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Laboratory simulations under martian environmental conditions: water vs. brine flowing over a sloping substrate

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There are many observations that indicate that liquid water has been recently flowing on Mars' surface: for example at the present day 10m-scale lobate flows have been observed to occur each spring, termed "recurring slope linae" [1] and kilometre-scale gullies [2] are known to have been active in the recent past (<5 Ma) [3-4]. However, the temperature and pressure are too low, at present for liquid water to be stable, and similar conditions are thought to extend into the recent past. A possible solution to this paradox is that these flows are not pure water, but brines, that are stable under much lower temperature conditions. The static behaviour of brines at low pressure and low temperature has already been investigated [e.g. 5]; however the interaction of such brines flowing over sediment has not yet been explored. In this suite of experiments we aim to repeat the experiments performed by Conway et al. [6], in which a fixed volume of pure water was passed over an unstaturated, cold (-25°C) sediment bed (1x0.5m) at low pressure (7 mbar), but with brines of different concentrations. Our aims are to answer the following questions: 1.Are different quantities of water required to produce flows with the same runout length (measurable from orbit) but mediated by water or brine? 2. Do flows mediated by brine produce any distinctive behaviour or morphology that we could recognise at the martian surface?
The suite of experiments are ongoing, but our initial experiments have already shown that for a given quantity of water, brine-flows are able to flow for much greater distances than pure water. Brine mediated flows are more than 4 times wider than their pure water counterparts. Once the flows are complete they freeze – this leaves a trace that has the same tone as the surrounding sediment in the case of water. In the case of brine there are both darker and lighter toned areas depending on the position in the flow-trace. Future analysis includes quantifying the amount of erosion and deposition, and assessing the impact of fluid viscosity on infiltration rate.

References cited: [1] McEwan et al. (2011) Science, 333, 740-743. [2] Malin and Edgett (2000) Science, 288, 2330-2335. [3] Reiss et al. (2004) JGR, doi:10.1029/2004JE002251 [4] Schon et al. (2009) Geology, 37, 207-210. [5] Chevrier et al. (2009) JGR, doi :10.1029/2009JE003376 [6] Conway et al. (2011) Icarus, 211, 443-457.