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Do impactors on comets survive, buried in the nucleus ?

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Abstract

Like all objects in the Solar System, cometary nuclei are impacted by smaller bodies. However the nucleus surface does not necessarily keep a record of these events. Indeed parts of the surface are modified or renewed due to the sublimation of volatiles when the comet is close to the Sun, with local losses of up to 10s of meters resulting in the total erasure of small craters after a few orbits. Crater-like features have been detected on the least modified regions of cometary nuclei, with diameters as large as a few hundred meters [1]. They are usually flatter than craters of similar sizes seen on asteroids, mainly because of the specific physical properties of the surface (low density, porous material) and the evolutionary processes reshaping active regions. It should be noted that these circular features could also be interpreted as a result of the collapse of the dusty crust in a depression created by the sublimation of a subsurface ice chamber, and might not be impact related at all.

In this paper we discuss the fate of rocky impactors when they collide with a cometary nucleus. Typical collisions with planets or asteroids results in the total destruction of the impactor but this might not be the case when the target is a cometary nucleus. We model the collision to calculate the survival chances when hitting a very low density, highly porous object. In case of survival, we simulate how the local gravity field of the impact site is affected by the presence of a high density rocky body buried below the surface. We discuss whether a local gravitational enhancement can affect granular flows or dust deposition in the vicinity of the crater, and if this can be detected by in-situ missions like Rosetta.

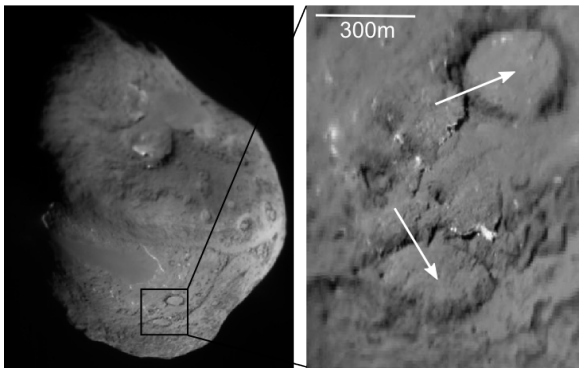

Figure 1: The nucleus of comet 9P/Tempel 1 as seen by the Deep Impact spacecraft in July 2005. Arrows indicate two circular features that are likely to be impact craters. Source: Deep Impact team

References

[1] Thomas et al, The shape, topography, and geology of Tempel 1 from Deep Impact observations, 2007, Icarus 187