Jauno geologinio aktyvumo požymiai Mėnulio paviršiuje

New evidence for recent geologic activity on the surface of the Moon

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The conventional understanding of the Moon states that it is a differentiated but currently a geologically 'dead' body. Most of the lunar mare volcanism took place ~4-3 Ga ago and basin related extensional tectonics ended 3.6 Ga ago with some degree of contractional tectonics up to 1.2 Ga [1,2]. However, with the help of high resolution images provided by NASA's Lunar Reconnaissance Orbiter (LRO) a number of geologically young structures have been recently identified by various workers. Evidence for basaltic volcanism in the past 100 Ma has been proposed from the observations of so called Irregular Mare Patches (IMPs) [3]. A number of surface tectonic expressions such as small graben and lobate scarps were found to be also <~100 Ma [4].

Figure 1. Analyzed wrinkle ridge locations on the nearside of the Moon. LRO Wide angle Camera image.

Using LRO Narrow Angle Camera (NAC) data set and LRO Diviner instrument rock abundance maps, we analyze several contractional lunar wrinkle ridge systems (locations marked in Fig. 1) which are thought to be manifestations of global stress fields along nearside maria edges [5]. Results from stratigraphic relationships and the lack of large superimposing craters suggests that all wrinkle ridges in our study regions are late Copernican (i.e. <100 Ma in age). We derive model ages from crater size frequency distributions (CSFD) which result in ages all below 30 Ma (see Fig. 2). Also analyzed lunar wrinkle ridges appear morphologically crisp and include various degrees of pristine rocky outcrops. One wrinkle ridge system exhibits particularly high boulder concentrations in northern Mare Humorum. The high reflective properties of these up <5 m boulders can be seen in Fig. 3.

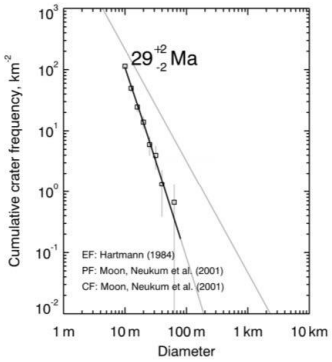

Figure 2. Cumulative CSFD plot and its model age for wrinkle ridge count area in Mare Imbrium.

Our results suggest that there is a strong correlation between rocky terrains and low crater densities for wrinkle ridge areas analyzed in this work. Rock abundances also support the evidence that they are geologically young because estimates of lunar surface boulder obliteration rates imply that rock populations are fully destroyed via meteorite impacts in 300 Ma [6]. The process that could excavate such amounts of lunar regolith and reshape the top layer of lunar maria is unknown. However, past Apollo missions have recorded deep and shallow lunar quakes [7]. The findings presented in this work point to a more complex lunar thermal and late stage tectonic evolution.

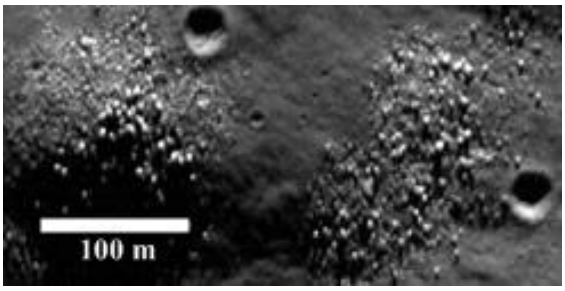

Figure 3. Close up image of boulders observed on a wrinkle ridge in Mare Humorum. LRO NAC.

Keywords: Moon, tectonics, CSFD, wrinkle ridges

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