Graz University of Technology
Institute for Rock Mechanics and Tunnelling

Master Thesis (MA, 30 ECTS)

Field Stability Assessment of Martian Lava Tubes

Description

A crewed mission to Mars is one of the most ambitious challenges of the 21st century. Besides the search for traces of live, Mars missions shall characterize the (paleo-)environment, including geotechnical investigations that consolidate our understanding about the planet's (sub)surface. They also serve as a basis for future construction projects on Mars, also in hindsight of future settlements. As part of the logistical preparations for such a mission, it is necessary to think about possible locations for a human base on the red planet. Such a location must provide shelter from cosmic radiation, micro-meteorites, winds, dust storms, high temperature fluctuations etc. Lava tubes (i.e. natural, tunnel-shaped cavities within the planet) are considered to be prime locations for human habitation.

This thesis' goal is to establish a field assessment workflow and classification scheme that permits an astronaut to check the suitability of a lava tube as a location for a base. Classical rock mass classification systems like the Q-system that have originally been designed for tunnel application should be adapted and extended for this purpose. Furthermore, easily executable field test like the Schmidt hammer should be considered for this assessment.

After an assessment workflow has been theoretically established, its suitability will be tested in a field trip to lava tubes at Sicily (Italy).

Workflow:

1. Literature research concerning:
    a. the formation, shape, rock strength properties and stability of terrestrial lava tubes.
    b. rock mass classification systems.
2. Establishing a workflow that permits a field stability assessment of a lava tube considering limiting factors like lower gravity or an operator who wears a space suit.
3. Testing and adapting the workflow for terrestrial lava tubes.
4. Evaluation and interpretation of the results.

The study will be done in close cooperation with the Austrian Space Forum.

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