Rates of Dune Migration in a Polar Cavi on Mars

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Sand is mobile under the current Martian climate. Here we present a detailed study of the morphometry and migration of barchan and dome dunes in the North Polar Region of Mars. The dunes are located at the head of an unnamed Polar Cavi. Dune sediment is locally sourced from the Basal Unit exposed in the adjacent Cavi wall. The dunes are enriched with gypsum derived from the Upper Layered Deposits. The dunefield is composed of barchan and barchanoid dunes that traverse a number of topographic steps away from the Cavi head wall. Dune width and length of 34 dunes were measured from 25 cm/pixel resolution HiRISE Images. In order to estimate dune heights, a HiRISE stereo pair was processed to build a high resolution DTM. Change in dune morphology and position was mapped using HiRISE images taken at two time steps extending over two Mars years.

Dune Morphometry. Dunes are on average 170 m long and 121 m wide. Mean dune height is 18 m and is positively correlated with dune width ($R^2 = 0.71$). 68% of the sample dunes are asymmetric suggesting that, similar to Earth, barchan asymmetry is a morphological norm.

Dune Displacement. Although data are few, it has been established that asymmetric barchans migrate at rates comparable to non-asymmetric barchans in the same region. Dunes at the Cavi sample site have migrated 5 m on average over 2 Mars Years. The individual dune rates are highly variable, measuring between 0.57 and 17.7 m. Dune displacement distances decrease with increasing dune height, but the relationship is poorly correlated.

Dunes in the North Polar Region are migrating under the current climate regime. Rates are variable and may be influenced by topography, proximity to other dunes but not dune form. The smallest dunes have migrated the greatest distance. These include both dome dunes and dunes that are transitional forms between dome and barchan.