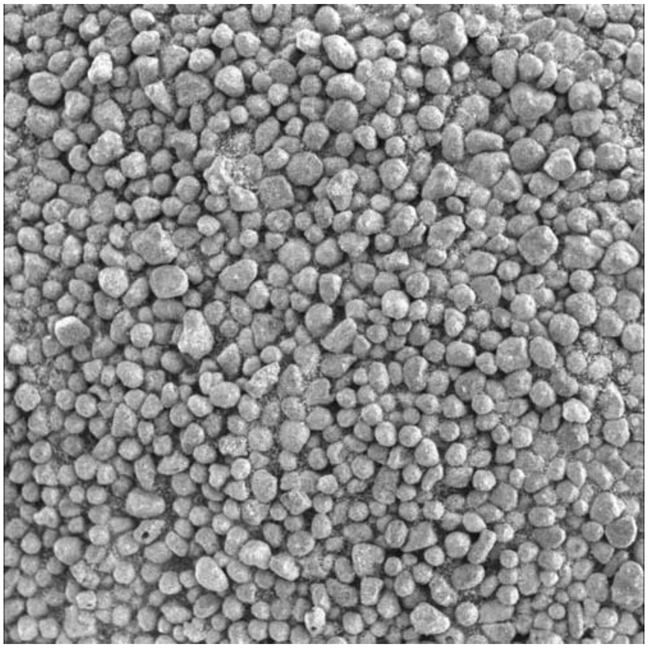

Figure 33. Radiometrically calibrated MI image 1M160851916 of target RippleCrest_2, taken on sol 368 in full shadow. Note homogeneity of grain sizes, as observed on all ripple crests at Meridiani. Area shown is 31 mm square.

4.2.3. Angular Rocks

[68] Angular rocks most likely represent fragments of rocks in the other classes. They are classified separately here on the basis of texture rather than origin. The fine-fractured texture, platy appearance and sharp, angular edges all suggest that these rocks are composed of an unknown cementing material that is highly friable.

4.2.4. Massive-Dark Rocks

[69] The massive-dark rocks show little evidence of secondary cementation except for the Normandy target. This class may be representative of the Burns formation lower unit defined by *Grotzinger et al.* [2005], as many of the rocks in this class are either found within or on the outer rim of Endurance Crater, where the stratigraphic sequence might have been overturned.

4.2.5. Massive-Bright Rocks

[70] The cavities in massive-bright rocks may be associated with dissolved minerals or may have previously contained grains or grain aggregates that were preferentially removed by the RAT. The irregular, rough edges of these cavities are more consistent with the latter interpretation, but in either case, chemical dissolution/recrystallization by water is indicated.

4.2.6. Cobbles

[71] The exotic compositional nature of the cobbles argues against their being erosional remnants of an upper stratum [*Jolliff et al.*, 2006]. Pancam data show different spectral signatures for potential clasts and potential matrix, but this is not diagnostic, as varying mineralogy could be either external or internal. We favor the interpretation that the cobbles are remnants of a breccia, but the ultimate determination depends on whether or not the brighter segments of these cobbles represent intrinsic characteristics (clasts in matrix) or external coatings with different reflectance.

4.2.7. Rock Outcrops

4.2.7.1. Grain Size Distribution

[72] Two sharply contrasting hypotheses have been proposed for the formation of layered rocks at Meridiani Planum. On the basis of grain size, centimeter-scale features identified as festoon cross-beds, and facies relationships in the measured section at Endurance Crater, the MER team interpreted Meridiani outcrop rocks as sandstones, deposited by wind and locally reworked by water [*Squyres et al.*, 2004b, 2006; *Grotzinger et al.*, 2005, 2006]. In contrast, *McCollom and Hynek* [2005] and *Knauth et al.* [2005] interpreted Meridiani rocks as volcanic and impact surge deposits, respectively. Microscopic images can play an important role in the resolution of this debate, because both hypotheses make predictions for the size and sorting of grains within layers. *Squyres et al.* [2006] briefly discussed grain size data from Meridinai outcrop rocks. Here we present grain size distributions and sorting data for MIs of two Meridiani samples: "Cobble Hill," a bed exposed within Endurance Crater, imaged on sol 144 (Figure 28a), and Overgaard, an outcrop block within the "Olympia" outcrop pavement near Erebus Crater, imaged on sol 721 (Figure 15).

[73] Theoretical and experimental studies of the effects of Martian gravity and atmospheric density on saltation indicate that, while much stronger winds are required to move particles on Mars, the size of grains that are most easily moved by winds is only slightly larger on Mars than on Earth [*Greeley and Iversen*, 1985]. Hence, it is appropriate and useful to compare the size distribution of grains in terrestrial and Martian sandstones. *Ahlbrandt* [1979] published a textural interpretation of 506 eolian sands distributed widely across the Earth's surface. Eolian deposits consist predominantly of medium- to fine-grained sand; in *Ahlbrandt*'s [1979] sample set, 85% of the deposits have mean grain size in the range 175–375 μm, and few deposits have mean grain sizes above 1 mm or below 62 μm. Eolian sands are also well to moderately well sorted, only slightly skewed toward larger sizes, and mesokurtic (similar to a normal distribution) to slightly platykurtic (relatively "broad shoulders" and tails shorter than predicted by a normal distribution). The size frequency distributions of grains in the two Meridiani outcrop samples display similar characteristics (Figure 29).

[74] The constituent grains of Meridiani outcrop rocks thus meet the predictions inherent in the eolian hypothesis, but are they equally compatible with surge hypotheses? *Sparks* [1976] plotted grain size data for more than 200 surge deposits. Figure 30 shows Sparks' data on a plot of mean grain size versus sorting. Following convention, *Sparks* [1976] and *Ahlbrandt* [1979] both used the sorting statistic σ_φ:

$$\sigma_\varphi = (\sigma_{84\text{th percentile}} - \sigma_{16\text{th percentile}})/2.$$

Sparks further examined a subset of 117 samples for which he separated individual components (pumice, lithic grains, and crystals) and redid the analysis, eliminating the fraction smaller than 125 μm. Because the MI cannot reliably