Primary Study of The Relationship Between the Lunar Surface Topography and Geological Informations.
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Introduction: The topographic and compositional features of the lunar are formed due to internal dynamics and external impact in the long history of the lunar evolution. Before the formation of Imbium, the lunar mare, basalt and highland plagioclase rock were formed. From that geological peroid to now, a lot of ring mountains were formed due to large-scale impact. It still is an important science problems how to study the dynamic evolution of the Moon before Imbrium and the effects of impacts on the topography and compositions features of the Lunar surface using satellite remote sensing data. Until now, a lot of remote sensing data of the Moon has been collected, which could be used to study the elements and minerals composition of the lunar surface, the lunar topography and the relationship between composition and topography of the lunar surface.In this abstract, the distributions of elements and minerals of the lunar surface are retrieved using Clementine data, and DEM model is retrieved using LIDAR data of ChangE-1 satellite. Finally, the relationship between the compositions and topography of the lunar surface is analyed.

The lunar surface DEM analysis: The DEM derived from LAM data of ChangE-1 satellite shows that, the lunar surface is divided into two topographic units which are mare and highland(Fig.1). The highland unit distributes like the letter U. The aspect analysis indicates that the lunar surface is composed of 6.25 percent of flat area, 31.25 percent of slope area inclined to north, and 37.5 percent of slope area inclined to south(Fig.2). There exist some ring units in mare. The lunar surface is relatively flat. The biggest slope is about 23 degree, most of them are 0° ～ 9°. Great slope changes have taken place in lunar highlands, the average slope is bigger than 9°. The slope changed greatly in the edge of craters and mares. It ranged from 5 degree to 10 degree. Most areas in the bottom of the craters and mares have flat terrain. The slope is 0° ～ 2°(Fig.3). The slope distribution map clearly reflects the development of the circular cell. Some of these are simple single-ring impact craters or circular structure. And some are complex multi-ring, and show some ladder-like distribution characteristics, which may be the craters impacted for many times.

The relationship between topography and tectonics: The U-shape pattern of highland distribution may reflect that there exist two southwest and southeast deep faults along the U-shape in lunar interior, and both of them intersected in the southern hemisphere of the nearside of the moon. The U shape of highland probably indicates that there exist west-to-east and north-to-south twist forces(should be validated further), thereby causing mare basalt events flooding.

The relationship between topography and elements distribution: Using Clementine data, after processing, TiO_2, FeO distribution map were obtained using Lucey method(Fig.4)[1]. Ti mainly distribute in two regions, one is a high-enrichment area taking Oceanus Procellarum and Serenitatis as the center, the second is found in high concentration outside. The distribution of Fe is very similar to Ti. They mainly distribute in Imbrium and Oceanus Procellarum, as well as in Crisium, which shows Ti and Fe mainly distribute in relatively flat terrain areas.

The relationship between topography and minerals distribution: Pyroxene, plagioclase, olivine, and ilmenite, etc. were extracted by using Clementine data. The result was shown in Fig.5 as followed. Clinopyroxenes mainly distribute in the mare basalt, especially it is mostly enriched in Oceanus Procellarum, Serenitatis and Frigoris, and the abundance is the highest in the largest circular structure on the moon (sub-mare), that is, the west of Frigoris. Orthopyroxene is enriched in Australe and the northern of Frigoris. The content of olivine is lower, there is a few in Oceanus Procellarum and other areas. Plagioclase distribute more common in the lunar rocks, the content is relatively high. It mainly distributes on the lunar highlands, few in mare basalt. Ilmenite mainly distribute in Oceanus Procellarum. There is a few in Serenitatis, Imbrium, Crisium, etc.

Conclusions: There are two deep faults of southwest and southeast in the moon. Under the effect of the internal dynamics and shear, the U-shape pattern on the lunar surface formed, and the distribution characteristic of lunar highlands plagioclase and mare basalts and basic abnormal rock with high FeO in Aitken Basin. The distributions of clinopyroxene, olivine and ilmenite are positively correlated with each other, and are negatively correlated with orthopyroxene and plagioclase. Due to the constraints of the spatial resolution and spectral resolution of remote sensing data, as well as the lack of samples and datum, this paper only had some initial exploratory research. The recognization about the moon was quite superficial. The results of these studies there may be inadequate. With the in-depth study, these will be gradually modified and deepened in order to improve and enhance the lunar geological research.

References:

[1] Lucey P. G., blewett D. T. and Jolliff B. L. (2000) *JGR, 105*, 20297-20305.

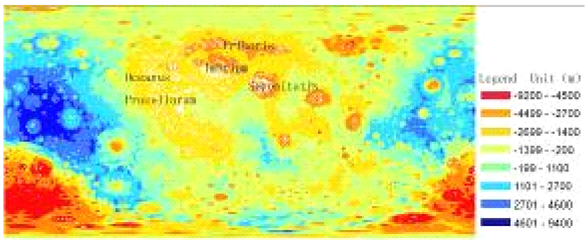


Fig.1 DEM map of the Moon

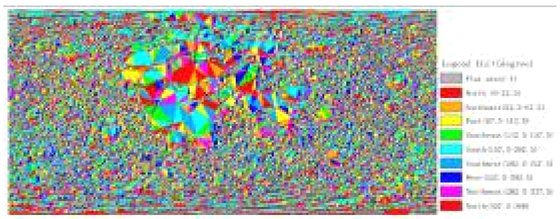


Fig.2 Aspect map of the Moon

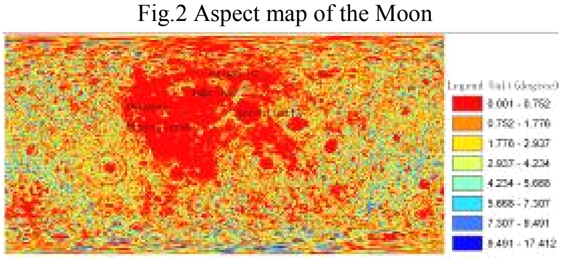
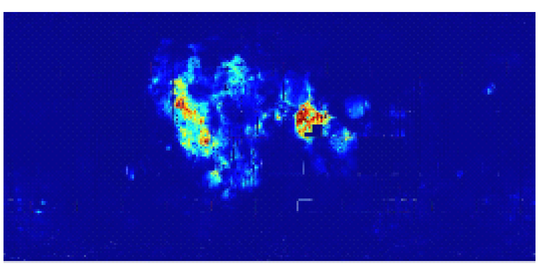
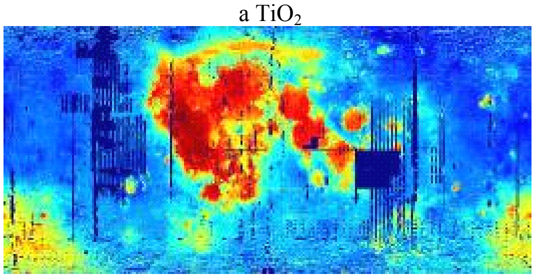


Fig.3 Slope map of the Moon

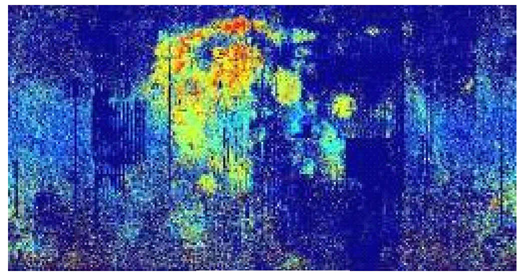


a TiO_2

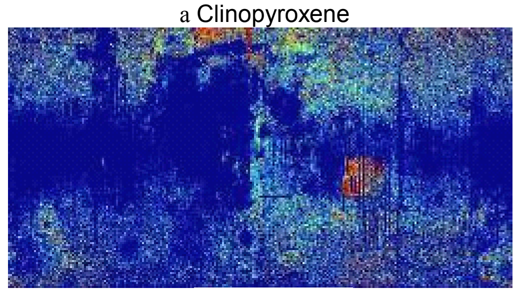


b FeO

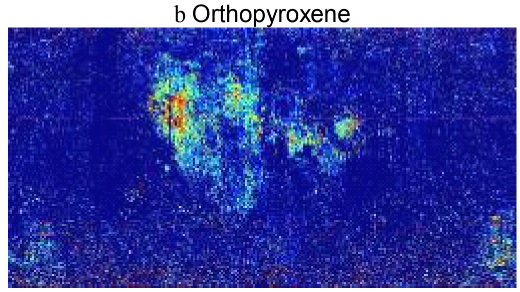
Fig.4 TiO_2、FeO distribution maps



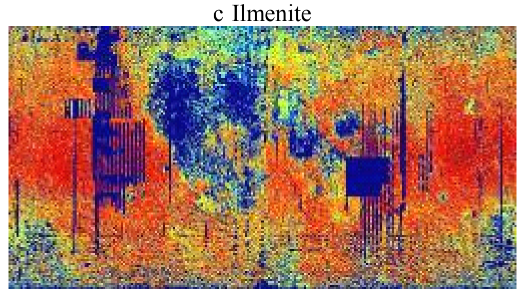
a Clinopyroxene



b Orthopyroxene



c Ilmenite



d Plagioclase

low  high

Fig.5 Distribution of minerals on the lunar surface