COMPARISON OF MASS-WASTING FEATURES IN CRATERS ON ASTEROID 4 VESTA AND THE MOON.

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Introduction: Mass wasting on airless rocky bodies is driven by gravity and often triggered by seismic shaking of nearby impacts. We will analyze the similarities and differences of mass wasting features on the Moon and asteroid Vesta in relation to their gravity. Although the Moon's gravitational acceleration (~1.6 m/s²) is about six times larger than asteroid Vesta's (~0.24 m/s²) and both have different orbital properties, they show several similar mass-wasting features. Here, we focus on the mass-wasting processes in two famous craters: the Rheasilvia crater (~500 km in diameter) on Vesta and the Tycho crater (~86 km in diameter) on the Moon.

Asteroid Vesta: Vesta is the second most massive asteroid of the main asteroid belt between Mars and Jupiter and has been orbited by NASA's Dawn spacecraft in 2011 / 2012. Vesta is a differentiated oblate spheroid shaped proto-planet with a mean diameter of ~525 km. One of Vesta's most prominent features is its ~500 km diameter south polar impact basin, called Rheasilvia [1, 2].

Methods: For comparison of Vestan and Lunar mass-wasting features we used the Low Altitude Mapping Orbit (LAMO) data from the NASA Dawn mission with a resolution of ~20 m/pixel [3, 4] and Wide Angle Camera (WAC) data from the Lunar Reconnaissance Orbiter (LRO) mission with a resolution of ~100 m/pixel [5]. For topographic analysis of the terrain, we used a Digital Terrain Models (DTM) of Vesta [6] and of the Moon [7], both with a spatial resolution of ~100 m/pixel.

Results: Figure 1 shows differences and similarities between the Rheasilvia crater on Vesta and the Tycho crater on the Moon. We found intra-crater mass-wasting in both craters, such as slumps, slides and flow-like features.

The slides at Tycho can be divided into rock slides and debris slides [8], where rock slides are sheets of impact melt moving down a slope and debris slides are composed of displaced smaller sized grains. The slides on Vesta are predominantly debris slides forming landslide bodies of up to 100 km in length (Fig.1) [9]. Slides of this dimension in Tycho only occur outside the crater and are associated with impact ejecta.

Flow-like features are observable mainly between 35°E and 95°E in Rheasilvia and in the north and south of Tycho; however, they appear rarely (Fig. 1). They are slides of low friction or liquid behavior developing striations [8, 9]. They are often associated with impact melt or ejecta [9, 10].

Additionally, slumps form on the crater rims of Rheasilvia and Tycho. Slumps are characterized by a relatively short mass movement on a concave surface of rupture forming slumping blocks (Fig. 2). Slumping in Tycho is distributed along the entire crater wall, whereas in Rheasilvia the slumping areas are often eroded by later debris slides.

Conclusion: The study of Rheasilvia and Tycho shows similar mass wasting processes in both craters, such as slumps, slides and flow-like features. The different physical conditions, like gravity or surface material properties may cause differences in the morphology.

Rheasilvia shows a smooth transition between crater floor and crater rim, whereas the transition at Tycho is more distinctive. The most common degradation process in Tycho is slumping forming steep scarps. Rheasilvia has also been eroded by large debris slides forming a smooth transition between crater wall and floor.

Slumping is triggered when gravity forms a torque on the slumping body which exceeds the frictional forces. Therefore slumping develops more efficiently on bodies with higher gravity.

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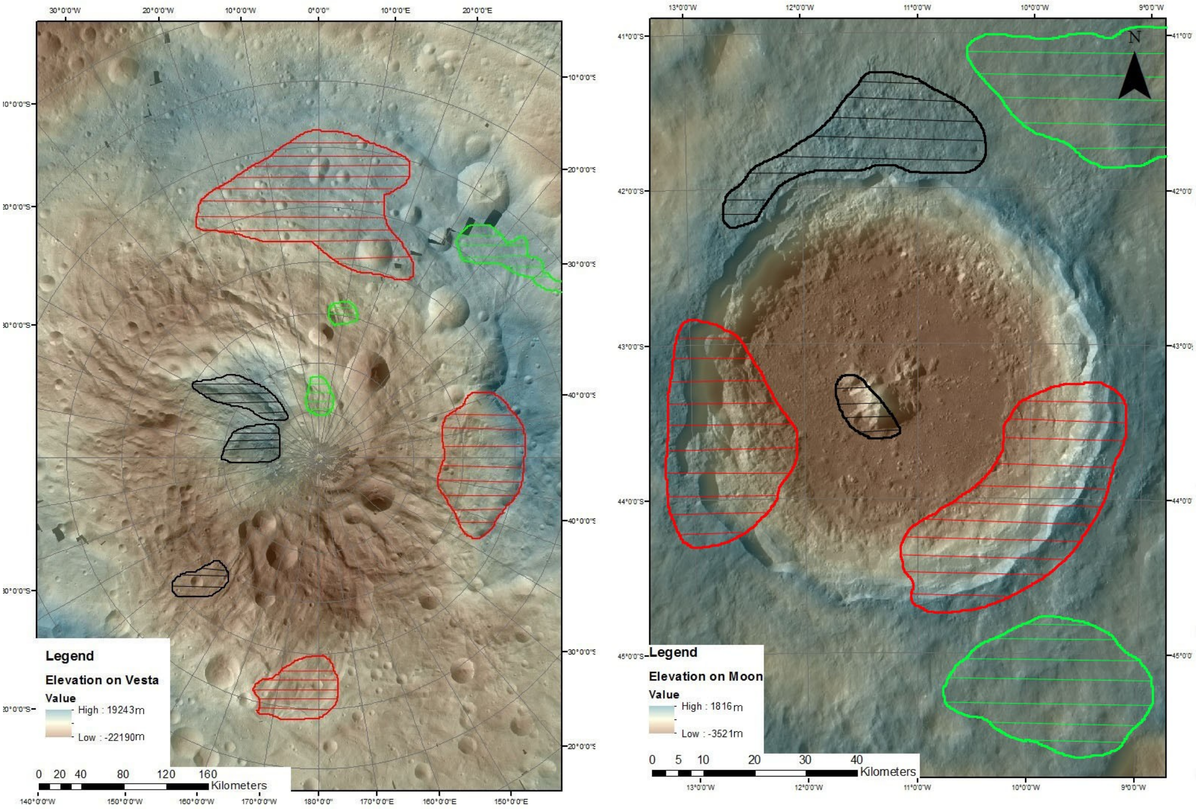

Fig. 1: Distribution of slumping, sliding and flow-like areas inside Rheasilvia (left) and Tycho (right); red: slumps, black: slides, green: flow-like features.

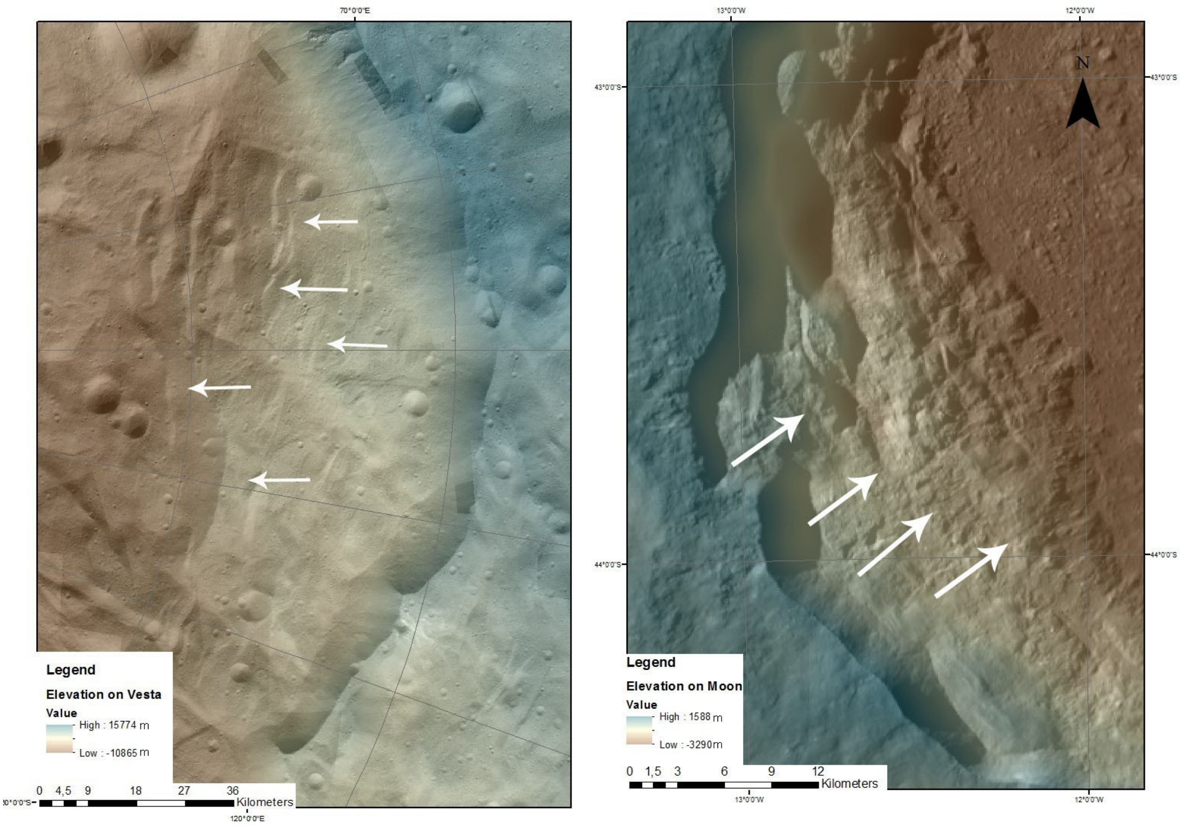

Fig. 2: Slumping areas within Rheasilvia (left) and Tycho (right). The arrows indicate heads of slumping blocks.