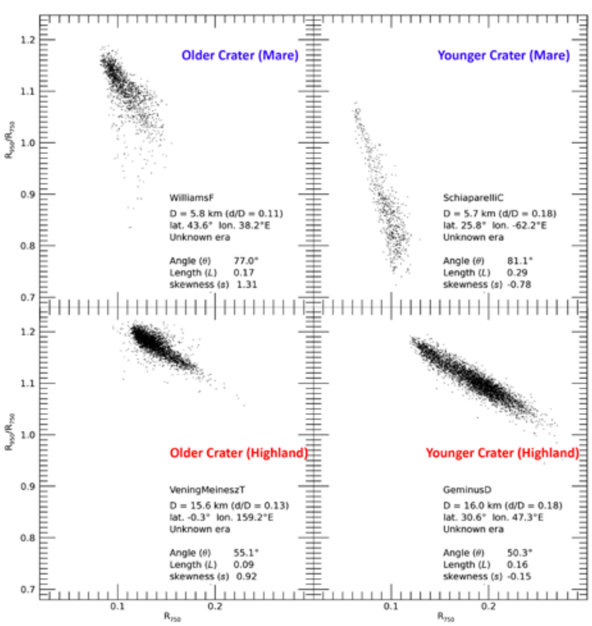
CHARACTERIZING THE MATURITY TREND OF IMPACT CRATERS ON THE MOON. C. K. Sim[1] and S. S. Kim[1], [1]School of Space Research, Kyung Hee University, Yongin, Gyeonggi 17104, South Korea (cksim@khu.ac.kr)

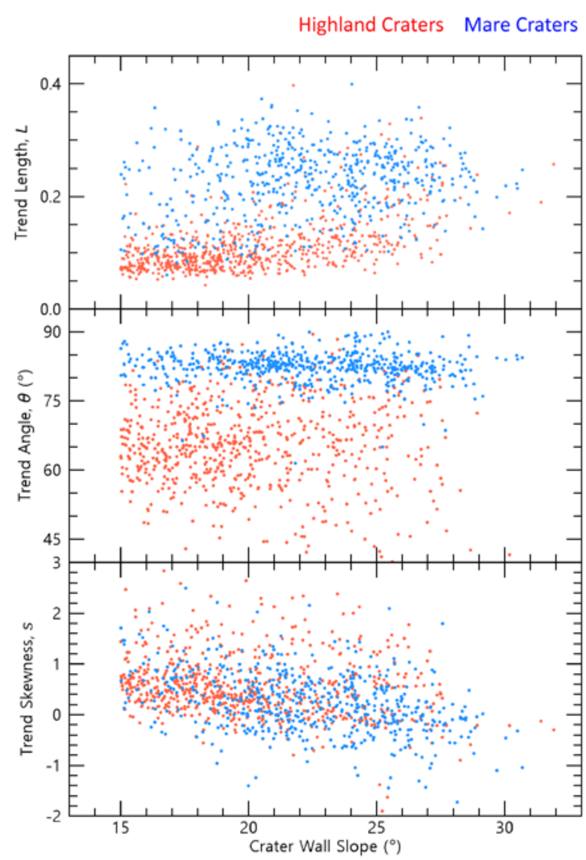
Introduction: A crater shows a negative and almost linear relationship on the 750-nm reflectance versus 950-nm/750-nm reflectance ratio plot [1]. It is the spectral variation of the heterogeneous regolith on the crater surface that makes this maturity trend. Once it is formed, a crater experiences optical alteration such as darkening and reddening by space weathering [2-4] and physical degradation by topographical diffusion [5]. The complex ensemble of maturing and refreshing processes slowly moves the maturity trend towards the hyper-mature member on the upper left on the diagram of 750-nm reflectance versus 950-nm/750-nm reflectance ratio [6], changing its shape due to the variation of the aging rate among the surface regolith. In this work, we the becavior of maturity trends for both mare and highland craters across the Moon and suggest three new parameters to quantitatively describe the shape of the trend which are the length (*L*), the angle (*θ*) from the horizontal line, and the skewness (*s*) of the distribution. Characterizing and quantifying the maturity trend of craters will help us to track the evolutionary stages of the impact craters on the Moon.



Maturity Trend of Craters: We analyze the maturity trend of 1,586 imact craters whose diameter ranges between 2 and 10 kilometers and whose average slope of the annular wall is grater than 15° in the latitudes between 50°S and 50°N on the moon. Reflectance data of Multiband Imager onboard the SELENE(Kaguya) orbiter [7,8] and SELENE/LRO Digital Elevation Model (SLDEM) [9] are used.

On 750-nm reflectance versus 950-nm/750-nm reflec-tance ratio plot, dark mare craters tend to have longer and steeper trends while bright highland craters show shorter and shawllower trends. Although there are differences in degree, a younger crater is a wide, highly variable, and symmetric distribution while an older crater has a shortened, compressed, and skewed (toward the upper left) trend. It is indicated that the heterogeneous particles on a fresh surface get mature with different rates decreasing its heterogeneity.

This maturity trend can be described by its 95th percentile length (*L*), the angle (*θ*) measured clockwise between the horizontal line and its principal axis, and its statistical skewness (*s*).

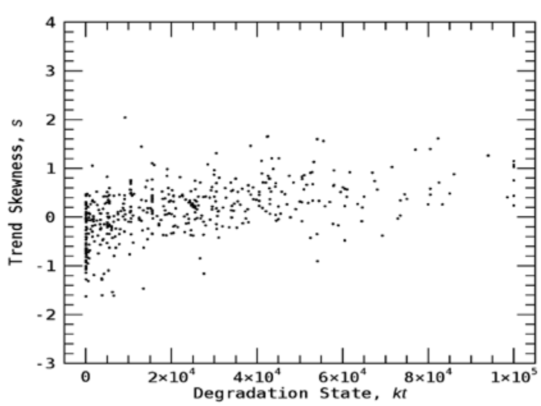


Trend length (L). Mare craters tend to have larger *L* than the highland craters do. It seems to be partly due to the fact that the mare craters have more diverse materials on its surface. The dark surface material of the lunar maria consists a thin layer on the top of the highland materials in the deepter layers which can be easily excavated by an impact that makes a km-sized crater [1]. We also note that the mare craters are generally younger than the highland craters. Among the highland craters, similarly, a crater with a steeper wall have longer L than a shallower crater.

Trend angle (θ). Mare craters have high θ with less variation while highland craters have wider variation of lower θ. Among each group individually, craters with steeper wall slope have lower θ values while the craters with shallower wall slope tend to have higher θ values. It is indicated that relatively more mature paritles experience more reddening and less darkening process while less mature parts experience less reddening and more darkening.

Trend skewness (s). Statistical skewness s is calculated after rotating the maturity trend counter-clockwise by θ. Younger craters tend to have right-skewed ($s < 0$) or symmetric ($s = 0$) trend where older craters tend to be left-skewed ($s > 0$) distribution, indicating that the surface regolith evolves at various rates inside. It also should be mentioned that s shows similar behaviors for mare and highland craters and seems less affected by the regolith maturity of pre-impact background surface. We suggest that s, a parameter derived from the optical properties, can be used as a measure of the crater age.

Fassett & Thomson [5] derived a degradation state parameter, kt, by diffusion model for small (D < 5 km) mare craters. From an additional analysis on the maturity trend of 486 craters whose kt is available and whose SELENE/MI image is relatively free from shades, we note that s is also correlated to kt, as expected.



When used together with other maturity parameters such as reflectances, OMAT, continuum slope, and 1-μm iron band depth, etc., the three parameters suggested in this work, L, θ, and s will allow us a new study that understands the evolutionary track of lunar craters.

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