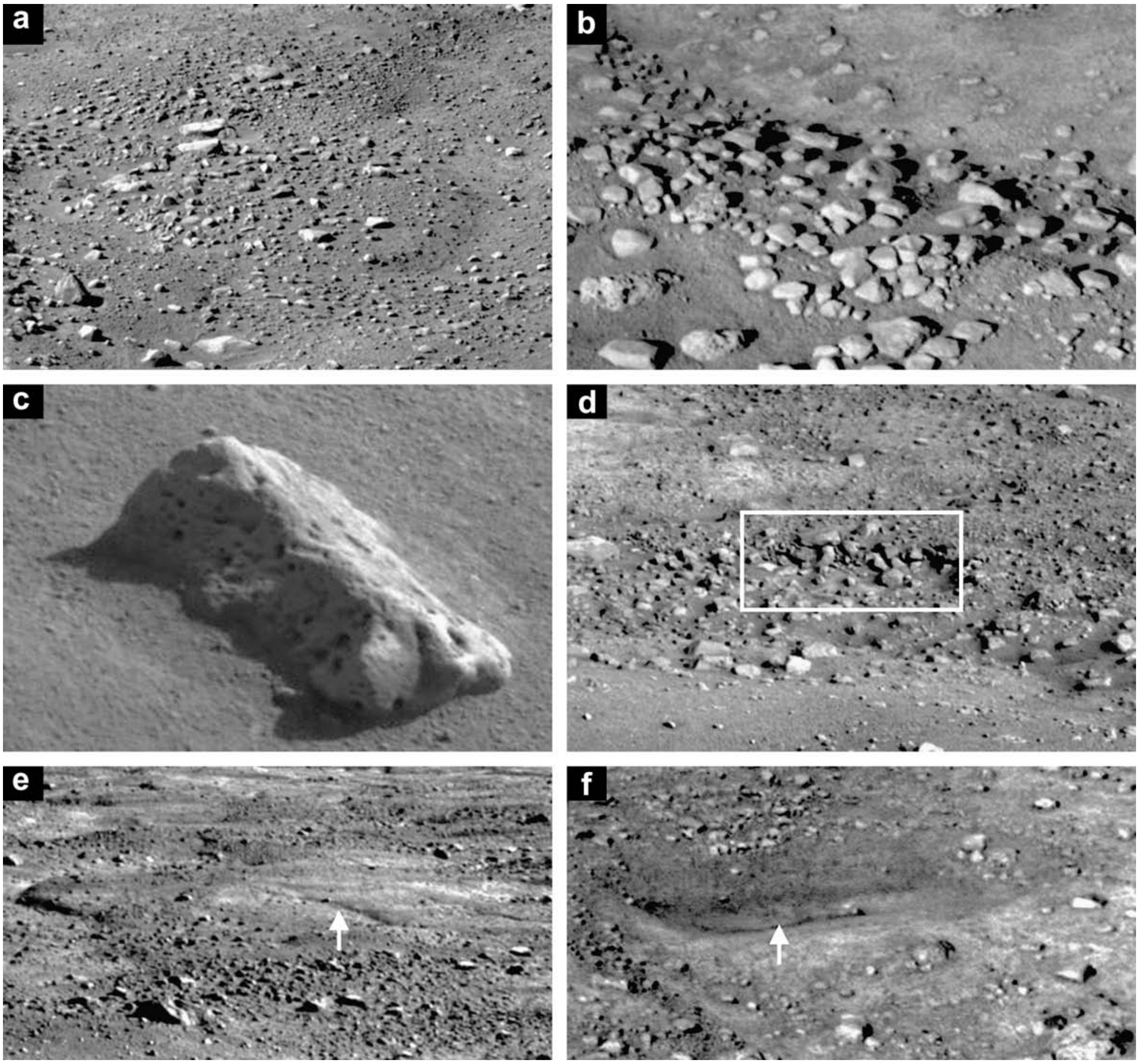

Fig. 15. Surface Stereo Imager views of the Phoenix landing site. All images excerpted from Phoenix image 17106 (see Smith et al., 2008, 2009). (a) Polygon with dense interior clast coverage, surrounded by troughs with reduced clast coverage, suggesting ongoing shedding of interior cobbles/boulders by gentle processes such as slumping and transport of fines by aeolian activity, typical of terrestrial sublimation polygons. (b) Cobbles overlying finer-grained sediment on a polygon interior. Superposition of coarse clasts over finer sediments suggests desert pavement formation, rather than upthrusting from within the polygon or frost-jacking. (c) Pitted boulder in near-foreground of PHX image 17106. Pits may be vesicles, or salt-weathering pits typical of boulders on stable surfaces in Antarctica (Marchant and Head, 2007). (d) A tightly clustered group of cobbles (box) similar in appearance to terrestrial "puzzle rocks" that form by in situ disintegration (e.g., Marchant and Head, 2007). (e) High-centered, round-shouldered polygon bounded by depressed troughs, and cross-cut by a narrower trough (arrow) connecting the polygon center to the bounding troughs. Multiple generations of fractures suggests ongoing thermal contraction cracking. (f) Possible furrow (arrow) in surface of trough between polygons, potentially indicating active winnowing of fines into open thermal contraction cracks.

Ongoing analysis of the Phoenix landing site will help localize global-scale observations of martian thermal contraction crack polygon terrain, extending observational evidence suggesting a history for permafrost at the site and environs characterized by the recent dominance of ice removal by sublimation, ongoing thermal contraction cracking, and very limited cryoturbation by either wet or dry processes. These observations are consistent with global observations of the martian latitude-dependent mantle (Head et al., 2003) suggesting the vertical ablation of excess ice in the martian subsurface (e.g., Schorghofer, 2007)—ice that is originally of primary atmospheric-deposition origin. With regional characterizations of the polygonally-patterned portions of the LDM in hand (Mangold, 2005; Levy et al., 2009c), local analyses, such as those performed at the Phoenix landing site, are the logical next step in documenting the processes operating on the martian LDM.

6. Conclusions

Thermal contraction crack polygons on Earth are a complex landform that has begun to be decoded by the combined investigative efforts of field geologists, physical modelers, climate modelers, and geochemists. Understanding the full history and significance of thermal contraction crack polygons on Mars will require a similarly coordinated effort to disentangle the complexities of local substrate and climate processes. Terrestrial thermal contraction crack polygons are excellent indicators of the current or past presence of ground ice, ranging in composition from massive ice to weakly cemented soils. Accordingly, polygons on Mars provide a unique perspective on climate processes that have dominated the martian surface over ka to Ma timescales. Polygons indicate overwhelmingly cold and dry conditions for at least the past several million years on Mars, characterized by ice-age snow and ice pre-