The RSL@Ω project: investigation on Martian Recurring Slope Lineae formation mechanisms in lab experiments

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The Recurring Slope Lineae (RSL) are seasonal linear dark movements of dozens of meters (see Figure 1) that occur on steep slopes of Mars (> 30°). Since their first discovery in 2011 [1] using the very high resolution HiRISE camera on board Mars Reconnaissance Orbiter (MRO, NASA), there is debate about the nature of these movements. Firstly, studies suggest that the RSL are liquid water flows [1, 2] or brines [3, 4, 5, 6, 7, 8]. These hypotheses have been challenged by other studies showing: no detected water associated with RSL (detection threshold fixed a limit at 0.5-3% of the RSL mass) [9], the surface temperature of some RSL sites are below the water fusion point [10], no main detection of salts has been made, and the RSL geomorphology can also correspond to dry movements [11]. Secondly, some studies support the idea that RSL are dry movements which mobilise sand [12] and/or dust [13, 14, 15, 16, 17]. This hypothesis is now privileged by the community, and some formation mechanisms have been proposed: initiation by winds [13, 18], by dust devils, or by gas flux from the surface (Knudsen pump [10]). However, from orbital data, it is complex to verify if the proposed mechanism can explain the RSL for different RSL sites (large diversity of RSL) and also to know which is the main-transported material (dust, sand), as the quantity of matter transported (e.g., which can be very small [18]). From this conclusion, we suggest that one way to better understand the RSL formation mechanisms is to develop lab experiments to better understand what happens precisely in these movements.

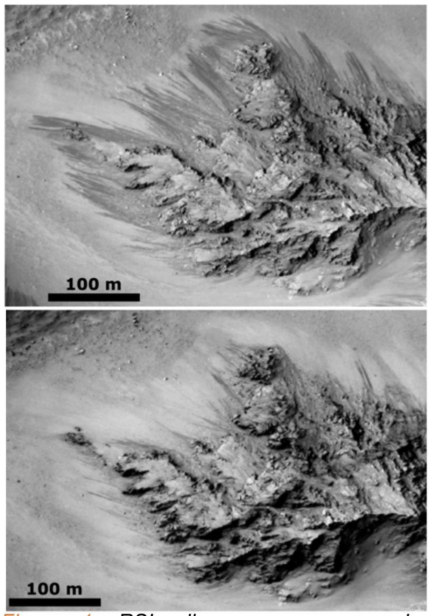

Figure 1: RSL disappearance seen by HiRISE/MRO on Hale crater. These two images are 88 Martian days apart.

With this idea, we developed a project called RSL@Ω to lead RSL lab experiments in the Mars Chamber of Open University (note that this project is funded by the PNP!). The main objectives of this project are to test three formation mechanisms: winds, dust devils and heating of the surface. The Mars Chamber facility (see Figure 2) and our setup, which we will present at "journées SF2A", allow us to control the pressure, the composition of the atmosphere, the temperature, the illumination, the slope angle, and potentially to introduce gas using tubes to simulate the wind on the slope. Then we plan to make different measurements during the almost 30 experiments, such as: camera, high-speed camera, visible and near-infrared spectrometer, which will help to interpret the orbital data.

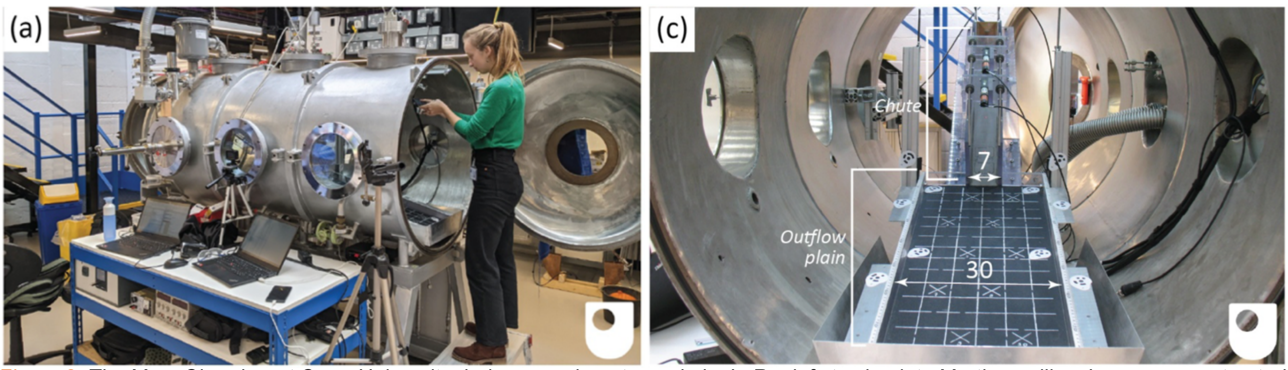

Figure 2: The Mars Chamber at Open University during experiments made by L. Roelofs to simulate Martian gullies. Images are extracted from [19].

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