X5.03 Lunar Volatile Resource Prospecting and Collection

Lead Center: JSC

Participating Center(s): GRC, JPL, KSC

Lunar volatile extraction, separation, and collection consists of all aspects of locating and characterizing lunar volatile resources (especially polar hydrogen/water); excavating regolith in the permanently shadowed craters (-233°C and down to 2 meters); mechanical, thermal, chemical, and/or electrical processing of this regolith to release volatiles; identifying/quantifying all volatiles; and separating and collecting volatiles of interest. Metrics of interest include: excavation rate (kg/hr); excavation efficiency (power required/excavation rate); resource extraction efficiency (Watts per mass of volatiles produced per hour); collection efficiency (mass collected vs. total evolved); and collection purity (mass collected of desired product vs. total collected). Specific areas of interest include:

- Excavation techniques for soil-like to rock-like regolith (70MPa), depending on water content, and very cold (40K to 100K) regolith and local environment conditions;
- Excavation technology or systems for collecting regolith while preserving the loosely held volatile species that may be present;
- Regolith handling, processing, and heating techniques that minimize the amount of time and energy required to evolve volatiles (either solar wind implanted or in permanently shadowed craters);
- Gas separation and collection techniques for a product stream containing various concentrations of hydrogen, carbon dioxide, nitrogen, helium, water, ammonia, and methane;
- Demonstration of sealing technology for repetitive (less than 50 times) use at a wide range of temperatures (40K - 500K nominal and up to 1500K maximum) in abrasive, electrostatic, high vacuum environment; and
- Specific technologies or recipes for implanting volatile species in terrestrial samples of lunar regolith simulant to support volatile species collection and extraction technology development.