Impact and heat processing of Mars' moon Phobos

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External supervisor: N/A

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Description:

Aim
To investigate the survival and modification of organic material and the chemical and physical effects of impact modification on the surface of Phobos and carbonaceous asteroids.

Background
The surface of Phobos is believed to be covered by a thick, predominantly fine-grained, regolith layer, which may have been excavated by micrometeorites or larger meteoroids derived from the asteroid belt, or from Mars itself.

The composition of Phobos is estimated to be carbonaceous [1] but geologically heterogeneous [2]. Spectral data have indicated that the two typical lithological 'units' are compositionally similar to the related P- and D-type (carbonaceous) asteroids [3, 4]. The low albedo is believed to be indicative of the presence of organic molecules.

This project will investigate how the loosely consolidated surface of Phobos and carbonaceous asteroids may have been modified by impact processes. The specific objectives are thus:
- to undertake hypervelocity experiments simulating the impact modification of Phobos and carbonaceous asteroids
- to undertake flash heat tests invoking impact-related thermal regimes
- to undertake geochemical analyses to quantify the survival and modification of organic material that occurs as result of the impact/thermal processing

Research questions
- To what extent are organic molecules within a Phobos-like regolith modified by impact processes?
- To what extent do thermal conditions control the modification of organic species during impacts?

Methodology
The applicant will use the hypervelocity All-Axis Light Gas Gun (AALGG) facility at the Open University to fire projectiles into a variety of targets.

Flash heating instrumentation (Pyrola) will be used to simulate the effects of impacts under controlled conditions.

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The projectile and target materials will be characterised before and after impact for their chemical and physical properties, using a suite of analytical instruments available at the OU (e.g. Py-GC-MS/Py-GCxGC- TofMS, Raman, FTIR, SEM).

OU context

This project is a logical extension to the ESA Sterlim contract (Patel PI, Pearson Co-I), which invoked equivalent methodology to ascertain the survival of microorganisms during impact and thermal processing. No geochemical analysis was undertaken as part of that study.

The team bring expertise in organic geochemistry and flash heating experimentation (Pearson), impact experimentation (Patel), and asteroid composition and processing (Green).

References

1. Mazursky et al., (1972), JGL 78(20), pp.4009–4030;
2. Murchie and Erard, (1996) Icarus, 123(1), pp.63–86;
3. Zellner and Wells, (1994) 25th LPSC, #1541Z;
4. Rivkin et al., (2002) Icarus, 156(1), pp.64–75

Qualifications required

Earth sciences or chemistry degree.