COMPARISON OF SHORT AND LONG-LIVED AEOLIAN FEATURE ORIENTATION WITH GCM VECTORS TO INFER PAST CLIMATE VARIABILITY ON MARS E. Sefton-Nash[1], N. A. Teanby[2], R. Clancy[2] and C. Newman[3], [1]Department of Earth and Space Sciences, University of California Los Angeles, 595 Charles Young Drive East, Box 951567, Los Angeles, CA 90095-1567, USA (esn@ucla.edu), [2]School of Earth Sciences, University of Bristol, Queen's Road, Clifton, BS8 1RJ, UK. [3]Ashima Research, 600 S. Lake Ave, Suite 104, Pasadena, CA 91106, USA.

Introduction: Aeolian modification has been the dominant surface process on Mars throughout the Amazonian. The orientation of aeolian features such as dunes and yardangs are representative of the wind regime over their respective timescales of formation. Changes in wind regime may therefore be inferred where there are differences between the orientations of the most and least transient wind features.

If aeolian features lie on elevated units that protrude from the surrounding terrain, it is more likely that differences between the orientations of these aeolian features are due to climatic change, rather than local topographic changes (due to impacts, slumping, wind deflation etc…). Higher altitude wind vectors are dictated by the prevailing wind regime, and less influenced by lower level terrain.

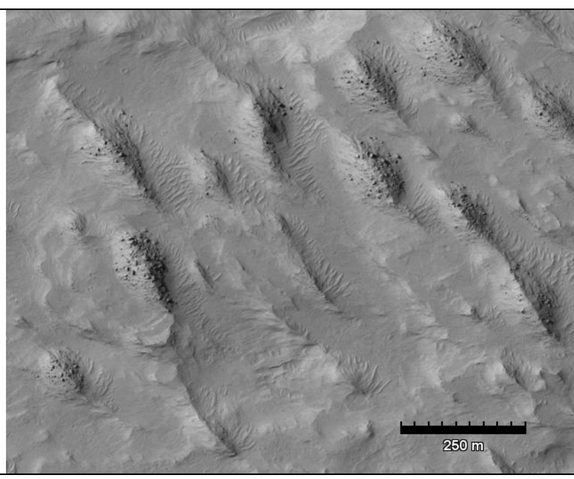

Figure 1: Portion of HiRISE image showing yardangs and transverse dune field in Arabia Terra.

Interior layered deposits are young, easily eroded deposits, identifiable by high albedo, visible layering and low crater densities [1, 3, 4]. Their relatively recent deposition and generally high elevation above surrounding terrain therefore implies that aeolian features on ILDs are a reasonable record of recent prevailing wind conditions.

Methods: Therefore, for selected interior layered deposits we map the azimuth of dune slip faces and the long axes of yardangs. We extract wind vectors from the Mars Climate Database (V5.0) [2] and calculate the predicted bedform orientation using a variety of weighted numerical approaches, including consideration of that which achieves maximum gross bedform-normal transport [7].

Discussion: To constrain the maximum age of the least transient aeolian features we perform crater dating of ILDs (Figure 3) using HiRISE images. Derived ages for most ILDs generally range between 0.1 – 10Ma, which agrees well with other estimates [5, 6]. With exposure ages of this duration, ILD surfaces and aeolian features would have been subject to climate changes invoked by obliquity cycles, which occur on 4 – 5Ma timescales.

Conclusions: In general, yardang and dune slip face orientations are correlated within a few degrees. However, larger difference are noted for sites in the Aeolis region as well as Candor Chasma (Figure 2), perhaps suggesting that local topography has affected wind direction relatively recently.

Dune slip face azimuths generally show a 1-2° better agreement with those predicted by GCM output. This indicates that dunes are more in equilibrium with the present day climate and that yardang orientation may be influenced by past (0.1 – 10Ma) wind regimes.

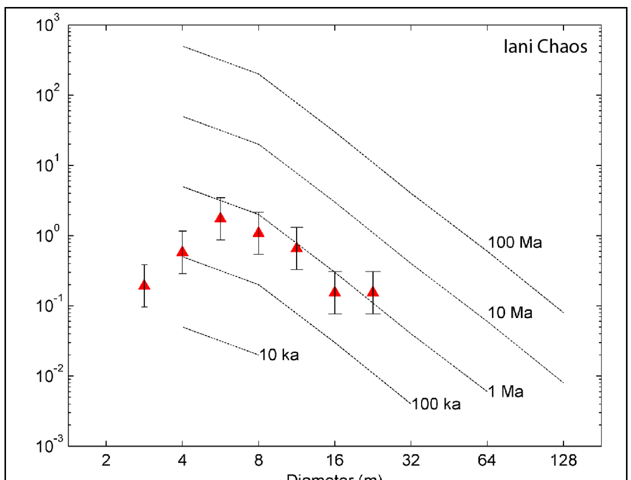

Figure 2: Comparison of crater size distributions for ILDs in Iani Chaos with isochrons from [5].

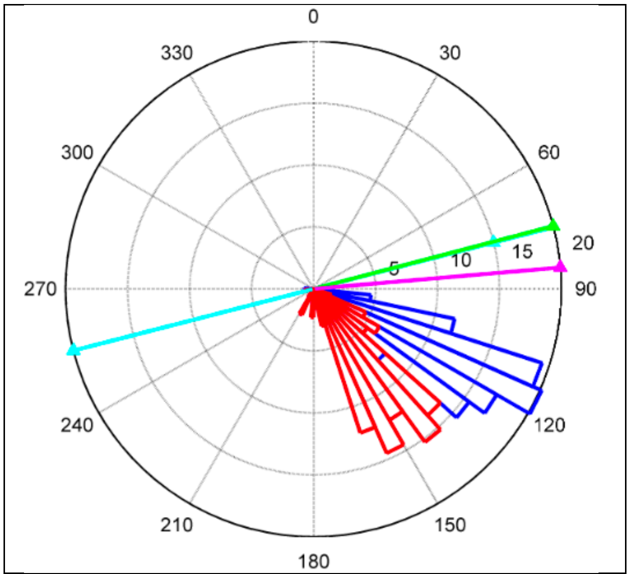

Figure 3: Rose diagram showing azimuth of bedforms (blue) and yardangs (red) in Candor Chasma, as well as the direction of bedforms predicted from MCD outputs using three different numerical weighting approaches (magenta, green and cyan). Note the cyan method of [7], cyan calculates bidirectional orientation. The diameter of each bar represents the percentage of the number of each feature that falls within the orientation range that the bar spans.

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