SECULAR CHANGE IN SOUTH POLAR SEDIMENTARY PROCESSES INFERRED FROM THE MORPHOLOGIES AND AGES OF LAYERED AND PITTED TERRAINS; J. Plaut, E. Guinness, R. Arvidson, and R. Kahn, McDonnell Center for the Space Sciences, Dept. of Earth and Planetary Sci., Washington Univ., St. Louis, MO 63130

The dichotomy of sedimentary landforms found in the south polar region of Mars indicates secular changes in erosional and depositional processes. In this study, we examine data on the morphology, stratigraphy and age of the deposits to provide constraints on the climate history of the planet.

Figure 1 is a map of the terrain units poleward of -65 degrees latitude. Viking Orbiter images with the highest resolution for this region (typically 150-200 m/pixel) were examined in making this map. The layered and pitted terrains exhibit distinctly different morphologies (1,2,3). The pitted terrain appears massive (non-layered) at available resolution and exhibits a number of etched regions. The layered terrain is relatively smooth and featureless, with exception of the exposed layering. The layered terrain margins are convex, consistent with models involving ablation on sun-facing slopes (4). Where the margin of the pitted terrain can be discerned it appears serrated. These observations imply distinctly different styles of deposition and erosion. Estimates of pit depths, made using measurements of shadows cast by pit walls, can be used to place a lower bound on the thickness of the debris mantle comprising the pitted terrain. The thickness of the deposit, about 1 km, is similar to the 1-2 km thickness estimated for the layered terrain (5).

The stratigraphic relationships between layered terrain, pitted terrain and older units are summarized in Figure 2. The oldest unit in this region is densely cratered terrain. Superimposed on this unit is a smooth plains unit, which appears to be well consolidated because it has not been greatly eroded. For example, numerous bowl-shaped craters can be seen on the smooth plains unit. Pitted terrain materials overlie this smooth plains unit. With available data, it is difficult to tell if pitted terrain is a single depositional unit or consists of multiple units. Furthermore, layered terrain overlies the pitted terrain in places, partially burying several pits. This implies discrete depositional episodes, separated by a period of erosion. Using the cratering rate model of Hartmann (6), crater density data suggests that smooth plains are about 4 billion years old and that pitted terrain is about 1.5 billion years old. Thus, the production of layered terrain cannot be extended back in time further than about 1.5 billion years.

The unconformity between pitted terrain and layered terrain implies that the south polar region has experienced distinct sedimentary episodes, suggesting that climatic conditions governing the sedimentary process have varied over geologic time. No climatic models have as yet quantitatively addressed the origin of the pitted terrain or the timing of the transition between these episodes.

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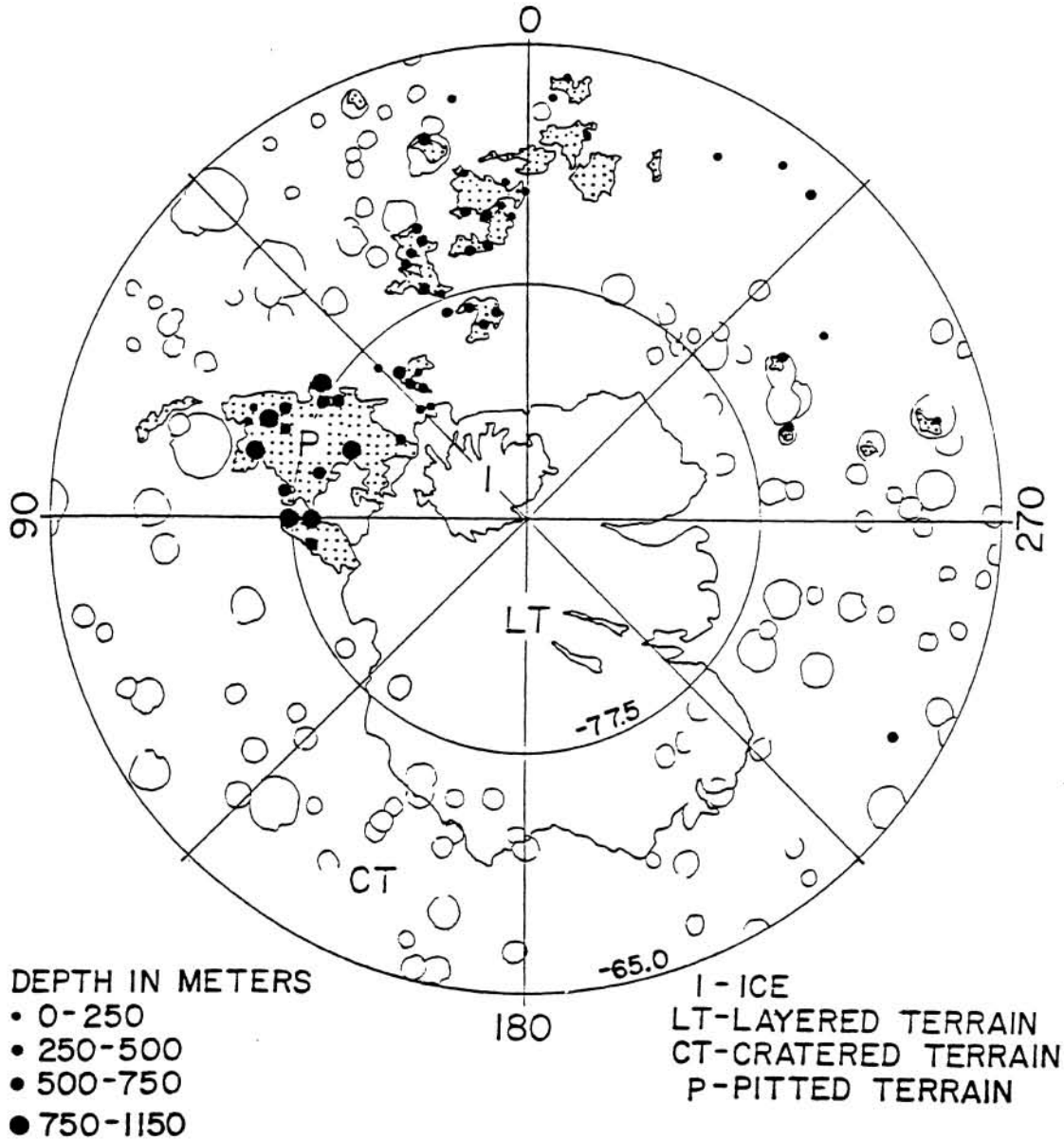

Fig. 1. Terrain map of south polar region of Mars. Pit depths derived from shadow measurements.

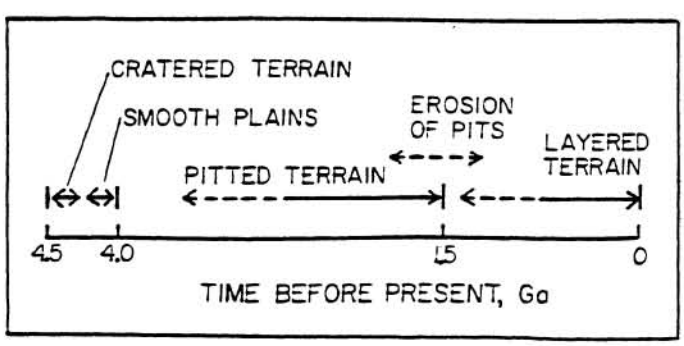

Fig. 2. Time sequence of terrain deposition. Relationships based on stratigraphic and cratering information.