

THE DISCOVERY OF THE “FREEZING AND THAWING LANDFORM” OF TYCHO IMPACT CRATER OF THE MOON. X. Z. Ding¹ and D. Wang², ¹Institute of Geology, Chinese Academy of Geological Sciences, Baiwanzhuang Road, Beijing 100037, China, xiaozhongding@sina.com, ²Institute of Geology, Chinese Academy of Geological Sciences, Baiwanzhuang Road, Beijing 100037, China, wangdan92y@163.com.

With the continuous development of lunar exploration, whether the existence of water or water-ice on the Moon has caused the scientists who carry out the planet and lunar research great attention. Previous studies emphasized on the detection of instrument and tiny amounts of lunar sample test. But, all the results are unsatisfactory. By the detailed analysis of high-resolution satellite images of the lunar exploration, and the specific geomorphic type of water or water-ice formation, we discover a great deal of “freezing and thawing landform” type which is similar to the earth produced by the action of freeze-thaw on the Moon. The “freezing and thawing landform” mainly include the following types: freeze-thaw solifluction, frost mound, frost ridge, frost cracks, hot melt landslides, hot melt collapse, etc.. and these freezing and thawing landform are reserved at best and most complete in the Copernican Tycho crater and its surrounding area. The discovery of “freeze-thawed landforms” is significance in exploring whether exist water or water-ice on the Moon, and further research the evolution of the Moon.

Tycho crater is about 83km in diameter and located in the southern hemisphere of the Moon. Center longitude and latitude is S43°23'40.78", W11°10'1.02". The distribution range of the rays around the crater is about 560000 km², which occupies about a quarter of the lunar positive southern hemisphere, and the longest is 1800km. It is a complex impact crater with obvious central peak. Based on the analysis of the rays samples collected by Apollo 17, the age is (109±4) Ma, which is the late Copernican. The main material consists of relatively loose granular rock debris, breccia, vitreous fragments and meteorite material. The impact crater is generally higher in the north and west, and the relative depth is about 4460m. The study shows that the freezing and thawing landform is mainly developed in the area of the center accumulation plain, the arc block accumulation belts and the crater rim. In particular, the most concentrated area is the lower eastern terrain of the center accumulation plain and the arc block accumulation belt.

The main types and characteristics of the freezing and thawing landform. Freezing and thawing landform is the result of freezing and melting of water-bearing materials in the surface of the earth. It is due to the periodic occurrence of positive and negative changes in temperature. Then, the underground water or ice that exists in the top soil layer or rocky layer is constantly

phase changing and moving, causing a series of stress deformation such as frost heaving, flow and deformation. Compared with the surface of the earth, the temperature varies enormously. The average temperature is as high as 127°C during the day, plummeted to -183°C at night. Day and night temperature difference change up to 310°C. The conditions for the Moon to form freeze-thaw landforms are provided. Tycho crater was formed in the late Copernican. Therefore, the morphological features are well preserved, and the freeze-thaw landform is very clear and obvious in the crater and its surrounding area, so that we can carry out the detailed research.

According to the preliminary analysis of the near side image, the distribution of freezing and thawing landform is widespread in the Tycho crater and its surrounding area, and the types are complex and diverse. In addition to freeze-thaw solifluction, frost mound, frost ridge, frost cracks, hot melt landslides and hot melt collapse, it also distributes freeze-thaw scree, freeze-thaw talus slope, frozen bulking column, freeze-thaw stone line, felsenmeer and stone ring. These are very similar to the freezing and thawing landform features of the earth. The causes may be related to the freezing and thawing of water, water-ice or water-bearing materials. From the whole Moon, the distribution of freeze-thaw landform is the same as the earth latitude zonality. The frost heaving, the frost mound bulge and the surrounding detritus is gradually increasing from the low latitudes to the poles, but the hot melt action is the opposite.

References:

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