

The “Strength” of Cometary Surface Material: Relevance of Deep Impact Results for Future Comet Missions

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In the view of the ongoing Rosetta Mission, which was launched in March 2004 and will arrive at the target comet, 67P/Churyumov-Gerasimenko in 2014, where a Lander is going to be delivered, the results of the Deep Impact Mission (in particular regarding comet surface properties) have been acknowledged with highest interest.

Analysis of the velocity of dust ejecta indicates very soft surface material of comet Tempel 1 with strength of only ≤ 65 Pa (A’Hearn, M.F. et al., Deep Impact: Excavating Comet Tempel 1, Science 310, 258-264, 14 Oct. 2005). It appears however necessary to discuss three principal issues in the interpretation of the data:

- 1.) By the impact shock itself, the material is stressed (fractured) and its tensile strength is modified. Thus, the pristine material properties can most likely not be determined with the applied method.
- 2.) Due to the impact a non-negligible amount of gas has been released from an extended source modifying the velocity distribution of the ejected dust particles. Thus, the detection of a minimum velocity of dust grains cannot be directly related to the material strength.
- 3.) The definition of “strength” in [A’Hearn et al., 2005] needs to be defined more clearly in order to draw conclusions on e.g. the penetration of a lander device with an impact speed of ~ 1 m/s. Slow penetration into cometary material is depending primarily on the compressive strength, which is typically at least one order of magnitude higher than the tensile strength

We will discuss the three issues stated above and estimate the real compressive strength of cometary surface materials. Modelling the touchdown of Philae (the Rosetta Lander) results in a maximum depth of the order of 20 cm. Experimental studies are being prepared at DLR to investigate low velocity penetration of blunt bodies into dust-rich, fluffy comet analogue materials.