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The Evolution of Aeolian-Like Morphologies on Comet 67P Churyumov-Gerasimenko

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Abstract

We investigate aeolian-like wind-tails on comet 67P Churyumov-Gerasimenko. These features are associated with particle transport induced by cometary activity. Our aim is to understand their formation processes for which we use OSIRIS and ROLIS images to characterize changes in wind-tail morphologies and orientation that occur over the timespan of the Rosetta visit at the comet.

Introduction

High resolution image data of the ROLIS and OSIRIS instruments on-board the Rosetta spacecraft and its lander Philae revealed the presence of aeolian-like morphologies on 67P's surface [e.g. 1, 2, 3], such as elongated wind-tail like deposits and moat-like depressions around some larger boulders (> 5 m, Figure 1). Such features are commonly associated with wind accumulation and wind erosion on Earth and other planets [e.g. 4, 5]. However, the formation mechanism of wind-tail-like features on Churyumov-Gerasimenko appears to be of different origin. It is probable that they form as a result of abrasion of a sand-bed of air-fall particles [3]. This process may be dependent on the activity level of the comet. Fortunately, the Rosetta Mission accompanied 67P during a range of different activity levels from the relatively calm pre-perihelion phase to the active perihelion passage. The image data of the OSIRIS camera on-board Rosetta of these different activity stages give us the opportunity to relate the aeolian-like wind-tail morphology, distribution and formation process with cometary activity levels.

Previously, we have reported on the distribution and orientation of such wind-tails found in pre-perihelion images and reported an accumulation of wind-tails in the Ma'at region and a tendency of the wind-tails to point north [6]. In this work, we investigate the evolution with time of aeolian-like wind-tails on 67P aiming at a better understanding of how they form and what they tell us about the particle distribution processes on comet 67P.

Method and Data

We investigate boulders with wind-tail like morphologies in OSIRIS images and ROLIS descent images. We concentrate on a set of exemplary boulders with associated wind-tail like morphology in a series of subsequent images and analyze their morphologic evolution with time. This includes the characterization of the orientation, size, slope and volume of the wind-tails. The specific boulders are located near the first touchdown area of the Philae lander in the Ma'at region (small lobe) and the Ash region (big lobe). We also investigate the evolution of the wind-tail like morphology of the boulder observed with the ROLIS camera during the Philae descent (Figure 1).

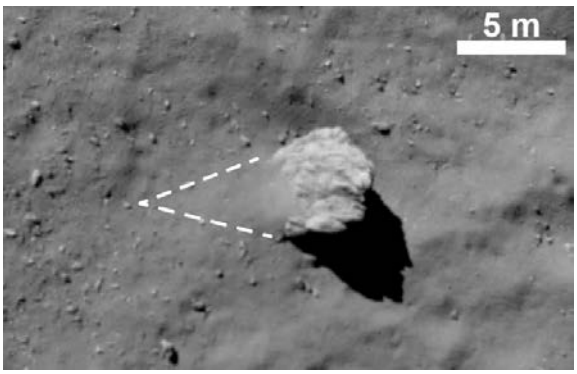

Figure 1: Boulder with wind-tail like feature imaged by the ROLIS camera onboard the Philae lander. The boulder is approximately 5 m across and possesses a moat opposing a wind-tail like feature (dashed line). Image extracted from Mottola et al. (2015) [3].

Results

Due to Rosetta's changing distances from the comet surface, the resolution of the image data varies with time. Additionally, different illumination and observation angels posed difficulties in tracking changes. Having these limitations in mind, the wind-tail like morphologies did not significantly change their shape or orientation over the timespan observed. This may hint at the wind-tail like morphologies being less fragile compared to other features observed in smooth areas on 67P (e.g. [7]) or at the wind-tail formation as a sustainable process.

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