ATACAMA ROVER ASTROBIOLOGY DRILLING STUDIES PROJECT: FIRST DEPLOYMENT. B. Glass[1], A. Davila[1], V. Parro[2], R. Quinn[1], P. Willis[3], W. Brinckherhoff[4], J. DiRuggiero[5], M.B. Wilhelm[,6], D. Bergman[1], C. McKay[1], C. Stoker[1]. [1]NASA Ames Research Center, Moffett Field, CA 94305, USA, Email: brian.glass@nasa.gov, [2]Centro de Astrobiologia, 28850 Torrejón de Ardoz, Spain, [3]Jet Propulsion Laboratory, Pasadena, CA 91109, USA, [4]Goddard Space Flight Center, Greenbelt, MD 20771, USA, [5]Johns Hopkins University, Baltimore, MD 21218, USA, [6]Georgia Institute Of Technology, Atlanta, GA 30332, USA.

Introduction: The Atacama Rover Astrobiology Drilling Studies (ARADS) project [1], part of NASA's Planetary Science and Technology Through Analog Research (PSTAR) Program, is iteratively developing a simulated Mars rover analog mission. ARADS will be marked by a series of field tests of an integrated rover-drill system (Fig. 1) with mission-prototype instruments. Depth and sample volume for scientific sample acquisition require a drill capable of penetrating depths of a meter or greater. Observing the operation of the rover/drilling system in a high fidelity analog environment will illuminate the difficult issues of low-gravity drilling into an unknown substrate, drill site sensing and selection, and drill system emplacement and stabilization.

ARADS Elements: The essential elements of ARADS are: 1) use of an integrated drill and rover at sites in the Atacama Desert in Chile in unprepared "regolith"; 2) field use of instruments with the rover/drill that are flight prototypes comparable to those planned for/part of future mission proposals; 3) acquire drilled cuttings and transfer to instruments; 4) on-board autonomy and monitoring to support drilling and sample transfer; (5) demonstrate mission and science support (operations and control) for the rover/drill/instrument operations (6) “ground-truthing” of instrument prototypes with laboratory based measurements of these Mars-analog soils.

The fifth generation of a series of space-prototype, 1-2m-class rotary-percussive drills by Honeybee Robotics, a sample transfer robotic arm from the developers of the Phoenix and InSight arms (MDA Aerospace) and a new autonomous mid-sized rover concept (K-REX2) developed by NASA-Ames, have been designed, developed or modified to be compatible for the integration required for the ARADS analog site field experiments. Three of the four ARADS instruments, an MDA arm, and an earlier Honeybee drill, were part of the “Icebreaker” 2015 Step-1 Discovery mission proposal [2].

The ARADS project will demonstrate the feasibility of roving and drilling missions to Mars and show the science value of such a mission in the search for signs of life. It will demonstrate mobile “tricorder”-like biomarker detection technologies that will be candidate methods for instruments on future missions, in a realistic science operations simulation.

Fig. 1. Initial integration in December 2016 of the ARADS biomarker-search test vehicle, with drill, sample transfer arm, on the KREX2 rover.

Interim Results/Status: In February 2016 the first ARADS deployment in the Atacama was completed, gathering ground-truth samples for subsequent laboratory analysis. ARADS drilling control software was deployed and tested. The Signs of Life Detector (SOLID) prototype and a brassboard of Phoenix's Wet Chemistry Laboratory (WCL) were deployed and tested alongside the drill. Some early SOLID results are given in another abstract [3]. A MinION nanopore sequencer was tested in the field. In Nov. 2016 a new-design drill and sample transfer arm were integrated and tested with the KREX2 rover at NASA Ames.

Near-Term Plans: In Feb. 2017 the ARADS 2nd deployment will bring the JPL Microfluidic Life Analyzer (MILA) instrument on its first field test alongside WCL and SOLID. The newly integrated rover/drill/arm combination will be tested as a unit for the first time in field conditions, drilling 1-2m from the mobile platform while characterizing the vibration, thermal and power environments there. Later in 2017 each instrumemt will be integrated with the rover/drill platform in turn, leading to an integrated test with instruments before the following 2018 deployment.

References: [1] Glass, B., et al, Biosignatures Workshop, #2061, May 2016. [2] McKay, C. et al, *Astrobiology*, May 2013. [3] Davila, A. et al, AbSciCon 2017.