LUNAR MULTI-SCALE TOPOGRAPHIC ANALYSIS BASED ON DEVIATION FROM MEAN ELEVATION. Jianping Chen[1], Cheng Cheng[1], [1]The Institute of High and New Techniques Applied to Lad Resources, China University of Geosciences (Beijing), 29 Xueyuan Road, Beijing, 100083, China (3s@cugb.edu.cn).

Introduction: Lunar surfaces record the formation and evolution history of the moon. Topography of the moon provides the most magnificent exhibition for lunar landscapes. Previous studies of slope [1-3], roughness [4-7] and entropy [8] by different methods on topographic analysis for the moon or other planets had been accumulated great achievements. However, the distinct geological domains between nearside and farside of the moon lack of contrast which topographic features vary with continuous multi-scale. This paper focuses on the deviation from mean elevation (DEV) which is a relative topographic position metric, and visualizes multi-scale elevation residuals feature at optimal spatial ranges. It is significant to the recovery of basin and lunar geological mapping for feature.

Methods: Multi-scale topographic analysis for the study is based on LOLA Reduced Data from PDS. To explore global lunar topographic position information with fast data processing, the dada is resampled to a raster with 5 km/pix.

DEV: Deviation from mean elevation (DEV) is similar to topographic position index (TPI)[9] which can explore the relationship between the lunar surface and the mean elevation of roving window at various scales. DEV is equal to the ratio of TPI and the standard deviation (SD)[10], where z_0 represents the central elevation of the roving window; $\bar{z}$ is the mean elevation of searching window with window half-size *r*.

$$DEV = \frac{z_0 - \bar{z}}{SD}.$$

DEV multi-scale signatures: Typical landscape locations for lunar topography are shown in Fig.1. Five signatures respectively represent lunar highland (Point1and Point5), Ocean Procellarum (Point2), lunar mare (Point3 and Point4). These signature points are selected for the various scale elevation deviation feature study by using the Whitebox Geospatial Analysis Tools which is a open-source GIS[11].

DEV_{max} Raster: Maximum elevation deviation (DEV_{max}) represents local deviation the largest value in various roving window. DEV_{max} Raster can substantially provide significant elevation deviation feature that the relative position change biggest among different scales. It integrates multi-scale relative topographic position feature into a single raster.

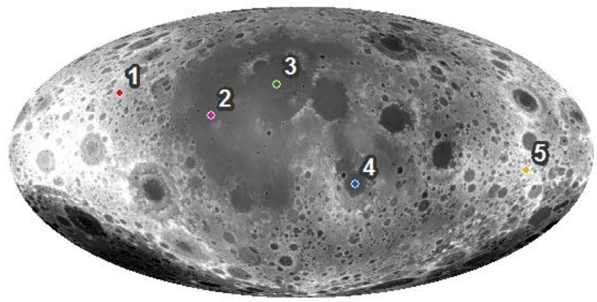

Fig.1 Locations and numbers of *DEV* multi-scale signatures. LOLA global morphology basemap in Mollweide projection. Point1 Lunar highland (122 °W , 30 °N), point2 Ocean Procellarum (57 °W,18 °N), point3 Imbrium (17 °W,35 °N), point4 Nectaris (34 °E, 16 °S), poinr5 Lunar Highland (139 °E,9 °S).

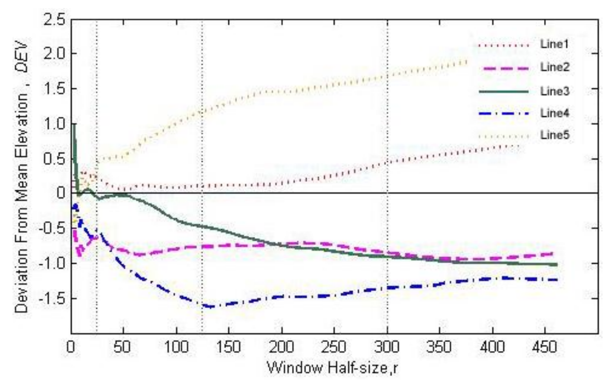

Fig.2 *DEV* multi-scale signatures for five locations in Fig.1. Searching window diameter *D*=2*r*+1, window half-size represented by *r* which is a sequence from 1 to 461. Window half size *r* at local scale from 1 to 25; meco scale from 25 to 125; broad scale from 125 to 300; edge effect from 300 to 461.

Results: As shown in Fig.2, the characteristic cures of elevation deviation vary with the type of landscapes. The elevation residual fluctuation is obvious in a small neighborhood. Although the curves fluctuate, they can be roughly divided into two classes with dividing line 0. They indicate the positive (DEV>0) and negative landform (DEV<0) which represented by lunar highland and mare (or basin) respectively. Factors mainly influence DEV feature are the relative position of the terrain and the scale of the landscape. Furthermore, three spatial ranges derived from Fig.2 according to the fluctuation of the curves. The window half-size *r* for local, meco and broad scales with the following ranges: 1-25 (about 15-125km), 25-125 (125-

625km), 125-300(625-1500km). The maximum values of DEV compose the at the specific spatial range. DEV_{max} raster can excellently reserve the maximum change of the elevation, which provide efficient mapping method for multi-scale topographic analysis on lunar landscapes and tectonics.

Discussion and Conclusion: More relative topography trait can be derive from the multi-scale DEV_{max} raster (Fig.3).

Difference between multi-scale DEV_{max} raster. The range of DEV_{max} values decrease with the larger window size. For instance, the broad scale DEV_{max} raster has the smallest DEV range (-4.80~6.91). The smaller impacts can be identified well, especially the crater rim and crater wall at local scale. Additionally, structures such as the major basins, ridges and valleys are mainfest at meco scale, and the inner ring structure of Imbrium basin is easily distinguishable. The Ocean Procellarum and the South Pole-Aitken basin have lower DEV value at broad scale.

Contrast between nearside and farside. Large impact structures are different in the nearside and farside. The basins in the farside almost exist basin rim with high DEV value. However, the DEV of small tectonic features such as small impact craters all the moon are similar. There are also relative topography position change at nearside mare plain. The DEV_{max} raster of South Pole-Aitken basin is similar to the nearside basin formation at broad scale. New views of lunar relative topographic position are provided by multi-scale DEV_{max} rasters.

Acknowledgments: Thank you for the LOLA data provided by NASA. And this research is supported by the National Natural Science Foundation of China (41490634).

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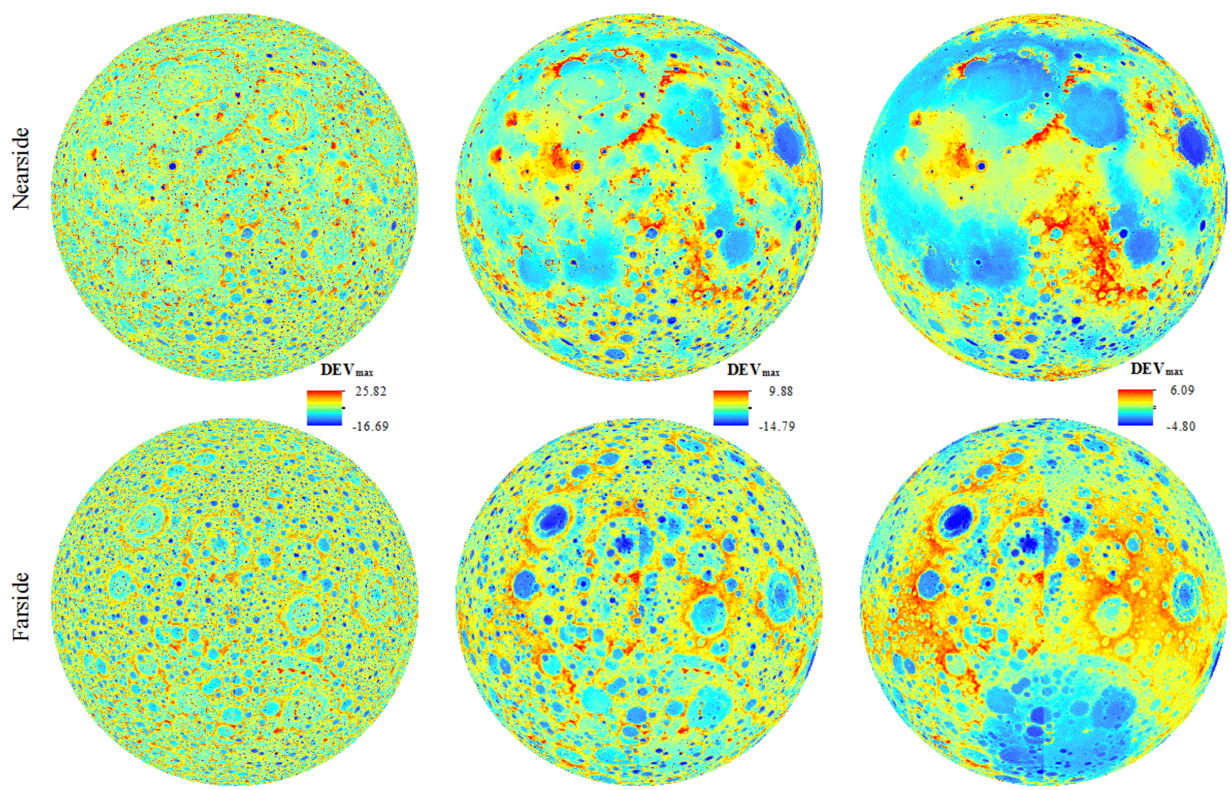

Fig.3 Orthographic views of nearside and farside DEM_{max} rasters at local, meso and broad scales correspondingly from left to right.