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The Central Crater Region on (21) Lutetia

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Abstract

A crater structure of about 21 km diameter is the most prominent feature on the hemisphere of Asteroid (21) Lutetia that was observed by the OSIRIS cameras during the flyby of the Rosetta spacecraft. It shows the presence of landslides, numerous large boulders, and the largest colour variations found on the surface of the asteroid. We present evidence that it is the youngest large geological feature seen by Rosetta, and we show that there are variations in composition or size of its surface material.

1. Introduction

When Rosetta flew by asteroid Lutetia in July 2010, the OSIRIS cameras imaged about half of its surface with a resolution of up to 60 m/pixel [1]. The most prominent structure is a crater complex close to the North Pole of the asteroid (Figure 1).

2. Boulders

There are about 200 boulders larger than 60 m (the approximate detection limit) visible in and around the crater, with only a few scattered to larger distances. We model the trajectories of boulders ejected from the central crater. The launch velocities were taken from semi-empirical size-velocity distributions of impact fragments [2], and the gravity of Lutetia was calculated from the shape model of the asteroid described in [1], using the analytical formula for the gravity of a polyhedron [3]. The model results are consistent with the observations, suggesting that indeed most of the boulders visible on Lutetia are resulting from the impact that created the central crater.

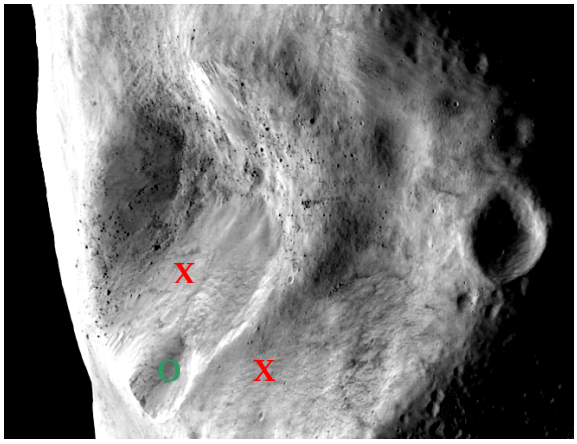

Figure 1: Image of Asteroid (21) Lutetia taken near closest approach. The central crater is visible on the left. It is surrounded by large boulders (60-300 m diameter) except for the part covered by a landslide.

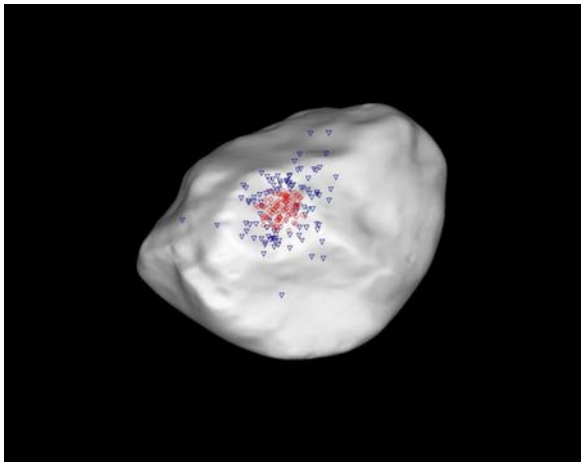
Figure 2: Launch (red) and landing (blue) positions of boulders ejected from the central crater of Lutetia.

Some of the boulders are visible in smaller craters, indicating that the central crater is younger than these impact features that surround it. Additional evidence for a young age is provided from the boulder size distribution that is less steep than expected from scaling laws [2]. We will provide estimates of the age of the crater from the analysis of boulder destruction mechanisms (impact destruction, burying by regolith, thermal stress).

3. Landslides and Colours

The regions covered by landslides are denoted with "X" in Figure 1. The landslides may either be material having moved down the newly formed crater or may have been caused by the impact creating the crater denoted "O" in Figure 1. The material in the landslides is darker and bluer than its surroundings, even after illumination corrections are applied. Either the material sliding down consists of smaller particles (possibly through impact comminution), or its composition is different from that of the surrounding material.

4. Summary and Conclusions

The presence and distribution of many boulders shows that Lutetia's interior is made at least partly of solid rock. The boulders are concentrated at the central crater, the youngest geological region of the observed hemisphere of Lutetia. At the same time this region shows the largest observed colour variations, with material that moved down in landslides being bluer than its surroundings. The large variation within a region may indicate some global scale regolith transport on the asteroid.

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