SEDIMENTOLOGICAL ANEMOMETERS: RIPPLES AND SCOUR FLUTES OF THE STRZELECKI DESERT, EARTH AND HELLESPONTUS INTRACRATER DUNEFIELDS, MARS. Mark A. Bishop[1,2] and Andrew J. Wheeler[1], [1]Barbara Hardy Centre [Terrain Analogue Understanding (TAU) research], School of Natural and Built Environments, University of South Australia, Adelaide, SA, 5000, Australia, [2]Planetary Science Institute, 1700 E. Fort Lowell, Suite 106 Tucson, AZ 85719-2395, USA, bishop@psi.edu.

Introduction: Aeolian landscapes comprise a range of landform dimensions that are capable of differentiating global (regional) and local variations in wind direction and relative strength through time. Dune slipface orientation and associated metrics are commonly used as a reference for past and present sediment mobility [1], however little use has been made of micro-scale sedimentological features such as ripples and scour flutes, for either terrestrial or extra-terrestrial studies. Previously, Sharp [2], Howard [3], and Bishop [4] have used surficial sedimentological features formed by air flow over and around dunes to successfully determine antecedent wind conditions. Using a suite of features inclusive of ripple patterns, Bishop [4] showed that trimodal seasonal and diurnal wind directions and relative intensities were accurately recorded for the Strzelecki desert. Furthermore, it was found that the genesis and evolution of scour flutes around obstacles of aeolinite also identified the variability and intensity of wind direction. Scour development required that a cementing agent (montmorillonite) act cohesively on the unconsolidated substrate. Such processes and agents also occur on Mars, and are likely to significantly contribute to the relative immobility of dunes and large-scale ripples.

Results: Ripple Patterns for Hellespontus: Data from the High Resolution Imaging Science Experiment (HiRISE) offers an orbital perspective of Mars at a spatial resolution (25.5 cm/pixel) that identifies large-scale (mega-) ripples and scour around obstacles such as boulders (Fig. 1). Image ESP_06036_1370 comprises an intracrater dunefield (42.7°S, 38.0°E) that shows ripple morphologies that are likely to be associated with changes in grain-size and breaks in slope, alongside differences in shear stress and air flow velocity. The southern portion of the dunefield (Fig. 1) shows a suite of ripple patterns, ranging between straight, bifurcating, sinuous and catenary-to-lunate forms. Interference patterns are prevalent across the entire range of morphologies, which for those of catenary shape, form a reticulate or network arrangement [Fig.1. (B)]. Raised rectilinear ridges (spurs) parallel to flow [5] also assist with the reticulate form of adjoining ridges.

Ripple trains are oriented both parallel [Fig.1 (A)] and orthogonal [Fig. 1 (C)] to the direction of dune migration which indicates a bidirectional wind regime. The north-south (orthogonal) patterns are secondary ripple-sets formed by lower intensity winds relative to the west-east oriented primary ripple trains. Ripple troughs and crests are differentiated by albedo, which in terrestrial settings represents grain-size sorting and often, heavy mineral separation. The absence of any significant disturbance to ripple form by cross-cutting dust devils suggests the ripples to be chiefly composed of granules and/or be indurated bedforms. Similarly, the occurrence of numerous boulder induced scour flutes may infer sediment cohesion.

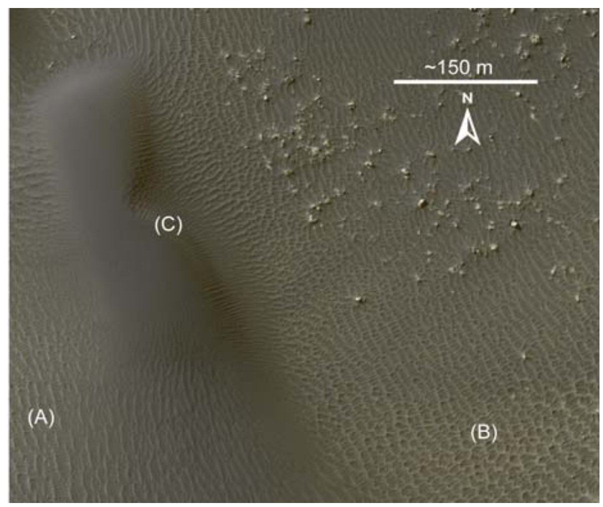

Fig. 1. Southern part of intracrater dunefield showing interference ripple patterns across the boulder laden floor of an unnamed crater (Image: ESP_06036_1370_COLOR, NASA/JPL/University of Arizona).

Conclusions: Surficial sedimentary structures offer detailed data from which planetary boundary conditions at the surface-air interface can be better interpreted, and for conducting risk analyses for siting and operating landers and rovers on planetary surfaces. Monitoring studies of ripples and scour features would also better define aeolian erosion rates and sediment mobility for Mars, than does dune monitoring alone.

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