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Moon Exploration – Part 1 (2A)

Author: Mr. Petr Bohacek
TRL Space, Czech Republic

Dr. Petr Broz
Czech Academy of Sciences, Czech Republic
Mr. Akos Kereszturi
Konkoly Observatory, Hungary
Mr. Henrik Hargitai
University Eotvos - Space Research Group, Hungary
Prof. Daniel Mege
Space Research Centre (SRC), Poland
Dr. Sam Poppe
Space Research Centre,PolishAcademy of Sciences (CBK-PAN), Poland
Dr. Tomas Kohout
Czech Academy of Sciences, Czech Republic
Dr. Michael Pisarik
Institute of Physics, CAS, Czech Republic
Mr. Ernst Hauber
German Aerospace Center (DLR), Berlin, Germany
Dr. Hiesinger Harald
Westfalische Wilhelms-Universitat, Germany
Dr. Anna Losiak
Polish Academy of Sciences, Poland
Mr. Benjamin Fernando
University of Oxford, United Kingdom
Prof. Ian Garrick-Bethell
United States

LUNAR GEOLOGY ORBITER: THE IMPACT ONTO THE THERMAL EVOLUTION OF THE MOON

Abstract

Even after decades of lunar exploration by orbiters, landers, rovers and crewed missions we still do not fully understand the thermal evolution of the Moon. It is generally accepted that the mare volcanism ended 1.2 Gyrs ago, however, younger activity might be plausible. It was proposed that Irregular Mare Patches (IMPs), the most enigmatic edifices of volcanic origin discovered in the Apollo-era, might represent the expression of such young volcanic activity, as the results of crater counting show that they might be only 100 My or fewer years old. Thus, an international consortium of scientific and industrial actors, is studying a dedicated lunar mission with the main objective to study IMPs in an attempt to find out how they were formed and hence improve our understanding of lunar evolution. The mission is proposed to take place under ESA's E3P3 program.

The mission concept is based on two probes, a lunar orbiter and an IMP impactor. Both of them integrated or separately will be delivered in the lunar orbital injection (LOI) on a piggyback opportunity

by a larger space vehicle. The lunar orbiter will be a 24-27U CubeSat dedicated to remote sensing of the targeted geological features. The IMP impactor will be a 1-3U CubeSat with autonomous navigation, altitude and orbit control system (AOCS) and propulsion to direct itself towards the target area. The targeted observational lunar orbit will be highly eccentric with a very low perilune (10-20 km) over the selected areas of interest (targeted IMPs) in order to provide high-resolution observation data. The mission will include four major payloads: a LiDAR, a ground penetrating radar (GPR), a multispectral camera and a mass spectrometer. In the first phase, IMP's topography and subsurface structure will be mapped by the LiDAR and GPR. The second phase, the observed impact and post-impact observations, will use the multispectral camera for impact plasma emission analysis, the ion-trap mass spectrometer analysis of the ejected dust and the LiDAR with GPR for post-impact analysis.

In the paper we will review the results of the ongoing preliminary study of the mission concept, objectives, analysis and architecture. This will include analysis of required orbital parameters for the orbiter and impactor and preliminary payload concept, justification, design and requirements.