DEVELOPMENT AND TESTING OF A LUNAR RESOURCE PROSPECTOR DRILL. G. Paulsen[1], K. Zacny[1], D. Kim[1], Z. Mank[1], A. Wang[1], T. Thomas[1], C. Hyman[1], B. Mellerowicz[1], B. Yaggi[1], Z. Fitzgerald[1], A. Ridilla[1], J. Atkinson[1], J. Quinn[2], J. Smith[2], J. Kleinhenz[3], [1]Honeybee Robotics, Pasadena, CA, zacny@honeybeerobotics.com, [2]NASA Kennedy Space Center, FL, [3]NASA Glenn Research Center, Cleveland, OH.

Introduction: The goal of the Lunar Resource Prospector (RP) mission is to capture and identify volatiles species within the top one meter layer of the lunar surface [1]. The RP drill has been designed to 1. Generate cuttings and place them on the surface for analysis by the Near InfraRed Volatiles Spectrometer Subsystem (NIRVSS), and 2. Capture cuttings and transfer them to the Oxygen and Volatile Extraction Node (OVEN) coupled with the Lunar Advanced Volatiles Analysis (LAVA) subsystem.

Figure 1: Resource Prospector Rover with the Drill

RP Drill: The RP drill is based on the TRL4 Mars Icebreaker drill and TRL5 LITA drill developed for capturing samples of ice and ice cemented ground on Mars, and represents over a decade of technology development effort [2-4]. The TRL6 RP drill weighs approximately 15 kg and is rated at just over 500 Watt. The drill consists of: 1. Rotary-Percussive Drill Head, 2. Sampling Auger, 3. Brushing Station, 4. Feed Stage, and 5. Deployment Stage.

To reduce sample handling complexity, the drill auger is designed to capture cuttings as opposed to cores. High sampling efficiency is possible through a dual design of the auger. The lower section has deep and low pitch flutes for retaining of cuttings. The upper section has been designed to efficiently move the cuttings out of the hole. The drill uses a "bite" sampling approach where samples are captured in ~10 cm depth intervals.

The first generation, TRL4 Icebreaker drill was tested in Mars chamber as well as in Antarctica and the Arctic. It demonstrated drilling at 1-1-100-100 level (1 meter in 1 hour with 100 Watt and 100 N Weight on Bit) in ice, ice cemented ground, soil, and rocks. The second generation, TRL5 LITA drill was deployed on a Carnegie Mellon University rover, called Zoe, and tested in Atacama, Antarctica, the Arctic, and Greenland. The tests demonstrated fully autonomous sample acquisition and delivery to a carousel. The modified LITA drill was tested in NASA GRC's lunar vacuum chamber at <10^-5 torr and <200 K [5]. It demonstrated successful capture and transfer of volatile rich frozen samples to a crucible for analysis. The modified LITA drill has also been successfully vibration tested at NASA KSC. The drill was integrated with RP rover at NASA JSC and successfully tested in a lab and in the field, as well as on a large vibration table and steep slope.

The latest TRL6 RP drill has successfully underwent testing at NASA GRC lunar chamber facilities.

Figure 1: TRL6 Resource Prospector Drill

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