GEOLOGIC INVESTIGATION AND MAPPING OF THE SINUS IRIDUM QUADRANGLE FROM CLEMENTINE, SELENE, AND CHANG'E-1. S. B. Chen[1] , Z. G. Meng[1], T. F. Cui[1], and Y. Lian[1]. [1]Jilin University, No.938, Xi Minzhu Street, Changchun 130026, China. CHENSB@JLU.EDU.CN

Introduction: Since 1990, some new lunar satellites have been launched and a new era is beginning for lunar exploration. The typical lunar exploration missions are involved in Clementine (U.S.A, in Jan.25, 1994), SELENE(Japan, in Sept.14, 2007), Chang'e-1(China, in Oct.24, 2007), Chandrayaan-1(India, in Oct. 22, 2008), LRO and LCROSS(U.S.A, in Jun.18, 2009). Thus, more lunar satellite data are now available to meet high-resolution geological interpretation for lunar surface using these terrain, multi-spectral, hyperspectral, and microwave data [1-4].

The objectives of lunar satellite remote sensing are to study lunar surface characteristics, inner structure, and its evolution history by application of geological concept.

Sinus Iridum of Mare Imbrium in the nearside of the Moon may be a potential landing or sampling site of the future lunar missions of China[3]. In the study, it is first investigated by integrating new data from Clementine, SELENE, and Chang'e-1 satellites. The terrain, element composition, the thickness and ages of different sediments, and regional gravity anomalies for the Sinus Iridum quadrangle are geologic analyzed and mapped for the determination of future landing or sampling sits.

Geographic Location: Sinus Iridum is located in the Northwest of Mare Imbrium in the nearside of the Moon. Its center latitude/longitude is 44.1°N/ 31.5°W.

Data Processing: In this study, the data from Clementine satellite, SELENE satellite, Chang'e-1 satellite are projected to a coorridinate system, GCS_Moon_2000. The eclipse is Moon_2000_IAU_IAG. The terrain, the mineral and element distribution, the regolith thickness, the geologic age, and the gravital anomalies are analyzed for Sinus Iridum by these data.

Geology Investigation: The geology interpretation of Sinus Iridum is carried out based on the enhanced SELENE TC image, integrating the TiO_2 and FeO content maps derived from Clementine UV/Visible data, and the regolith thickness retrieved with CELMS data. 19 kinds of geology units are identified from the image. With the help of lunar geology map of USGS [8], the geology of Sinus Iridum is mapped.

Based on the previous study, several results are infered as follows,

Sinus Iridum is the sinus of Mare Imbrium, but it exists before the large area of volcanic eruption in Mare Imbrium. The volcanic ejecta (E1m) extends widely towards the Sinus Iridum. The geologic units (Im1, Im2 and Ccsc) with different ages are covered by E1m. The altitude of Sinus Iridum is lower than that of Mare Imbrium and the slope is less than two degree.

The gravity anomaly map presents that there is negative gravity anomaly in Sinus Iridum, while the surrounding is postive one. There is postive gravity anomaly in the center of Mare Imbrium, while the surrounding is negative one. An obvious gravity grad occurs along the line between the two capes of Sinus Iridum. It shows that it is different in the deep structure.

The regolith thickness is thinner in Sinus Iridum than that in Mare Imbrium. The mineral components in the two regions are different distinctly from each other. The FeO content is high in Sinus Iridum, while it is low in Mare Imbrium. The boundary is clear. The TiO2 content is fairly high in Mare Imbrium, while it is medium in Sinus Iridum. It also indicates that the mechanism and the geologic age of their formation are different.

There are three main geological units, which are Im1(3.13Ga)、Im2(3.06Ga) and Ccsc. The relative age is coincided with the statistics of the crater size-frequency. These geology units are along northwest direction. The direction is perpendicular to the isoline of the regolith thickness. It shows that it is probably related with the volcanic ejecting in Mare Imbrium. On the other hand, TiO2 and FeO contents are relative high in Im2 and low in Ccsc.

There are multi-level terraces in the inner side of Sinus Iridum, where exists naked slope (Cs) and naked rocks or volcanic flows locally extended into lower areas (Ip) topographically. Iiw, complex mixture of slumped Iridum ejecta, reworked Imbrium basin ejecta and uncovered pre-Imbrium basement materials, mainly took place in 4.02Ga ago. Cs (3.92 Ga) is volcanic flows locally extended into lower areas topographically. Ip is the accumulation of volcanic flows locally extended into low areas topographically.

Iirh, locating at the outside of the Sinus Iridum, is an older geology unit (4.03 Ga) in this region. Iirr, debris ejected from the Iridum crater, happened about 4.05 Ga ago and it covered partly the older unit.

In a word, a strong geologic activity happened in Sinus Iridum in 4.0 Ga ago. It made the original shape of the sinus. Then, the outside of the sinus is uplifted into platform and great deposit occurred in the center. This resulted in the multi-level terrace of the border of Sinus Iridum. On the slope, the naked base rock, Iiw, has nearly the same age as the deposits in platform, and some slope materials (Cs) weathered from the base rock. Cs is relatively young. Then several deposits activities (Im1 and Im2) occurred in the region. On the other hand, volcanic activities are frequently taken place in several part of the sinus (Ccsc). It formed the negative gravity anomaly in the southwest. Craters with small diameter and good shape occurred frequently in the region since Copernicus era.

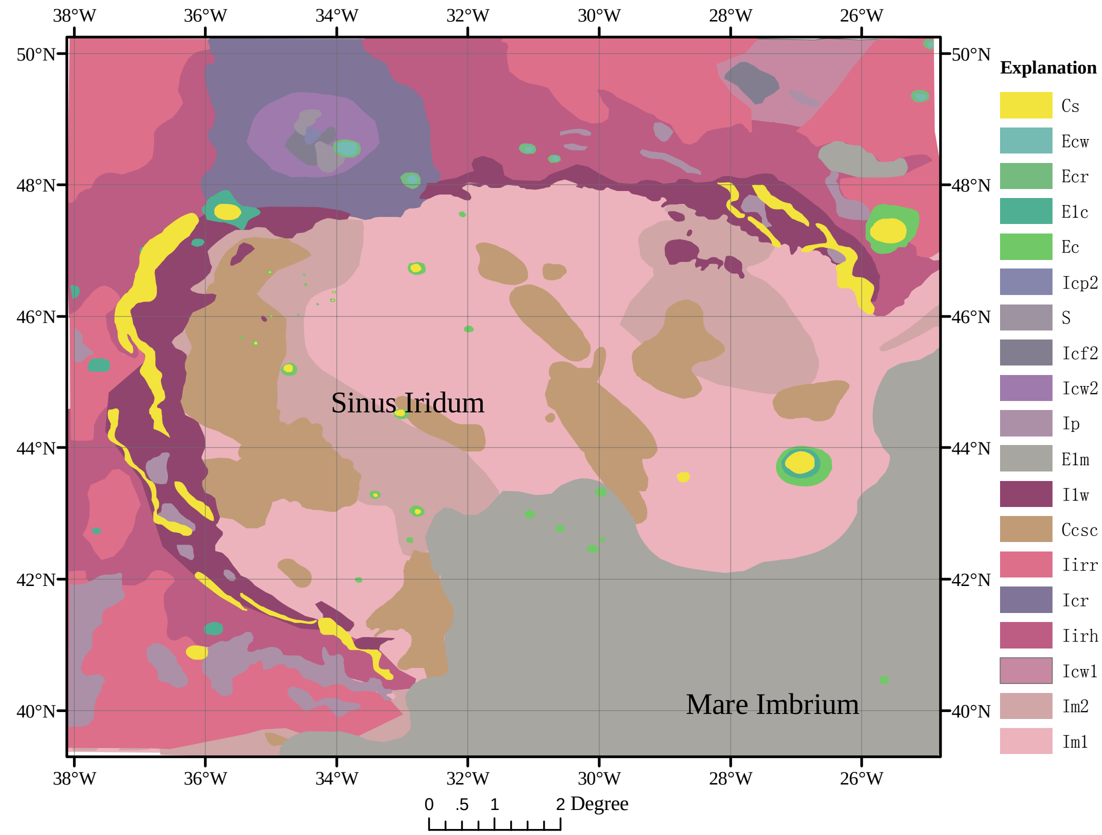

Figure 1. Geology interpretation map in Sinus Iridum

Conclusions: Sinus Iridum is the potential region for the future landing area of China. In this study, the TiO_2 and the FeO content map are derived from Clementine UV/Visible data. The geology interpretation of Sinus Iridum and the ages of several geological units are achieved with the enhanced SELENE TC image. The gravity field model (SGM90d) shows the different gravity features in Sinus Iridum and Mare Imbrium. These indicates that they are different geological units. The regolith thickness retrieved from CELMS data is corresponding to the SELENE digital terrain model in their spatial distribution.

Not only the inner structure of Sinus Iridum and Mare Imbrium but also their spatial distribution and components of the surface materials are different in their formation mechanism and ages. In Pre –Imbrium era, a strong volcanic activity shaped the original Sinus Iridum. The outside of the sinus was uplifted to be the platform (Iirr and Iirh). The slope materials are exposed (Iiw and Cs) and the ejecta deposit in lower areas (Ip), which happened in Imbrium era (3.92Ga). Then there happened central descending and deposit extensively (Im1 and Im2) in the post-Eratosthenian era. Since Copernican era, there are so many well-developed crater. Therefore, Sinus Iridum is the representative of many geological events from Pre-Imbrium to Copernican era and presents the rich history of the moon's evolution. Moreover, the terrain of the sinus is suitable for landing and sampling of the lunar vehicles owing to its slopes. The geologic significance and topographic features make it be a potential landing site in future lunar exploration.

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