Mapping of exposed bright features on the comet 67P/Churyumov-Gerasimenko

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Abstract

Within the context of Rosetta space mission to the comet 67P/Churyumov-Gerasimenko (67P), our study focusses on the distribution and evolution of exposed bright features on the comet, that have been observed by OSIRIS, the scientific imaging instrument aboard Rosetta. With multi-filter OSIRIS data available from near-UV to near-IR wavelengths, it is possible to perform spectrophotometric studies [1] on these bright features. Present work includes a catalogue of 57 exposed bright features observed on the nucleus of the comet, all of which are attributed to the presence of H_2O ice on the comet 67P according to their spectrophotometry [2]. Depending on the morphologies of these features, four types (Fig. 1) of features are identified suggesting different mechanisms that would have triggered their appearance. It is shown that despite the nucleus of the comet 67P appears to be dark in general, there are localised H_2O ice sources on the comet and that cometary activity escalating towards the perihelion passage reveals such volatile ices. It is proposed that isolated H_2O ice patches found in smooth terrains in regions, such as Imhotep, Bes, and Hapi, result from frost as an aftermath of the cessation of the diurnal water cycle on the comet as it recedes from perihelion. Upon the comet's return to perihelion, such patches are revealed when sublimation-driven erosion removes the thin dust layers that got deposited earlier. More powerful activity sources such as cometary outbursts are capable of revealing much fresher, less contaminated H_2O ice that is preserved with consolidated cometary material, as observed on exposed patches resting on boulders. This is corroborated by our albedo calculations that attribute higher albedo (~ 0.5) for bright features with formations related to outbursts. The survival times before complete sublimation for the features vary in the range of few days to several months, reflecting the combined effect of both diurnal and seasonal insolation conditions on the surface.

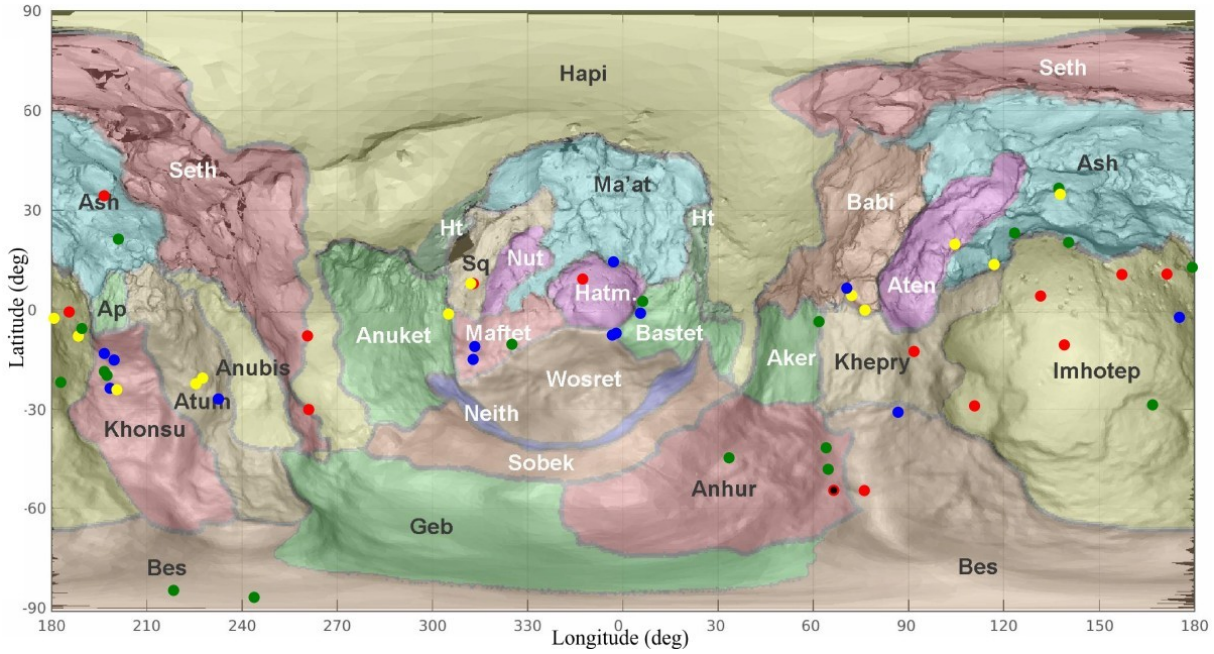

Figure 1: Map of bright features observed on 67P: The detections of H_2O ice are presented in different colours that correspond to four feature types and the black dot indicates the unique detection of CO_2 ice [3] where H_2O ice was detected few weeks later [4]. This map is the cylindrical projection of a merged shape model resulting from the shape models SHAP4S [5] and SHAP5 [6] respectively for the northern hemisphere and the southern hemisphere.

References

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