

# Europlanet TNA Report

## PROJECT LEADER

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## COLLABORATORS

<b>Name:</b>	<b>Affiliation:</b>
Susan Conway	LPGN, Université de Nantes, France
<b>Date of TNA visit:</b>	November 2011
<b>No. of days:</b>	20
<b>Host laboratory:</b>	The Mars Chamber, Open University, Milton Keynes, UK
<b>Reimbursed</b>	Yes

## Project Title – A study of 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 in November 2011. In 2007, some preliminary laboratory simulations were done in a cold room (Vedie 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. In our analysis of these experiments we will assume that scale is not a limiting factor. We will focus on the relative importance of these variables (rather than their absolute values) and their respective influence on the morphology (similar to Conway, et al, Icarus 2011). 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 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). The temperature of the permafrost, melted layer and the chamber pressure were monitored throughout. 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. Once measurements were completed the tray was prepared to be refrozen. This procedure allowed us to perform between one and two experiment runs per day.

From the data collected we will calculate both the total volume of sand eroded and deposited and these volumes as a function of the distance along the flow. We will also quantify the height of the levees and depth of the channel along the flow. The speed of the flow will be 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 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 March-April 2011 to present the results of these experiments.
- 1 abstract is planned for the Lunar and Planetary Science Conference 2012 in Houston and 1 abstract for the European Geosciences Union, in Vienna, Austria 2012.

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

- Approval is confirmed by Dr. M. Patel (OU), see report submission email.