Europlanet TNA Report

PROJECT LEADER

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COLLABORATORS

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Date of TNA visit:	2012
No. of days:	15
Host laboratory:	The Mars Chamber, Open University, Milton Keynes, UK
Reimbursed	Yes

Project Title – **An investigation of possible water generation mechanisms to form debris flows under Martian conditions.**

Scientific Report Summary.
(plain text, no figures, maximum 250 words, to be included in database)

We performed a series of experiments to simulate debris flows over a frozen sand dune under Martian conditions in the Mars Chamber Facility at the Open University as an extension of previous experiments performed in November 2011. In 2007, some preliminary laboratory simulations were done in a cold room (Védie et al, GRL 2007) to test the effect of a melted surface layer on the formation of linear gullies on a sand dune. The aim of this study was to explore the formation mechanisms of linear gullies that are observed on large sand dunes on Mars – a subject currently under heated debate. Our aim is to extend this study by repeating similar experiments under Martian atmospheric pressure (in the Open University Mars Chamber) and in a cold room at the IDES laboratory (Orsay, France). For the Martian experiments we varied the discharge, the slope, the depth of the ice rich permafrost. We have measured the resulting morphology to quantify erosion and deposition. We also measured the flow speed and runout distance. The Mars Chamber enabled us to perform these experiments at the low pressure (7mb) and carbon dioxide atmospheric conditions experienced on the surface of Mars.

Full Scientific Report on the outcome of your TNA visit

Approx. 1 page

We performed a series of 20 experiments to simulate debris flows over a frozen sand dune. The Mars Chamber at the Open University enabled us to perform these experiments at the low pressure (7mb) and carbon dioxide atmospheric conditions experienced on the surface of Mars. In this first set of experiments (in November 2011), we varied the discharge, the depth of melting of the permafrost layer and the bed inclination. The ~20 new experiments performed in February 2012 have completed the data set acquired in 2011.

The experiments progressed in the following way: for each experiment we prepared the sediment bed at least 15 hours in advance. The sand in the test bed was saturated with water, levelled off and then placed in the freezer onsite. Once completely frozen (after 15hrs) the tray was removed and a defrosted layer allowed to form. Once the correct depth of melting had been achieved (after ~3hrs) the tray was placed in the chamber and the pressure reduced to 7mbar (~1hr). Once the correct pressure was achieved water was introduced from an external reservoir for a set duration (dependant on discharge, ranging from 2-15s). The progress of each experiment was monitored using two internal webcams and two external video devices. Photo-documentation was performed prior, during and after each experimental run. Once the experiment was complete the chamber was returned to atmospheric pressure and the depth of the melted layer was measured. The tray was then removed for laser scanning to generate a full elevation model of the sediment surface and make any other additional measurements. This procedure allowed us to perform between one and two experiment runs per day.

In our first set of experiments (in November 2011), we introduced water from an external reservoir to form the debris flows. In these new set of experiments we used an heating sources to generate the melting of ice. We tried to simulate the formation of debris flows by the melting of permafrost or snow, using insolation (from a suspended lamp) and also point heat source.

From the data collected we calculated both the total volume of sand eroded and deposited and these volumes as a function of the distance along the flow. We have also quantified the height of the levees and depth of the channel along the flow. The speed of the flow has been calculated precisely from the video devices.

The results from this set of experiments will be compared to a parallel set of experiments being performed in June 2012 in the cold room facility at IDES laboratory (Orsay, France) under terrestrial atmospheric conditions. The results from these two sets of experiments are intended to generate a number of journal publications and will be used to assess the action of water in forming gullies on Mars, recent kilometre-scale features believed to be formed by the action of liquid water. The results will also provide better constraints on the behaviour of liquid water in a metastable state under realistic Martian conditions, which is currently poorly understood. These 20 experiments are unique in being only possible at the Open University using the Mars Chamber facilities.

Please include:

- Publications arising/planned (include conference abstracts etc)

- A first paper will be submitted to a high impact peer-reviewed scientific journal (Icarus / Journal of Geophysical Research) in December 2012 to present the results of these experiments.
- Jouannic, G., Conway, S.J., Gargani, J., Costard, F., Patel, M.R., Ori, G.G. (2012). Experimental investigation of gully formation under low pressure and low temperature conditions. *Lunar and Planetary Science Conference vol. 43 abstract #1904,*oral presentation.

- Host approval

The host is required to approve the report agreeing it is an accurate account of the research performed.

I approve this report as an accurate representation and account of the work performed.

Dr. Manish Patel