SAND ON MARS: DARK AEOLIAN DEPOSITS ON CRATER FLOORS RELATED TO REGIONAL WINDS. ***Kenneth S. Edgett and Philip R. Christensen,** Department of Geology, Arizona State University, Tempe, Arizona 85287.*

Intracrater dark features are common on Mars, especially on the floors of craters larger than ~25 km in diameter [1]. They typically occur on the predominant downwind side of the crater, and a number of them are composed of sand dunes [2-6]. The dark features, commonly termed "splotches" [7,8], are also apparently relatively free of incorporated fine dust [6] and coarse rocks [9]. All of the previous work that considered these features suggests that they have an aeolian origin, and that most may be composed of granulometrically unimodal deposits of sand-sized material. The purpose of the present study is to search for regional versus local differences in the properties of materials comprising the dark intracrater features; in order to make inferences concerning the nature and global distribution of martian sands.

The approach of this study involved: (1) examination of the highest resolution *Mariner 9* and *Viking Orbiter* photographs, in an effort to locate dunes, and (2) determination of the thermophysical properties of intracrater dunes, followed by the same for intracrater dark features with no visible duneforms. *Viking* Infrared Thermal Mapper (IRTM) 20 μm brightness temperatures and an assumed surface albedo of 0.15 were used to calculate thermal inertia. (The reader should note that a 0.15 albedo is a more realistic value than the 0.25 used to calculate thermal inertias presented in an earlier abstract [10]). A standard albedo of 0.15 was used because actual albedos for all of the dark intracrater features are not available. The IRTM data were constrained to avoid the effects of atmospheric dust, clouds, surface frosts, surface roughness, and surface emissivity. The best IRTM data for these purposes were taken at night (one reason for using an assumed albedo) and between L_S 344° to 125°. The resolution of the data were constrained, so that only data which lie exactly (or as close as possible) on the dark feature were used. Thermal inertia (expressed in units x 10^{-3} cal cm^{-2} sec$^{-1/2}$ °K^{-1}), at martian atmospheric pressures and temperatures, can be used to estimate effective particle size of unconsolidated materials [11,12]. This relationship is most useful for examining sand dunes, because they are the most likely martian feature which would be unconsolidated *and* have a unimodal grain size distribution which should be equal to the effective grain size determined by the thermal inertia-grain size relationship.

Compared to terrestrial dunefields, we would expect intracrater dunefields to have an effective particle size in the medium sand range (250 - 500μm, or 6.0 - 7.9 thermal inertia units) [13], or perhaps slightly larger [14]. The best IRTM data avialable for dunes is that of the large Hellespontus dunefields in the craters Kaiser, Rabe, and Proctor. The thermal inertias calculated for these are all ~8.0 (effective grain sizes ~ 550μm). The actual thermal inertias may be slightly less than 8.0, because the actual albedos for these dunes are closer to 0.13 rather than the standard 0.15 used to calculate thermal inertias from predawn data. Regardless of the actual albedo, it is clear that the thermal inertia of these dunes is consistent with an average particle size in the upper-medium or lower-coarse sand size range. Dunefields in the craters Wirtz (-48.5°, 25.6°) and Moreux (+42.1°, 315.5°) yield similar thermal inertias (8.4 and 8.3, respectively) and grain sizes.

Because the effective particle sizes indicated for the dunefields fall within a reasonable, expected range of grain sizes, we believe that the data for intracrater features that do not have visible duneforms also represent the actual effective particle sizes of those deposits. Figure 1 shows the range of thermal inertia values and effective grain sizes for 133 dark intracrater features in 11 geographic regions. The figure shows that there is a different mean thermal inertia for each region, each with a narrow range of variation in thermal inertia among individual dark features within the regions. The regions are identified on the basis of overall regional albedo patterns [15] and the observed clustering of dark intracrater thermal inertia values reported here. The overall mean thermal inertia is about 8.4 (coarse sand, ~0.65 mm). The finest-grained intracrater deposits occur in Northern Arabia (NA), where the mean thermal inertia is 3.7 (very fine sand, ~0.07 mm), while the coarsest deposits occur in the Margaritifer Sinus (MS) region, where the mean is 13.7 (granules, ~ 2.5 mm). Many of the dark features are apparently composed of sand-sized particles, and might show duneforms when photographed at higher resolutions (most were photographed at resolutions > 150 m/pixel). Some of the deposits with high thermal inertias may be regions where there are barchan dunes with coarser interdune deposits; this is apparently the case for some of the dark deposits in the Oxia Palus region, where barchan dunes are seen in photographs with resolutions of less than 40 m/pixel.

Regions with the highest thermal inertia dark features correlate well with regions of high surface wind stress as predicted by the Mars General Circulation Model (GCM) [16, 17]. Greeley *et al.* (1989) [17] showed that there is a correlation between high surface wind stress and high rock abundance, suggesting that stronger winds remove fine particles from those regions [17, 18]. We speculate that the same may occur on the sandy, rock-free dark intracrater features. In regions where surface wind velocity is high, finer sands are winnowed out, leaving behind very coarse sand and granules. In Northern Arabia, where the dark features effectively consist of very fine sands, the regional winds are correspondingly low. Alternatives include the barchan dunes with coarse interdune explanation, and the possiblity that the coarser sands simply occur nearer to their source.

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FIGURE 1. Regional variation of intracrater dark feature thermal inertia. The points show the average thermal inertia of dark intracrater deposits in each region shown on the map. The bars represent one standard deviation from the mean. Numbers to the right of the bars indicate the number of data points included in each region. Grain sizes are based on the standard Wentworth scale, the relationship between thermal inertia and grain size is best explained by Kieffer *et al* (1973) [11]. One region not depicted on the map, SP, includes dunes of the south polar region, between latitudes -65° and -75°, and longitudes 145° to 250°. There are a number of uncertainties in the south polar dunes data, and they may not be representative of the acutal thermal inertias.