MARTIAN SMALL VOLCANIC SHIELDS AND SHIELD FIELDS. S. E. H. Sakimoto, 1, 1 Department of Civil Engineering and Geological Sciences, University of Notre Dame, Notre Dame, IN, 46556, ssakimot@nd.edu.

Introduction: The last decade of Mars exploration has dramatically changed our understanding of martian volcanology. One aspect of this is the detection of numerous small volcanic vents and shield volcanoes in what had often appeared to be “smooth plains” in earlier data products [e.g. 1-7]. Hundreds—and perhaps thousands—of volcanic vent features in the size range of a few km to less than 100 km in diameter have been found (see Figure 1), and their characteristics yield insights into topics such as shallow martian subsurface conditions [3, 5], and post shield formation tectonic deformation [8]. Early work [2] based on Mars Orbiter Laser Altimeter (MOLA) data demonstrated a possible global variation in shield properties suggested to be indicative of interactions between subsurface water and/or ice. This study combines the early topographic results with new high resolution image data to reconsider the small shields and shield fields, and their potential global-scale variations.

Approach: Several hundred small shields were previously mapped from MOLA data [1-4, 8 and others]. These were re-sampled for consistency, and then the combined THEMIS, HRSC and MOC image releases are used with the MOLA data to identify further shields, and to consider local eruptive styles for each shield or shield cluster. Typical measurements include location, base elevation and diameter, underlying slope, height, acerage flank slope, crater diameter, depth, summit slopes, etc… Where one data type is ambiguous, such as using image data for picking shield extents from slope breaks, other sources (e.g. MOLA) were used instead. Where MOLA resolution is too coarse—such as for smaller summit craters, it is combined with imae data for measurements.

For example, Figure 2 shows a ~50 km diameter shield in Elysium Planitia initially mapped in MOLA data as a low shield with radial channel flows. The THEMIS image confirms this, and also allows us to combine data to estimate levee heights, local slopes, and summit crater dimensions. The summit crater dimensions are a key characteristic in assessing eruptive styles [e.g. 2,3], as low effusive shields typically have low flank slopes and smaller diameter summit craters that may be deeper than the total volcano height, while shields or edifices with more explosive deposits have relatively larger summit craters and steeper flank slopes. The shield in figure 2 is typical of near-equatorial edifices, with clear effusive landforms, low slopes, and a smaller summit crater. Figure 3 shows global summary results for those shields that—to so far—can be demonstrated to have a summit crater.

Discussion and Conclusions: As shown in figure 3, the small shields do vary in properties at a given latitude or field, making it difficult to consider regional subsurface variations. However, global trends are still apparent in properties like edifice volume, flank slope and summit crater characteristics. Figure 3c shows a dimensionless measure of explosive versus effusive eruption styles, showing that near the poles the shield morphologies appear to gradually shift to more explosive features. One obvious explanation is interaction with groundwater, since groundwater abundance is clearly latitude dependent (based on other mission measurements.). While dust and terrain age obscured summit craters in some latitude bands, the number of edifices visible with the combined data sets shows a stronger latitude dependence than the earlier work.

Figure 2. This low shield in Elysium Planitia is shown at top in THEMIS data, at center in high resolution topographic (MOLA) data, and at bottom in low resolution topography data. The central crater, radial flows, and leveed channels are apparent in all three data products.

Figure 3. For small martian volcanic shields where the summit craters could be resolved, several global trends are apparent. A) Average flank slope versus distance from the equator, b) Summit crater diameter normalized by basal diameter versus distance from the equator, and C) is the diameter ratio in B multiplied by average flank slope versus the distance from the equator. The y-axis parameter in C is effectively a dimensionless measure of explosivity that tends to increase towards the poles. Shaded volcano profiles are topographic profiles at VE=10.