AN LROC UPDATE: THE TSIOLKOVSKY LANDSLIDE: Joseph M. Boyce[1], Peter Mouginis-Mark[1], and Mark Robinson[2], [1] Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI, 96822, [2] School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85281. jboyce@higp.hawaii.edu

Introduction: The Tsiolkovsky landslide was created when the western rim of Tsiolkovsky crater collapsed, sliding on to the floor of Fermi crater [1-4]. This slide is the only long run-out landslide found on an airless body (completely dominated by friction). Consequently, it represents an end-member of long run-out landslides, and its study offers an opportunity to gain insight into the mechanics and conditions that control the emplacement of such features.

Morphology: Tsiolkovsky crater's rim collapsed in two places leaving a pinnacle on the rim, and producing two adjacent landslides (Fig. 1). A trough between the slides extends from the pinnacle on the rim outward. The northern slide (Slide A) is fan-shaped, grooved radially, and has a low, narrow terminal rampart [1 - 4]. The grooves are strikingly similar to those on the Sherman rockslide [5]. The southern slide (Slide B) has two parts: a northern part similar to Slide A, but with a well-developed terminal ridge, and an irregular-shaped, hummocky, groove-free southern part. Their differences in morphology (e.g., presence or absence of lineations) may be due to differences in roughness of the pre-slide surface [see 6] where the southern part of Slide B likely traveled across hummocky ejecta from Tsiolkovsky while Slide A and the northern part of Slide B were emplaced on the plains in Fermi crater. Normally the cratered plains should be buried by ejecta because of their proximity to Tsiolkovsky but, as noted by [7], Tsiolkovsky ejecta are asymmetrical with thin or no deposits in area of slide A.

Morphometry: Slide A is ~65 km long [L], its volume [V] is ~1325 km^3, a vertical drop from its original position of ~4.5 km [H], an L/H = 14.4, and a coefficient of friction [H/L] of 0.07. For slide B: L = ~73 km, V = ~ 1659 km^3, H = ~4.5 km, L/H = ~ 16.2 and H/L = ~0.06. Fig. 2 plots the L/H ratio and V, and Fig. 3 plots H/L ratio and V for Slide A and B, and terrestrial and Mars long run-out landslides. These plots show that the mobility and coefficient of friction (efficiency) of Slides A and B are comparable to some long run-out landslides on Mars in Valles Marineris (VM), but less efficient than those on Earth, which has implications for the landslides in VM [8].

Superposed Impact Craters: Previous investigators suggested that there is a high density of small fresh craters on the slide, and that these craters may be caused by drainage of fine-grained ejecta into voids [2], degassing [1], or differences in material properties such as an absence of a regolith on the landslide [9]. Crater counts, using NAC images (Fig.4), show that the density of craters on the slide is no greater than on any surrounding unit hence, the earlier perception of a high density of small craters on the slides compared with the surrounding units is incorrect. In addition, LROC NAC images clearly show that most craters on the slides have raised rims, hence not rimless drainage craters. Also, crater chains are not found along the grooves, hence a degassing origin is unlikely.

Conclusion: The Tsiolkovsky landslide is actually two adjacent slides formed nearly simultaneously (at about ~ 3.6 Ga.), likely soon after Tsiolkovsky crater. Their morphologic differences are probably due to differences in the terrain they traversed. They were emplaced dry, but have similar efficiencies as slides in VM. The density of small craters on the slides appears greater than it is, possibly due to a lower rate of morphologic maturing. This work supported under a NASA GSFC/ASU LROC contract.

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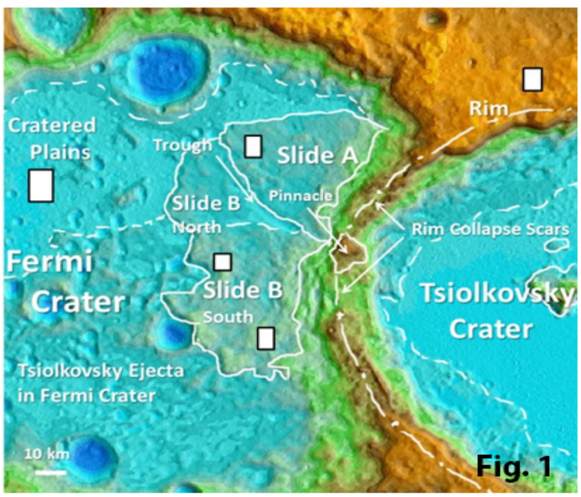

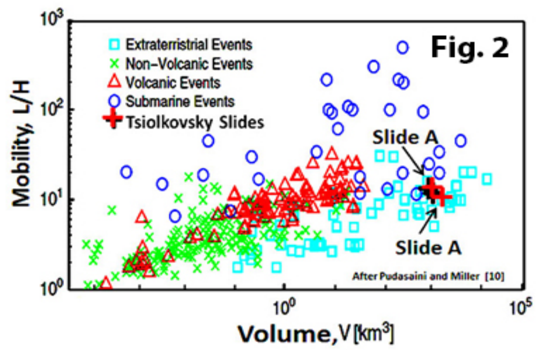

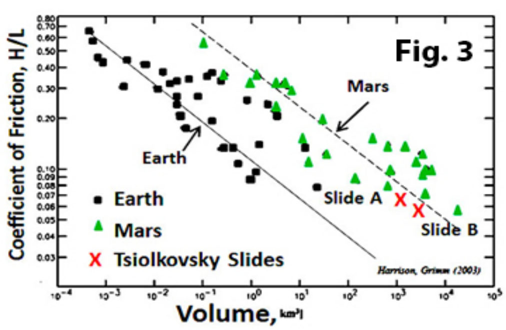

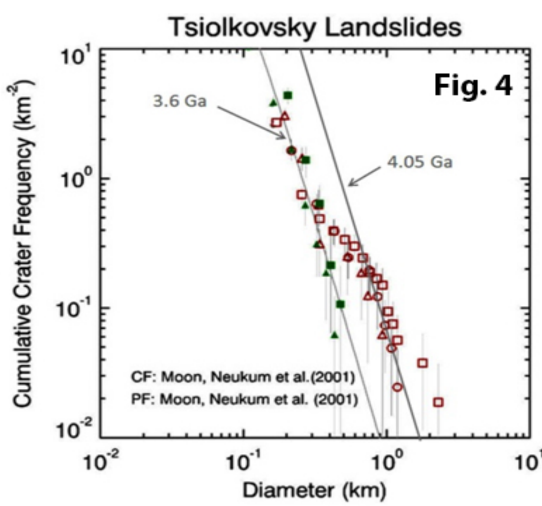

Fig. 1. Sketch map of the Tsiolkovsky landslides area. Base map is color coded WAC-based shaded relief image with topography colored (browns highest, blues lowest). White boxes are craters count sample areas. Fig. 2. Relationship between the landslide volume (V) and mobility (L/H) [10], and Fig.3 is the relationship between the coefficient of friction of the slides (H/L) [11], and volume for the Tsiolkovsky slides, extraterrestrial, non-volcanic, volcanic and submarine events. Fig.4. Crater count data for slides A & B (green) (model age = 3.6 Ga), cratered plains in Fermi (red squares), ejecta at the base of Tsiolkovsky's southwest rim (red triangles), and Tsiolkovsky's northwest rim (red circles) (model age = ~ 4.05 Ga). Note the similarity in density of all craters < 350 m dia.