Geophysical Research Abstracts
Vol. 19, EGU2017-12620, 2017
EGU General Assembly 2017

Material strength on 67P/Churyumov-Gerasimenko and its influence on cliff stability

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The OSIRIS scientific camera system [1] on board ESA's Rosetta spacecraft has been observing comet 67P/Churyumov-Gerasimenko since its arrival in August 2014. Visible on the OSIRIS images are cliff structures with associated taluses at their bottom. It is likely that these taluses were created during a (partial) collapse of the neighboring cliff. Several of these taluses display individual boulders with different brightness and spectral slope than the rest of the boulders, indicating a varying content of volatiles.

A possible cause for the collapse of cliffs is thermal stresses and heat that intensify the fracturing of possibly pre-fractured walls or form new fractures. This results in sublimation with a progressively eroding cliff. The direct consequence is the occurrence of gravitational events and formation of boulder fields at the foot of the cliffs [2,3]. Both of these processes serve to weaken the structural integrity of the cliff but it is unclear how large the relative contribution of these processes is.

In this study we investigate how the depletion of volatiles and damage to the cliff structure introduced by cracks will change the integrity and stability of the cliff. We aim to derive limits to the material strength to be compared to those found from observed cliffs and cliff collapses [4,5] using the DEM software ESyS Particle [6].

Acknowledgements: OSIRIS was built by a consortium led by the Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany, in collaboration with CISAS, University of Padova, Italy, the Laboratoire d'Astrophysique de Marseille, France, the Instituto de Astrofísica de Andalucia, CSIC, Granada, Spain, the Scientific Support Office of the European Space Agency, Noordwijk, The Netherlands, the Instituto Nacional de Técnica Aeroespacial, Madrid, Spain, the Universidad Politécnica de Madrid, Spain, the Department of Physics and Astronomy of Uppsala University, Sweden, and the Institut für Datentechnik und Kommunikationsnetze der Technischen Universität Braunschweig, Germany.

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