Informing Planetary Science Operations Scenarios through Underwater Analog Mission Activities at Pavilion Lake, Canada

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Introduction

Analog field science and exploration research can approximate the Earth's past as well as humanity's future in space. Analog field research affords the opportunity to study modern terrestrial systems and acquire geochemical, physical, technical, social and other data relatable to historical or future scenarios that cannot be accessed directly. Such is the case with the research of the Pavilion Lake Research Project (PLRP).

The PLRP – a multi-disciplinary, science and exploration endeavor – focuses on understanding the morphogenesis of modern microbialites in Pavilion Lake, Canada. Microbialite is a general term used to describe organo-sedimentary structures, which include stromatolites that are commonly formed through the trapping and binding of sediment and/or mineralization of microbes [1]. By characterizing the biological and physiochemical controls that influence the development of microbialites in Pavilion Lake, we are afforded an opportunity to test hypotheses related to factors that controlled the distribution and occurrence of microbialites, especially stromatolites, in the fossil record. These ancient structures can be key evolutionary markers, and they are sometimes the only fossil evidence of life prior to the development of multicellular organisms.

Over the years, the PLRP has employed a suite of lab and field based methods to accomplish their scientific and exploration goals [2]. In doing so, it became apparent that this project presented another analog application – human space exploration. The project's field research demands the seamless integration of science and exploration field activities in an underwater environment inherently hostile to humans. The physical, mental and operational rigors

associated with PLRP field science and exploration activities are comparable to lunar and martian extra-vehicular activities (EVA) where scientific exploration is a key driver. Underwater, humans must, as they do in space, contend with limited connection to their colleagues, protection from their environment, and life support systems (LSS), while at the same time explore and conduct scientific tasks in variable and unfamiliar terrains. These working constraints are not simulated, but real and inextricable from the PLRP's activities. The PLRP's analog science activities provide a real science setting in which to inform the development of scientific and mission operations architectures, train astronauts as field scientists [3], test technology, evaluate technical requirements to meet scientific needs, and design science backroom team protocols.

Here we present a synopsis of the analog science and exploration activities at Pavilion Lake, which will also include an overview of their scientific research results to date and Education and Public Outreach activities. For more information on the project, please see www.pavilionlake.com.

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