temperature and is most strongly dependent on the thermal conductivity of the surface materials. Thermal inertia is defined as a combination of thermal conductivity k, density ρ, and heat capacity c:

$$I \equiv \sqrt{k\rho c} \tag{1}$$

Thermal inertia depends primarily on the average particle size of the grains comprising the surface, the size and abundance of rocks on and near the surface, and the degree of induration of duricrust. Low-albedo regions make up about 50% of the Martian surface and have thermal inertias and spectral contrasts expected for sand-sized particles [e.g., *Kieffer et al.*, 1977; *Presley and Christensen*, 1997], enabling detailed analysis of surface compositions. For a complete description of how thermal inertia is calculated, see *Mellon et al.* [2000].

3.2. Mars Orbiter Camera

[12] MOC narrow angle (NA) and wide angle (WA) images are obtained at spatial resolutions of 1.5 to 6 m/pixel and 240 to 7500 m/pixel respectively. A description of the MOC instrument is detailed by *Malin and Edgett* [2001]. Available images for this study were acquired between September 1997 and December 2001, and all images were obtained with the MGS spacecraft in a nadir-viewing orientation. WA mosaics are provided courtesy of NASA/JPL/Malin Space Science Systems and provide the context for NA images that are used for high-resolution detailed mapping.

3.3. Mars Orbiter Laser Altimeter

[13] MOLA topography data are used to create digital topographic maps and 3-D shaded relief images of the Martian surface in Oxia Palus. For a complete description of the MOLA instrument, analytical techniques, and instrument-related errors, see *Zuber et al.* [1992]. MOLA data are binned in a $\sim$500 m/pixel grid and are used as a base map for overlaying TES compositional maps and MOC NA and WA images.

3.4. Data Set Registration

[14] The TES, MOC, and MOLA data sets are all defined by latitude and longitude coordinates. When these data sets are translated to a map projection, each data set will also be defined in a Cartesian coordinate system as described by the selected projection. Map projected TES compositional images, MOC composite images, and MOLA digital elevation maps (DEMs) are aligned in ArcView (ESRI) based on their Cartesian coordinates. In ArcView, for raster data sets, this is expressed by the top left pixel location and the pixel dimension in map units (i.e., meters). Each data set can then be overlain and merged together within the ArcView software interface. Changes to map locations can also be done manually to compensate for any small offsets in registration of map-projected images.

4. Distribution of TES Surface Compositions

4.1. Regional View

[15] Figure 2 shows the regional distribution of surface type 1 (green) and 2 (red) lithologies in Oxia Palus derived from linear deconvolution of TES emissivity spectra. Blue pixels on the TES composition map represent areas covered by fine-grained bright dust, which sufficiently blankets the surface to prohibit spectral analysis of sand and rock compositions (particle diameters of 10 μm or less and a mantle thickness of tens of microns) [e.g., *Ruff and Christensen*, 2002]. The "concentration" of fine dust was determined not from linear deconvolution but instead by using the derived TES data set index parameter "long-wavelength depth," which distinguishes between bright and dark regions. This parameter has proven useful in mapping where coarse particles are located on the Martian surface, and hence where fine dust is absent, and correlates very well with albedo and thermal inertia [*Bandfield*, 2000]. Yellow pixels indicate mixing of surface type 1 and 2 materials, whereas black stripes and pixels indicate lack of TES surface coverage.

[16] Surface type 1 dominates the southern highlands of Xanthe Terra and southern Arabia Terra, and surface type 2 dominates northern Acidalia Planitia. Both surface types coincide well with observed low-albedo regions, despite the higher uncertainty with surface type 2 because of random and systematic noise inherent in this spectral signature [*Bandfield et al.*, 2000a]. A mixing/transition from surface type 1 to surface type 2 (south to north) compositions is observed in low-albedo regions marking the southern extent of Acidalia Planitia and northeastern extent of Chryse Planitia.

[17] The MP Landing site (marked with an X in Figure 2) is located in an area that appears to be near the surface type 1 and type 2 transition in southern Acidalia Planitia. It is difficult to discern if TES observations at this regional scale agree with Mars Pathfinder IMP observations of the landing site showing that the tops of rocks, and surfaces in between rocks, are largely covered by fine-grained dust [*McSween et al.*, 1999]. Ares and Tiu Valles show a similar covering of fine-grained dust. Low-albedo crater floors and wind streaks in western Arabia Terra, however, show strong concentrations of surface type 1 and 2 materials even at a regional scale (outline of box in Figure 2).

4.2. Southern Acidalia Planitia

[18] The mixing/transition from surface type 1 to surface type 2 (south to north) compositions in the low-albedo regions of southern Acidalia Planitia is illustrated in Figure 3. Two gray scale TES maps (16 pixels/degree) show the concentrations of surface type 1 and type 2 materials in Figures 3a and 3b, respectively. Figure 3c is a gray scale MOLA shaded relief image sampled at 500 m/pixel, and Figure 3d is a mosaic of MOC images of the same area. Superimposed on all panel images is a curved dashed line marking the extent of a proposed ancient shoreline for a large standing body of water in southern Acidalia Planitia [*Parker et al.*, 1993; *Head et al.*, 1999] and a curved solid line marking the southern extent of the Vastitas Borealis formation [*Head et al.*, 2002]. The images in Figure 3 extend north of 30°N, which marks the northern extent of the Oxia Palus quadrangle, to show the distribution of surface materials in a greater area of Acidalia Planitia. Red boxes indicate locations of TES surface spectra shown in Figure 4.

[19] Figure 3a clearly shows the extent of surface type 1 materials in southern Acidalia Planitia, while Figure 3b