**SMOOTH REGIONS ON COMET 9P/TEMPEL 1: CRYOVOLCANIC EMPLACEMENT?.** K. J. Meech[1], L. Wilson[2], & D. Prialnik[3]. [1]Inst. for Astron., 2680 Woodlawn Drive, Honolulu HI 96822, meech@ifa.hawaii.edu, [2]Environmental Science Dept., Lancaster Univ., Lancaster, LA1 4YQ, UK, L.Wilson@Lancaster.ac.uk, [3]Tel-Aviv University, P. O. Box 39040, Ramat-Aviv, Tel-Aviv 68978, Israel, dina@planet.tau.ac.il

**Introduction:** On July 4, 2005 the NASA Deep Impact spacecraft flew past the nucleus of comet 9P/Tempel 1 [1]. Interpretation of the flyby and impact experiments have yielded new insight into cometary processes with new constraints on the extremely low thermal conductivity of the surface materials [2], the presence of near-surface ices [3] and a new comet formation paradigm [4]. High resolution images of the surface showed several regions of distinct morphology. One large smooth flow-like region was seen in the southern hemisphere (Fig. 1a).

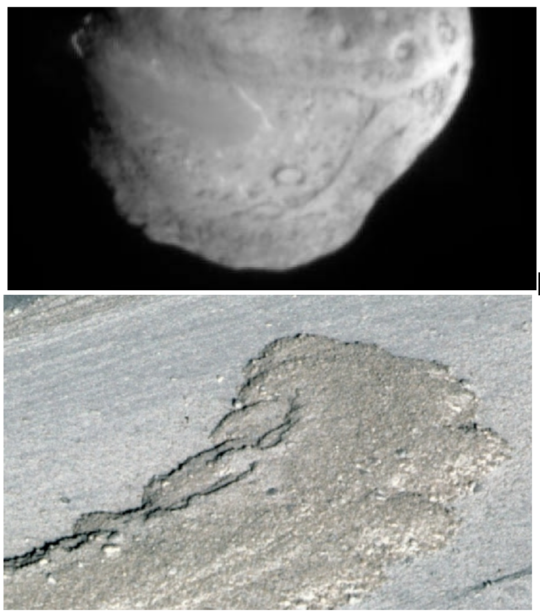
[a] [b]

**Figure 1**: [a] Composite Deep Impact image of the lower portion of the nucleus of comet 9P/Tempel 1 (the sun is to the right). The smooth region extends from beyond the terminator toward the lower right, and is bounded by a scarp ~20 m high [1]. [b] Pyroclastic density current deposit (~15 m wide, 1 m thick) on the flanks of Mount St. Helens volcano, August, 1980.

**Discussion:** The deposit has a smoother texture than most of the rest of the surface of the comet and, rather than filling a depression, is characterized by having somewhat lobate margins and a distinct boundary scarp (Fig. 1a). Its general morphology is reminiscent of some pyroclastic density current deposits on Earth, especially those that are emplaced on fairly shallow slopes and are fed from discrete, relatively small-volume source regions. Well-studied examples of such deposits include those from the dome-collapse events at Mount St. Helens following the May 1980 eruption (Fig. 1b). A distinctive feature of these is the presence of a relatively fine-grained interior and coarse-grained margins, the consequence of spatially varying degrees of fluidization of the deposit [5]. Fluidization of the interior of the flow maintains a low viscosity and high mobility, whereas elutriation of fine material by preferential gas escape at the margins leads to the development of a finite yield strength and high viscosity, allowing the steep levees and flow front to develop.

Comets commonly release jets consisting of a mixture of gas and small dust grains. The speed at which the dust travels away from the nucleus is a function of the dust/gas mass ratio in the source region, the dustsize distribution, the temperature of the volatile component when it is exposed to the surrounding vacuum, and the circumstances of that exposure. Initiation of the release may be the consequence of thermal changes penetrating the interior of the comet. When the dust is dominated by very small grains, efficient entrainment of most of the particles by the gas flow is expected, leading to the well-defined jets commonly observed. However, if the release occurs in part of the comet having a wide range of particle sizes, the potential for more complex processes exists. The mixture of gas and fully-entrained small clasts may act as a "dusty-gas", able to fluidize, but not fully entrain, the larger clasts, leading to the formation of a fluidized bed that, if sustained for long enough, will be capable of moving down-slope across the surface as a density current.

It is not yet clear if the same fluid-dynamic regime that operates in terrestrial pyroclastic density currents will operate in this kind of mixture of gas and particles released from the interior of a comet. However, we are exploring the possibility of such an explanation for the smooth deposit by modeling the combinations of volatile to non-volatile ratio, particle size distribution, and bulk material release rate that would allow a stable fluidized bed to form and to be maintained for a sufficiently long time to allow emplacement of a deposit of the size seen on the nucleus of comet 9P/Tempel 1.

**References:** [1] A'Hearn, M. F., *et al.* (2005) *Science* **310**, 258-264. [2] Groussin, O. *et al.* (2007) *Icarus* **187**, 16-25. [3] Sunshine, J. M. *et al.* (2006). *Science* **311**, 1453-1455. [4] Belton, M. J. S. *et. al.* (2006). *Icarus* **187**, 332-344. [5] Wilson, L. and Head, J.W. (1981) in ***The 1980 Eruptions of Mount St. Helens, Washington,*** U.S.G.S. Prof. Paper 1250, pp. 513-524.