CASSE - ACOUSTIC INVESTIGATION OF A COMETARY SURFACE; M. Kretschmer, U. Konopka, H. Kochan, D. Möhlmann, DLR, Institute of Space Simulation, D-51140 Köln, FRG

In 2003 the ESA Cornerstone Mission Rosetta will be launched for the first rendezvouz maneuver with a cometary nucleus. The proposed target comet P/Wirtanen with a orbital period of 5.5 years will be reached on his way to the inner solar system at a distance of 5 AU. Out there, Rosetta will be inserted into an orbit around the cometary nucleus and, after doing first inspections, will deploy two landing devices, RoLand and Champollion.

RoLand, the Rosetta Lander managed by the German Aerospace Research Establishment DLR, will perform first *in situ* investigations of the cometary surface material. The cometary material, a porous and loosely bound ice/dust mixture [1,2] with a density of 0.2 gcm^{-3} (P/Halley) [3], is of special interest because it is supposed to be rather unchanged since the formation of our solar system, having spent most of the recent 4 Ga in the Oort-Cloud far beyond Pluto's orbit.

Once scattered into the inner solar system, the surface composition is changed by outgasing of volatile ices, as CO_2 and water, due to solar heating, leaving a dusty surface regolith layer which consists of the cometary mineral material, from dust grain (μm) up to boulder size (m). The thickness of this regolith layer is assumed to be a few meters. [4]

On board RoLand, the experiment CASSE (Cometary Acoustic Sounding and Seismic Experiment) will perform audio acoustic investigations of the surface layer. Each of the three legs of RoLand is planned to be equipped with piezo-electrical devices which combine acoustic transmitters and receivers. Thus, it should be possible to measure sound velocities of different wave types, p and s waves, to determine elastic parameters of the surface material. Furthermore, CASSE is able to work as an acoustic radar, detecting the near-by composition of the underground, especially the thickness of the regolith layer.

Preparatory experiments dealing with sound waves in porous ice ($\rho \approx 0.4$ gcm^{-3}), ice/dust mixtures (Cometary Analog Material, CAM) and pure dust (Dunite) were performed at the Institute of Space Simulation, DLR Cologne. The results, e.g. the acoustic attenuation in Dunite (Fig. 1), show that acoustic investigation of the assumed cometary regolith layer should in general be feasible.

Further experiments will focus on different CAM compositions, e.g. the addition of *organica* observed on comets; detecting layers in stratified media, and methods of acoustic 'imaging' of structures (caves/boulders) in the underground.

References:

[1] Whipple, F. L., A comet model. I. Acceleration of Comet Encke. *Astrophys. J.* **111,** 374-394, 1950.

[2] Whipple, F. L., A comet model. II. Physical relations for comets and meteors. *Astrophys. J.* **113**: 464-474, 1951.

[3] Keller, H.U., *et al*, Comet P/Halley´s nucleus and its activity, *Astron. Astrophys.* **187**, 807-823, 1987.

[4] Möhlmann, D., Surface regolith and environment of comets, *Planet. Space Sci.* **Vol. 42**, No. 11, 933-939, Nov. 1994.

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Fig. 1: Acoustic attenuation in mineral dust (Dunite) with μm grain size as an extreme case of a cometary regolith layer. The figure shows, that a leg-to-leg sounding (i.e. over a distance of app. 1.5 m) should work on the cometary surface, even if it would consists of pure mineral dust.