Resource Prospector: Evaluating the ISRU Potential of the Lunar Poles. A. Colaprete[1], R. Elphic[1], D. Andrews[1], J. Trimble[1], B. Bluethmann[2], J. Quinn[3], G. Chavers[4], [1]NASA Ames Research Center, Moffett Field, CA, [2]NASA Johnson Space Center, Houston, TX, [3]NASA Kennedy Space Center, FL, [4]NASA Marshal Space Flight Center, Hunstville, AL.

Introduction: Resource Prospector (RP) is a lunar volatiles prospecting mission being developed for potential flight in CY2021-2022. The mission includes a rover-borne payload that (1) can locate surface and near-subsurface volatiles, (2) excavate and analyze samples of the volatile-bearing regolith, and (3) demonstrate the form, extractability and usefulness of the materials. The primary mission goal for RP is to evaluate the In-Situ Resource Utilization (ISRU) potential of the lunar poles.

Mission Goals: While it is now understood that lunar water and other volatiles have a much greater extent of distribution, possible forms, and concentrations than previously believed, to fully understand how viable these volatiles are as a resource to support human exploration of the solar system, the distribution and form needs to be understood at a "human" scale. That is, the "ore body" must be better understood at the scales it would be worked before it can be evaluated as a potential architectural element within any evolvable lunar or Mars campaign. To this end the primary mission goals for RP are to:

- Provide enough information to allow for the next step: e.g., targeted survey, excavation and pilot processing plant demonstration
- Provide ground truth for models and orbital data sets, including:
  - Temperatures at small scales, subsurface temperatures and regolith densities
  - Surface hydration
  - Hazards (rocks and slopes)
- Correlate surface environments and volatiles with orbital data sets to allow for better prediction of resource potential using orbital data sets
- Address key hypothesis regarding polar volatile sources and sinks, retention and distribution, key to developing economic models and identifying excavation sites

To address the viability / economics of lunar ISRU the volatile distribution (concentration, including lateral and vertical extent and variability), volatile Form (H_2, OH, H_2O, CO_2, Ice vs bound, etc.), and accessibility, including overburden, soil mechanics, and trafficability, must be understood. To this end RP will assess the hydrogen and water distribution across several relevant environments that can be extended to a more regional and global assessment. Currently these environments are defined by their thermal character:

- Dry: Temperatures in the top meter expected to be too warm for ice to be stable
- Deep: Ice expected to be stable between 50-100 cm of the surface
- Shallow: Ice expected to be stable within 50cm of surface
- Surface: Ice expected to be stable at the surface (i.e., within a Permanently Shadowed Region, PSR)

Real-time Prospecting and Combined Instrument Measurements: Given the relatively short planned duration of this lunar mission, prospecting for sites of interest needs to occur in near real-time. The two prospecting instruments are the Neutron Spectrometer System (NSS) and the NIR Volatile Spectrometer System (NIRVSS). NSS will be used to sense hydrogen at concentrations as low as 0.5WT% to a depth of approximately 80-100 cm. This instrument is the principle instrument for identifying buried hydrogen bearing materials. NIRVSS, which includes its own calibrated light source, radiometer (for thermal correction) and context camera, will look at surface reflectance for signatures of bound H_2O/OH and general mineralogy. Once an area of interest is identified by the prospecting instruments the option to map the area in more detail (an Area of Interest activity) and/or subsurface extraction via drilling is considered. The RP drill is an auger which can sample from discrete depths using "biting" flutes, deep flutes with shallow pitch which hold material as the drill is extracted. As the drill is extracted a brush can deposit cuttings from the biting flutes to the surface in view of NIRVSS for a "quick assay" of the materials for water or other volatiles. If this quick assay shows indications of water or other volatiles, a regolith sample may be extracted for processing. Processing of the sample is performed by the Oxygen and Volatile Extraction Node (OVEN). OVEN will heat the sample to first 150C, pause, then to 450C. Any gases evolved from the sample are analyzed by the Lunar Advanced Volatile Analysis (LAVA) system which includes a Gas Chromatograph / Mass Spectrometer system.

This talk will provide an overview of the RP mission with an emphasis on mission goals and measurements, and will provide an update as to its current status.