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Layerings in cometary nuclei

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Comets are believed to have been formed in the outer regions of the solar nebula, and may thus allow us to constrain the chemical, mineralogical, and physical conditions in the early solar system. Several cometary nuclei visited by spacecraft appear to have a surface that consists of layered material. These layerings help us understand whether the nuclei formed as rubble piles by hierarchical accretion, or through streaming instabilities, or if a hybrid model is most appropriate [1]. Their curvature and orientation also indicate whether comets are primordial bodies or collisional remnants of much larger bodies.

When the Rosetta spacecraft arrived at comet 67P/Churyumov-Gerasimenko, its instruments returned data of unprecedented scope and resolution, which made possible a detailed examination of the layerings on the nuclei of a comet. An initial study of these layerings found that the comet appears to consist of two independent lobes that are concentrically layered to a depth of several hundred meters below the surface [2].

In order to take measurements of three-dimensional structures on the surface of cometary nuclei, we project images onto a shape model of the nucleus. In the case of comet 67P we used data from the OSIRIS Narrow Angle Camera and a shape model produced from these images. We extrapolate the orientation of potential layerings by mapping discontinuity surfaces where they are exposed at cliffs and hillsides (Figure 1), and by projecting them into the nucleus surface. We model the global orientation of the layerings by fitting ellipsoidic shells to our measurements [3].

Results of the measurements and analysis of the layerings are presented and compared to findings by Penasa et al. [3].

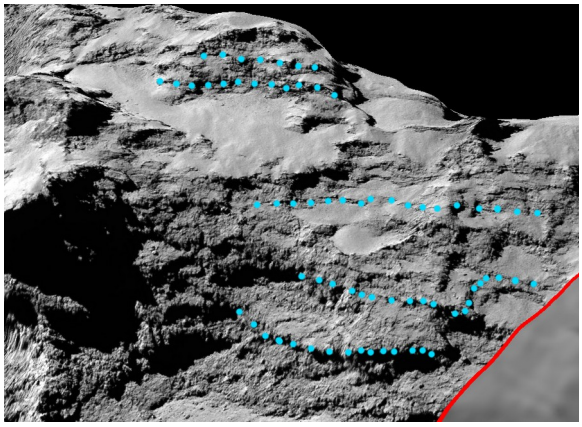

Figure 1: Screenshot of the software used for mapping, which projects OSIRIS images (framed in red) onto a shape mode (visible in lower right corner). Blue dots represent locations of measurements.

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References

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