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PROTOTYPING OF LUNAR SURFACE GEOLOGICAL SAMPLING TOOLS FOR MOON SPACEWALK SIMULATIONS BY ESA

Abstract

Apollo Lunar missions returned to scientists on Earth the first collection of geological extra-terrestrial planetary samples, other than meteorites. Scientists around the world are still studying rocks and soil samples that were collected, by the Apollo 11 through 17 missions, using modern equipment, methods and technologies. The return of samples has allowed the field of planetary science to advance in ways unthinkable with the restrictions of in-situ analysis and remote observations.

As for every other aspect of the Apollo programme, the design and manufacturing of the tools utilized by astronauts for sample collection had to meet rigorous planetary protection requirements, whilst respecting stringent environmental and operability constraints. Many of those tools went through various redesign efforts, based on feedback from the very skillful and resourceful astronauts using them. In future planetary exploration missions, geological and geo-microbiological sampling will be a key to further development of our understanding of the evolution of the solar system, and to develop successful technologies for in-situ resource utilization and 3D printing.

Designing and manufacturing technologies and ergonomics have developed since the 1960s, and so have chemical and biological hazard containment protocols, and analytical tools. Whilst it is important to solidly build on the lessons learned in the Apollo era, there is a serious opportunity for innovative design solutions.

The European Space Agency (ESA) Neutral Buoyancy Facility (NBF) based in the European Astronaut Centre (EAC) in Cologne has a large experience in performing 0g simulations for ISS (International Space Station) Extra Vehicular Activities (EVA), and has recently engaged in simulations of Lunar surface operations, replicating reduced gravity and mobility constraints, in order to prepare future human and robotics surface operations. One of the main objectives within this area is prototyping and testing new geological sampling tools which could be used in future human surface Lunar missions. The tools are being developed in cooperation with the team of planetary geologists of the PANGAEA project (Planetary ANalogue Geological and Astrobiological Exercise for Astronauts), and field tested during the PANGAEA Space Analogue test campaigns.

This paper discusses the requirements and objectives to be met while developing such tools, the challenges related to EVA suits and Lunar environment which impact the astronauts' mobility and tools performance. It presents the status of development achieved during NBF and PANGAEA analogue field

testing. The examples include a variety of sample collectors, containers, markers and the outcome of test performed in various mission scenarios.