Geophysical Research Abstracts
Vol. 17, EGU2015-5017, 2015
EGU General Assembly 2015

A Comparison of the Size Frequency Distributions of the Quasi-circular Flat-floor Depression Structures on Comet 67P/Churyumov-Gerasimenko and Comet Wild 2

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The close-up views of comet 67P/Churyumov-Gerasimenko by the OSIRIS camera system on board Rosetta have shown that the nucleus structure can be broadly divided into three parts: head, body and neck (Sierks et al., 2015; Thomas et al., 2015). The surfaces of the head and body are covered by near-circular flat-floor depression structures (or pits). The relatively large diameter-to-depth ratios do not follow the pattern of impact craters. Some of these structures are embedded with sinkholes characterized by active outgassing in the form of dust jets (Vincent et al., 2015). The largest structure with a diameter of about one km – if of the same physical nature - is located at the tip of the head in Hamehit. Such steep-walled and flat-floored depressions have also been found on comet 81P/Wild 2 by Stardust in the 2004 encounter (Brownlee et al., 2004). The size frequency distributions of these surface structures are similar even though they have different power-law behaviors. This comparative study suggests the interesting possibility that the flat-floored depressions on both comets could have similar origin and evolutionary history. From a comparison of the size frequency distributions of the impact craters on the Martian moons, Phobos and Deimos, and the Saturnian icy moon, Phoebe, with that of comet Wild 2, Cheng et al. (2013) proposed that erosion/subsidence process of impact craters due to active outgassing could be at play in the modification of the original diameter-depth relation to the present flat-floored structure. Floor collapse of a deep-seated cavity filled with volatile ice is another alternative mechanism (Vincent et al., 2015). Because the bulk density of comet 67P is only 470+/-45 kg/m3, its interior must be highly porous. It remains to be investigated how would such porous structure be related to the quasi-circular depression features (Marchi et al., 2015).

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