surface type 1 and 2 lithologies, as well as past spacecraft landing sites that may provide ground truth for spectral interpretations from orbit. In this study, we examine the distribution of TES-derived surface type 1 and 2 materials in Oxia Palus through high-spatial-resolution mapping and integrate Mars Orbiter Camera (MOC) and Mars Orbiter Laser Altimeter (MOLA) data sets for a detailed description of the Martian surface. The diversity of observable landforms in Oxia Palus, which reflect both active geologic processes and remnants of paleoclimate effects, has made this one of the most studied regions on Mars. Features of interest within Oxia Palus for this study include volcanic/sedimentary materials in southern Acidalia Planitia, low-albedo crater floors and wind streaks in western Arabia Terra, and the channel outflow deposits of the Mars Pathfinder (MP) landing site in Chryse Planitia. We also attempt to fit the basalt and andesite/weathered basalt interpretations of the TES surface types into multiple working hypotheses to describe the origin of surface materials on local and regional scales.

2. Geologic Setting

[4] Within the Oxia Palus quadrangle (0°–45°W longitude, 0°–30°N latitude), the northern lowland terrains of Chryse and Acidalia Planitiae are bounded by the southern highland terrains of Xanthe and Arabia Terrae (Figure 1, MOC Composite Image). Relative ages of northern lowland materials based on the crater-density stratigraphy of *Tanaka* [1986] range from Late Noachian to Early Amazonian, while older southern highland materials range in age from Middle Noachian to Early Hesperian. In ascending stratigraphic order, the exposed surface units within the Oxia Palus quadrangle are (1) the Middle to Late Noachian southern-cratered terrain, (2) the Hesperian-aged Vastitas Borealis Formation, a unit interpreted to be degraded lava flows and sediments, (3) Hesperian-aged outflow channel deposits at the margins of the lowlands in Chryse Planitia, and (4) various local Amazonian-aged plains units [*Head et al.*, 2002].

2.1. Northern Lowlands

[5] Chryse Planitia makes up the southern portion of a basin with elevations ranging from 0 to −2000 m (relative to geoid) and grades north into Acidalia Planitia with elevations decreasing to −4000 m. Several large outflow channels (Ares, Simud, and Tiu Valles) empty into Chryse Planitia and eventually grade into broad relatively smooth plains further north in Acidalia Planitia. The MP landing site was selected in Chryse Planitia partly because of the expected high rock abundances [*Edgett and Christensen*, 1997] in the Ares and Tiu Valles outflow deposits. High rock abundances at the landing site were confirmed by Imager for Mars Pathfinder (IMP) observations that showed the area to be strewn with large boulders, although with significant amounts of surface dust coatings [*McSween et al.*, 1999]. Chryse and Acidalia Planitiae landforms and surface materials have been variously interpreted as subaerially emplaced mass flows [*Tanaka*, 1997], coastal marine [*Parker et al.*, 1993], and residual sedimentary deposits [*Head et al.*, 2002]. A curved dashed white line displayed in Figure 1 marks 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]. A curved solid white line in Figure 1 marks the southern extent of the Vastitas Borealis Formation [*Head et al.*, 2002].

2.2. Southern Highlands

[6] Xanthe Terra is part of the heavily cratered highlands and is cut by long systems of grabens in the Valles Marineris system of canyons to the west. Arabia Terra has numerous impact craters with large low-albedo wind streaks emanating from low-albedo areas on crater floors. Most models for the formation of dark intracrater materials involve the entrapment of sand-sized particles that can be transported into, but not out of, craters by wind [e.g., *Arvidson*, 1974; *Christensen*, 1983; *Thomas*, 1984]. Several hypotheses exist for the origin of adjacent low-albedo wind streaks. Some models interpret them to be a result of saltation and traction [e.g., *Arvidson*, 1974; *Thomas et al.*, 1981], consisting of sandy material deflated from adjacent dark intracrater deposits; other models interpret them to be the result of material being stripped from the surface revealing a darker substrate [e.g., *Soderblom et al.*, 1978]. More recent models have proposed that streaks form by the deposition of fine dark silt from plumes of suspended material [*Thomas and Veverka*, 1986]. This view is now supported by MOC observations that suggest the dark materials are mantle deposits of fine-grained sediment deflated from adjacent crater floors not sand-sized particles [*Edgett*, 2002].

[7] The Sinus Meridiani and Aram Chaos hematite regions in Terra Meridiani identified by TES also occur partly within the Oxia Palus quadrangle [*Christensen et al.*, 2000b, 2002]. A range of possible mechanisms for the formation of coarse-grained, crystalline hematite on Mars was critically examined by *Christensen et al.* [2000b], with a favored interpretation proposed as in-place sedimentary units composed primarily of basaltic sediment with ∼10–15% crystalline gray hematite.

3. Data Sets

3.1. Thermal Emission Spectrometer

[8] Thermal infrared spectral observations by the TES instrument cover the wavelength range from 1655 to 200 cm^{-1} (∼6 to 50 μm) at 10 or 5 cm^{-1} sampling [*Christensen et al.*, 1992]. A complete description of the TES instrument, radiometric calibration, and instrument-related errors is given by *Christensen et al.* [2001]. Spectra used for analysis of surface compositions were collected from the start of the mapping orbit data set up to orbit 5317 (ock 7000, L_s 104–352). The orbit range is restricted because of an anomaly, possibly resulting from vibrations with the MGS spacecraft, that causes a sporadic minor feature to appear in TES spectral data at ∼1000 cm^{-1} in orbits after 5317. Only data at 10 cm^{-1} sampling are examined in this study, which is approximately 99% of the total data collected from this orbit range. Spectra are limited to those with surface temperatures >250K, dust extinctions of <0.18 (1075 cm^{-1} opacity of approximately 0.3), and water ice extinctions of <0.1 (800 cm^{-1} opacity of approximately 0.15) to ensure a high surface signal to noise ratio [*Bandfield et al.*, 2000a]. A data restriction of emission