each data set, respectively. Mosaics of each data type were produced for Gusev (Figures 1 and 2). Daytime and nighttime TIR images were used to compare and contrast the relative temperatures of surfaces within Gusev (by comparison of relative temperatures on gray scale normalized TIR images). *Relative* temperatures were qualitatively characterized as "hot", "warm", and "cold" on the basis of the relative pixel brightness in daytime and nighttime TIR images. Orbital variations result in the THEMIS instrument collecting images over a range of local solar times and seasons, producing temperature variations that are dependent on time-of-day and season. Normalizing images only allows for relative comparisons between individual THEMIS images within an image mosaic. For point of reference, within a single THEMIS night TIR image (I01511006 – Apr. 17, 2002, 23:14 local solar time), temperatures ranged from 174–196 K for units defined in this study. Daytime images showed comparable temperature contrasts. Visible and daytime TIR images were also used to measure crater densities for defined units (discussed later).

[11] TES [*Christensen et al.*, 1992, 2001] is a Fourier transform Michelson interferometer that collects TIR spectra over 1709–200 cm^{-1} (5.8–50 μm) with 5 and 10 cm^{-1} spectral sampling and 3 × 5 km spatial resolution. During its initial mapping phase, which lasted approximately 1 Martian year, TES collected approximately 5×10^7 spectra. Most of Gusev crater has been mapped by TES. TES spectra were used to note the presence of surface types 1 and 2 [*Bandfield et al.*, 2000] in Gusev, and a TES thermal inertia map by *Jakosky and Mellon* [2001] was used to determine thermal inertias of the more areally extensive units. TES bolometric data were used to measure relative albedo variations across surfaces. Albedos ranged from 0.19–0.26 and, when describing units, were categorized as "low" (<0.23) or "high" (≥0.23).

[12] Narrow-angle, high spatial resolution (1.46–5.68 m/pixel) MOC (Mars Global Surveyor) images were used to identify distinctive morphologies within Gusev. Surfaces that (a) were laterally extensive, (b) had consistent morphologic characters, and (c) occur within a specific range of elevations were identified as distinctive morphologic units. Viking Orbiter and THEMIS data were also used with MOC data to track larger-scale modifications to surfaces within Gusev. For more on the MOC instrument, see *Malin et al.* [1992] and *Malin and Edgett* [2001].

[13] MOLA is a laser altimeter used to collect high-precision elevation data from the Martian surface. MOLA fires 10 Hz (∼8 ns) pulses toward the Martian surface and measures return times to calculate surface elevations with a vertical accuracy of <1 m [*Zuber et al.*, 1992; *Smith et al.*, 2001]. The MOLA team has produced global topographic grids for Mars at 1/128°, 1/64°, and 1/32° per pixel resolutions. Data from the 1/128° per pixel v. 2.0 MEGDR topographic grid (between 0°–44°S, 90°–180°E) were used to generate a topographic map for Gusev (Figure 3). This map, along with topographic profiles of key unit boundaries, was used to estimate the maximum and minimum elevations of floor units. Topographic relief was calculated as an indication of each unit's minimum thickness (assuming horizontality). Topographic profiles were used to identify prominent slope changes or "benches" that occur at constant elevations. Such identifiable slope breaks, where present, may represent contacts between units.

3. Identification of Units

3.1. Unit Nomenclature

[14] For this study, a primary objective has been to identify and delineate units on the floor of Gusev crater. Our approach has been to map units independently on the basis of their thermophysical and morphological properties and to highlight where correlations exist between the two techniques. When strong correlations between both types of units can be made, names have been shared. Unit names are denoted by two or three capital letters and, in most cases, have been derived from morphologic features of that particular unit. For clarity, subscripts "t" and "m" refer to the type of unit (thermophysical and morphological unit respectively). The combined results of thermophysical and morphologic unit mapping resulted in a surface unit map. To avoid developing an additional naming scheme for surface units, the original unit designations were maintained, but subscripts were dropped. Our naming system avoids using crater density ages as a part of unit designations because of the problems that surface modification by erosive/depositional processes presents to crater ages in the Aeolis quadrangle.

3.2. Thermophysical Properties

[15] Eight *thermophysical units* were identified in Gusev crater by qualitative comparisons of albedos and relative temperature differences (Table 1) derived from THEMIS and TES observations as described above. As used here, a thermophysical unit is defined as rock or sediment that is laterally extensive, defining an area with similar albedos and day/night relative temperature variations.

[16] The most obvious thermophysical unit is the Low Albedo (LA_t) unit (Figure 4a). As its name implies, LA_t has low albedos (Figure 1) and is hot in THEMIS daytime and nighttime TIR images (Figure 2). LA_t has a mean thermal inertia value of 240 ± 20 J m^{-2} K^{-1} $s^{-1/2}$, consistent with a surface whose average particle size is consistent with medium-grained sand [*Pelkey et al.*, 2001]. LA_t is presently split into two areas, a western area having sharp boundaries (as determined by visible and daytime TIR images) and an eastern area having more diffuse boundaries (visible and daytime/nighttime TIR). THEMIS nighttime TIR shows eastern LA_t extending farther southeast than is shown by daytime TIR imagery.

[17] A High Thermal Inertia (HTI_t) unit has been identified in southeastern Gusev using THEMIS and TES data (Figure 4a). Visibly, this unit has areas with both high and low albedos (Figure 1) and is warm to cold in daytime TIR (Figure 2a). Nighttime TIR shows this as a hot unit, occurring as eastern and western lobes (Figure 2b). Both lobes are centered around an irregular depression in southeastern Gusev. The eastern lobe appears as a THEMIS nighttime TIR hot unit with sharp, well-defined boundaries. Nighttime TIR images show that relative temperatures are more diffuse and boundary contacts less distinct for the western lobe. TES thermal inertia values for this area are ∼400 ± 70 J m^{-2} K^{-1} $s^{-1/2}$. Such high thermal inertias are consistent with very coarse sand to granule particle sizes [*Pelkey et al.*, 2001].