**LUNAR SURFACE ROUGHNESS AT BASELINE 0.15–100 KM AND THE IMPACT HISTORY OF THE HIGHLANDS.** Y. Yokota[1], K. Gwinner[2], J. Oberst[2], J. Haruyama[3], T. Matsunaga[1], T. Morota[4], H. Noda[5], H. Araki[5], M. Ohtake[3], and S. Yamamoto[1], [1]National Institute for Environmental Studies, Japan (yokota.yasuhiro@nies.go.jp), [2]German Aerospace Center, Institute of Planetary Research, Germany, [3]Japanese Aerospace Exploration Agency, Japan, [4]Nagoya Univ., Japan, [5]National Astronomical Observatory of Japan.

**Introduction:** Recent Lunar explorations enable reseachers to use the high resolution Lunar digital topography data for various studies of Lunar surface roughness (e.g. [1–7]).

We focus on the impact history of the Lunar highlands. The surface roughness of the Lunar highlands at baseline scale around 1–10 kilo-meter is heavily affected by cumulative meteoroid impacts. Hence, quantitative roughness measurement using digital topography data can contribute significantly to the stratigraphic and chronological study of the Lunar highlands.

Here we report roughness measurement results at the baseline scale from 0.15 to 100 km, using the digital topography data derived from the SELENE Laser Altimeter (LALT) and Terrain Camera (TC).

**Dataset:** SELENE data products are distributed at the SELENE Data Archive (https://www.soac.selene.isas.jaxa.jp/archive/index.html.en). Details of the LALT and TC observations are described in [2] and [8], respectively.

*LALT data*. We use the time sequential dataset, containing the elevation data along the spacecraft orbit with ~1.54 km sampling interval (1 Hz).

*TC data*. We use the Digital Terrain Model (DTM) maps (3°x3° mosaic) derived from the stereoscopic images. The horizontal resolution of the original image is ~10 m. Since the shadowed area increases at high latitude, we use DTM at 66°N–66°S.

**Roughness measurement:** We use the Median Differential Slope (MDS) [9][1][3] as the indicator of roughness. This method is easy to understand intuitively.

The area size for the statistical roughness calculation is important. The Lunar highlands surface is a complicated mosaic of impact craters and their ejecta deposits with recent crater events dominating local topographies. For obtaining information on older ages, we must define sufficiently large unit areas to avoid the effect of such recent local events. In addition, crater size frequency distribution models (e.g. [10]) suggest to use sizes larger than ~100 km to avoid the geometric saturation of the craters in the highlands. Head et al. [11] used a circle with 1000 km diameter for the large crater (≥20km) density analysis. We also employed a circle with 1000 km diameter as the unit area. We moved this circle on the lunar surface by each 1° steps for the calculation, and produced global roughness maps at various baseline scales.

**Results and discussion:** The global roughness maps made from LALT data are shown in Fig. 1. The highlands and mare are clearly distinguishable by the roughness at this baseline range. When we focus on the highlands region, the MDS basically decreases with the baseline increasing. However, there are two exceptions. Firstly, between the baseline 3.08 and 6.16km, the MDS of the area indicated by dotted lines increases with the baseline increasing. Secondly, between the baseline 12.32 and 30.80 km, the MDS of the area indicated by break lines also increases. Fig. 2 (a) and (b) are the figures for checking the distributions of those features. We selected characteristic areas (A–J) in Fig. 2, and the baseline vs. MDS plots of these areas are shown in Fig. 3. This graph is calculated from TC data to obtain short baseline data down to 0.15 km. Interesting features were found as follows: (1) At the baseline shorter than ~400m, MDS of Mare is higher than highlands. This is consistent with Rosenburg et al. [3]. (2) The local minimum of MDS appears at baseline around several hundred meters for all highlands data in Fig. 3. (3) The highlands data in Fig. 3 have maximum points at the baseline range ~3–~40 km. (4) Areas A and B have single upward convex profile around the maximum. However, the places indicated as red in Fig 2(b) (C, D, E, and F) have more complex profiles.

In the southern hemisphere, the red regions of Fig 2(b) (including C, D and E) roughly correspond to the Pre-Nectarian system (Fig. 4, [12]) except the interiar of South Pole-Aitken basin. This implies that cumulative impacts dominate the large scale topography. However, in the northen hemisphere, the red regions do not match with Fig. 4. The reason for this remains unresolved.

**References:** [1] Yokota et al. (2008) *LPS XXXIX*, Abstract #1921. [2] Araki H. et al. (2009) *Science*, *323*, 897. [3] Rosenburg et al. (2011) *JGR*, *116*, E02001. [4] Kreslavsky M. A. (2011) *LPS XLII*, Abstract #1531. [5] Kreslavsky M. A. (2011) *EPSC-DPS2011*, Abstract #1497. [6] Boyd, A. et al. (2011) *LPS XLII*, Abstract #2684. [7] Neumann et al. (2011) *LPS XLII*, Abstract #2313 [8] Haruyama J. et al. (2008) *Earth Planets Space*, *60*, 243–255. [9] Kreslavsky M. A. and Head J. W. (2000) *JGR*, *105*, E11, 26,695–26,711. [10] Neukum G. (1983) *Meteoritenbombardement und Da-*

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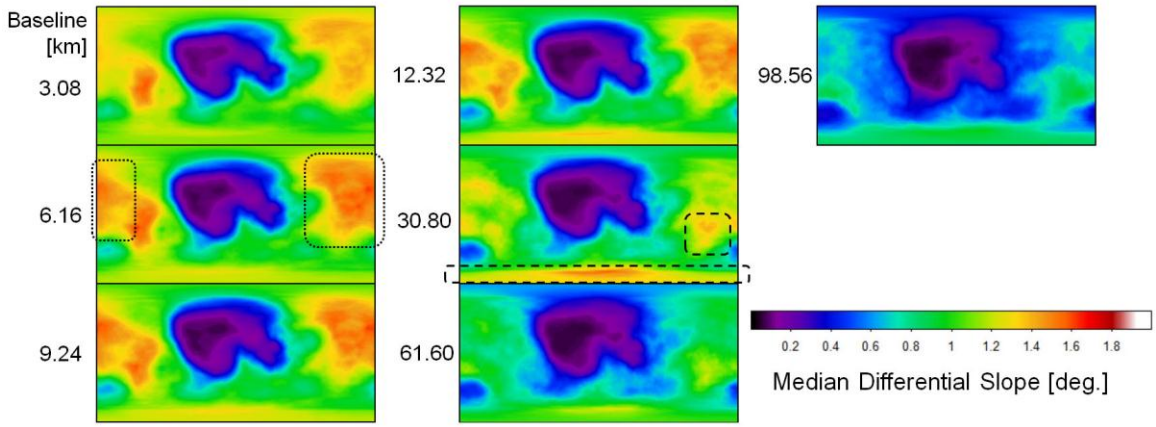


Fig. 1. Lunar global roughness maps (Simple cylindrical projection) at various baselines made from LALT data. Nearside is in the center of each map.

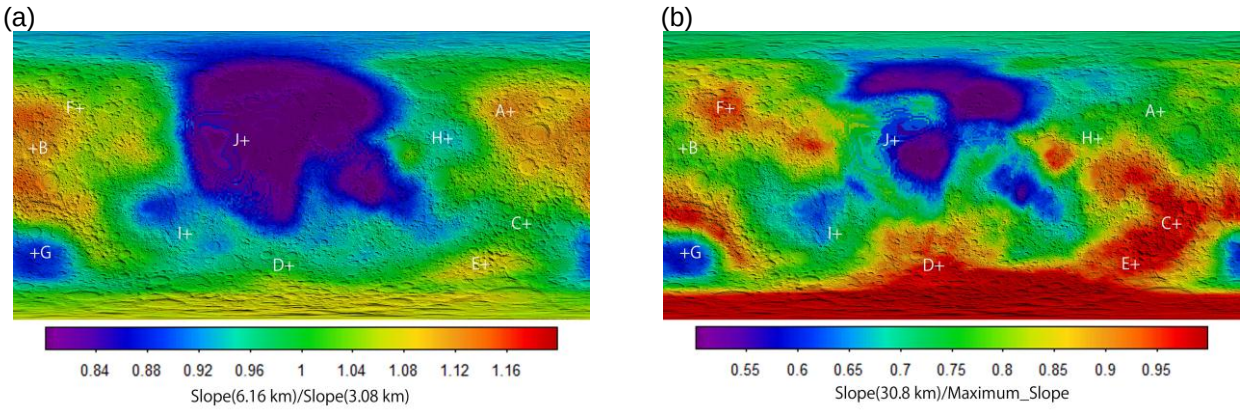


Fig. 2. Ratios of Median Differential Slopes (MDS) for different baselines. (a) MDS (6.16 km) /MDS (3.08 km) shown in color codes. The backgroud image is a shaded relief of the LALT elevation map (LALT_GGT_MAP) [2]. (b) MDS (30.8 km) /MDS (Maximum value in the range of 3–45 km) shown in color codes.

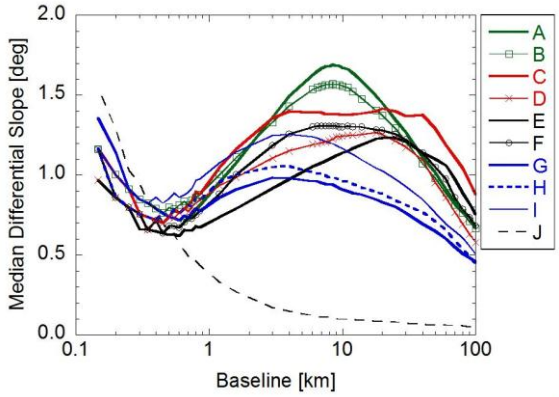


Fig. 3. Baseline vs. MDS plot for the positions indicated in Fig. 2. The range of baseline is from 0.15 to 100 km. The MDS data were calculated from TC DTMs for 1000 km diameter circles.

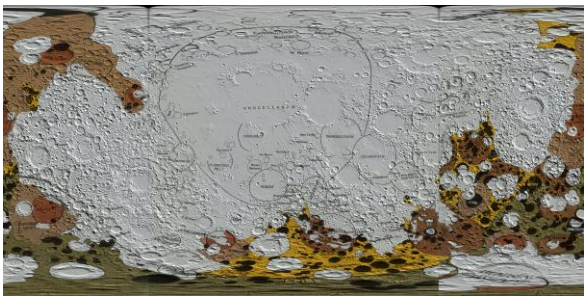

Fig. 4. Distribution of the Pre-Nectarian system determined in [12] (Plate6A and B) by the stratigraphic study. The projection method of the map was converted from the original.