TEMPEL 1: SURFACE PROCESSES AND THE ORIGIN OF SMOOTH TERRAINS. J. Veverka, P. Thomas[1] and A. Hidy[2], [1]Center for Radiophysics and Space Research, Space Sciences Building, Cornell University, Ithaca, NY 14853, veverka@astro.cornell.edu, thomas@baritone.astro.cornell.edu; [2]Utah State University, Logan, Utah 84322-0160, alanhidy@cc.usu.edu.

Introduction: On 4 July 2005 NASA's Deep Impact spacecraft [1] obtained high resolution views (better than 10m/pxl) of some 30% of the surface of comet 9P/Tempel 1. The images reveal the nucleus to be a geologically complex body with a) prominent layering, possibly of global extent, b) widespread preservation of apparent impact scars, c) strong evidence of scarp retreat and a diversity of slope morphologies, d) extensive smooth terrains strongly suggestive of flow deposits.

Layering: Three or four layers of significant lateral extent can be identified. Whether or not these are truly global in extent cannot be determined from the DI coverage. At least three layers have exposures 10's to 250 m in width, and appear to be steeply dipping relative to the surface over more than 3 km length. Other areas (lower right quadrant of Fig. 1) show remnants of layers up to a few 10's of m thick that essentially parallel the surface of the comet. Thus, at least

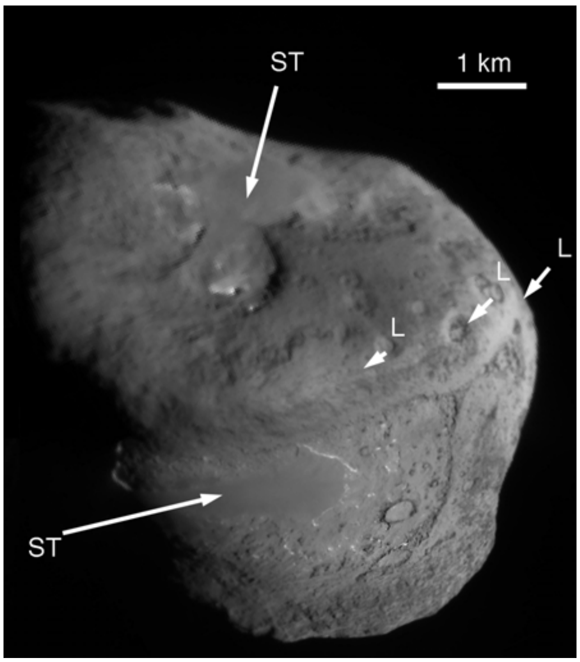

Fig. 1. Global view of the nucleus of Tempel 1. The two areas of smooth terrain (ST) are indicated, as are some of the more prominent layer boundaries (L). The scale bar is 1 km.

the top 500 meters or so of this under-dense nucleus (estimated mean density ~ 0.3 gm/cm^3 [2]) are layered. Differences in surface morphology suggest that the layers probably differ somewhat in composition and/or texture. It has been proposed that the layering reflects primordial accretion processes [3], but it is equally possible the layering is evidence of post-accretionary events. Less striking evidence of possible layering has been noted on other nuclei, for example Borrelly [4].

Scarps and Surface Erosion: There is widespread evidence of surface erosion (scarps, apparently exhumed crater rims, etc.) associated with volatile sublimation. However, only very limited exposures of water ice have been located on the current surface [5]. Scarps and related slopes typically range in height from 10 – 20 meters to 100 – 200 meters and display a variety of slope angles and morphology. This diversity is probably related to the rate and style of slope retreat; such differences must, in part, be due to differences in material properties.

Smooth Terrains: Two areas of extensive smooth terrain are evident. They are completely uncratered, suggesting a young relative age, and very smooth at meter scales. Both occur in gravitational lows [6]. The better imaged is an elongated tongue of material 3 km in length, 1 km wide, and at least 20 meters thick. Its surface displays sub-parallel markings suggestive of a "downhill" moving flow which

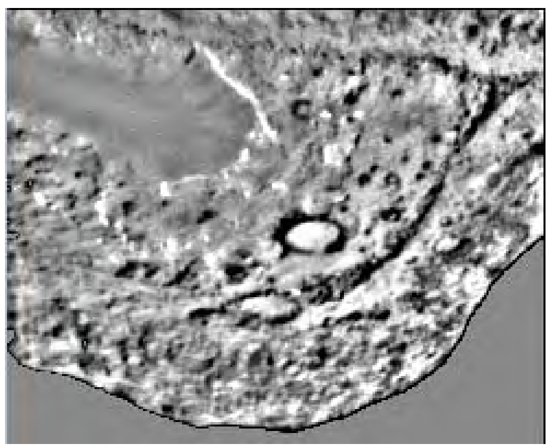

Fig. 2. High-pass filtered version of the bottom portion of Fig. 1 showing several flow-like characteristics of the ST area. Also note the extreme smoothness of the ST area compared to the surroundings.

spreads at this distal end (Fig. 2). This end is bounded by a scrarp with re-entrant digitate alcoves characteristic of slope retreat. A potential source area (only a few hundred meters wide) can be identified. The extremely smooth surface of this feature suggests that this putative flow consisted of materials which are extremely fine and uniform in texture. The characteristics of this smooth feature, and those of the less well imaged one as well, are consistent with those expected of young geologic features.

Craters: Several areas of the nucleus appear to preserve evidence of past cratering, suggesting that the nucleus spent significant amounts of time in environments in which sublimation erosion rates were very low compared to cratering rates. At least 60 craters ranging in diameter from 50 to 2500 meters can be identified. The resulting population has a slope of about -2 on a cumulative plot, consistent with a highly eroded crater population. The crater density is about one tenth that found on asteroid Gaspra [7]. This value, low by asteroid standards, nevertheless suggests a remarkably old age for portions of the surface of 9P/Tempel 1.

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