



OPAG's Goals in Relation to Habitability

Morgan L. Cable (on behalf of OPAG Steering Committee)

ExoPAG Public Meeting

**AbSciCon Splinter Meeting
5 May 2024**





What is OPAG?

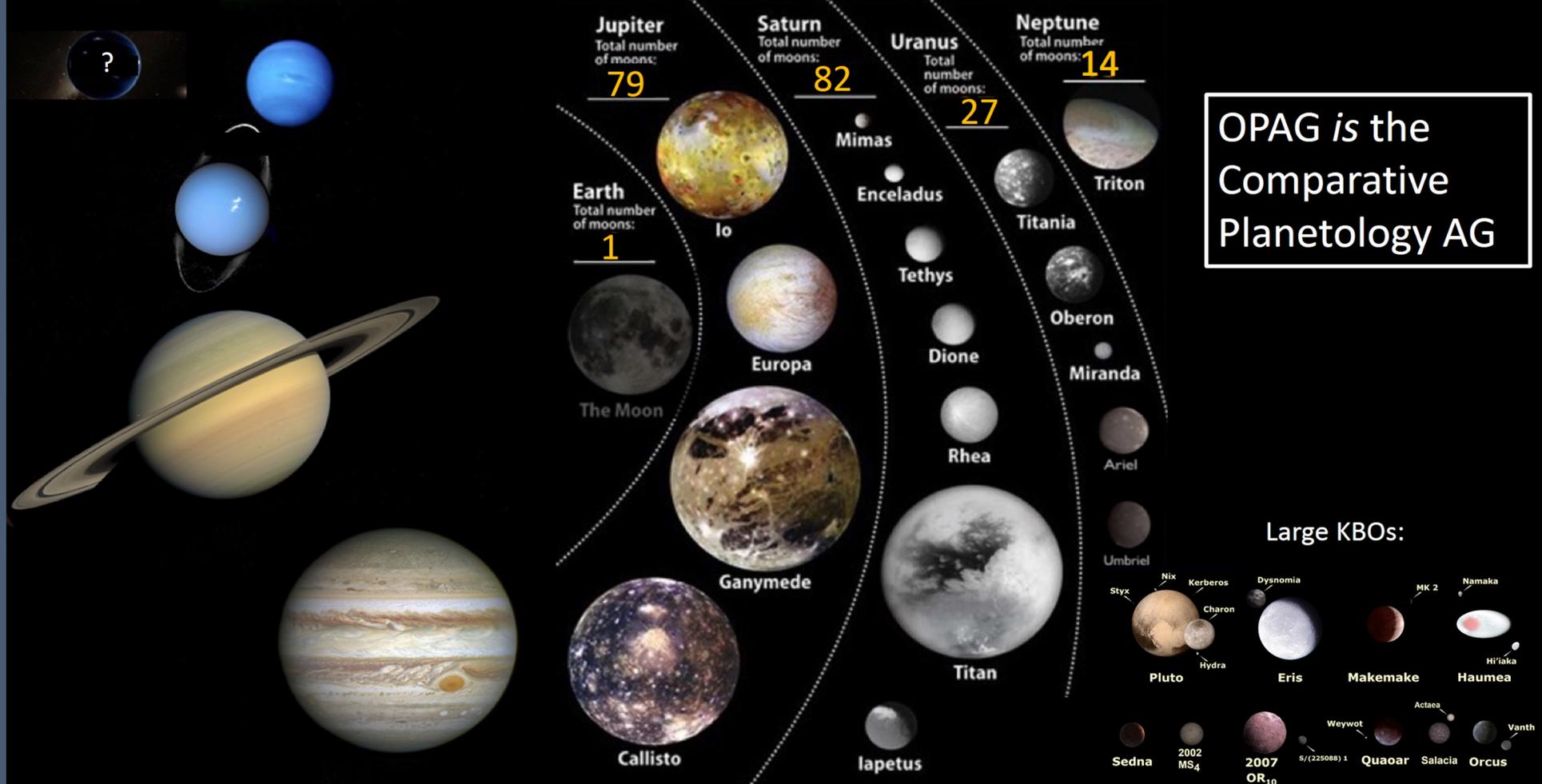
- The Outer Planets Assessment Group
- A community-based forum established by NASA in 2004 to identify scientific priorities and pathways for exploration in the outer solar system
- Open to all interested scientists, OPAG regularly evaluates outer solar system exploration goals, objectives, investigations and required measurements on the basis of the widest possible community outreach





What is OPAG?

Outer Solar System: Many Worlds to Explore

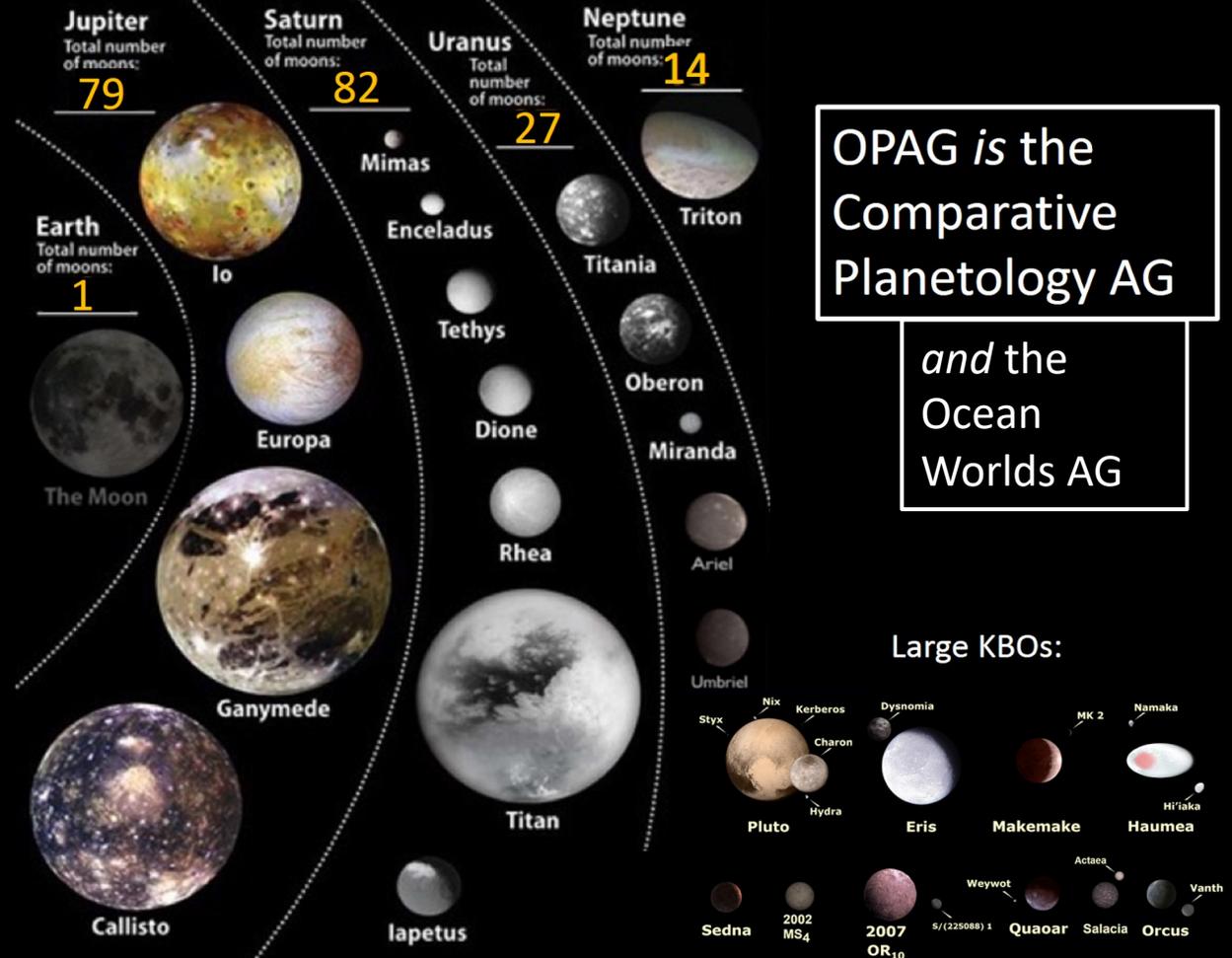
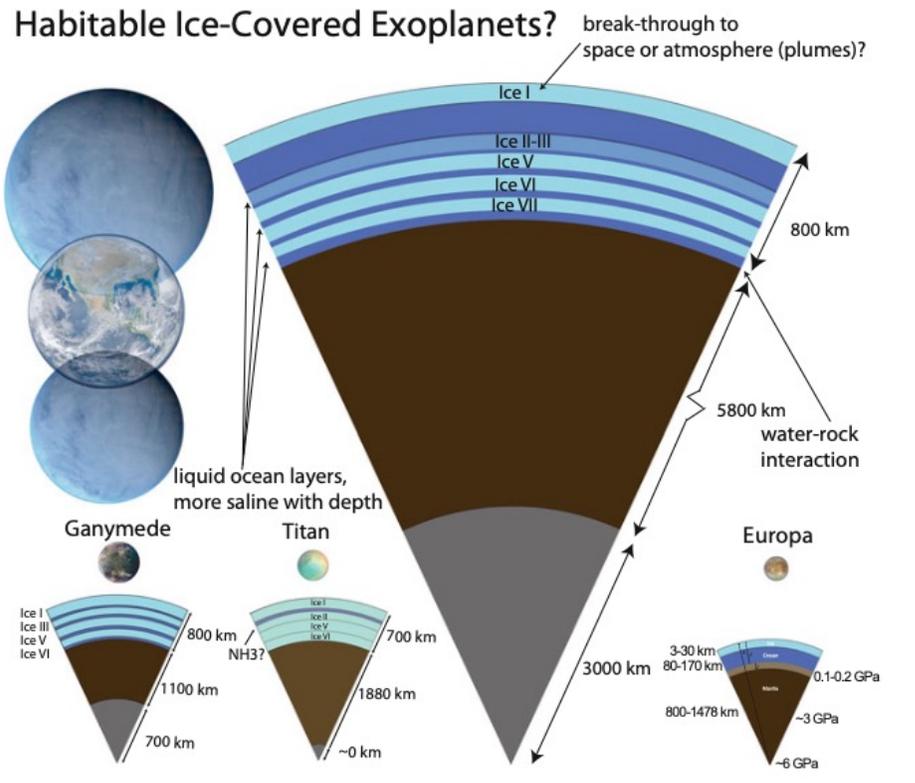




What is OPAG?

Outer Solar System: Many Worlds to Explore

Habitable Ice-Covered Exoplanets?



OPAG is the Comparative Planetology AG

and the Ocean Worlds AG



OPAG Steering Committee



Steve Vance*
Jet Propulsion Laboratory



Catherine Walker*
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Krista Soderlund
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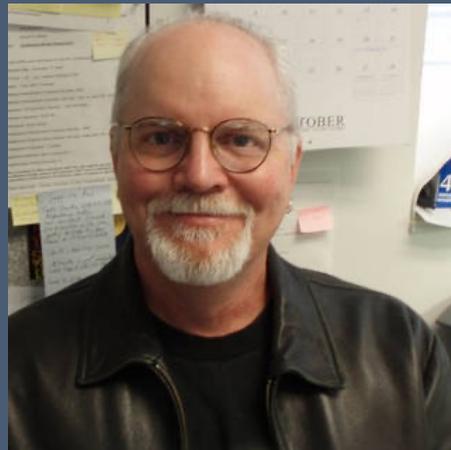
Lynnae Quick
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OPAG Steering Committee



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*New member (as of Apr 2024)



OPAG Steering Committee



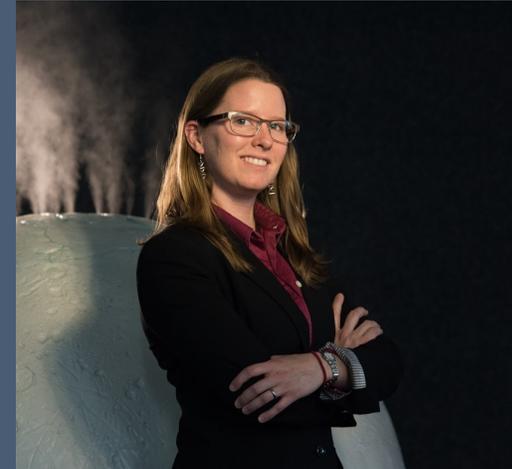
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OPAG Steering Committee



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OPAG Steering Committee: Rolling off



Linda Spilker
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Thanks so much for your service to the outer planets community!



OPAG Meetings

- The OPAG Steering Committee holds biweekly meetings
- OPAG typically holds two hybrid community meetings per year
 - June 2024, Cornell
 - November 2023, LASP/Colorado
 - April 2023, APL/JHU
 - November 2023, LPI
 - February 2020, LPI – with Exoplanets in our Backyard #1
- The focus of the community meetings is generating findings
- OPAG also reports out and gathers community feedback at townhall meetings during conferences (e.g., AGU, DPS, LPSC)



OPAG Focus

- Gather community feedback/opinions to influence the NASA Planetary Science Division or PSD (via the Planetary Science Advisory Committee or PAC, which reports to the NASA Advisory Council or NAC Science Committee, which reports to Nicky Fox, Science Mission Directorate Associate Administrator)
 - Lori Glaze, the PSD Director, attends the PAC meetings
 - OPAG reports on findings at the PAC meetings
- We also meet with Lori Glaze one-on-one (at LPSC, others)
- Of major importance to OPAG are
 - ***Outer planets research*** (R&A programs as a foundation)
 - ***Missions & infrastructure*** (Europa Clipper, Dragonfly, Jupiter Icy Moons Explorer, Uranus Orbiter and Probe, New Frontiers, Discovery; Radioisotope Power Supplies, Deep Space Network, etc.; plus continual support for operating missions)
 - ***Workforce***



OPAG and Habitability

- OPAG's purview includes a multitude of **habitable worlds**
 - Ocean Worlds and candidate Ocean Worlds that are moons of Jupiter, Saturn, Uranus and Neptune (Europa, Titan, Enceladus, Ganymede, Triton, etc.)
 - Dwarf planets (Pluto) and other Kuiper Belt Objects in the outer solar system that may also host habitable environments
- As this topic is cross-AG, OPAG jointly works with SBAG to support the **Ocean Worlds Working Group**
 - Led by Cynthia Phillips and Mike Bland
 - Established two subgroups to develop the **Ocean Worlds Exploration Strategy**
 - **Science Goals** Subgroup (Leads: Angela Marusiak and Misha Zolotov)
 - **Technology Roadmap** Subgroup (Leads: Kate Craft, Peter Willis and Paula do Vale Pereira)



OPAG and Habitability

- OPAG SC members are also involved in the **Habitable World Observatory (HWO)**, the next astrophysics flagship mission
 - Lynnae Quick is a member of the HWO Science, Technology, Architecture Review Team (START) and Co-Chair of the HWO Solar System Observations Subgroup
 - Amanda Hendrix, Lynnae Quick and Terry Hurford are also members of the HWO Solar System Observations Subgroup Steering Committee



OPAG and Habitability: Goals

- Support **Europa Clipper** through launch, cruise and operations
- Support **Dragonfly**
 - Recently confirmed, but nothing is guaranteed until it's on the launch pad
- Advocate strongly to get **focused studies started for UOP**
 - Uranus has several candidate Ocean Worlds that should be explored
- Consistently push for support of **research and technology development** that are enabling for outer planet science, including Ocean Worlds
 - RPS
 - Sampling and sample handling
 - Biosignature detection/characterization
- Continue to encourage/support **New Frontiers**, as this mission class is critical to reach outer planet targets
- Participate and represent OPAG in **Cross-AG EDIA Working Group**



OPAG and Habitability: Opportunities

- **Europa Clipper, Dragonfly, Juice and Uranus Orbiter and Probe (UOP):** potentially habitable ocean worlds in our solar system (Europa, Titan, Enceladus, Uranian worlds such as Miranda, Titania, etc.) may serve as analogs for volatile-rich terrestrial exoplanets
- If a planet with a Europa-like bulk composition (90% rock) were identified by HWO, TESS, etc., it would likely be categorized as a terrestrial exoplanet as opposed to an ocean world (Quick et al., 2020, *PASP*; Quick et al., 2023, *ApJ*)
- **The study of ocean worlds in our solar system with missions like Clipper, Juice, Dragonfly and UOP can help us better characterize and identify the many types of habitable exoplanets in our galaxy**
- Proxima Centauri b, a few non-transiting planets, and the outer Trappist planets may be very Europa or Enceladus-like as well (Luger et al., 2017, *NatAstron*; Ehrenreich et al., 2006, *ApJ*; Del Genio et al., 2019, *Astrobiology*)



OPAG and Habitability: International

- **Europa Clipper/Juice** synergistic science
 - Juice/Clipper Steering Committee (JCSC) chaired by Louise Prockter (facilitator Mathieu Choukroun) to review and revise joint science opportunities
 - Focus: Prioritization for Cruise/Approach phases first due to Clipper cruise review timing
 - Providing feedback periodically to both teams and OPAG
- ESA recently announced that the next large class mission of **Voyage 2050** (ESA's long-term plan for space activities) will be to **Enceladus**



Solar System Giant Planets: The Key to Understanding Exoplanets

- How did giant planets form? (e.g., core accretion versus gravitational instability)
- What are the compositional/structural differences between Jupiter- and Neptune-class planets?
- What are the effects of giant planets on planetary system architectures?
 - How do giant planets migrate and shape planetary system architectures?
- How do giant planets affect **habitability** of terrestrial planets?



Thank you!