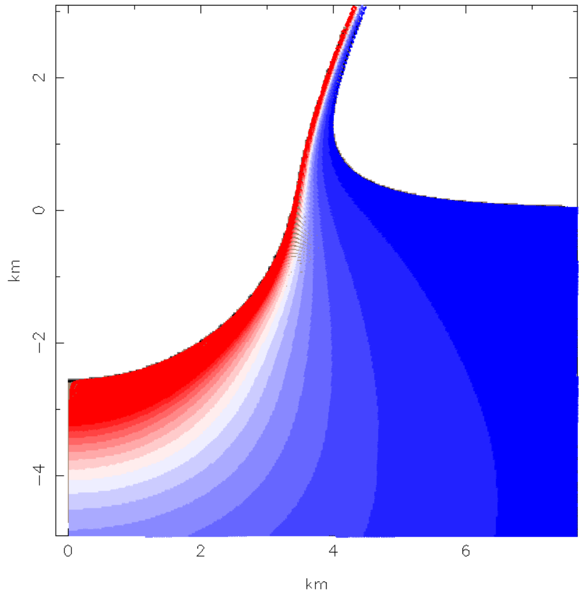
**Numerical methods for simulating ejection and survivability of meteorites from Mars**

*Supervised by Gareth Collins, Alan Dawes and Andy Barlow*




**Martian and Lunar meteorites** found on Earth are evidence for the interplanetary transfer of near-surface rocks. Evidence from these meteorites suggests that the ejection mechanism did not expose the rocks to shock pressures in excess of 15-45 GPa, which might allow micro-organisms in the rock to survive the ejection process. The leading hypothesis for how the Martian meteorites were ejected from Mars without being exposed to high shock pressures is via spallation—the interaction of a shockwave with rarefactions from a free surface [1]. Numerical simulations of km-scale impacts on Mars support this hypothesis, predicting that material just below the free surface can be accelerated to a velocity of 5 km/s without being subjected to pressures exceeding 10 GPa [2,3].

Recently, the validity of the spallation hypothesis has been questioned [4]—it is suggested that the low shock pressure predicted by previous simulations is an artifact of the numerical techniques used to track the shockwave. Rigorous testing of the spallation hypothesis for the ejection of martian meteorites requires a thorough analysis of the sensitivity of impact simulations to internal model parameters and the techniques employed to simulate the passage of the shock wave and material interfaces. Such analyses are crucial for understanding a range of other processes, such as the survivability of asteroids and comets during impact, and for advancing numerical techniques for shock modeling.

**The aim of this PhD project** is to investigate whether small impacts on Mars can eject rocks fast enough to escape the gravitational field of the planet without exposing the ejected material to high shock pressures. To achieve this the project will examine the ability of existing numerical impact models to accurately simulate the interaction between shockwaves and the free surface (and other material interfaces). Novel shock/interface capturing techniques will be developed to address and shortcomings of existing approaches.

**The successful candidate** will join, and be supported by, a vibrant and dynamic research group with world-class expertise modelling geophysical flows. They will be trained in state-of-the-art numerical methods for simulating compressible multimaterial flow, impact and shock physics and high-performance computing. The candidate will have the opportunity to develop their career and profile by presenting at international conferences and publishing in high impact journals. Candidates for PhD positions should have a good mathematical background and a good degree in an appropriate field such as physics, mathematics, earth science, computer science or engineering. Applications from candidates with an MSc in scientific computing or numerical modeling are particularly welcome.


[1] Vickery, AM and Melosh, HJ (1987) Science 237: 738—743.
[2] Head et al. (2002) Science 298: 1752—1756.
[3] Artemieva N and Ivanov BA (2004) Icarus, 171:84—101.
[4] DeCarli et al. (2007) Proc. Shock Compression of Condensed Matter, AIP.



For more information please contact Gareth Collins (g.collins@imperial.ac.uk).

For application details please contact Samantha Delamaine (sam.delamaine@imperial.ac.uk) or write to:
Department of Earth Science and Engineering, Imperial College London, South Kensington Campus, SW7 2AZ

This Information can also be found on our website: www.ese.ic.ac.uk