Following the wind on Mars

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ABRADE
http://research.ncl.ac.uk/abrade/

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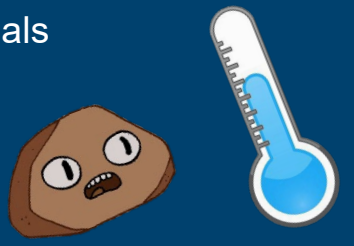
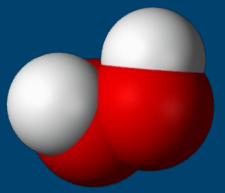
Mars is a cold planet where wind driven abrasion is the dominant form of erosion. Erosion can occur through the wind induced saltation of sand sized particles, this process causes collisions that fracture silicate minerals and generate dust.

- We ask the question: How much abrasion do different Martian materials experience through saltation and what is the effect of temperature?



- To answer this: We simulated the saltation of Martian analogue materials at a range of temperatures relevant to the Martian surface.

- Why is this important?
  Fractured silicate minerals have been shown to generate oxidants that can drive surface chemical processes, can destroy organic material and are harmful to human health. The resistance to abrasion of different rock types also has implications for drilling on Mars



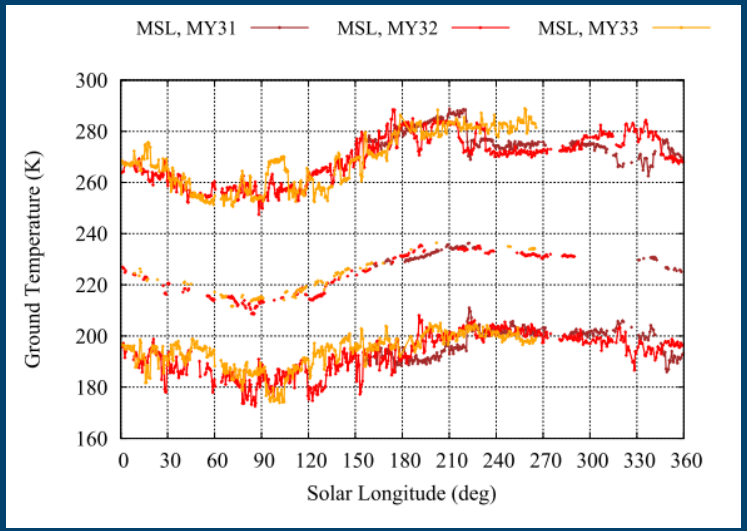
This image shows 2 sizes of ripple at the top of a sand dune on Mars

NASA/JPL-Caltech/MSSS

How cold is Mars?

Martian ground temperatures vary greatly over the space of a day.

The image to the right shows minimum, mean and maximum daily temperatures recorded by NASA's Curiosity rover over.



(Chart from Martinez et al. 2017)

What materials is Mars' surface made of?

Mars is a dominantly basaltic planet with typical major mineral species feldspar, olivine, and pyroxene. It also hosts minor species including magnetite, hematite, quartz and opal.

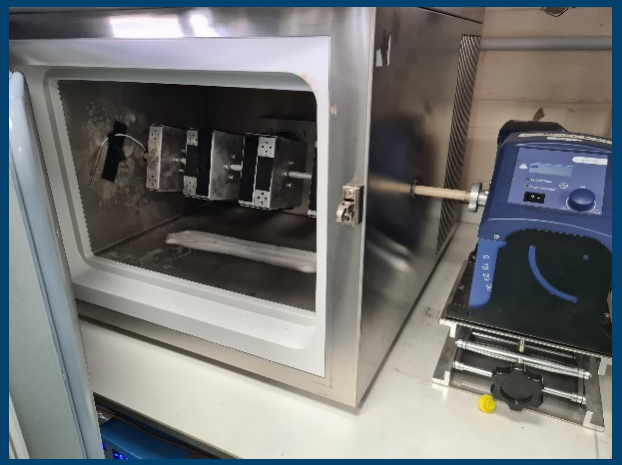
Below is an image of our ampoules that housed our experiments.

This image shows small ripples (~ 10 m) at the edge of the South Polar Layered Deposits

NASA/JPL-Caltech/Univ. of Arizona

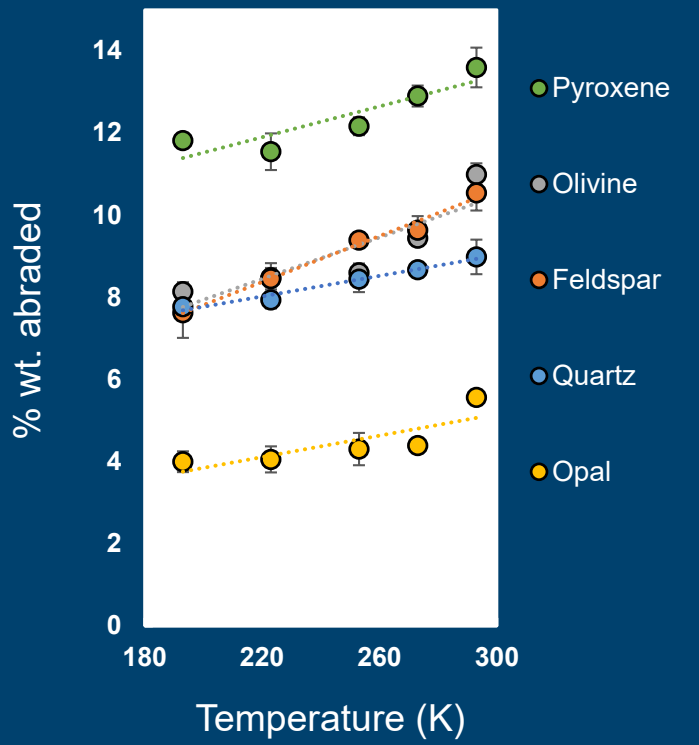
Simulating saltation

We simulated saltation by adding material to ampoules and adding an analogue Martian gas mix. The ampoules were then attached to discs that could be placed in incubators to regulate the temperature. The discs were further attached to axels which were rotated from the outside of the incubators – as in the image below.

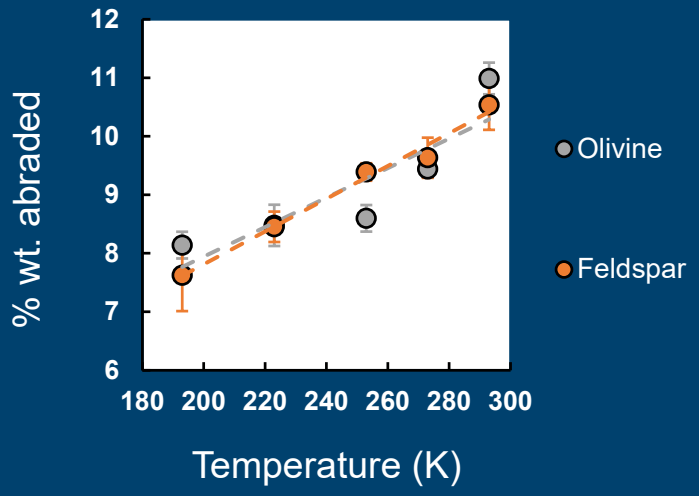


The rotation allowed the contents to fall from one end to the other under gravity. This replicates the approximate 1 ms^{-1} impacts experienced by saltating particles on Mars at threshold wind speeds.

Preliminary results



- A minimum of 4.0 ± 0.4 and a maximum of 13.6 ± 0.8 % by mass of the material in each ampoule was below its starting grain size at the end of the experiment.
- Importantly, each of the minerals tested produced significantly ($p < .05$) less fines at 193 K than at 293 K, with a mean decrease of ~ 22 %.



- To the left is an example of the mineral pair experiments. Intriguingly it looks as though there may be non-similar rates of change in resistance to abrasion with temperature.