CAN WATER MOVE SEDIMENT ON PRESENT-DAY MARS? INSIGHTS INTO GULLY FORMATION FROM LABORATORY SIMULATIONS. S. J. Conway[1], M. R. Balme[1], M. C. Towner[2] and J. B. Murray[1], [1]Planetary Surfaces Research Team, Dept. of Earth & Environmental Sciences, Open University, Walton Hall, Milton Keynes, United Kingdom, MK7 6AA s.j.conway.00@cantab.net [2]Impacts and Astromaterials Research Centre, Department of Earth Science and Engineering, Imperial College London, United Kingdom SW7 2AZ.

Introduction: We describe experiments designed to study sediment transport by liquid water under the current low temperature and low pressure conditions on Mars. We show that water flowing over unconsolidated material on Mars (1) causes as much erosion as water flowing under ambient terrestrial conditions, (2) propagates faster and further and (3) produces unique sedimentary features due to the combination of boiling and freezing.

Methods: We used a large hypobaric chamber containing a tilted tray 0.5m wide and 1m long filled to a 5cm depth with three different unconsolidated materials. The angle of tilt was 14° and the pressure was maintained at ~7mb. The three materials used were: fine sand, medium sand and a rock crush with grain sizes from very fine to coarse. A base plate containing liquid nitrogen provided cooling. The temperature was reduced to an average of -20°C within the sediment before water was released from an external reservoir at a constant flow rate of 4l/s. The results of the flow were captured on video-camera. The surface profile of the sediment was measured before and after each experiment to ascertain the change in volume. For each material: (i) three experiments were performed at low pressure and low temperature (low T&P), (ii) one experiment at low pressure only (low P) and (iii) another under ambient temperature and pressure (ambient T&P). A detailed treatment of the methods used is given in [1].

Results: Figure 1 shows the typical end result of the experiment. Figure 2 shows the results of the volume calculations. A more detailed description of the results is given in [1]. In summary, for all material types the flow propagates fastest under low T&P conditions (up to 0.17ms^{-1}) and under these conditions erosion rates are equivalent to those under low P, or ambient T&P. Calculated deposition volumes are much greater than erosional volumes under low T&P, because ice and air are incorporated into the deposits. Considering the different sediment types: (i) rock crush has the slowest propagation speed and the least erosion, and exhibits sheet flow and flow spreading, (ii) medium sand has the largest erosion and propagates a little slower than the fine sand, with good channelization and lobe formation, and (iii) the fine sand has the fastest propagation speed, intermediate erosion and good channelization. It also developed multiple lobes.

Discussion and conclusions: The formation of a basal ice lens affects the mode and efficiency of deposition and erosion of water flowing over unconsolidated sediments, but boiling has a less marked effect. A basal ice lens shifts the mode of erosion from dominantly entrainment to thermal erosion [2]. The formation of ice at the base of the flow also inhibits infiltration, which explains the faster propagation of the flow under freezing conditions. These fast flow rates mean that the flow would have a greater runout if unconstrained. Hence, the high discharges to form gullies on Mars quoted in previous work [3, 4] seem to be unnecessary. Potential observable textures include: increased surface roughness of gully deposits and a volume discrepancy between erosion and deposition volumes caused by the inclusion of ice and bubbles in the deposits.

Acknowledgments: We acknowledge a NERC (UK) studentship grant and thank Helen Townsend for her laboratory assistance.

References: [1] Conway S. J. et al. (2010) *Icarus, in review.* [2] Costard F. et al. (1999) *JGR Planets, 104*, 14091-14098. [3] Hart S. D. et al. (2009) *LPSC XL*, abst.# 2349. [4] Heldmann J. L. and Mellon M. T. (2004) *Icarus, 168*, 285-304.

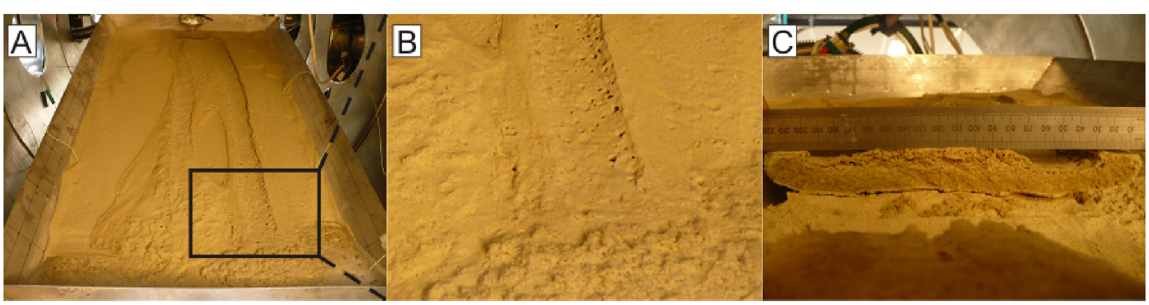

Figure 1. Photos after experiment 090619_001 with fine sand: (A) the whole sediment tray, (B) zoom-in on inset marked in (A), showing lateral levees, bubbles in the channel and rough texture of icy deposits, and (C) cross section of the flow near the top, showing the ice-lens, clear channels and lots of bubbles throughout the upper 1cm.

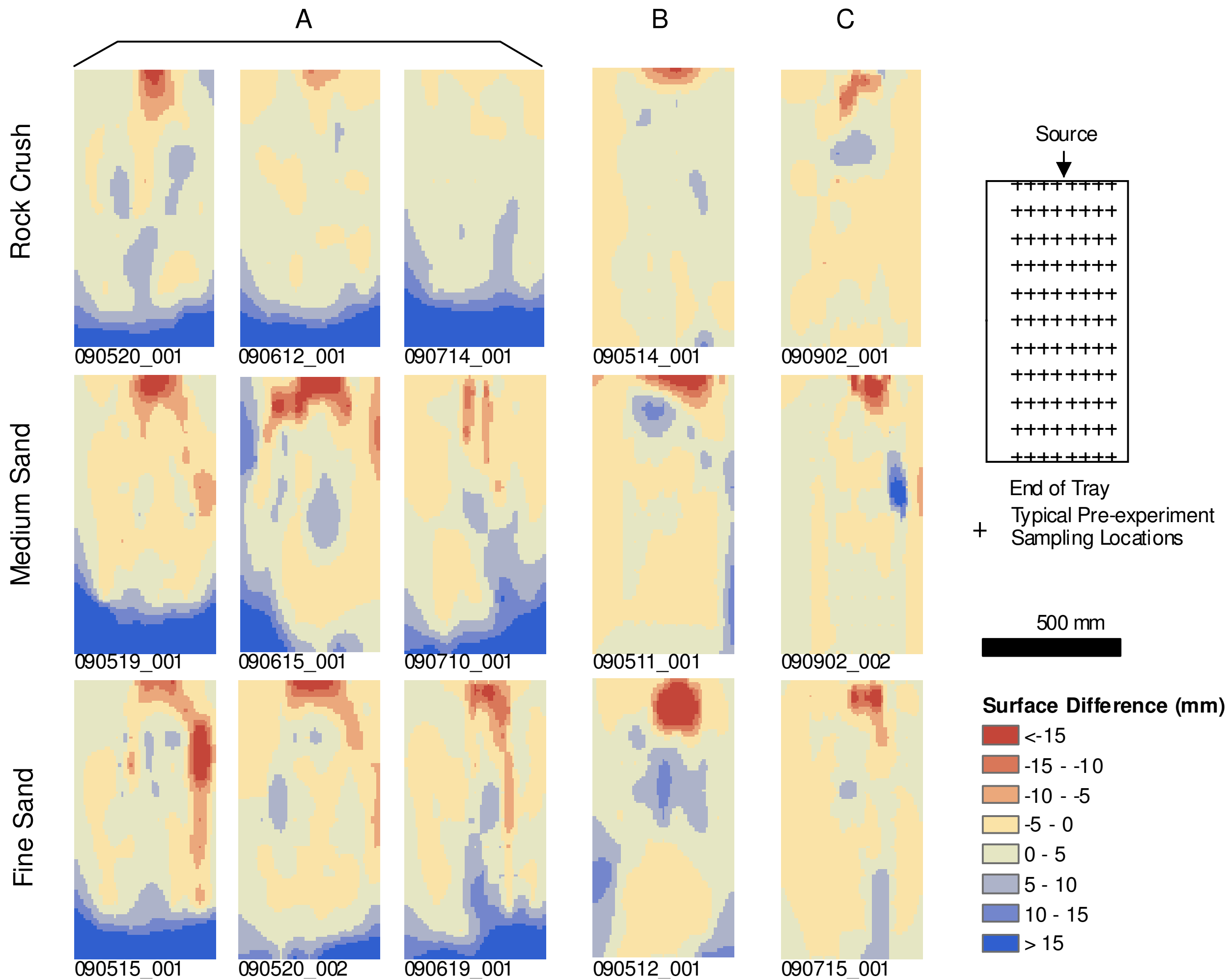

Figure 2. Matrix of isopach maps for each experiment. Each row is a different sediment type and each column represents different ambient experimental conditions, with **A** being low temperature/low pressure, **B** ambient temperature/low pressure and **C** ambient temperature/ambient pressure. Diagram top right shows typical arrangement of measured points pre-experiment. After the experiment, more measurements were taken around areas of greatest change.