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The ESA PROSPECT Payload for Luna27: Development Status

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1. Abstract

This presentation will outline the development status of the PROSPECT payload for Lun27 and highlight the science goals and some of the work on-going to ensure that these goals can be met.

2. Introduction

The Package for Resource Observation and in-Situ Prospecting for Exploration, Commercial exploitation and Transportation (PROSPECT) is a payload in development by ESA for use at the lunar surface. Current development is for flight on the Russian-led Luna-Resource Lander (Luna 27) mission, which will target the south polar region of the Moon. PROSPECT will perform an assessment of volatile inventory in near surface regolith (down to ~ 1 m), and analyses to determine the abundance and origin of any volatiles discovered. Lunar polar volatiles present compelling science and exploration objectives for PROSPECT, but solar wind-implanted volatiles and oxygen in lunar minerals (extracted via ISRU techniques) constitute potential science return anywhere on the Moon, independently of a polar landing site. PROSPECT is comprised of the ProSEED drill module and the ProSPA analytical laboratory plus the Solids Inlet System (SIS), a carousel of sealable ovens (for evolving volatiles from regolith).

In ensemble, PROSPECT has a number of sensors and instruments (including ion-trap and magnetic sector mass spectrometers, imagers, and sensors for temperature, pressure, and permittivity) that form the basis for a range of science investigations that are (almost all) led by the PROSPECT Science Team:

- Imaging, Surface Modelling and Spectral Analysis
- Drilling, Geotechnics and Sample Handling
- ProSPA ISRU Precursor Experiments
- ProSPA ISRU Prospecting
- ProSPA Light Elements & Isotopes
- ProSPA Noble Gases
- Thermal Environment and Volatile Preservation
- Permittivity (ESA-led)

3. Development status and current activities

PROSPECT Phase C, 'detailed definition', began in December 2019. A plan of research activities is in progress to gain from and guide on-going development, build strategic scientific knowledge, and to prepare for operation of the payload.

Drill Testing. Testing of the ProSEED Development Model was carried out in December 2019 as part of the final Phase B activities. Test procedures were formulated to demonstrate drilling and sampling functionality in ambient, cold and thermal vacuum (TV) laboratory conditions (at CISAS, University of Padova). Tests included drilling into, and sampling from, well-characterized NU-LHT-2M simulant mixed with anorthosite inclusions of various sizes, according to a layered scheme that describe depth-density profile and distribution of inclusions and a range of plausible water ice contents.

ProSPA Bench Development Model (BDM). The BDM of the ProSPA analytical lab at the Open University has been tested to demonstrate science performance against measurement requirements. Dedicated efforts in 2019 focused on verification of evolved gas analysis (EGA) via measurement of meteorite standards, constraint of oxygen yield via demonstration of ISRU capabilities, improving understanding of sensitivity of science requirements to regolith volatile abundance and possible contamination, and understanding the performance of oven seal materials.

4. Volatile preservation

Particular efforts since 2018 have focused on understanding the capability of PROSPECT to sufficiently preserve volatile content in regolith throughout the sampling-analysis chain: from drilling to sealing of the ovens, until measurement of evolved gases in ProSPA's ion-trap and magnetic sector mass spectrometers. PROSPECT's ability to meet science requirements must persist for the range of possible volatile contents expected in near-surface regolith at landing sites in the lunar south polar region.