

SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

Author: Mr. Zhao Zeng
China

RESEARCH OF DRILLING IN THE SIMULATED MOON VACUUM ENVIRONMENT

Abstract

Core sampler of lunar soil is used to complete the mission of unmanned sampling, it requires drilling to 2 meters length in the moon vacuum and anhydrous environment, moreover as a drill object, lunar soil has high density and low thermal conductivity characteristics, which leads to high temperature of the drilling tool until failure of bit burnt in the drilling process. It is more rigorous at the working condition of lunar rock. This paper commits the research on drilling in the simulated moon vacuum environment based on the drilling thermal simulations. The experiment equipment has been manufactured with vacuum sealing ability (vacuum degree can be less than 10^{-3} Pa) in the process of rotary drilling, it can also realize real-time acquisition and transmission of drilling parameters such as temperature, drilling pressure and torsion moment. Through the experiment research of lunar soil stimulant and vesicular basalt drilling, it has been analyzed that input power of sampler coincides well with the drilling temperature. The relation between penetration speed, drilling pressure and the temperature rise is obtained. And the security strategy of drilling is achieved by manipulating penetration speed to control the temperature rise. It is indicated in experiment that temperature rise of lunar soil drilling is far below lunar rock drilling. The scale of hardness of lunar rock can be judged by the ratio of drilling pressure to penetration speed. It adopts low speed strategy of rotary speed at 100-120rpm, penetration speed at 2mm/min to drill breccia safely. And it adopts the strategy of intermittent drilling to drill vesicular basalt safely, as the strategy of low speed drilling is hard to reach temperature dynamic balance. It is also demonstrated that the rock of 50mm thickness is difficult to drill out safely at the rotary drilling mode because of the high drilling temperature and pressure, and rotary-percussive drilling mode can be better to choose.