Research Advances

Revealing the Landform Types and Morphologic Features of Lunar Surface

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Objective

A lunar geologic map at a scale of 1:5000000 was finished in the 1970s by the National Aeronautics and Space Administration, U.S. Department of the Interior, U.S. Geological Survey. Till now, the landform classification system and lunar morphologic mapping have not been clarified. The work aims to put forward a new landform classification system and to obtain index and map in the Sheet H010. Some key morphologic features of lunar surface were compared with those of the Earth. This research is very important for whole lunar morphologic mapping and unraveling evolutionary progress.

Methods

Three classification elements, including surface materials, geologic age and morphologic features were used to classify lunar landform types. A matrix combination method was put forward, which can integrate geologic age, surface materials and morphologic feature (Fig. 1). The geologic ages can be divided into Copernican system (C), Eartosthenian system (E), Imbrian system (I) and Pre-Imbrian system. And some excessive types, including Copernican-Eartosthenian system (CE), Eartosthenian-Inbrian system (EI) and Imbrian-PreImbrian system (IpI) were appeared. As to surface materials, the whole lunar surface can be divided into dark materials, basin materials, terra materials and crater materials. Morphologic features and their subclasses can be obtained by means of surface materials, fine DEM and Remote Sensed data.

Results

A matrix combination classification system was put forward, which integrates geologic age, material types and morphologic types. The Sheet H010 is the study area. The geologic ages can be divided into seven classes (Fig. 2a). As to material types, the whole lunar surface can be divided into four categories (Fig. 2b). As to morphologic types of lunar surface, 14 classes were obtained (Fig. 2c).

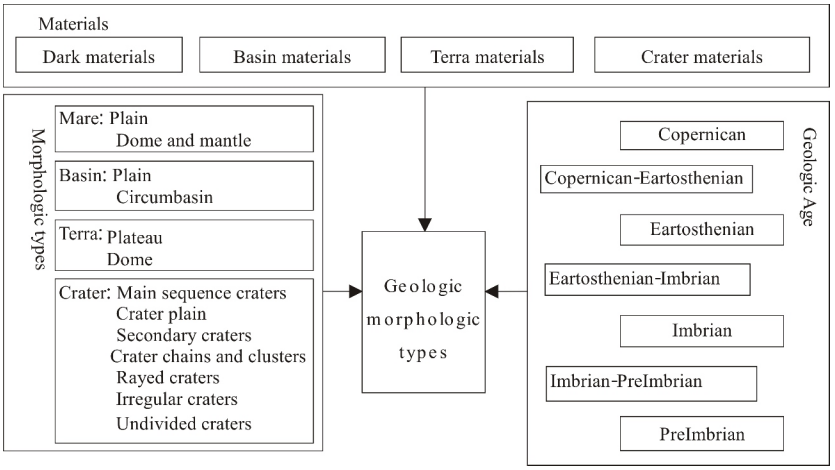

Fig. 1. Classification system of lunar landform based on surface materials, geology age and morphologic types.

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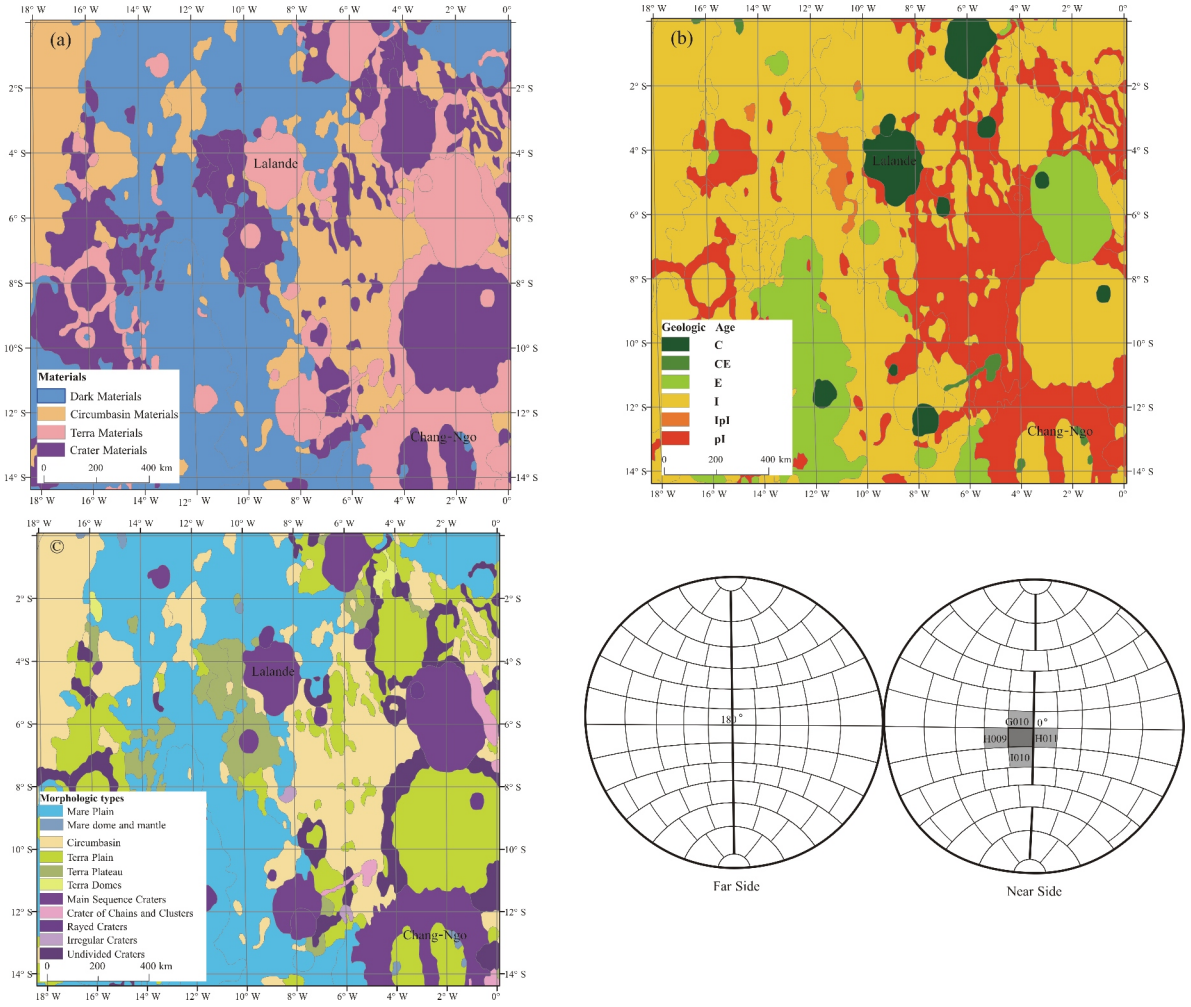

Fig. 2. Maps of materials, geologic age and morphologic types of Sheet H010.
a, Materials; b, Geologic age; c, Morphologic types.

The highest altitude of the lunar surface is 10611 m, located in the edge of Engel'gard Crater, which is 1767 m higher than the peak altitude of the Mount Qomolangma, 8844.43 m of the Earth. The deepest point is -9430m, located in the inner of the Minkowski Crater, which is less than that of the Mariana Trench, -10911 m, of the Earth.

The area of Lunar Mare is about 17% and Lunar Terra is about 83% of whole lunar surface. A total of 106016 craters in lunar surface with diameter more than 500 m were extracted based on multi data sources for the first time. The reasons of most different phenomenon are that the Earth's surface is being protected by the atmosphere, 70% of which is covered by ocean water.

Conclusions

A matrix combination classification system of lunar morphology based on geologic age, surface materials and morphologic feature was addressed from geologic maps in the 1970s in the U.S., which includes seven geologic ages, four material categories, 14 morphologic classes. Thus, 46 subclasses including geologic, lunar surface material and morphologic features were obtained in this classification system. The test mapping method was addressed in the Sheet H010, which shows the combination classification method is reasonable.

The morphologic types of lunar surface are simple than these of the Earth's surface. The landform types of the former can be divided into lunar mares, lunar terras, lunar craters and lunar basins. The landform types of the latter can be divided land plateaus, land plains, land mountains, land hills and land basins, ocean continental shelves, ocean continental slopes, ocean basins, ocean ridges and ocean trenches.

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