Resource Prospector: Evaluating the ISRU Potential of the Lunar Poles. A. Colaprete[1], R. Elphic[1], M. Shirley[1], R. Beyer[1], Matt Siegler[2] [1]NASA Ames Research Center, Moffett Field, CA, [2]Planetary Science Institute, Tucson, AZ.

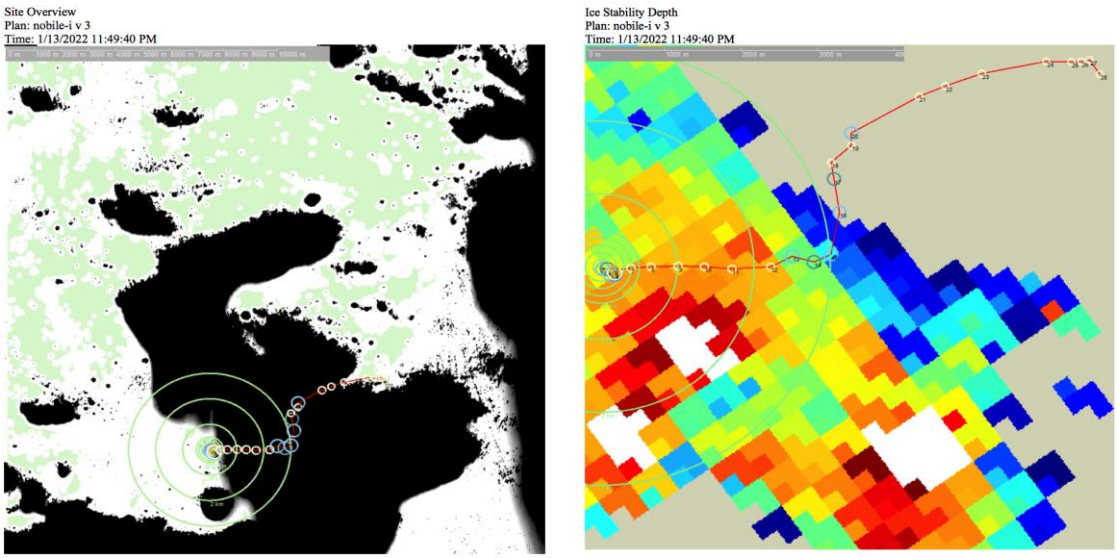
Introduction: Resource Prospector (RP) is a lunar volatiles prospecting mission being developed for potential flight in CY2022. The mission includes a rover-borne payload that (1) can locate surface and near-subsurface volatiles, (2) excavate and analyze samples of the volatile-bearing regolith, and (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 steps: 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 hypotheses 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



An example traverse planned at a South Pole study site area dubbed "North Nobile". Left Panel: Traverse (red curve) with planned activities (light blue circles). The three larger green circles indicate radial distance of 500 m. Right Panel: Same area as Left Panel showing traverse overplotted on top of predicted water ice stability depth (from Matt Siegler, personal communications).

- 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)

Site Selection Constraints: A critical facet of the RP mission design is the selection of a landing site that meets several criteria:

1. Evidence of Surface/Subsurface Volatiles
2. Reasonable terrain for traverse
3. Direct view to Earth (DTE) for communication
4. Sunlight for duration of mission for power

In addition to these four criteria, the overlap of all four must persist for a sufficient amount of time for the mission to accomplish its mission goals. In some instances these criteria are static in time, for example slopes which influence trafficability, while others are dynamic in time, for example DTE vs location and time. The RP Site Analysis Team has evaluated several example "study sites" to determine if these four criteria can be met for the necessary periods of time, and also to evaluate the fidelity of existing data products and tools for site evaluation and planning. This talk will provide an overview of the RP site analysis requirements, analysis process and to date identified key data products and tools necessary to select a site, plan and conduct the mission.