterisation with GC-MS.
- Characterisation is vital to prevent false-positive identification of biomarkers.

Defining biomarkers

- Biomarkers represent the essential building blocks for a broad range of life forms and could survive billions of years in the harsh martian surface environment [7].
- The contamination in the gun constrains the chosen biomarker.
- Possible biomarkers include:
  - Sterols
  - Amino Acids
  - Long chain Fatty acids
  - Alkanes
- The biomarker(s) will be used to dope martian bedrock analogue & bespoke projectiles.

Developing bespoke projectiles

Bespoke projectiles are required to simulate martian ejecta.
- They should exhibit:
  - Compositional and physical constituency with martian ejecta.
  - Spatially homogenous doping with biomarkers to a known concentration

Summary and implications

The results from these procedural and analytical developments:
- Allow for bespoke impact experiments, focussed on organics, to take place with constrained instrument contamination.
- Highlight the detection limits of analytical techniques (e.g. GC-MS) when analysing shock processed biomarkers, with major implications for current and future astrobiology missions.

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