INTRACRATER MATERIAL IN EASTERN ARABIA TERRA: THEMIS, MOC, AND MOLA ANALYSIS OF WIND-BLOWN DEPOSITS AND POSSIBLE HIGH-INERTIA SOURCE MATERIAL. R.L. Fergason and P. R. Christensen, Department of Geological Sciences, Mars Space Flight Facility, Arizona State University, Box 876305, Tempe, AZ 85287-6305, robin.fergason@asu.edu.

Introduction: Intracrater deposits in eastern Arabia Terra contain sand-sized particles and high-inertia outcrops. This observation challenges both the current hypothesis that these sands originated from a global source from the north [1, 12], and that dust is currently accumulating in this region [3]. Low-inertia dust blankets eastern Arabia [13], effectively masking the composition and thermophysics of much of this region. Within this area are several craters containing material identifiable by their relatively high inertia and low albedo (Figure 1). Similar deposits to the west are located in a region with minimal dust allowing compositional and particle-size analyses to be performed, and have been studied by many previous authors using Viking, TES, and MOC data [4, 5, 10, 2, 6, 12, 15]. The characteristics of the intracrater deposits in eastern and western Arabia Terra are similar, and it is possible that the origin of the deposits in these two regions are comparable in nature. This study focuses on the eastern Arabia materials only, in an effort to better understand these deposits and their origin.

The eastern Arabia deposits have been noted since Viking [14, 1], but due to the low inertia of this region, obtaining thermophysical and compositional information has been a challenge. Our ability to understand the geologic history of this area has been improved with the incorporation of higher resolution data from Mars Global Surveyor and Mars Odyssey. Preliminary results suggest that these deposits are basaltic in composition and are sand-sized particles (thermal inertia of 210-250 $J/m^2Ks^{1/2}$) with a low albedo (0.19). The images also illustrate layered material along the crater wall, and some of these layers have an albedo similar to the deposits, suggesting a possible local source. This is in contrast to the present hypothesis that the deposits in this region are formed from a global sand source originating from the north [1, 12].

The features in these craters have a higher thermal inertia, indicating that an appreciable amount of dust is not accumulating on this surface. This is notable because it has been suggested that eastern Arabia (in addition to Tharsis and part of Elysium) is an active dust-sink in which dust is currently accumulating [3]. These features have not accumulated a discernible amount of dust since they were first viewed with Viking data and imply that either this is not an area of detectable dust accumulation as previously thought, or may provide constraints on the rate of dust accumulation in this area. Either result has implications for the global exchange of atmospheric dust, and the settling of dust after a global dust storm.

Approach: This study incorporates many different data sets to observe the chemical and physical characteristics of these materials and understand the origin of these deposits. Topographic information was obtained using MOLA data, and is used to understand the role the depth of the craters is playing in trapping sand in the crater floors. MOC and THEMIS visible images are used to study the physical characteristics and geomorphic relationships of these materials and the surrounding area. THEMIS day and night infrared images were also used, and provide information that enables us to derive the thermophysical properties of the deposits and surrounding material. THEMIS nighttime temperature data was used to calculate the thermal inertia of these materials. *Fergason and Christensen* [7] developed a technique to calculate thermal inertia at THEMIS IR resolution (100 meters per pixel). This method is applied to THEMIS nighttime temperature images to analyze thermophysical features that are undetectable at TES resolution. This technique provides higher resolution information that allows improved quantitative studies of small-scale surface features and a better understanding of the geological processes affecting this region. The first step in calculating thermal inertia involves determining surface temperatures from the THEMIS spectral radiance at 12.57 μm (Band 9). Then for each individual image, a look-up table of surface temperatures and their corresponding thermal inertia values is created for a given set of parameters. These parameters include latitude, time of day, season, elevation, albedo, and atmospheric opacity, each of which influences the nighttime surface temperature and is therefore required for an accurate estimate of thermal inertia. The latitude, time of day, and season are determined from spacecraft ephemeris. Elevation is obtained from MOLA data, and albedo and atmospheric opacity are derived seasonally from TES observations. The thermal effects of localized slopes (i.e. crater and slope walls) are not considered in this work. For an individual image, a look-up table is created at roughly every 25 km down track, and parameters are linearly interpolated between look-up tables. The look-up table values are calculated using a thermal model similar to those developed for Viking IRTM [8] and TES [9]. An extensive error analysis has been performed on the THEMIS thermal inertia calculations and uncertainties in this model vary based on the variability of surface characteristics (primarily albedo and elevation) in the scene. In this region, errors in thermophysical measurements are about 15%. The inertias in this region also compare well with those calculated using TES. THEMIS infrared data provides the highest resolution thermophysical data to date, enabling us to calculate the thermal inertia of small-scale features, such as these intracrater deposits and layers observed in the crater walls.

Results: In this area 10 craters have intracrater deposits (Figure 1). The thermal inertia of these deposits range from 210-250 $J/m^2Ks^{1/2}$, suggesting a particle size of medium-sand (100-500 microns, Figure 2). These sand deposits rarely show duneforms but are primarily observed as sand sheets occurring on the south side of the crater floor and often climbing up the wall of the crater. The area surrounding these deposits is fine-grained dust with a low thermal inertia (60-85 $J/m^2Ks^{1/2}$), and cause these sand deposits to be easily identifiable from their thermophysical properties.

In the walls of these craters, layered deposits have been observed in both THEMIS and MOC visible images [9]. These layers are also present in THEMIS infrared images and provide information on the thermophysical properties of these features. Preliminary analysis suggests that these layers have higher inertias than the surrounding material, and have albedos that are similar to the sand deposits, suggesting a local source for the sand deposits. Not all craters display layers in their walls, yet given the proximity of these craters to one another, it is likely that those layers do exist, but may be obscured by sediment or viewing angle. In addition, some of the craters contain resistive outcrops (thermal inertia of 400-435 $J/m^2Ks^{1/2}$) that appear scoured by wind (Figure 2). Where these landforms are present, the sand-sized particles are trapped around these features, and provide another potential sand source.

Conclusions: Intracrater deposits in eastern Arabia Terra contain sand-sized particles and high-inertia bedforms. This observation challenges both the current hypothesis that these sands originated from a global source, and that dust is currently accumulating in this region. Preliminary results suggest that the source of these deposits is not a single sand sheet from the north, but rather a local source, potentially high-inertia layers observed in the crater wall or scoured high-inertia bedforms in the crater floors. These deposits do not display a discernable amount of dust accumulation, yet are found in a region that is believed to be an area of active dust deposition. This suggests that either dust is no longer accumulating in Eastern Arabia, or may provide constraints on the rate of dust accumulation in this area. Either result has implications for the global exchange of atmospheric dust, and the settling of dust after a global dust storm.

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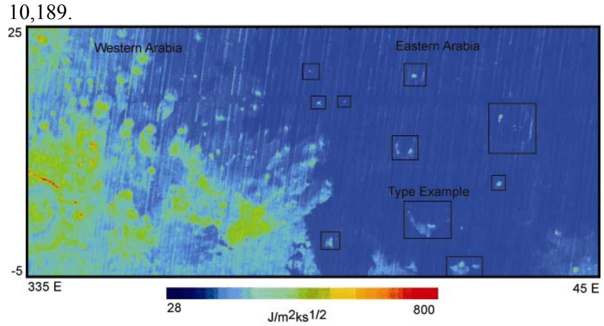

Figure 1. TES thermal inertia map of Arabia Terra Mars. Boxes indicate examples of craters containing intracrater sand deposits. Box labeled Type Example is further illustrated in Figure 2.

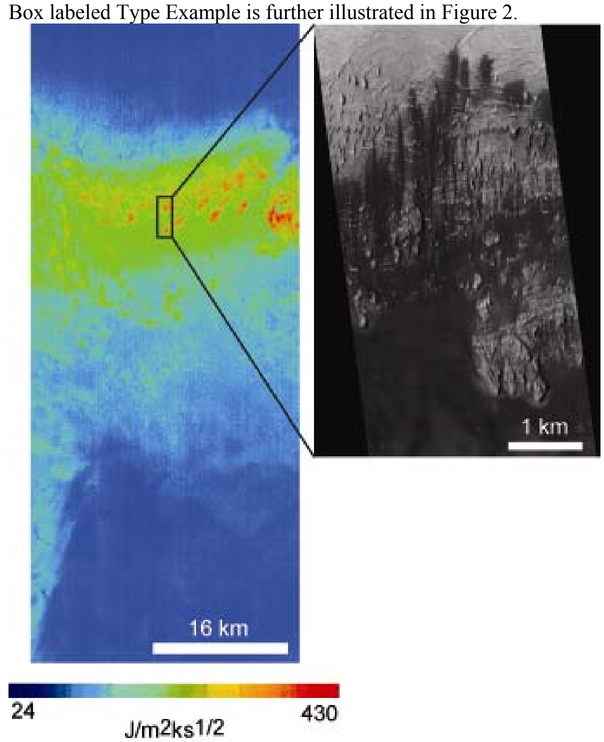

Figure 2a. Portion of THEMIS thermal inertia map from THEMIS night IR image I01229007. The blue material is dust, green is sand deposits, and red is resistive outcrops. Figure 2b. Portion of MOC narrow-angle image M0310925.