Ocean World Exploration and SLS: Enabling the Search for Life

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Abstract

Whether life exists on worlds other than Earth is one of the most compelling questions facing space science today. Given that, on Earth, life exists wherever water is found, worlds harboring large amounts of water are prime targets in the search for an answer to this question. Jovian moons Europa, Callisto, and Ganymede; Saturnian moons Enceladus and Titan; and possibly Neptune’s Triton are all worlds in the outer solar system on which large quantities of water can be found in solid and liquid form. So compelling are these worlds as targets for scientific study that the United States Congress recently initiated a directive to NASA to create an “Ocean Worlds Exploration Program, comprised of frequent small, medium and large missions that poses the potential to revolutionize our understanding of the solar system and life within it, perhaps more profoundly event than the modern-day search for past or extant life on Mars. Any life detected at the remote “ocean worlds” in the outer solar system would likely have formed and evolved along an independent path from life on Earth itself, giving us a deeper understanding of the potential for broad variety amongst life in the universe. In NASA’s robotic study of Mars, a key to the success of the “search for water” was the ability to conduct iterative exploration via a series of missions launched on a regular cadence based on 26-month cycles of prime planetary-alignment windows of reduced transit time. Through this cadence, NASA was able to send to Mars a series of orbiters and landers, using the knowledge gained from each mission to inform and refine the goals of the next. The ability to conduct iterative exploration in this manner could have a substantial impact on exploration of the “ocean worlds,” allowing scientists to narrow their targets of interest in the search for life based on data sent back by successive missions. This ability is currently limited by the transit periods available from contemporary evolved expendable launch vehicles. In the case of Europa, one of the nearer of these ocean worlds, current transit times are seven to nine years; iterative exploration of Europa would require decades. In the coming decade, NASA’s new Space Launch System (SLS) could revolutionize exploration of the outer solar system by dramatically reducing transit times. Designed to enable human exploration of deep space, SLS will be the world’s most powerful launch vehicle, offering unparalleled payload mass and volume and departure energy. In the case of Europa, SLS will reduce transit time to two to three years, enabling an iterative exploration cadence closer to what is currently experienced for Mars. SLS competed its critical design review during summer 2015 and is making rapid progress toward initial launch readiness. This paper will provide background on the importance of these ocean worlds and an overview and status of SLS, and will discuss the potential for the use of SLS in a robust iterative search for life in our solar system.