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IN SITU PYRO-GC-MS CHEMICAL ANALYSIS OF LUNAR SOIL : A GROUND TRUTH TO INTERPRET THE ANALYSES OF THE SAMPLES RETURNED FROM THE MOON

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Abstract

Volatiles were recently discovered to be present at the Lunar pole. These volatiles probably comes from meteorites and micrometeorites which continue to deliver their material at the surface of the satellite. Thus, their characterisation would enable to better constrain the nature of the species brought by the meteorites to the solar system bodies, evaluate their evolution under Moon surface conditions. Thus is what we expect to be able to do within a few years with the Gas Analytical Package experiment onboard the Louna Globe mission.

1. Introduction

The chemical characterization of lunar samples will be of primary importance to assess their content in volatile species. These volatiles could reveal, for instance, part of the nature of : materials delivered to Earth from exogenous sources, minerals present in the Lunar regolith and surface rocks, and Lunar organic material. Even if the accuracy and sensitivity of the analytical instrumentation used in laboratory are very high to allow to thoroughly analyze the content of samples brought from the Moon, the journey of these samples in space, as well as their transportation to Earth environment, could change the nature of the sample volatiles (e.g. loss of chemical species, possible chemical reactions or contaminations). For these reasons, an in situ chemical characterization of the samples could be of precious help for the interpretation of the results obtained in laboratory, and their transposition to the Moon surface environment.

2. The GAC experiment

This is the reason why our team proposes an instrumentation to characterize in situ the content of volatiles in the lunar soil and rocks. This instrumentation would provide important reference data about the samples collected and returned to Earth. It is based on pyrolysis coupled with gas chromatography and mass spectrometry, and could have the capability to: extract volatile materials (either condensed or present in the minerals) from the solid samples, separate the volatile and analyze their structure for identification and quantification, and analyze isotopic ratios in a certain extent. This instrumentation is based on an inheritance of the GAP instrument that was present onboard the late Phobos-Grunt probe. The instrumentation would be composed of : i. a pyrolyzer capable to heat the samples up to about 1000°C, and developed by IKI (Rus), which is also in charge to the whole instrument (PI M. Gerasimov); ii. a gas chromatograph devoted to separate and detect the volatile species released from the samples, developed by LATMOS and LISA (Fra.) (CoI C. Szopa & P. Coll); iii. a time of flight mass spectrometer for the structural identification of the molecules, developed by the University of Bern (Swi.) (CoI P. Wurz). This instrumentation should allow the identification of inorganic volatile molecules and small organic molecules (up to about benzene). This communication aims at presenting this instrumentation that should be onboard the Luna Resource probe to the Lunar South pole, and it could be used for a return sample mission to get ground truth data about the returned samples.