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LABORATORY ON THE MOON: EQUIPPING AND TESTING OF A HABITAT LABORATORY FOR THE SCIENTIFIC EXPLORATION OF THE MOON BY HUMANS

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A human habitat on the Moon is predestined to house a laboratory, especially if it is built for scientific missions on the Moon. This laboratory could be used for (1) conducting experiments utilizing the lunar gravity and prepare experiments to be placed outside the laboratory in the lunar environment, (2) conducting analyses of lunar rock and regolith in high volume, and (3) performing preliminary analyses and screening of samples to be sent to Earth for more detailed, specialized analysis.

In the past, spaceflight missions have often been implemented by adding scientific instruments after most of the engineering work is already finished, limiting scientific studies to relatively scattered, insular topics. However, if prepared appropriately, a research laboratory on the Moon can help address scientific questions thoroughly and at a fundamental level. Moreover,

the challenge of creating a viable habitat is not only an engineering one, but one that requires input from architects, designers, and psychologists. After all, the crew not only works inside the habitat laboratory, but they spend (close to) their entire time on the Moon inside the habitat and under the isolation and confinement that comes with it.

We combine science, engineering, and architecture to create a habitat laboratory that meets their conflicting requirements: The laboratory of the Moon and Mars Base Analog (MaMBA) has been designed with inputs from (1) scientists of selected disciplines, particularly geology, materials science, chemistry, biology, and medicine, (2) space architects specializing on extraterrestrial bases, and (3) engineers for the constraints imposed by the lunar environment. The MaMBA laboratory was built in 2019 into the mock-up of the first MaMBA module (out of six). Subsequently, the laboratory was tested by volunteer scientists for its usability. The scientists used the laboratory for work deemed representative of lunar scientific analyses; the complete test runs lasted one week each, with one test run in June 2019 and the second test run in late September 2019 following some modifications suggested by the scientists.

Here, we will present an overview of the scientific topics that we think should be addressed on the Moon, together with a suggestion of scientific instrumentation that would be helpful for such investigations. Moreover, we present the MaMBA laboratory, equipped with the proposed instrumentation, and the outcomes of the test runs with a particular focus on the lessons learned regarding the equipping of the laboratory.