CORING SYSTEM FOR ASEPTIC ACQUISITION OF CORE SAMPLES. F. Rehnmark[1], K. Zacny[1], G. Adams[1], B. Wei[1], D. Kim[1], N. Cabrol[2], [1]Honeybee Robotics (zacny@honeybeerobotics.com), [2]SETI

Introduction: Acquisition of core samples in field requires a coring tool. To date, we developed numerous robotic coring tools for future planetary robotic missions. Since there is a need for geologists to capture core samples in a field, we redesigned the robotic systems to be deployed using a HomeDepot drill.

Core Breakoff: The critical technology during coring is core breakoff. We implemented Honeybee Robotics' patented "eccentric tubes" core breakoff method. In this approach, the Bit and the Breakoff Tube each have bores which are slightly offset from center by the same distance (Figure 1). During the drilling process, the two tubes are aligned such that the thru bore of the Breakoff Tube is aligned with the drilling axis. When core breakoff is desired, the Breakoff Tube is rotated relative to the Bit, which gradually shifts the central axis of the Breakoff Tube. This pushes the entire portion of the core within the Bit to one side, shearing it at the base. The core does not fall out.

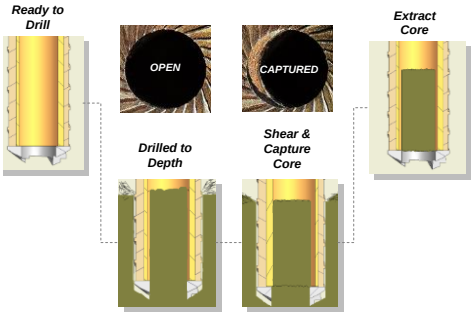

Figure 1. Honeybee Robotics patented "eccentric tubes" core breakoff approach.

Drill Bit: In Honeybee robotic drill systems, the core breakoff is done using a mechanism within the drill itself. However, this makes the drill mechanism more complex, heavier, and expensive. In order for the system to be accessible to geologists, we decided to move the complexity from the drill to the drill bit itself (**Figure 2**). The drill bit has been designed with breakoff features in such a way as to allow it to work with a HomeDepot drill.

To drill a hole, an operator inserts the bit into a chuck of a drill (in our tests we used Hilti 7A rotary-percussive drill). To start a hole with a coring bit is quite difficult because the bit does not have a center point. For this reason, we fabricated a hole starting tool – essentially a tube that slides around the bit and preloads against a rock surface to provide lateral constraints to the coring bit (**Figure 3**).

The operator then decides between rotary vs rotary-percussive based on rock hardness (hammer drilling is preferably in harder rocks while in softer rocks rotary drilling is sufficient and provides best quality cores). Upon reaching 10 cm depth, the operator reverse drill rotation, the core breakoff is engaged and the core is captured. The bit with the 2 cm diameter core is pulled out of the hole. To place the core in a sample cylinder, the bit is rotated clockwise again and the core gravity falls into the tube.

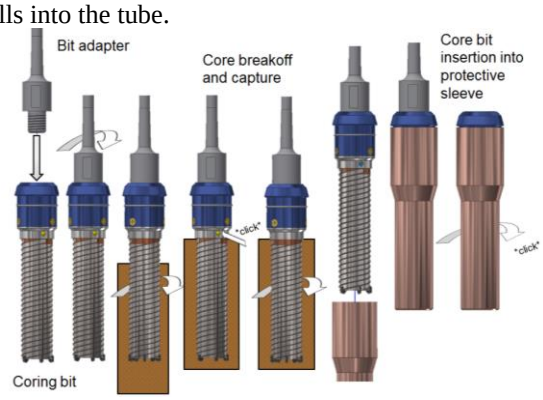

Figure 2. Coring steps.

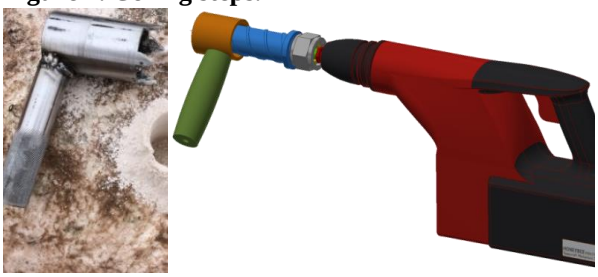

Figure 3. Core bit stabilizer.

Testing: The system has been successfully tested in a lab and during Atacama field deployment in 2016 (**Figure 4**). Lessons learned from the field will be incorporated to develop next generation coring bit.

Figure 4. L. Lab tests. R. Atacama tests

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