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Deep Impact: Excavating Comet Tempel 1

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On 4 July 2005, Deep Impact delivered 19 GJoules of kinetic energy to comet 9P/Tempel 1. On approach, we learned that outbursts by comets are far more common than previously realized and that they can be associated with regions on the surface. We can confidently rule out exogenic sources for these outbursts. The geology of the surface is clearly different from that of the few other cometary nuclei visited and very puzzling. There are clearly distinct layers, which are likely not complete shells. Surface photometric properties are reasonably uniform except in a few small areas. The impact itself was oblique. Most ejecta were cold, slow-moving, few-micron sized particles. After the first second, the ejecta include small crystals of ordinary ice, indicating excavation without heating and thus without chemical alteration. The ejected gases included a large amount of CO2 and a very large amount of organics in addition to water and species yet unidentified. The refractory to volatile ratio in the ejecta is greater than unity but not dramatically so. The ejecta enable us to determine both the strength of the surface layers at scales from microscopic to a few hundred meters and the bulk density of the nucleus, which must be extremely porous. This talk will present the current state of our rapidly evolving understanding of comet Tempel 1. This work was supported by NASA's Discovery Program.