MEGABARCHANS ON MARS. M. C. Bourke[1] and M. Balme[1] [1]Planetary Science Institute, Tucson, Arizona, 85719, USA, mbourke@psi.edu, mbalme@psi.edu

Introduction: Megabarchans are large dunes generally >500 m wide. The term has been applied to both transverse ridges and isolated crescentic dunes [1]. The latter are less common, but have been described in a few localities: *e.g.,* Peru [2], the southern end of the Algodones dunefield, and the Skeleton coast [3].

While most barchans range between 3 and 10 m high, isolated crescentic megabarchans are significantly higher (see below). On Earth the growth of these dunes to a larger size is also marked by a progression from simple to compound or complex [1].

Some of the largest barchans on Mars occur in the northern latitudes. In Viking images they were measured to be up to 1 km^2 and 150 m high [4]. Tsoar et al. [5] noted that they were often located at significant distances upwind of dunefields and created a 'frame' of merged large barchan dunes. This was attributed to a higher sediment supply.

Methodology: We conducted a survey of 350 Themis Visible images in the north polar region of Mars (between 70°N and 90°N). The selection criteria were for dunes to be ≥500 m wide, have a crescentic shape and be isolated from surrounding dunes. In order to avoid barchanoid dunes we deselected forms that had multiple slipfaces or crescentic segments. Our data base contains morphometric measurements (width, length and height) of 36 megabarchans. We used methods outlined in other publications [6, 7].

Morphometry: Megabarchans on Mars are on average 740 m wide, 245 m long and 65 m high (Table 1). Dune width, height and length are positively correlated, but the relationships are not statistically significant. Maximum values indicate that isolated megabarchans in the north polar region of Mars can attain widths of 1,340 m, lengths of 500 m and can be up to 130 m high (Table 1 and Fig 1).

There are few data on isolated crescentic megabarchans on Earth to compare the Martian data to. Horn-to-horn width on the Pur-Pur dune in Peru is between 750-850 m, and maximum height is 55 m. [2]. Isolated megabarchans on the margins of the Algones dunefield in Arizona measure between 800 and 1,600 m wide [8]. In the Rub' al Khali, Saudi Arabia, megabarchans are 2,760 wide and 3,000 m long (to base of slipface) [1] . Skeleton coast megabarchans are 25-30 m high [3]. These data suggests that megabarchan morphometry on Mars is similar to Earth. We note one example of a megabarchan that is a candidate for the largest barchan dune in our solar system. Kaiser Dune, in the southern hemisphere is ~500 m tall, 6.5 km wide and has an estimated volume of 2.5 km^3 [9].

Morphology: The majority of megabarchans in the north polar region tend to have a simple form, *i.e.* no superimposed smaller dunes at the available resolution (Fig. 2a). This suggests that simple barchans grow into simple megabarchans on Mars. Complex megabarchans do exist but are not frequently observed (Fig. 2c). Dune collision may be an additional important mechanism of megabarchan growth on Mars. The sinuous crestlines on some megabarchans suggest a former phase of dune collision and merging where smaller dunes have been almost completely absorbed (Fig. 2b). If there is a reduction in collision frequency, the megabarchans evolve towards a more simple morphology. The sequence of evolution is illustrated by viewing figure 2c through 2a.

Based on a ratio of the length of the stoss slope to width, barchan dune shape has been categorized as Fat, Pudgy, Normal and Slim [10]. Megabarchans in the NPSS fall into the Slim to Normal class with a ratio of 0.35.

Location and Orientation: Megabarchans are located in chasma, on crater floors, along the margins of akle and rectilinear dune fields and both upwind and downwind of converging dune masses. While our findings support the observations of Tsoar et al. [5] for the location of frame dunes they show that megabarchans are not limited to those locations on Mars.

The majority of megabarchans sampled were oriented in a direction similar to other dunes in the area (Fig. 2a and c). These include significantly smaller barchans that are able to adjust to a change in wind regime at a faster rate than the megabarchans. The matching orientations suggest a consistent wind direction for millennia at these locations on Mars.

References: [1] Breed, C. S. *et al.*, in *A study of global sand seas,* E. D. McKee, Ed. (United States Geological Survey, Professional Paper, 1052, 1979), pp. 253-304. [2] Simons, F. S., *Journal of Geology* **64**, 517-521 (1956). [3] Lancaster, N., *Earth Surface Processes and Landforms* **7**, 575-587 (1982). [4] Breed, C. S. *et al.*, *Journal of Geophysical Research (Planets)* **84**, 8183-8204 (1979). [5] Tsoar, H. *et al.*, *Journal of Geophysical Research* **84**, 8167-8180 (1979). [6] Bourke, M. C. *et al.*, Lunar and Planetary Science Conference XXXV, Abs. #1453 2004. [7] Bourke, M. C. *et al.*, *Geomorphology* **81**, 440-452 (2006). [8] Norris, R. M. *et al.*, *Geological Society of America, Bulletin* **72**, 605-620 (1961). [9] Bourke, M. C., Lunar and Planetary Science Conference, XXXVI, Abs. # 2373 2005. [10] Long, J. T. *et al.*, *Geological Society of America Bulletin* **75**, 149-156 (1964).

Summary Statistics	Width (m)	Stoss Length (m)	Height (m)
Mean	741	246	65
Median	666	237	52
Mode	600	237	39
Standard Deviation	227	91	32
Minimum	440	120	26
Maximum	1343	500	130

Table 1: Summary morphometric data for 36 megabarchans in the north polar region of Mars.

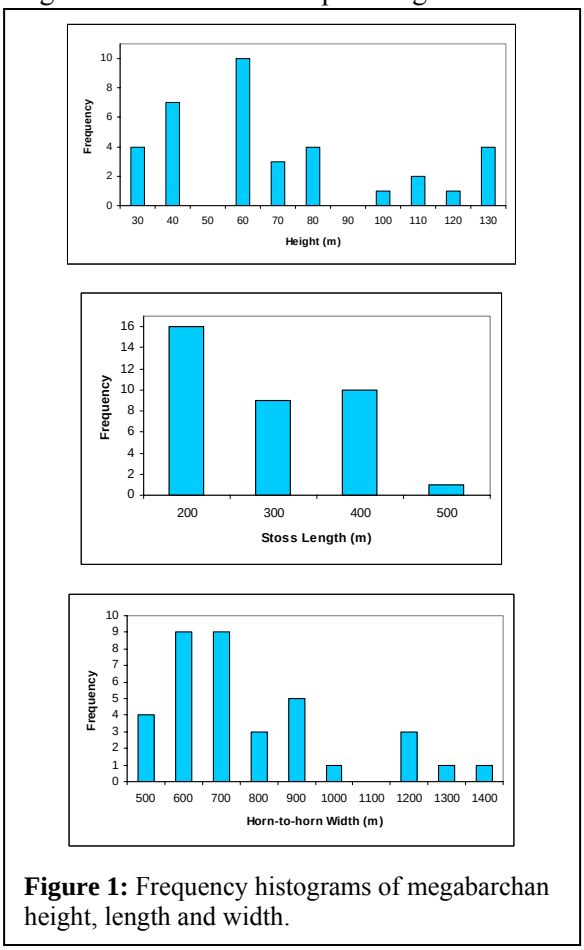

Figure 1: Frequency histograms of megabarchan height, length and width.

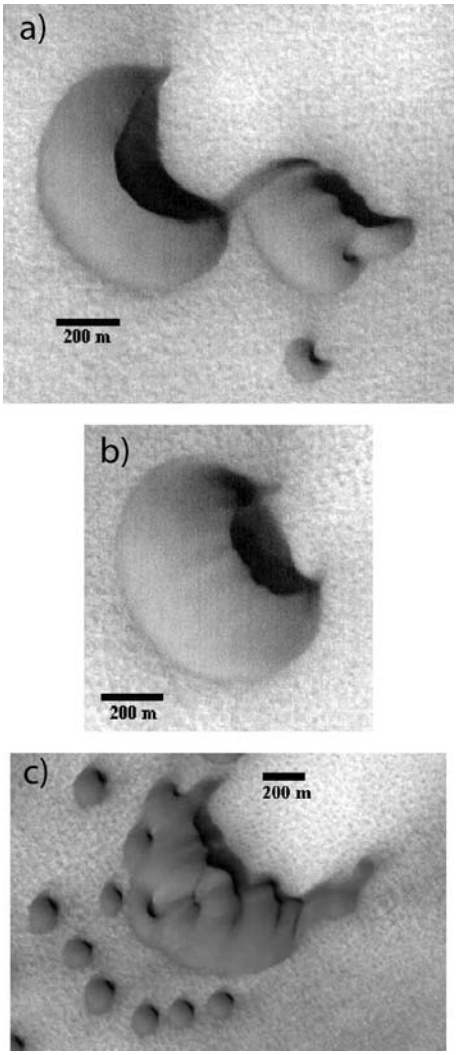

Figure 2: Megabarchan morphology on Mars.
a) Simple megabarchan form. Note the similar alignment with the small barchan. MOC E0400575
b) Megabarchan with a sinuous crestline. This crestline morphology represents the remnants of merged dunes on the windward slope. MOC E0400575
c) Complex megabarchan. MOC E0101781