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PROGRAM OPTIONS TO EXPLORE OCEAN WORLDS

Abstract

The US Congress now requires NASA to implement a “virtual” Ocean Worlds Exploration Program (OWEP) using a mix of mission classes and types. The next US planetary Decadal Survey’s priorities will be published in 2022. In the meantime, NASA and ESA are currently developing large missions to explore Europa and Ganymede; NASA may also develop a large mission to search for biosignatures on the Europa surface. Small-class mission concepts to explore Titan and Enceladus have not been selected; NASA is evaluating medium-class mission concepts this year. However, a “virtual” OWEP cannot progress rapidly. None of six key conditions that enabled the Mars Exploration Program (MEP) over the past 15 years apply. OWEP technical challenges are formidable. The solar system contains almost a dozen diverse ocean worlds of varying importance, and key pieces of the ocean-world scientific puzzle are distributed among them. Missions to the Jovian and Saturnian ocean worlds are power-limited. Standard expendable launch vehicles impose half-decade (to Jupiter) or decade-long (to Saturn) transfers with multiple gravity assists. And the oceans themselves are beneath kilometers of cryogenic ice. In addition to these physical challenges, a virtual program would be severely handicapped: its technologies would have to compete for priority with other solar system objectives; and its missions would have to compete against unrelated science objectives in a rigidly non-strategic selection process. NASA has no class of mission opportunity comparable to the MEP strategic backbone (MGS, Odyssey, MER, and MRO, all directed, medium-class missions). Without a coherent program plan, the promise of an OWEP is likely to remain unfulfilled. Progress would be fastest if NASA could adapt three characteristics key to an explicit program like the MEP: 1) major technology investments outside of individual mission projects; 2) directed, medium-class missions that conduct pivotal investigations on a roadmap; and 3) multi-mission technical infrastructure, e.g., use of the Space Launch System so that direct-transfer trajectories into the outer solar system could halve trip time. This analysis treats the governing programmatic constraints, technical uncertainties, and policy gaps for an OWEP, then lays out multiple options for maximizing progress given these realities.