DEEP IMPACT SITE AS IMAGED BY STARDUST NEXT ON COMET 9P/TEMPEL 1 REVEALS A STRONG SURFACE AND EXTENSIVE EJECTA BLANKET.

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Introduction: The Stardust NexT spacecraft imaged much of ~6 km-diameter Comet Tempel 1's surface during its February 14, 2011 flyby. The spacecraft captured the crater created during the Deep Impact mission when a "smart" 370 kg projectile impacted its surface at 10.2 km/s on July 4, 2005 [1]. One of the Deep Impact mission goals was to assess the surface physical characteristics of Tempel 1 through study of the size and shape of the resulting crater, however, the ejected gas and dust plumes were sufficiently opaque and long lasting to prevent the Deep Impact flyby spacecraft from imaging the impact site during its 800 s-long viewing window necessitating another imaging effort.

Imaged Crater and Ejecta Blanket: The impact location was projected using Deep Impact smart projectile imagery coupled with telemetered guidance data [1]. The impact site reported by the Stardust NexT team at the post-flyby briefing was a relatively subdued 100-150 m-diameter feature at the predicted impact position. However, the impact actually occurred ~400 m north (comet's reference frame) where a ~20 m diameter bright spot occurs with two associated bright rays. The impact location is confirmed by the position of the initial light captured by the Deep Impact flyby spacecraft; it is further confirmed by both the position of the shadow generated by the impact ejecta plume and the path of specular reflections from the comet's surface of the glowing projectile as it traversed a dust layer near the comet.

The impact feature is a relatively dramatic bright albedo feature on Tempel 1's surface, and is the greatest visible change in appearance of the comet's surface between the two flybys. The impact was oblique with an elevation angle to the surface of ~30º [1, 2]; at low impact angles both natural and artificial craters develop asymmetric ejecta blankets. The ~130º chevron-shaped ejecta blanket aligns to the impact direction with ejecta spanning a broad "V" open downrange. The two rays defining the edges of the chevron extend ~150 m; this ~7 ratio is typical of the crater diameter to ray lengths observed at other oblique impact sites.

Implications for Tempel 1 Surface and Cratering Processes on Small Bodies: The ~20 m crater size and ejecta blanket characteristics imply a surface strength of >~10 kPa near the strong end of previous estimates [2]. The ~20 m size also implies an ~10^5 kg ejecta volume near the small end of proposed ejecta volumes [2]. The extensive ejecta blanket (that survived a perihelion passage before the second imaging attempt) indicates ejecta excavation at velocities of order 1 mm/sec for a large fraction of the crater's ejecta despite the 10.2 km/s impactor speed and a relatively strong impacted surface at odds with current expectations; this also implies that regolith generation by hypervelocity impacts on small bodies is an efficient process. The ~1.5 km-thick, comet-shrouding dust layer inferred from reflections of the glowing projectile near impact explains the initial diffuse light signature recorded by the Deep Impact flyby spacecraft; light from the compact (subpixel size) ejecta cone was scattered to form a broad symmetric shape several pixels across.

References: [1] A'Hearn et al. 2005, *Science* 310:258-264. [2] Holsapple, K.A. and Housen, K.R. 2007. *Icarus* 187:345-356.