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Global Spatial Distribution of the Lunar Subsurface Faults Revealed by GRAIL Gravity Data

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Abstract: Lunar fault is an important tectonic style for studying the evolution and sources of stress in early history of the Moon. Lunar faults were globally mapped based on gravity gradient data of the Moon. The basic parameters, including length and orientation were calculated. The results include the identification of 226 faults with a total length of 37137 km, and the mean length of all the faults is 164 km. Most of the faults are distributed in the low and middle latitudes, and more faults in the northern hemisphere than that in the southern. Based on their orientations, lunar faults were classified into four directions: N-S, NE-SW, NW-SE and E-W. Drawing the rose diagrams of the orientations of faults in globally and at different latitudes, respectively. All faults show a statistical NE-SW and NW-SE preferred orientations, and preferred orientations are generally N-S at low latitude and NE-SW, NW-SE at middle latitude and E-W at high latitude. The formation time of lunar faults was determined earlier than ~3.85 Ga by crosscutting relationship with the impact crater. The Moon was mainly subjected to two global stresses in the first billion years, thermal expansion and tidal stresses. The possible tectonic patterns can be formed by the two stresses were analyzed and compared with the identified results in this study, indicating that the lunar fault was the result of the combined action of global expansion and tidal stresses.

Key words: lunar faults, gravity gradient, global mapping, distribution characteristic, formation mechanism

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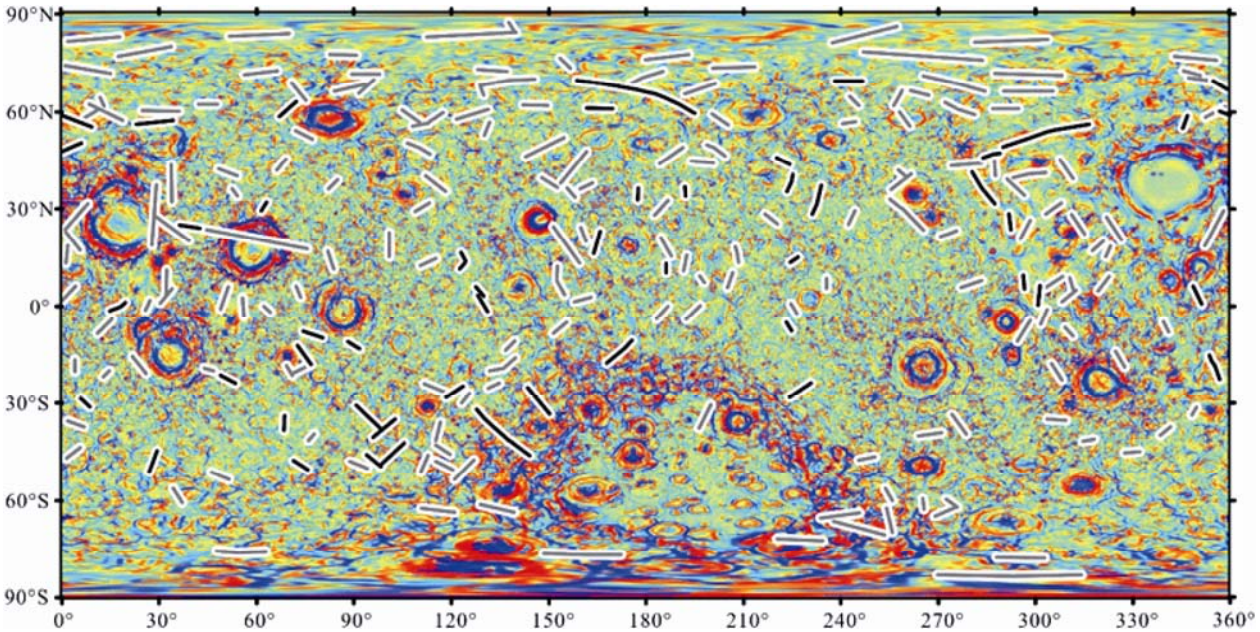

Fig. 1. Global distribution of the identified lunar subsurface faults. Base map: Horizontal Bouguer gradient.

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