SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

Author: Dr. Piergiovanni Magnani
Selex ES, Italy

Mr. Edoardo Re
Selex Galileo, Italy
Dr. Alessandro Fumagalli
Selex ES, Italy
Prof. Stefano Debei
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy
Prof. Gian Gabriele Ori
IRSPS, Italy
Dr. Pietro Baglioni
European Space Agency (ESA), The Netherlands
Mr. Davide Hazan
Selex Galileo, Italy

EXOMARS DRILL TOOL PERFORMANCE IN MARS-LIKE ENVIRONMENTAL CONDITIONS

Abstract

After completion of extensive tests with the breadboards of the ExoMars Drill, a new specific test campaign is in the pipeline for the Drill Tool Engineering Model. These upcoming test activities will be carried out in Mars-like environmental conditions, utilizing new sets of materials, specifically selected because of their similarity with the expected Mars terrains and because of their applicability for the characterization of the ExoMars Drill functionality and performance. These materials include: Hydrothermal deposits, Microcrystalline Gypsum, Sandstone (of different quartz contents), Claystone (of different calcium content), Regolith matrix (mixture of olivine and sand) and various forms of Basalt. A characterization of the 'Mars-like' materials in terms of Uni-axial Compressive Strength, Knoop hardness, Cerchar Abrasivity Index has already been performed together with drilling capability at laboratory conditions, in order to assess key performances such as speeds vs. thrust, torque and power needs. The next test campaign, whose outcomes will be reported in the proposed paper, are planned to be performed on a sample specimen assembled according to defined stratigraphies of above materials. Two soil scenarios will be considered: wet and dry conditions. Water will be added in order to verify the system under such conditions; two procedures will be used to 'wet' the layers forming the specimen: immersion and dropping. The tests will be performed in a dedicated TV facility at CISAS laboratories (University of Padova) suited to operate the drill for collecting samples down to 0.5 m depths and capable to create a 'Mars-like environment' in terms of pressure (e.g. 10 mBar CO2) and temperature (in the -130C / +20 C range). The testing activity will allow to collect significant data in terms of drilling, sampling and sample discharge capability as well as to evaluate and verify operational sequence aspects. The chamber has already been used for other programs including the qualification campaign of the Rosetta Drill Unit SD2 (in this case simulating cometary conditions). For the next testing of the complete Qualification Model of the Drill, with drilling and sampling operations down to 2 m depth, a dedicated T/V chamber is presently in development (at CISAS) and will be ready by June 2011. The proposed paper will summarize the main findings related to the already performed characterization of the Mars analogous materials with drilling and sample dis-

charge operation in laboratory conditions plus the main outcomes from the test campaign in Mars like environmental conditions soon to be started.