THICKNESS AND VOLUME OF MARE TSIOLKOVSKY, LUNAR FARSIDE; ***R.A. Craddock and R. Greeley,*** *Department of Geology and Center for Meteorite Studies, Arizona State University, Tempe, Arizona 85287.*

Determination of the thicknesses and volumes of lunar maria is important in understanding the moon's thermal history, the depth of major basins, the loading on the lithosphere, the depth of frequently associated impact basins, and in interpreting lunar and seismic data [1]. Mare deposits cover 17 percent of the total surface area of the moon [2], however mare deposits on the lunar nearside make up 30 percent of the total surface area, and mare deposits on the lunar farside make up 2 percent of the total surface area [3]. Why this difference exists poses one of the most important questions in selenology; quantifying this difference is important in fully understanding the processes involved.

Several techniques have been used in determining the thicknesses and volumes of lunar mare deposits; these include results from the Apollo lunar sounder experiment (ALSE) [4], geochemical data through remote sensing [5], simulated flooding of large unflooded impact craters [2], and the amount of mare flooding of local impact craters [6-10]. However, none of these techniques have been applied to the mare deposits on the lunar farside and quantifying these materials has not yet been accomplished.

Tsiolkovsky is a 180-km diameter crater formed by an oblique impact [11] and is located at approximately Lat. 23°S, Long. 128°E on the lunar farside. Like many craters of this size, Tsiolkovsky has terraced walls and a large central peak. Its smooth dark floor is typical of the localized occurence of mare deposits common on the lunar farside. Mapping of Tsiolkovsky was first accomplished by [11]. They recognized eight different units composing the Tsiolkovsky formation, the most significant of which are the dark floor material (mare deposit) and the edge of floor material (impact melt of country rock underlying the dark floor material and having a high albedo). Determination of the thickness and volume of the dark floor material, or Mare Tsilokovsky, could not be accomplished by using any of the previously mentioned techniques due to the lack of available or applicable data. We devised an alternate technique based on observations of the small (700-m to 2.0-km) craters on Mare Tsiolkovsky and the local geology.

Sharp rim or fresh craters on Mare Tsiolkovsky are frequently seen to vary in their ejecta patterns in Lunar Orbiter and Apollo metric photographs. For example, a fresh 1.0-km diameter crater on one side of Mare Tsiolkovsky would have a conspicuous bright associated ejecta while the same size crater some distance away would not. Noting that the edge of floor material underlies the dark floor material, it was suspected that in some instances a crater of a particular size would excavate to the edge of floor material and thus have a bright ejecta, while in other instances the same size crater would not have bright ejecta due to an increase in the thickness of the overlying mare. It was assumed that in a relatively small area (5-km^2) a median crater of a particular diameter would begin to excavate into the edge of floor material. Any crater larger than that particular crater would always excavate into this material, and thus continue to have a bright ejecta. Any crater smaller than the median diameter would excavate into dark floor material only and have a dark ejecta. A 5 by 5-km grid was generated to overlay large Apollo metric photographs with sun angles up to 35°. Once a median crater size was determined for a particular bin, its corresponding depth was determined through [12].

A total of 403 5 by 5-km bins were used to cover the entire surface area (~9,000-km^2 minus major kipukas) of Mare Tsiolkovsky. A total of 44 bins were not used in determining median crater sizes due to complications from the lack of sufficient number of craters or from heavy contamination of small fresh impact craters. The remaining bins and their determined median crater sizes were used to make an isopach map showing the

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distribution of Mare Tsiolkovsky thicknesses (Figure 1). Maximum mare thickness in the SE corresponds well with the location of expected maximum thickness assuming the oblique Tsiolkovsky impact allowed mare material to travel up from the mantle [13]. The isopach lines were digitized and the surface area between each line was calculated. The thickness between each isopach line was taken as the average value of the two lines; this yielded a total mare volume of ~350-km^3.

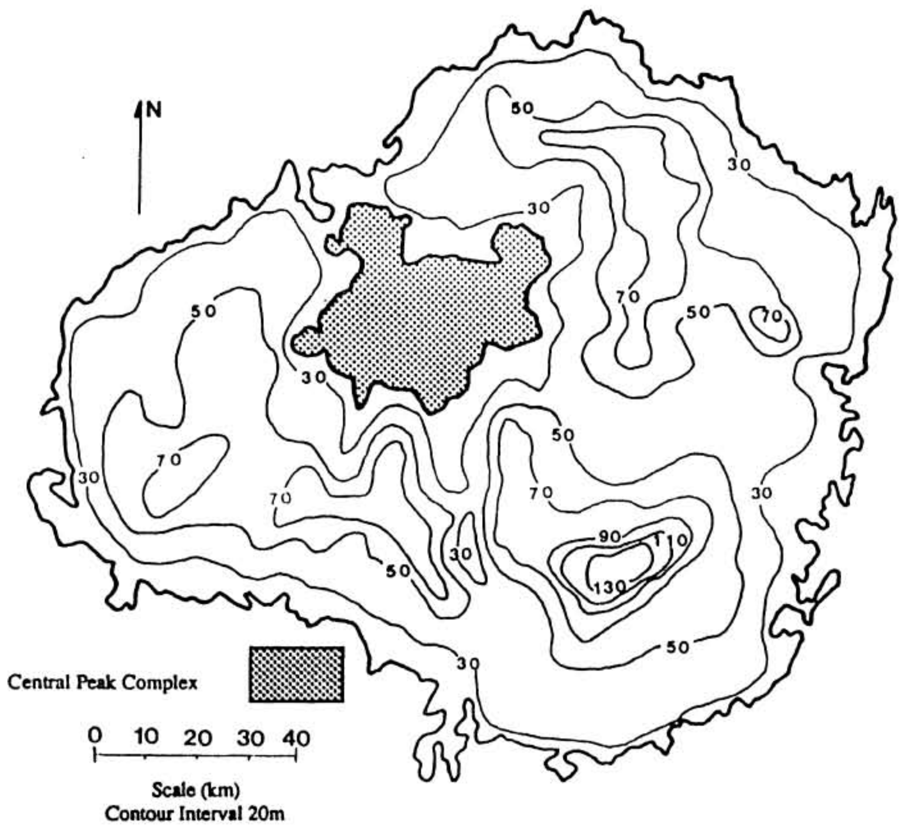

Figure 1. Isopach map showing the distribution of mare thickness within Tsiolkovsky (20.0°S, 128.5°E). The limit of distinguishable resolution was greater than 50-m, so a corresponding crater 10-m deep and the associated 10-m isopach line is missing.

References
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