THE ESA PROSPECT PAYLOAD FOR LUNA 27: DEVELOPMENT STATUS. E. Sefton-Nash[1], R. Fisackerly[1], R. Trautner[1], S. J. Barber[2], P. Reiss[1], D. Heather[1,4], D. Martin[3], C. Orgel[1], J. D. Carpenter[1], B. Houdou[1], the PROSPECT Science Team and Industrial Consortium. [1]ESTEC, European Space Agency, Keplerlaan 1, Noordwijk 2201AZ, Netherlands (e.sefton-nash@cosmos.esa.int), [2]The Open University, Walton Hall, Milton Keynes, UK, [3]ECSAT, European Space Agency, Harwell, Oxford, UK, [4]ESAC, European Space Agency, Madrid, Spain.

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. 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 elemental and isotopic analyses to determine the abundance and origin of any volatiles discovered [1]. 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) (Fig. 1).

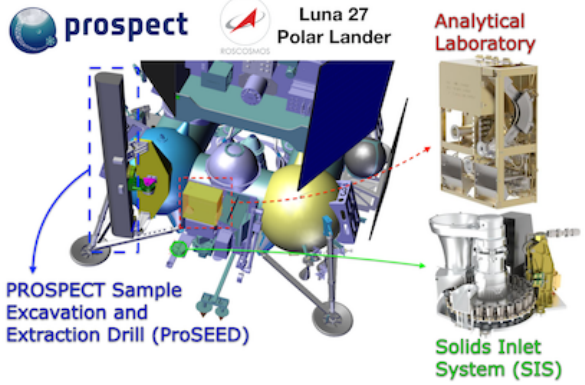

Figure 1: *Renderings of PROSPECT aboard Luna 27 polar lander, including the ProSEED drill module (left), and ProSPA (right). ProSPA comprises 1) the Solids Inlet System (lower right) to receive samples from drill sampling mechanism, with sample camera assembly (SamCam [2]) and carousel of ovens for volatile extraction from regolith samples, and 2) the analytical laboratory (upper right) containing a gas processing system, and magnetic sector plus ion-trap mass spectrometers.*

In ensemble, PROSPECT has a number of sensors and instruments (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, led principally 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

Development status and current activities: PROSPECT Phase C, 'detailed definition', began in December 2019. In parallel to the industrial schedule, an ongoing plan of research activities aims to gain from and guide ongoing development, build strategic scientific knowledge, and to prepare for operation of the payload. Particular efforts since 2018 have focussed on:

- Testing drill development model performance.
- Understanding the capability of PROSPECT to sufficiently preserve volatile content in regolith through the sampling handling and analysis chain.
- Demonstrating science performance against measurement requirements via, e.g. verification of evolved gas analysis by analyzing meteorite standards, constraint of oxygen yield via demonstration of ISRU capabilities [3, 4] improving understanding of sensitivity of measurement precision to regolith volatile content and possible contamination, and understanding oven seal performance [5].
- Investigating the complex landing site trade-space [e.g. 6, 7], involving solar illumination (for power considerations, and metrics of subsurface volatile stability [8, 9] and abundance [10]), landing site safety metrics, and visibility for data links.

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