SALTATION THRESHOLD AND IMPACT RIPPLE DYNAMICS DOWN TO MARTIAN PRESSURE AND BELOW. B. Andreotti[1], P. Claudin[2], J.J. Iversen[3], J.P. Merrison[3] and K.R. Rasmussen[3,4], [1]Laboratoire de Physique de l'Ecole Normale Supérieure, CNRS - Université de Paris - PSL Research University, 75005 Paris, France, [2]Physique et Mécanique des Milieux Hétérogènes, CNRS - ESPCI Paris - PSL Research University - Sorbonne Université - Université de Paris, 75005 Paris, France (philippe.claudin@espci.fr), [3]Department of Physics and Astronomy, Aarhus University, 8000 Aarhus C, Denmark, [4]Department of Geoscience, Aarhus University, 8000 Aarhus C, Denmark.

Introduction: Aeolian sediment transport is observed to occur on Mars as well as other extraterrestrial environments, generating ripples and dunes as on Earth [1,2,3]. The search for terrestrial analogues of planetary bedforms, as well as environmental simulation experiments able to reproduce their formation in planetary conditions, are powerful ways to question our understanding of geomorphological processes towards unusual environmental conditions. Here, we briefly report sediment transport laboratory experiments performed in a closed-circuit wind tunnel placed in a vacuum chamber and operated at extremely low pressures -- full details on experimental set-up and data analysis can be found in [4].

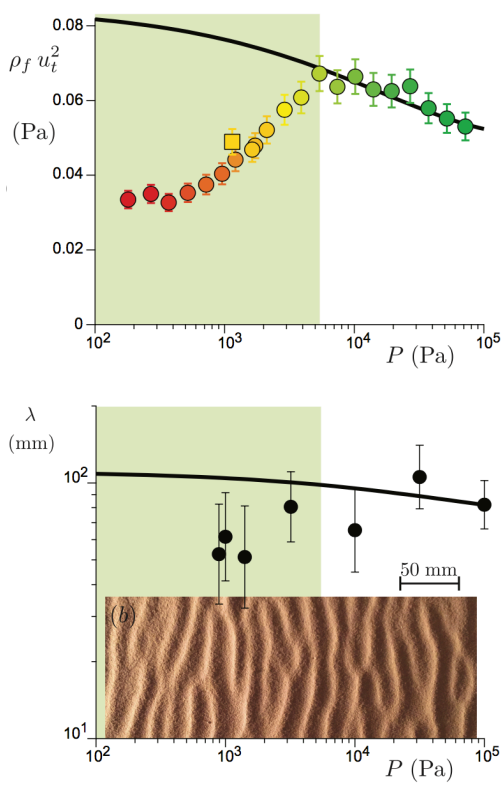

Fig: Variations of saltation threshold (top) and impact ripple emergent wavelength (bottom) with air pressure in the tunnel. Ripple data: $u_*/u_t = 1.5$; Ripple photo: $u_*/u_t = 1.1$. New regime in green.

Saltation threshold: The determination of the threshold wind speed below which no sediment transport occurs is an old problem, but is still currently investigated for various environments, see e.g. [5]. Previous data in low-pressure conditions show sensitivity of the threshold measurements with particle size [6,7]. In our experiments, the grain size is fixed but we systematically vary the pressure over three orders of magnitude. The saltation threshold is found to be only quantitatively predicted by models up to a density ratio between grain and air of 4×10^5, but unexpectedly falls to much lower values for higher density ratios (Fig., top), providing evidence for a previously unexplored regime, which includes Martian conditions

Impact ripples: The origin of Martian ripples, exhibiting two distinct length scales, are currently debated, see e.g. [8]. Here, we continuously observe the emergence of centimeter-scale impact ripples upon decreasing air pressure conditions (Fig., bottom). Their characteristic wavelength and propagation velocity are essentially independent of pressure, a result that can be understood in association with the existence of a surface collisional layer [9].

These findings challenge our fundamental understanding of sediment transport on planetary bodies and require further investigation.

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