tional sources (fluvio-lacustrine, aeolian, volcanoclastic). In addition, imaging instruments may be used to determine the true nature of some unit contacts (i.e., stratigraphic position, conformable vs. non-conformable) within Gusev.

[69] MER traverses will occur within only a limited portion (<1 km) of the MER-A landing ellipse. Considering this, we take a closer look at the geology of the landing ellipse (Figure 14a) from east to west, examining previous hypotheses and how MER might test them.

[70] A landing near the rim of Thira crater provides an opportunity to examine the TR and LB units. Is TR different spectrally (and thus compositionally) from LB, or did the Thira impact event sample a lower portion of WR? Analyses of rim material may also determine whether dark patches along the Thira rim is aeolian drifts of low-albedo material or exposed bedrock.

[71] Traverses farther west would likely encounter exposures of LB, PL, and low-albedo material. Analyses of low-albedo material in this area may indicate whether or not it overlies PL and LB or simply represents a scouring of the PL and LB surfaces. A landing on the eastern side of the escarpment between LB and PL/low-albedo material exposures could provide an opportunity to examine further the stratigraphic relationships and note the presence of additional strata not measured in this study.

[72] The center of the landing ellipse is dominated by the PL unit, which, if determined to represent fluvial deposition, provides a means of analyzing sediment from Ma'adim source regions [*Irwin et al.*, 2002]. Although PL is the dominant unit here, there are several craters that likely sampled subsurface strata (below the inferred 40 m thickness for PL). The measured depth (>1900 m) of an unnamed crater (Figure 13d) indicates that it likely excavated LB and WR strata, providing a means for MER to sample these strata. Elevation measurements from another crater northwest of the landing ellipse (Figure 13b) also indicate that this impact event sampled WR, ejecting material into the landing ellipse.

[73] Two isolated areas within the landing ellipse (Figure 14a; labeled as ET_t?) may provide access to other units. Each exposes material that morphologically, has an "etched" appearance, suggestive of ET. They also have nighttime TIR temperatures comparable to western ET. In daytime TIR, each window has thermophysical properties consistent with LB, ET, or the material immediately underlying PL. MOLA data show elevations consistent with PL and ET. MER traverses in this area may allow for the distinction between PL and ET for these areas. The presence of ET within the landing ellipse would further add to the geologic diversity of the ellipse.

[74] Quasi-Circular Depressions (QCDs), first identified on Mars by *Frey et al.* [1999], may also provide a means of sampling from Gusev's sub-surface strata within the landing ellipse. A Quasi-Circular Depression (QCD) within the southwestern portion of the landing ellipse has been detected (at 14.96°S, 175.04°E) from MOLA data (Figure 4b). This QCD, first identified by *Kuzmin et al.* [2000], is thought to represent a buried crater. Its rim has yet to be noted in visible or TIR data; however, a circular positive relief feature (−1820 to −1860 m) has been detected using MOLA data and is thought to represent the surficial expression of the crater rim. Measured rim diameters and heights have allowed us to calculate the transient crater diameter [*Croft*, 1985] and excavation depth for this QCD. This crater would have penetrated to depths of −3300 to −4000 m, well below the lowest exposed WR. Like Thira crater, this QCD may have sampled WR strata or older units. A landing near the center of the ellipse thus provides MER a means of sampling subsurface stratigraphy to address the following questions: (1) What are the stratigraphic relationships between PL, LB, WR, and potentially older units? (2) Are these units spectrally (and perhaps compositionally) distinct from each other? (3) Has Gusev's depositional environment changed from its early history?

[75] MER traverses within the western portion of the landing ellipse would also permit the examination of low-albedo material and PL, but more importantly, could allow the nature of MV to be determined. Is MV a real surface unit within Gusev, or does it represent a thermophysically distinct area within the PL unit? If it is a distinctive surface unit, how does it compare spectrally with PL? Does it represent a final stage of fluvial deposition? Answers to these questions would provide insight into Gusev's late-stage depositional environments.

[76] It is clear that the MER-A landing ellipse lies within a geologically heterogeneous area of Mars and of Gusev itself. If this heterogeneity represents changes in a single or multiple depositional environments, then direct analyses of Gusev surface units by MER may provide insight into changing geologic/climatic conditions over a significant interval of Martian geologic history. More importantly, MER would provide a means of examining the geologic and climatic record of Mars over an extended and important (Noachian-Hesperian) interval of Martian history.

5. Summary

[77] Gusev crater is a candidate site for MER because of its suspected former fluvio-lacustrine environment. This study has used high spatial-resolution data from THEMIS, supplemented by TES, MOC, and MOLA data, to identify units comprising the floor of Gusev and Ma'adim Vallis. Thermophysical and morphologic unit maps show broad correlations, supporting the validity of the seven proposed surface units, as follows:

[78] ● Ma'adim Vallis (MV) – THEMIS nighttime cold material (occurring as parallel ridges in the valley) from Ma'adim Vallis appearing to extend into Gusev

[79] ● Plains (PL) – unit trending from Ma'adim to northwest breach in Gusev's rim with hot nighttime TIR craters

[80] ● Mesa (MS) – dissected mesas with cold nighttime tops and hot TIR slopes

[81] ● Lobed (LB) – flat, freshly-cratered surface with distinctive lobate margins

[82] ● Etched (ET) – unit with a "mottled" daytime/nighttime TIR appearance and apparently eroded surface

[83] ● Wrinkled (WR) – unit with low, north-south oriented ridges that contains cold nighttime TIR craters

[84] ● Thira Rim (TR) – unit exposed along Thira crater rim; hot nighttime TIR material; strata exhumed from depth.

[85] ● Also observed were low-albedo materials that have apparently been redistributed/reexposed by aeolian processes since the Viking program.