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

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EXOMARS DRILL FOR SUBSURFACE SAMPLING AND DOWN-HOLE SCIENCE

Abstract

ExoMars mission foresees, in its operational scenario on Mars, the collection and on board processing of subsurface samples taken to a depth of up to 2 meters and the investigation of the drilled borehole via spectrometric techniques in both visible and infrared ranges. The key elements to perform this mission are: a multi-rod perforating drill capable to reach the subsurface depth and recover to surface samples of material and an advanced compact spectrometer (MaMiss) directly integrated in the front part of the drill string. The complete Drill System is mounted on the Exomars Rover.

The system is based on multi-stroke technology using one drill rod and a number of extension rods. The drill penetrates the soil by a rotary/translation action and subsequent addition of the extensions. At the desired depth a sample of subsurface material is 'swallowed' inside a dedicated front chamber; the drill rods are then progressively recovered to surface and the collected sample discharged and distributed on board.

The optical front end of the spectrometer (MaMiss) is placed in the drill rod such as to observe laterally the walls of the progressively excavated hole; the 'images' collected by the spectrometer front are conveyed to surface via optical fibers which run along all rods and reaches the spectrometer electronics (detector and processing) located in the upper containment box. The illumination of the hole is provided locally down stream by means of a dedicated lamp.

Exomars Drill System is now in development and an extensive breadbording activity has been carried out. The developed prototypes are very representative of the final system in terms of functionalities and implements all main foreseen components. Extensive testing activity has already been carried out including: drilling at two meters in laboratory conditions as stand alone drill system and integrated on a Rover breadboard, tests in Mars like conditions in terms of temperature and pressures. Furthermore, an Engineering Model of the drill tool, inclusive of the optical elements of the MaMiss spectrometer, has been manufactured and integrated; verifications are in progress.

More specific and extensive tests are planned in 2010 to investigate life related issues and drill performance in presence of possible water/ice fraction in the soil.

The proposed paper will summarize the main characteristics of the ExoMars Drill and Sampling System and will provide an overview of the performances, verified by test in very different conditions, of this outstanding and unique machine.