Geophysical Research Abstracts
Vol. 13, EGU2011-8021, 2011
EGU General Assembly 2011

Oblique impact experiments into soil-ice targets: conditions for uncovering ice

Katarina Miljkovic and Manish R. Patel
The Open University, PSSRI, Milton Keynes, United Kingdom (kacuncica@gmail.com)

Detection of subsurface water ice on Mars via fresh impact craters with bright floors and ejecta on Mars (Byrne et al, 2009) along with direct evidence gathered by the NASA Phoenix Mars Lander opened new questions about the extent of sub-surface water-ice on Mars and in the Solar system in general. There has been little experimental research to date on high velocity impacts into loose materials and particularly on layered materials that include loose granular materials (such as soil) and water ice. This research is vital to better understand the response to impact events of water-ice sub-surface deposits that are, for example, likely to exist on Mars. A detailed analysis of conditions under which water-ice deposits are revealed in high velocity impact events provides more precise information of the depth at which such water-ice deposits could be found.
Our impact experiments are performed using the light gas gun (LGG) at the Open University's Hypervelocity (HVI) laboratory. The LGG mount frame is capable of tilting while the target remains horizontal, allowing impact experiments to be conducted into loose targets at any oblique incident angle. The targets in our experiments were ∼14 x 19 x 3 cm water ice blocks (frozen at -10oC) covered with martian analogue soil. The impact experiments were made for a range of soil thicknesses (3-5 mm) at a range of impact energies (projectile sizes of 1-2 mm in diameter and impact velocities of 2-4 km/s). The impact incident angle in all experiments was 45o, which corresponds to the most probable impact angle in meteoroid bombardment in the Solar system (Pierazzo and Melosh, 2000). The martian analogue soil used in the experiments was Salten Skov I (Nørnerg et al., 2009).
The conditions for uncovering water ice in soil-ice layered targets in controlled laboratory conditions are presented, along with the high velocity impact behaviour of loose soil and water ice in layered targets. Depending on impact energy and soil thickness, we observed a wide range of possible cases; water ice underneath the soil could remain covered or become uncovered, cratered and cracked or completely fragmented, where the fragmentation could include some degree of melt or not.
The equipment capability unfortunately prevented the investigation of higher impact velocities and projectile sizes. However, in addition to modelled impact events into Martian surface in which the ice is uncovered (Reufer et al., 2010; Senft and Stewart, 2008), we also rescale and apply our experimental results to the Martian environment and compare to modelling results and evidence from recent images.

References:
Byrne, S. et al., 2009, Science 325, 1674; Pierazzo, E. and Melosh, J.H., 2000, Annu. Rev. Earth Planet. Sci. 28, 141-67; Nørnerg, P. et al., 2009, PSS 57, 628-631; Reufer, A. et al., 2009, PSS 2840; Senft, L.E. and Stewart, S.T., 2008, Met. Plan. Sci., 43 (12) 193-2013.