

**SUBSURFACE WATER EXTRACTION FROM EXTREME ENVIRONMENTS.** K. Zacny<sup>1</sup>, J. Palmowski<sup>1</sup>, J. Schultz<sup>1</sup>, K. Bywaters<sup>1</sup>, <sup>1</sup>Honeybee Robotics, 2408 Lincoln Ave. Altadena, CA 91001 (Contact: jtschultz@honeybeerobotics.com)

**Introduction:** In recent years, orbital measurements have revealed that there is a potential for ice deposits near the Martian surface in mid latitudes. This discovery has led to an increasing demand in the development of excavation and prospecting technologies. Understanding the stratigraphy of the Martian surface is paramount to human sustainability and future missions. Honeybee Robotics has a demonstrated history with leveraging existing terrestrial technology for space applications.

**RedWater** is a Rodriguez Well (RodWell) system developed to extract water from Martian ice deposits. This system utilizes a coiled tube drilling system to penetrate depths up to 25 meters below the Martian Surface to reach the ice that is buried deep in the subsurface.

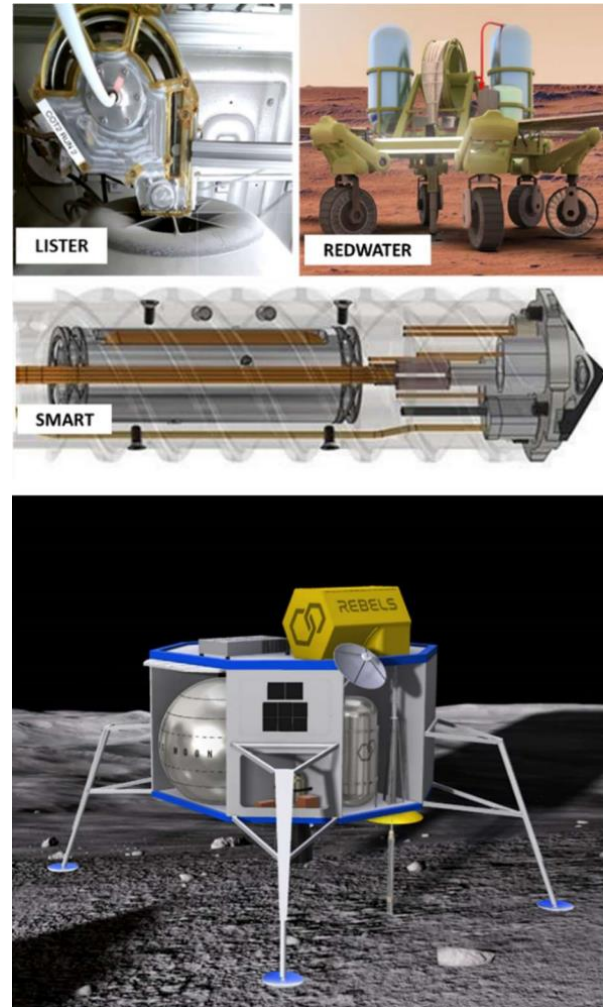
This system doesn't only apply to Mars though, REBELS (Rapidly Excavated Borehole for Exploring Lunar Subsurface) is a coiled tube drilling and instrumentation system designed to reach depths greater than 10 meters below the lunar surface. This system employs the use of three existing Honeybee Robotics technologies:

- RedWater: a coiled tube drilling system.
- LISTER: a 3-meter pneumatic drill scheduled to land on the lunar surface later this year and again in 2025.
- SMART: an instrumented drill head under development for the RESOURCE project funded by NASA SSERVI.

The primary advantage of these systems is that there are many sensors and instruments in the auger tip. This brings the instruments to the sample so data measurements can be collected real-time. Additionally, the cuttings created by drilling can be pneumatically cleared out of the borehole and can be collected and analyzed by surface-level instrumentation. The sampling instruments integrated into the head allow for detection of hydrogen as well as measuring the volatile content and mineralogy of the regolith.

**References:** [1] Zacny et al. (2018) SRR [2] Palmowski, et al. (2021) AIAA 2021-4038. [3] Nagihara et al. (2020) LPSC. [4] L.Stolov. (2022) Earth and Space.

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**Figure 1.** The integrated REBELS concept incorporates existing Honeybee technologies including the instrumented SMART drill (bottom right), the LISTER pneumatic drill (top center), and the Redwater coiled-tubing drill (top right). A 50-meter version of REBELS integrated with Blue Origin's Blue Moon lander is also being proposed for a mission to the Moon.