Automatic geological analysis of Mare Crisium using lunar surface GIS

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A lot of moon and planetary explorations are concluded and planned around the world in recent years, so it is expected that huge data will be acquired in various forms. Therefore it will be important that necessary information is extracted from these data quickly, analyzed efficiently, and that results are integrated.

The crater is one of the most important information in the lunar image data. It brings various knowledge such as the surface age, the thickness of the lava, and so on. We are proposing 'Computational Crater Geology' which is one vision about geological analysis and uses craters as key information, and we developed the lunar surface GIS for trial. This system detects and retained the lunar surface information from multi-spectral image data and also has automatic geological analysis functions.

In this presentation, we reported about the automatic geological analysis results of Mare Crisium using the lunar surface GIS. First of all, we classified the geological units using by the newly developed automatic geological classification method. This method is classifying lunar mare lava pixel by pixel basis using the multi-level slice approach and then integrating with groups of pixels using spatial and parameter information. As a result, it was possible to divide Mare Crisium into 13 units. These units agreed with published geological studies manually in general and more were identified which were appeared in the previous studies.

Next, we estimated age at each of geological units through the crater chronology using crater information (total 6356 craters) by the automatic crater detection method (MARC). It was suggested that Mare Crisium was formed among 3.0-3.7 b. y. before as the LUNA 24 samples indicated that the southeast region of the mare was formed among about 3.2-3.5 b. y. before. In addition, the relation among the age and the amount of FeO and TiO2 at each geological unit indicated that older units than 3.4-3.5 b. y. have various amounts of FeO and TiO2 which were estimated from Clementine UVVIS data using Lucey method, but younger units have only large amount of FeO and TiO2. The lava thicknesses were estimated from the diameter of detected simple crater and the ejecta distribution of highland material differed by FeO. The entire volume of lava in Mare Crisium was calculated about 122,000 km3 from the thickness of the lava using the ejecta distributions at the edge part of the mare and the radar sounding data of Apollo 17 at the center part. Moreover, the capacity of the lava which was erupted during 3.3-3.1 b. y. before was estimated about 16,600 km3 using the relation that younger lava had the only large amount of TiO2. This result corresponds with 10 percents or more of the entire Mare Crisium.