Development of the PROSPECT Payload Package for Subsurface Sample Acquisition and Analysis of Lunar Volatiles

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Motivation for PROSPECT: Lunar Volatiles

Evidence for volatiles, incl. water, on the Moon has been provided by various types of measurements such as neutron spectrometer (hydrogen detection), laser altimeter (reflectance), imaging spectrometer (Ly-α), and an impact experiment (LCROSS).

Map of polar water ice stability within 1m – LRO-Diviner (Paige et al. 2010.)
PROSPECT Overview - ProSEED drill

ProSEED CEU controls PROSPECT package

- Interfaces with S/C and with ProSPA
  - TM/TC, power I/F
  - Controls system & actuators
  - Data processing & storage
  - Controls camera
  - Controls Permittivity Sensor

Drill box & mechanisms

- Acquire and deliver samples

Credits: Leonardo
ProSPA - Overview

Solids Inlet System Functions

- Alignment to drill for sample reception
- Carousel / oven positioning
- Imaging, oven sealing, oven heating

Analytical Laboratory Functions

- Instrument ctrl, volatiles storage, processing, analysis
- Gas exchange pipe to Russian GAP instrument

Credits: OU
ProSPA – Processing, Analysis & Science

1: Is water released and how much? What else?
- L: Rosetta Philae Ptolemy ion trap mass spectrometer 10 x 10 x 10 cm; for ProSPA: 2-200 amu; ~500 gram

2: Where did it come from? Comets? Asteroids? etc
- L: Magnetic sector CAD
- R: Preliminary ProSPA breadboard data (A Verchovsky, F Abernethy, J Mortimer)

3: Can we extract it to support exploration / ISRU?
- FeTiO₃ + H₂ → Fe + TiO₂ + H₂O
Summary

• PROSPECT developed by ESA with European industry for flight on Luna-27 to lunar polar regions is a powerful and versatile analysis package to provide ground truth on volatiles nature and abundance

• Start of Phase C/D imminent

• Cryogenic drill testing ongoing, instrument and sensor testing proceeding

• Modular system with high re-use potential of different elements