Geophysical Research Abstracts
Vol. 21, EGU2019-14431, 2019
EGU General Assembly 2019

Deformation mechanisms during the lobe-merging impact of comet Churyumov–Gerasimenko/67P

Marco Franceschi (1), Luca Penasa (2), Matteo Massironi (1), Sabrina Ferrari (2), Giampiero Naletto (2,3,4), and the OSIRIS Team

(1) Geosciences Department, University of Padova, Via G. Gradenigo 6, I- 35131 Padova, Italy, (2) Center of Studies and Activities for Space, CISAS, 'G. Colombo', University of Padova, Via Venezia 15, I-35131 Padova, Italy, (3) Department of Physics and Astronomy, University of Padova, Via Marzolo 8, I-35131 Padova, Italy, (4) CNR-IFN UOS Padova LUXOR, Via Trasea 7, I-35131 Padova, Italy

High-resolution observations of comet 67P/Churyumov–Gerasimenko performed by the OSIRIS camera system onboard Rosetta have revealed a bilobate nucleus formed by the collision of two cometesimals, currently linked through a narrow bridge of cometary material (the neck region). Each lobe displays a prominent layering, organized in a concentric, onion-like fashion, which attests that the two bodies formed independently before their merging. The overall shape of the two independent layered structures, whose exposure on the surface of the comet gives rise to a characteristic staircase pattern, is well approximated as a concentric set of ellipsoidal shells (Penasa et al., 2017). Here we show that a refined 3D reconstruction of the layer arrangement and the features visible on the comet surface reveal some major deviations from this idealized form shedding light on the rheology and deformation mechanisms of the two lobes. Direct evidence of deformation is visible in the neck region where the layered structure is folded indicating dextral strike-slip kinematics. The new 3D model shows that with respect to the ellipsoidal reference shape, the smaller lobe appears compressed along an axis that links the neck region and its antipodes, and expanded in the directions orthogonal to this axis. The largest lobe, instead, displays compression in a restricted area close to the neck region that seems compatible with a more localized damage produced by the impact of the less-massive small lobe. These features are consistent with the deformation that could be expected following the impact that merged the two planetesimals and demonstrate that the lobes behaved plastically when they collided and that deformations were accommodated by folds in the layered structure and by the development of a pervasive small-scale fracture-network. Large-scale (>100 metres) fractures testify that the plastic deformation in some instances led to brittle failure which likely triggered the detachment of large volumes of material.