IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

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LUNAR "VOLATILE AND MINERALOGY MAPPING ORBITER (VMMO)" MISSION

Abstract

The lunar CubeSat mission proposal called VMMO (Volatile Mineralogy Mapping Orbiter) is among the two winners of the European Space Agency (ESA)'s SysNova Challenge on LUnar Cubesats for Exploration (LUCE) in 2018. VMMO has been developed by a multi-national team consisting of MPB Communications Inc, Surrey Space Centre, University of Winnipeg and Lens RD.

The proposed mission aims to address several key aspects of future lunar exploration:

•Lunar Resource Prospecting: Mapping the location of relevant in-situ resources and volatiles in sufficient quantities to be operationally useful (fuel, life-support) for future sustained surface missions. The VMMO's primary science payload (Lunar Volatile and Mineralogy Mapper or LVMM) is a miniaturised laser instrument that would probe Shackleton Crater, adjacent to the South Pole, for measuring the abundance of water ice. It uses a dual-wavelength chemical lidar at 532 nm and 1560 nm at relatively high SNR to improve the sensitivity to small changes in the water/ice content of the regolith. Scanning a 10m-wide path, LVMM would take around 260 days to build a high-resolution map of water ice inside the 20 km-diameter crater. LVMM would also map lunar resources such as ilmenite (TiFeO3) as it overflew sunlit regions, as well as monitoring the distribution of ice and other volatiles across darkened areas to gain understanding of how condensates migrate across the surface during the two-week lunar night.

•Lunar Environment and Effects: Measuring radiation, lofted dust and diurnal temperatures in the cis-lunar environment to support planning for future manned missions. A secondary radiation-detecting payload (Compact LunAr Ionizing Radiation Environment or CLAIRE) would build up a detailed model of the radiation environment for the benefit of follow-on mission hardware as well as human explorers.

•Lunar Explorations Technology: Developing enabling technologies for beyond-LEO CubeSats. VMMO adopts a low-cost 20kg 12U CubeSat de-sign, incorporating beyond-LEO navigation methodology and sensor suite as well as qualification of key electronics for CubeSats in the cis-lunar environment. The laser payload offers a dual use to demonstrate high-bandwidth and 1560nm optical downlink to an existing optical ground station.

VMMO has been designed for a potential flight opportunity within the Lunar Communications Pathfinder Mission currently being developed by Surrey Satellite Technology Ltd. (SSTL) and Goonhilly in partnership with ESA. The VMMO CubeSat would be injected by a mother spacecraft into a nominal high-eccentricity lunar orbit. It would then use its on-board propulsion to attain the desired operating lunar orbit.