

# Soil Preparation for the HP<sup>3</sup> Test beds

C. Krause (1,2), O. Krömer (1), E. Ksenik (1), T-M. Ho (1), T. van Zoest (1) and the HP<sup>3</sup> Team  
(1) DLR Institute of Space Systems, Robert-Hooke-Strasse 7, D-28359 Bremen, Germany, (2) DLR, Space Operations and Astronaut Training, MUSC, Linder Höhe, D-51147 Cologne, Germany

## Abstract

Tests with a self penetrating mole have been performed within the past years with different configurations and various soils or planetary soil simulants. The preparation of test beds for mole penetrations is an important and a difficult issue. For different operational scenarios soil preparations have been performed. The different soil preparation strategies and its difficulties will be presented.

## 1. Introduction

Soil physical properties are key values for the understanding of planetary surfaces, which have relevance for atmospheric exchange processes, wind transport processes and account in the exploration of the planetary development.

Soil physical properties play a major role for the forward motion of drilling and hammering instruments in near-surface layers of planetary surfaces. The performance of these instruments during penetration, the performance of drilling or hammering instruments provides the possibility to retrieve information about the soil physical properties of surfaces.

The HP<sup>3</sup> – Heat Flow and Physical Properties Package – will be one part of the GEMS proposal, a Discovery-class mission proposal to study the Martian interior. HP<sup>3</sup> will allow the measurement of the temperature dispersion and the heat flow to determine the planetary heat flux. Beside this HP<sup>3</sup> will detect soil physical properties. The HP<sup>3</sup> instrument package consists of a mole carrying a package of thermal and electrical sensors to a depth of five meters. The payload elements are the Thermal Excitation and Measurement Suite and a Permittivity Probe. The HP<sup>3</sup> experiment contains also of the sensors for the forward motion and the tilt information of the payload compartment (ACTIL).

The operational scenario of HP<sup>3</sup> will be the penetration of the mole down to a depth of 5m underneath the surface. Stops during penetration will be implemented for thermal and permittivity measurements. The mole hammering and the penetration performance itself will be used for the determination of soil physical properties.

In the past years mole tests have been performed in Quartz sand as well as different Mars soil simulants, also lunar surface conditions were simulated. For the different operational scenarios different amount of soils in different vessels up to 3 m depth were prepared. With increasing vessel heights and amount of soils the difficulties in preparing reproducible test conditions raise.

For the comparison of the mole penetration with the prediction of simulation models the soil conditions have to be known or determined, especially the depth profile of the soil properties. For test simulations of different surface conditions various soil density profiles have to be created.

The preparation strategy and soil conditions for the test campaigns of HP<sup>3</sup> tests will be presented.