

## OPAG: Scientific Goals for Exploration of the Outer Solar System

Alfred S. McEwen and the OPAG Steering Committee

University of Arizona, Lunar and Planetary Lab, Planetary Sciences, Tucson, United States (mcewen@lpl.arizona.edu)

NASA's Outer Planets Assessment Group (OPAG; <https://www.lpi.usra.edu/opag/>) was established in 2004 to identify scientific priorities and pathways for exploration in the outer solar system. The OPAG goals document describes the science objectives and priorities of the OPAG community. It is consistent with the 2013 Decadal Survey "Vision and Voyages" but kept up-to-date as new missions are approved, new discoveries are made, models evolve, our understanding of solar system processes changes, and new questions are posed. This document will be used as a resource for defining technology development directions and needed laboratory experiments, modeling, and other research. It should be used as a resource for mission and instrument science objectives. Ultimately this document will guide our preparation for the outer solar system portion of the next decadal survey, including mission studies being done in preparation for that survey. There are several major changes from the old (2006; 2015 draft) versions, based on new developments such as the Europa Clipper and JUICE missions, the Ocean Worlds program and Roadmap to Ocean Worlds (ROW), and studies of an ice giants mission and a Europa lander. In addition, for the first time this document includes the Kuiper Belt Object (KBO) planets. The outer solar system contains many unexplored bodies and environments, contains critical evidence for how our solar system formed, and it hosts environments where important planetary processes can be observed today. The outer solar system is also where extensive subsurface oceans of liquid water exist today, potentially the best places to find extant life beyond Earth. High-priority destinations for future exploration include Europa, the ice giant systems (Uranus and Neptune, and moons that are candidate ocean worlds such as Triton), other ocean worlds such as Enceladus and Titan, Io—the best place to understand tidal heating, Saturn and other gas giants for deep abundance of volatile elements and noble gases, and KBO planets including Pluto/Charon and unexplored worlds. Attempting to actually detect life in ocean worlds is an especially high-priority goal. International collaboration is of key importance to achieving these objectives. OPAG is collecting community feedback on what the priorities should be for the next decadal survey.