Intense Morphological Changes in a cliff situated at the Khonsu region of 67P/Churyamov-Gerasimenko

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Abstract

Situated along a latitude band of -11 to -25 degrees, Khonsu cliff is an area that experienced dramatic changes during the perihelion passage of August to September 2015. Firstly, Deshapriya et al. (2016) showed many bright spots appearing in this zone. Secondly, Vincent et al. (2016) pointed out two bright ejections in the area. However, further analysis of two full rotational sequences at August 1st 2015 reveled a total of 30 events of varied brightness. Most of the events cluster on the northern reach of the cliff and are apparently "dusty" (VIS spectral slope of 8-12 %/(100 nm)). In particular, two bright events occurred during cometary night in the same area, but almost one rotation apart.

Once these mass ejection events were located and identified, we searched through OSIRIS database of image sequences to search for morphological and/or spectrophotometric counterparts. After perihelion passage, closest images were obtained during the "Target of Opportunity observations" in June and July 2016, while before perihelion only a couple of images were taken in low altitude (30 km) on January 16th 2015 01:27. Comparing both sets, we identified 8 features related to mass loss and one new displaced boulder of tens of meter size (El-Maarry et al., 2017). Among these features we have 6 shallow cavities of 1.6 to 16.4 meters depth and 20 to 100 meters length, one retreating scarp of 25 meters height and 100 meters length and one mound of 16 meters height and 30 meters length. After the perihelion passage, the mound gave space to a 2.6-meter depth cavity and two cavities appeared, of 2.7 and 5-to-16 meters depth each. Looking precisely on the location of the previously identified events, we unveil an evident heterogeneity, the source points cluster in 5 morphological changes: the new "jumping boulder", the retreating scarp, a thick dust missing layer and one cavity in an extended bright patch. Except for the bright patch and the bordering part of the scarp, all mass ejection sources are apparently dry after 9 months of southern "summer fireworks" in late 2015. This is different from January 16th 2015 when most of the northern part of the cliff had VIS spectral slope inferior to comet average.

Finally, we estimate an ejected mass for a single perihelion passage, in respect to the global density of 533 kg/m3 (Paetzold et al., 2016; Jorda et al., 2016), of $3.4 \cdot 10^8$ kg, which correspond to 3.4% of the total ejected mass estimated by Paetzold et al. (2017). The minimum gas flux to release the largest buried mass is $1.2 \cdot 10^{22}$ $m^{-2}s^{-1}$ according to El-Maarry et al. (2017, Supp. Mat.) formulation. The characteristic features' depth and apparent violence of several events advocates for sub-surface energy storage mechanism (Agarwal et al., 2017) instead of a predominance of cliff collapses as raised by Vincent et al. (2016) and exemplified in Pajola et al. (2017).

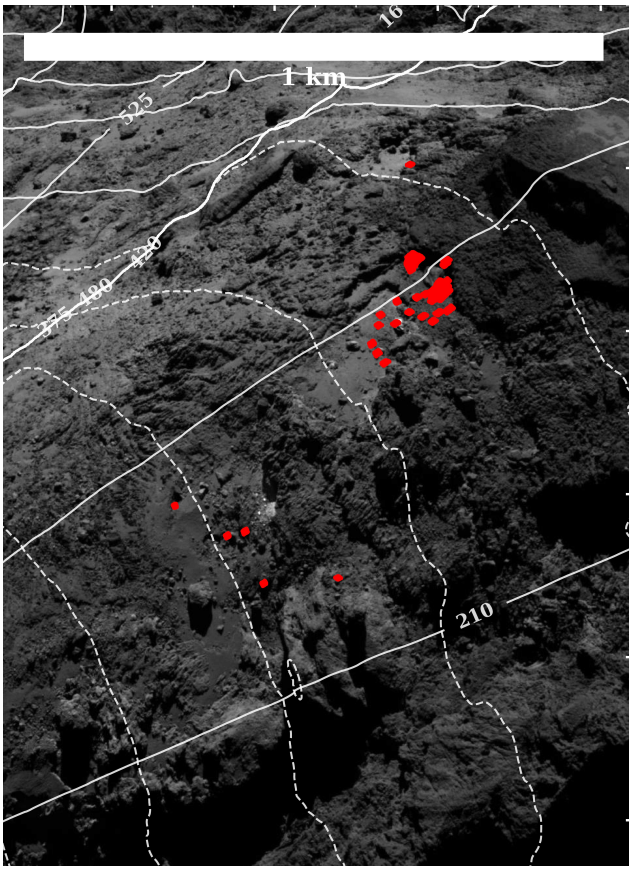

Figure 1: **All jet sources projected onto NAC image of January 30th 2016, 14:11.** Positions for events #7 (−12, 196) & #33 (−25, 198) of Vincent et al., 2016 are also included there. Most of the documented events cluster on the northern outskirts of Khonsu cliff, with sparse sources located in the southern reach.

References

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