EXPLORING COLD TRAPPED VOLATILES FROM STATIONARY PLATFORMS AND MOBILE ROVERS: ESA ACTIVTIES FOR RESOURCE PROSPECTING AT THE POLES. J. D. Carpenter[1], R. Fisackerly, S. Aziz, B. Houdou, [1]ESA ESTEC, Keplerlaan 1, 2201 AZ, Noordwijk, The Netherlands, james.carpenter@esa.int.

The ability to access and utilize local resources at the surface of the Moon could be a game changer for exploration of the Solar System. Of the Moon's potential resources there is perhaps none so tantalizing as cold trapped water at the lunar poles. If present in sufficient abundance this ice could prove to be a valuable source of water, oxygen, rocket fuel and other consumables. However great uncertainties remain regarding the abundance, distribution, accessibility, geotechnical properties and local environment associated with this ice. Until these uncertainties are addressed the resource potential cannot be meaningfully assessed.

All knowledge available to date has been generated by orbital missions and the L-CROSS impactor. The information provided by these recent missions has proved transformative, but while new orbital data sets can help in the search for ice, definitive answers require surface missions.

From orbital neutron measurements it is apparent that a hydrogen enhancement, conceivably from water, is present within approximately 1m of the surface in Polar Regions. This is consistent with bolometric temperature measurements from orbit, which suggest that water ice can be stable within 1m of the surface across much of the Polar Regions. An understanding of the abundance and distribution of water ice therefore requires access to the subsurface to depths of at least 1m and analysis of the materials found there. The ability to access greater depths would extend the information available beyond that which can be detected from orbit.

ESA is developing the PROSPECT system to access and analyze material from up to 2m beneath the surface in the Polar Regions; although the system is intended to be able to assess the in-situ resource potential of lunar regolith at any given location on the Moon. In order to achieve this PROSPECT is required to:

- Drill and extract samples from depths of up to 2m.
- Extract water, oxygen and other chemicals of interest in the context of resources.
- Identify the chemical species extracted.
- Quantify the abundances of these species.
- Characterize isotopes such that the origins and emplacement processes can be established.

In the lunar polar regions PROSPECT is able to target water ice. At all locations on the Moon PROSPECT is able to extract solar wind implanted volatiles from the regolith through heating and aims to extract oxygen and other chemicals of interest as resources from minerals by a variety of techniques.

The first flight for PROSPECT to the Moon will be on the Russian Luna-27 mission planned for 2020. This mission is a stationary platform that will land in the South Polar Region at a site which has yet to be finalized. From this platform PROSPECT will provide the abundance and depth distribution of volatiles at a single location, as well as providing a comprehensive analysis of the composition and isotopes of those volatiles. The technologies and experience developed through PROSPECT is intended to feed forwards into future missions including a joint Lunar Polar Sample Return mission, currently under investigation by ESA and ROSCOSMOS.

A potential evolution of the PROSPECT capability, which is under investigation, would be to include it on a mobile platform, as part of a comprehensive mobile suite of instruments. A mobile platform would allow the spatial distribution to be mapped laterally and vertically across a broad area, as well as increasing the probability of accessing high concentrations for analysis. This will be an important development as it may well be that ice concentration is variable on different spatial scales.

To this end an industrial system study into a Lunar Prospecting Rover (LPR) has been initiated by ESA, to investigate at system level the requirements for such a rover, operating at the lunar poles. In addition a mobility test platform, the Robotic Autonomy Testbed (RAT) has been developed, to allow testing of key technologies and processes associated with situational awareness and operations. A detailed investigation of operations in the lunar poles in an LPR mission scenario using the RAT has been initiated. This LUnar scenario Concept valIdation and Demonstration (LUCID) campaign will assess the combinations of tools and techniques required to operate in the environmental and operational constraints of the lunar poles, by means of a test campaign that mimics the mission scenario of the LPR. The test shall simulate the operation of a rover in an analog near-polar lunar location and under realistic terrain and illumination conditions.