Europlanet TA Scientific Report

PROJECT LEADER

Project number: 20-EPN-054
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TA Facility visited: Aarhus University, Planetary Environment Facility

Project Title:

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

In our experiments in the Planetary Environment Facility in Aarhus we obtained, for the first time, two superimposed ripple patterns on monodisperse sand beads in CO_2 air. The presence of two distinct sets of aeolian sand ripples in unimodal sand suggests two formational mechanisms. Morphological characteristics such as straight crests and regular spacing point toward an impact mechanism to be responsible for the formation of the smaller (cm-scale) ripples. Conversely, the higher sinuosity of the larger (decimeter) ripples suggest a different type instability (hydrodynamic) at work. We also detect an increase in sizes for the ripples with decreasing pressure which is currently under investigation. Collectively, our work seem to confirm the hydrodynamic nature hypothesized for the large Martian ripples.

Full Scientific Report on the outcome of your TNA visit

During our visit we used the facility to reproduce aeolian ripples with monodisperse sand beads at terrestrial and Martian pressures. We noticed the formation of two superimposed ripple patterns mimicking Martian rover observations (Fig. 1). Smaller impact ripples, as expected, formed after few minutes the wind exceeded the threshold for sand motion. Larger, decimeter-scale, "hydrodynamic ripples" formed after (Fig. 1). Interestingly, the large ripples did not form from merging of the smaller impact bedforms, but rather "emerged" as a distinct pattern suggesting two different processes at work: 1) the impact mechanism and 2) a hydrodynamic instability (Fig. 1). The same explanation was given to explain the superposition of different ripple sizes on Mars (Fig. 1 - inset). Two ripple patterns were detected at 992, 500 and at 250 mb. The hydrodynamic ripples were not detected at Martian pressure (17 mb. CO_2 air). Because we observed an increase in wavelength for the large ripples when decreasing the pressure, the limited length of the wind tunnel might likely explain why we did not observe these bedforms at lower pressures. We are also investigating in detail how the smaller (impact) ripple pattern changes in size when decreasing the pressure. A preliminary qualitative analysis seems to point toward an inverse relationship between ripple size and pressure. We are investigating this interesting behaviour (also hypothesized for the Martian impact ripples) quantitatively by computing how the wavelength of the bedforms and other pattern parameters (crest orientation and dispersion) change with time (Fig. 2).

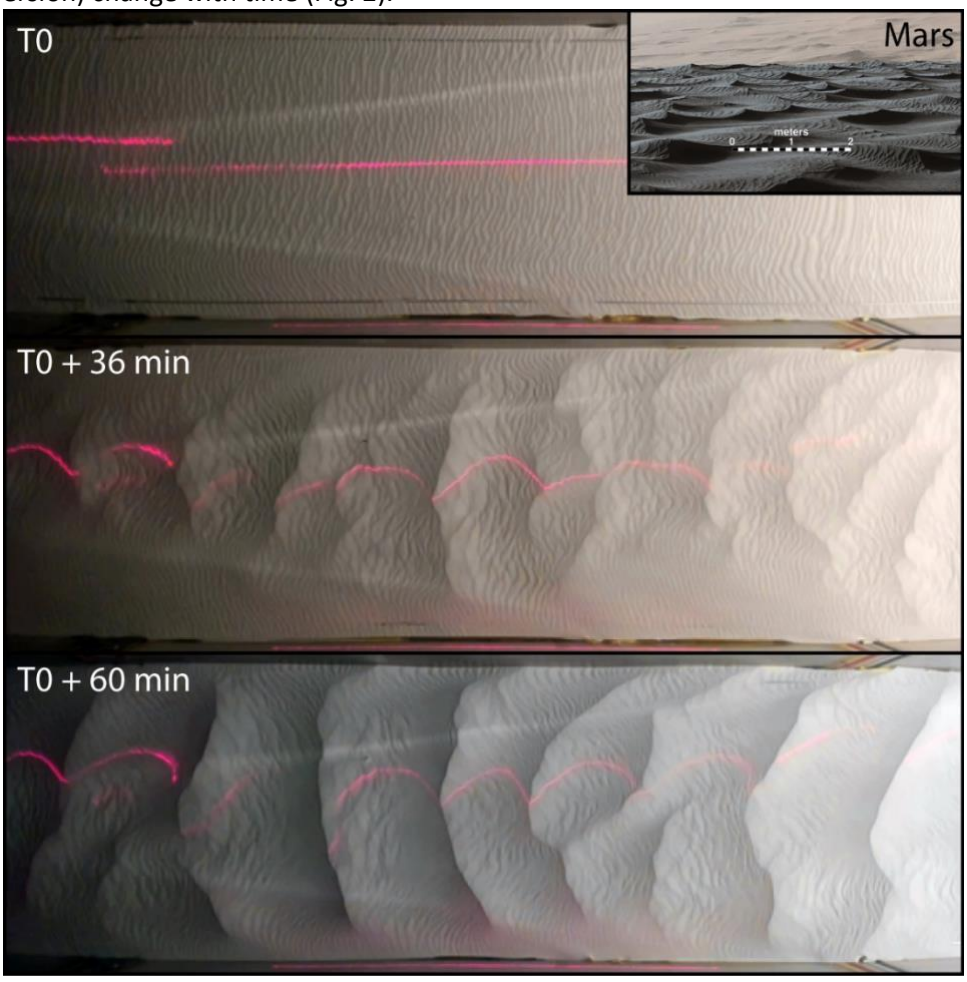

Fig. 1: formation of impact and hydrodynamic ripples in the wind tunnel at P = 500 mb. A similar ripple arrangement was observed on Mars over the stoss side of the Namib dune in Gale Crater (Inset, Curiosity MSL image - Image credit: NASA/JPL-Caltech/MSSS).

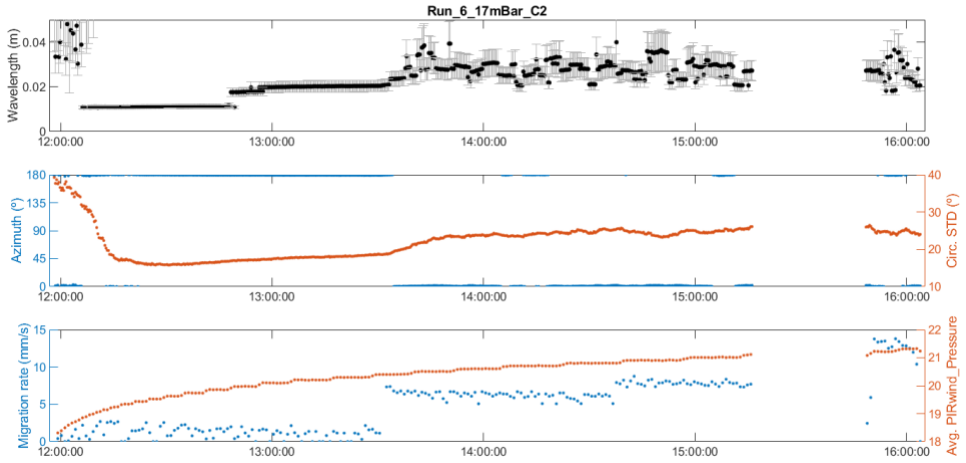

Fig. 2: measurements computed for the morphological characterization of the aeolian ripple pattern from wind tunnel images.

- Give details of any publications arising/planned (include conference abstracts etc)

1) Hydrodynamic aeolian ripples on Earth, submitted to Nature

- Host confirmation

Please can hosts fill in/check this table confirming the breakdown of time for this TA project:

Dates for travel to accommodation for TA visit (if physical visit by applicant)	Start Date of TA project at facility	Number of lab/field days spent on TA Visit pre-analytical preparation	Number of days in lab/field site for TA Visit	Number of days spent in lab for TA Visit data analysis	End Date of TA project at facility	Dates for travel home (if physical visit by applicant)
Departed: 02-04-22 Arrived: 04-04-22	04-04-22	[1]	[5]	[1]	08-04-22	Departed: 02-04-22 Arrived: 10-04-22

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

Host Name	**PEF**
Host Signature	
Date	**25-1-2023**

- Project Leader confirmation

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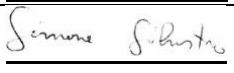
Project Leader Name	**Simone Silvestro**
Project Leader Signature	
Date	**25/01/2023**