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Drilling on the Moon and Mars: Human Exploration Simulation Experiments

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Abstract

The Drilling on the Moon and Mars Experiment (DOMEX) in collaboration with EuroGeoMars[1] plans a series of end-to-end analog science missions simulating human tended drilling operations on the moon and Mars. The missions are staged from the Mars Desert Research Station (MDRS), a planetary analog lander/habitat located in a remote desert area of south-central Utah, USA. The MDRS supports a crew of 6 people allowing them to operate under flight-like human mission constraints.

The field site in Utah's San Rafael desert is an important Mars analog hosting exposed, vegetation free lithified sedimentary structures deposited in the Jurassic and Cretaceous epochs. The regions offers excellent analogs to the Burns Formation at Sinus Meridiani on Mars which is also composed of interbedded sulfates and silt and sand-sized clastic sediments.

We will use subsurface access systems and instruments developed by NASA for future flight missions that include 1) The CRUX Ground Penetrating Radar [2] ; 2) the Moon/Mars Underground Mole (MMUM)[3], a subsurface penetrometer capable of 2 m penetration, *in situ* Raman spectral observations, and sample collection; 3) the MARTE drill [4]- a fully automated 10 m depth rock coring drill that produces 2 x 20 cm core segments and 4) the IceAx drill, an inchworm drill optimized for drilling in ice cemented soils that blows cuttings out of the hole.

The project has science, technology and mission operations objectives. Samples collected with the drilling systems will be analyzed as a relevant analog to sites on Mars visited by the Mars Exploration rovers and ExoMars. Field tests will advance the TRL of the instruments, and operational lessons learned from the mission simulations will aid planning for subsurface exploration on the moon and Mars by future robotic and human missions.

DOMEX will help develop the science and operations strategy for subsurface exploration including geophysical exploration, drilling, sample analysis and borehole logging, paving the way for future missions using these capabilities.

[1] Foing et al., EGU abstract 13180, 2009.
[2] Kim, S. et al., IEEEAC paper 1365, 2005.
[3] Stoker et al., NASA Tech. Conf., 2006.
[4] Stoker, C. et al., Astrobiology, 8, 5, 2008.