National Aeronautics and Space Administration

Mars Simulant Development for In-Situ Resource Utilization (ISRU) Applications

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OVERVIEW

Current design reference missions for the Evolvable Mars Campaign (EMC) call for the use of in-situ resources to enable human missions to the surface of Mars. One potential resource is water extracted from the Martian regolith. Current Mars' soil analogs (JSC Mars-1) have 5-10x more water than typical regolith on Mars. Therefore, there is a critical need to develop Mars simulants to be used in ISRU applications that mimic the chemical, mineralogical, and physical properties of the Martian regolith.

INNOVATION

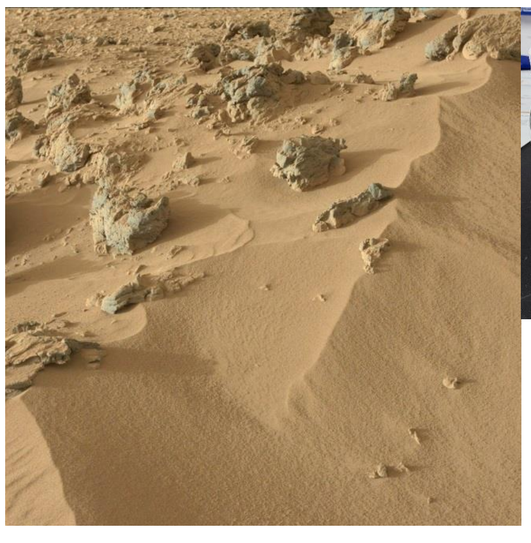
We have demonstrated that a mixture of the Mojave Mars Simulant (MMS), a crushed basalt, is a better match to the water release from windblown Mars regolith material (the Rocknest deposit sampled by MSL). We have added sulfates and perchlorates

OUTCOME

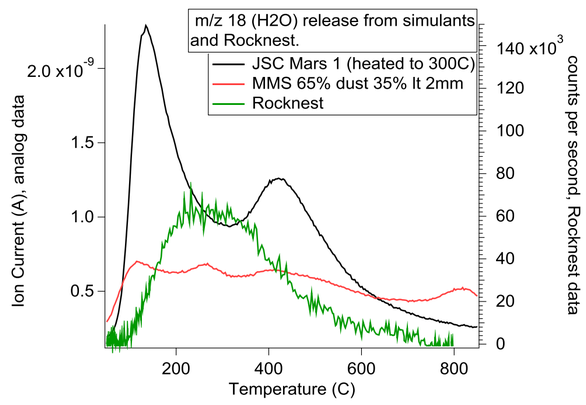
- A 65/35 mix of <MMS dust and <2mm MMS coarse grained material is a better analog for total water evolved than JSC Mars-1
- The additional of calcium sulfate (anhydrite) and magnesium perchlorate in Mars-relevant amounts results in HCl and SO_2 released during heating.

INFUSION SPACE / EARTH

- This regolith simulant can be used by any group testing water extraction from a realistic martian regolith simulant.



Left: Rocknest sand shadow, Gale Crater, Mars. Above: different size fractions of the Mojave Mars Simulant, crushed basaltic samples.



Sample	Rocknest	MMS	JSC-Mars 1
<1000 °C water	1-3 wt%	4-6 wt%	10-15 wt%

PARTNERSHIPS / COLLABORATIONS

This regolith simulant has been developed in collaboration with Gerry Sanders (JSC-EP), the ISRU Chief Engineer at JSC, and will be used in a JSC ISRU soil processing system to determine the efficiency of the extraction and the robustness of the system to potentially caustic gases released from the simulant during processing.

We intend to make this simulant available to the broader ISRU community as a common element between different groups to enable cross-comparison of methods/systems.

FUTURE WORK

We anticipate a need for large volumes of Martian simulants for developing ISRU capabilities. Furthermore, we anticipate a need for developing additional simulants because one simulant does not fit all needs.

We will investigate the effects of perchlorate and sulfate decomposition on ISRU systems to determine if perchlorate/sulfate removal prior to processing is necessary and will evaluate remediation techniques.