COSPAR Panel on Planetary Protection Meeting 2023 #2

A. Coustenis, N. Hedman, P. Doran, and

- *The COSPAR Panel on Planetary Protection*

https://cosparhq.cnes.fr/scientific-structure/ppp

- 04 May 2022

Agenda

COSPAR PPP Open Meeting,
Vienna, 6 December 2023

COSPAR Panel on Planetary Protection
OPEN SESSION
Agenda
6 December 2023

(Vienna International Centre (VIC), CR.VI, 7th floor C-Building, and remotely, all times in CET)

- *09.30-10.00 Coffee (coffee corner outside meeting room)*

1) 10.00-10.15: Welcome and introduction to the Open Session *(A. Coustenis)*

2) 10:15-10.30: Introduction by COSPAR President and Executive Director *(P. Ehrenfreund, J-C. Worms)*

3) 10:30-11:00: Overview of COSPAR PPP activities *(PPP Leads)*

4) 11.00-13.00: Presentations by space agency, industry and other institution representatives *(TBD)*

- *13.00-14.00 Luncheon (coffee corner outside meeting room)*

4) 14.00-15:00: (Continued) Presentations by space agency, industry and other institution representatives *(TBD)*

5) 15.00-16.00: Discussion on Icy Worlds *(introduction by P. Doran)*

- *16.00-16.30 Coffee break (coffee corner outside meeting room)*

6) 16.30-17.00: Planetary Protection for Ceres *(introduction by J. Castillo-Rogez)*

7) 17.00-17.45: Upcoming possible updates to the COSPAR PP Policy *(introduction by N. Hedman)*

8) 17:45-18:30: AOB and open discussion

Briefing from COSPAR Leadership

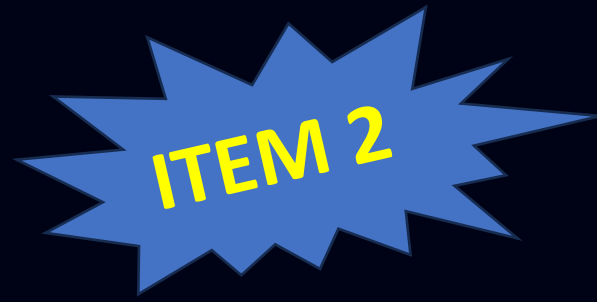
- Busan Scientific Assembly 13-21 July 2024: abstract deadline is 9 February 2024 → event on sustainable exploration?
- Lunar (and exploration) sustainability now being debated/addressed by many individuals and entities (e.g. UN WG-LTSSA, GEGSLA, LPP, World Institute for Sustainable Exploration) → coordination urgently needed !
- Media interest in COSPAR's views on exploitation of lunar resources

ITEM 2

Briefing from COSPAR Leadership

- Pressure on COSPAR to relax PP guidelines has not stopped in the past few years
- Many attempts to provide interpretations of OST67 that introduce less restrictions for non-governmental actors
- Recent example: Bill submitted to US Congress « *to amend title 51, US Code, to update government oversight of commercial space activities, and for other purposes* »

US BILL PROPOSAL "COMMERCIAL SPACE ACT"

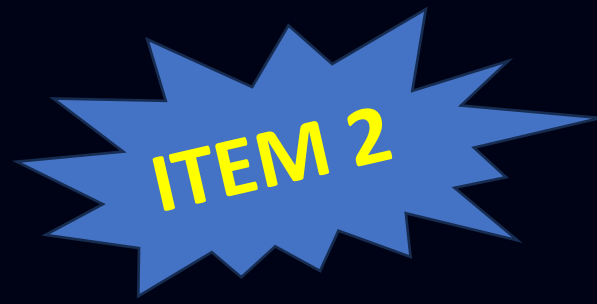


Briefing from COSPAR Leadership

LIMITATIONS

(A) The Federal Government shall interpret and fulfil its international obligations under the Outer Space Treaty in a manner that minimizes regulations and limitations on the freedom of US nongovernmental entities to explore and use space.

(B) The Federal Government shall interpret and fulfil its international obligations under the Outer Space Treaty in a manner that promotes free enterprise in outer space.



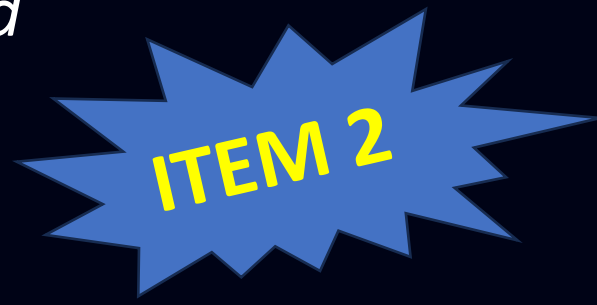
Briefing from COSPAR Leadership

LIMITATIONS (cont'd)

(D) The Federal Government may not consider guidelines promulgated by the Committee on Space Research of the International Science Counsel to be international obligations of the United States

PROHIBITIONS

(C) The Federal Government may not presume all obligations of the US under the Outer Space Treaty are obligations to be imputed upon US nongovernmental entities



Planetary protection and the global governance of outer space activities (key examples)

- 1967 Outer Space Treaty (OST) Articles VI and IX

- 2017 report of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) noted the long-standing role of COSPAR in maintaining the Planetary Protection Policy as a reference standard for spacefaring nations and in guiding compliance with Article IX of the Outer Space Treaty (A/72/20, para. 332)

- 2019 COPUOS Guidelines for the Long-term Sustainability of Outer Space Activities (Guideline D.1 Promote and support research into and the development of ways to support sustainable exploration and use of outer space):

"States and international intergovernmental organizations should consider appropriate safety measures to protect the earth and the space environment from harmful contamination, taking advantage of existing measures, practices and guidelines that may apply to those activities, and develop new measures as appropriate"

The Outer Space Treaty Article IX – and its complexities

- Principle of cooperation and mutual assistance
- Due regard to the corresponding interests of all other States Parties to the Treaty
- States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose
- If a State Part to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon or other celestial bodies, would cause potentially harmful interference with activities of other States Parties…it shall undertake international consultations before proceeding…

COSPAR contributions to COPUOS (key examples)

1963-1964 COSPAR reporting under COPUOS/STSC item on potentially harmful effects of space experiments – 1963 COPUOS report (A/5549) and 1964COPUOS report (A/5785) with inclusion of COSPAR Executive Council resolution (20 May 1964) and appendices

➢ COSPAR Consultative Group on Potentially Harmful Effects of Space Experiments:

a) Pollution of the upper atmosphere

b) Orbiting dipoles

c) Contamination of the moon and planets

- Panel on Standards for Space Probe Sterilization

1984 and 1988 reports by COSPAR on environmental effects of space activities (A/AC.105/344 and A/AC.105/420)

1980-1991 comprehensive COSPAR reports on progress of space research (starting with A/105/298)

COSPAR Panel on Planetary Protection Members

Chair: Athena **Coustenis** (planetology)

Vice-Chairs: Niklas **Hedman** (space law and policy) &
Peter **Doran** (LA State Univ., Hydrogeology, Extreme Environment)

12 members appointed by space agencies

Canada/CSA	**John Moores** (Engineering & planetary Sciences)
Germany/DLR	**Petra Rettberg** (microbiology, astrobiology)
China/CNSA	**Jing Peng** (engineering)
ESA	**Silvio Sinibaldi** (Astrobiology)
France/CNES	**Christian Mustin** (astrobiology)
India/ISRO	**Praveen Kumar K** (engineering science)
Italy/ASI	**Eleonora Ammannito** (planetologist)
Japan/JAXA-ISAS	**Masaki Fujimoto** (space plasma physics)
Russia/Roscosmos	**Natalia Khamidullina** (Radiation conditions)
UAE	**Omar Al Shehhi** (engineering)
UK/UKSA	**Karen Olsson-Francis** (astrob., microbiology)
USA/NASA	**Frank Groen** (Bayesian data analysis, engineering)

9 experts + 3 ex-officio

France	**Olivier Grasset** (geodynamics, planetology)
USA	**Alex Hayes** (planetology)
Russia	**Vyacheslav K. Ilyin** (microbiology, medicine)
Spain	**Olga Prieto-Ballesteros** (geology, astrobiology)
France	**François Raulin** (chemistry, planetology)
Japan	**Yohey Suzuki** (microbiology, geomicrobiology, metagenomics)
Canada	**Lyle Whyte** (Cold regions microbiology)
China	**Kanyan Xu** (microbiology, biochemistry)
Russia	**Maxim Zaitsev** (astrochem, organic chemistry)
NASEM ex officio	**Colleen Hartman** SB, ASEB & BPA Director
COSPAR CIR Ex-officio	**Michael Gold**
UNOOSA Ex-officio	**Michael Newman**

COSPAR planetary protection Panel & Policy

A special case among the Commissions and Panels in the COSPAR structure is the Panel of Planetary Protection (PPP) which serves an important function for space agencies pursuing the exploration of the planets. The primary objective of the COSPAR PPP is to develop, maintain, and promote the COSPAR policy and associated requirements for the reference of spacefaring nations and to guide compliance with the Outer Space Treaty ratified today by 112 nations, to protect against the harmful effects of forward and backward contamination, i. e.

- The conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardized.
- In addition, the Earth must be protected from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from an interplanetary mission.

- *This policy must be based upon the most current, peer-reviewed scientific knowledge, and should enable the exploration of the solar system, not prohibit it. The Panel has several meetings and invites all stakeholders including the private sector.*

- *It is not the purpose of the Panel to specify the means by which adherence to the COSPAR Planetary Protection Policy and associated guidelines is achieved; this is reserved to the engineering judgment of the organization responsible for the planetary mission, subject to certification of compliance with the COSPAR planetary protection requirements by the national or international authority responsible for compliance with the UN Outer Space Treaty.*

Operations of the COSPAR Panel on Planetary Protection

The Panel provides, through workshops and meetings also at COSPAR Assemblies, an international forum for the exchange of information on the best practices for adhering to the COSPAR planetary protection requirements. Through COSPAR the Panel informs the international community, including holding an active dialogue also with the private sector.

Since its restructuring in **mid-2018**, the Panel has had an average of **2-3 full meetings** per year and a large number of telecons between PPP Leads and parts of the Panel members, as well as among COSPAR Leads.

Several subcommittees work on different specific topics.

Community consultation by presentations in different meetings

The COSPAR Panel on Planetary Protection:
https://cosparhq.cnes.fr/scientific-structure/ppp

ITEMS 3- 4

Planetary protection categories

The different planetary protection categories (I-V) reflect the level of interest and concern that contamination can compromise future investigations or the safety of the Earth; the categories and associated requirements depend on the target body and mission type combinations

Category I: All types of mission to a target body which is not of direct interest for understanding the process of chemical evolution or the origin of life; *Undifferentiated, metamorphosed **asteroids**; others TBD*

Category II: All types of missions (gravity assist, orbiter, lander) to a target body where there is significant interest relative to the process of chemical evolution and the origin of life, but where there is only a remote[1] chance that contamination carried by a spacecraft could compromise future investigations; ***Venus; Moon (with organic inventory only for landed missions at the poles and in PSRs**); Comets; Carbonaceous Chondrite Asteroids; Jupiter; Saturn; Uranus; Neptune; Ganymede†; Titan†; Triton†; Pluto/Charon†; Ceres; Kuiper-Belt Objects > 1/2 the size of Pluto†; Kuiper-Belt Objects < 1/2 the size of Pluto; others TBD*

Category III: Flyby (i.e. gravity assist) and orbiter missions to a target body of chemical evolution and/or origin of life interest and for which scientific opinion provides a significant[2] chance of contamination which could compromise future investigations; *Mars; Europa; Enceladus; others TBD*

Category IV: Lander (and potentially orbiter) missions to a target body of chemical evolution and/or origin of life interest and for which scientific opinion provides a significant[2] chance of contamination which could compromise future investigations. 3 subcategories exist (IVa,b,c) depending on instruments, science investigations, special regions etc.; *Mars; Europa; Enceladus; TBD*

Category V: All Earth return: 2 subcategories - unrestricted return for solar system bodies deemed by scientific opinion to have no indigenous life forms and restricted return for all others

[1] *Implies the absence of environments where terrestrial organisms could survive and replicate, or a very low likelihood of transfer to environments where terrestrial organisms could survive and replicate*

[2] *Implies the presence of environments where terrestrial organisms could survive and replicate, and some likelihood of transfer to those places by a plausible mechanism*

Overview of COSPAR Panel on Planetary Protection Recent activities

ITEM 3

COSPAR PPP reported activities 2019-2022

- ***JAXA's Martian Moon Explorer (MMX)*: assigned planetary protection category : outbound Cat III and inbound Cat V: unrestricted Earth return. Full studies in *Life Sci. Space Res. 23 (2019)***

- ***Updated Planetary Protection for the Moon* :*Space Res. Today Aug. 2021, 211, 14-20***

Orbiter and fly-by missions to the Moon*: Category II*. There is no need to provide an organic inventory

Lander missions to the Moon :

- *Category IIa*. All missions to the surface of the Moon whose nominal mission profile does not access areas defined in Category IIb shall provide the planetary protection documentation and an organic inventory limited to organic products that may be released into the lunar environment by the propulsion system
- *Category IIb*. All missions to the surface of the Moon whose nominal profile accesses PSRs and the lunar poles, in particular latitudes south of 79°S and north of 86°N shall provide the planetary protection documentation and full organic inventory

Missions to small bodies

The small bodies of the solar system not elsewhere discussed in this policy represent a very large class of objects

The current COSPAR Policy for small bodies states that "imposing forward contamination controls on these missions is not warranted except on a case-by-case basis, so most such missions should reflect Categories I or II".

Released in 2022 and presented to the COSPAR Panel in 2022: the: *3rd CoPP report on Planetary Protection for missions to small bodies* (https://nap.nationalacademies.org/download/26714).

frontiers | Frontiers in Astronomy and Space Sciences

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Check for updates

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Planetary protection: an international concern and responsibility

Athena Coustenis[1]*, Niklas Hedman[2], Peter T. Doran[3], Omar Al Shehhi[4], Eleonora Ammannito[5], Masaki Fujimoto[6], Olivier Grasset[7], Frank Groen[8], Alexander G. Hayes[9], Vyacheslav Ilyin[10], K. Praveen Kumar[11], Caroline-Emmanuelle Morisset[12], Christian Mustin[13], Karen Olsson-Francis[14], Jing Peng[15], Olga Prieto-Ballesteros[16], Francois Raulin[17], Petra Rettberg[18], Silvio Sinibaldi[19], Yohey Suzuki[20], Kanyan Xu[21] and Maxim Zaitsev[22]

The CoPP report found that it is highly unlikely that small Solar System bodies harbor extinct or extant life or that terrestrial life could proliferate there. The Committee concluded that given the importance of some relatively primitive, volatile-rich, and organic-bearing small bodies to studies of prebiotic chemistry and the sparsity of current knowledge about them, there is no reason at this time to reduce the current categorizations (from Category II to Category I) for missions to small bodies. They did point out that larger objects like Ceres may be an exception. Knowledge about these larger objects is scant, and they should be assessed further before being visited, but for now, Category II is acceptable until further assessment.

PPP took the CoPP report into account at a meeting in 2022 and noted that the findings were compatible with the current policy. After thorough considerations and discussion by the Panel experts, it was decided that there was no need currently to change anything in the Policy as concerns small bodies.

Coustenis et al., 2023. Front. Astron. Space Sci. 10:1172546.

COSPAR PPP reported activities 2023

- ***No change in Planetary Protection category for Venus*** **:** the environmental conditions within the Venusian clouds are orders of magnitude drier and more acidic than the tolerated survival limits of any known terrestrial extremophile organism. Because of this, future orbital, landed or entry probe missions to Venus do not require extra planetary protection measures:

Zorzano Meier et al., 2023. LSSR 37, 18-24

- ***Mars Robotic missions*** **:** Although the science underpinning the Policy is advancing, as highlighted in recent reports (e.g. NASEM 2021, Spry et al. 2021) and in the Panel's work, there are still several knowledge gaps that need to be addressed before they can be directly applied to accommodate the interest of the user. They fall within three main themes, all of which will benefit from more measurements by space missions and ground-based observations: Biocidal effects, contamination transport model and Mars environmental conditions

Olsson-Francis et al., 2023. LSSR 36, 27-35

- ***Review of recent findings by the Panel and Policy history + small bodies :***
Coustenis et al., 2023. Front. Astron. Space Sci. 10:1172546 and

Coustenis & al., 2023, Acta Astron., 210, 446-452

The COSPAR planetary protection Policy for robotic missions to Mars

- In 2021, the Panel evaluated recent scientific data and literature regarding the planetary protection requirements for Mars and the implications of this on the guidelines. The group focused on three key areas:

1) Biocidal effects of the martian environment, 2) water stability, and 3) transport of spacecraft bioburden.

- These areas were discussed in the context of survival of dormant cells (where cells are either dormant or in a state of maintenance) vs proliferation (cells are actively defining) (National Academies of Sciences, Engineering, and Medicine. 2015; Rummel et al., 2014).

Life Sciences in Space Research 36 (2023) 27–35

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journal homepage: www.elsevier.com/locate/lssr

The COSPAR Planetary Protection Policy for robotic missions to Mars: A review of current scientific knowledge and future perspectives

Karen Olsson-Francis [a,*], Peter T. Doran [b], Vyacheslav Ilyin [c], Francois Raulin [d], Petra Rettberg [e], Gerhard Kminek [f], María-Paz Zorzano Mier [g], Athena Coustenis [h], Niklas Hedman [i], Omar Al Shehhi [j], Eleonora Ammannito [k], James Bernardini [l], Masaki Fujimoto [m], Olivier Grasset [n], Frank Groen [l], Alex Hayes [o], Sarah Gallagher [p], Praveen Kumar K [q], Christian Mustin [r], Akiko Nakamura [s], Elaine Seasly [l], Yohey Suzuki [s], Jing Peng [t], Olga Prieto-Ballesteros [g], Silvio Sinibaldi [f], Kanyan Xu [u], Maxim Zaitsev [v]

The COSPAR Panel on Planetary Protection will continue to work with the different national and international space agencies, the scientific community, and other stakeholders (e.g., the private sector and industry) to develop a roadmap for coordinating research activities addressing the identified knowledge gaps. This will include further characterisation of the biocidal effects at the surface of Mars, which needs to be addressed before *in-situ* reduction can be considered as an approach for bioburden control for robotic missions. Although the science underpinning the Policy is advancing, as highlighted in more recent reports (e.g. National Academies of Sciences, Engineering, and Medicine 2021, Spry et al. 2021) and in this paper, there are still several knowledge gaps that need to be addressed before they can be directly applied to accommodate the interest of the user. In brief, these knowledge gaps fall within three main themes, all of which will benefit from more measurements by space missions and ground-based observations: *Biocidal effects, contamination transport model and Mars environmental conditions*

Olsson-Francis et al., 2023. LSSR 36, 27-35

Other COSPAR PPP activities 2023 – communications/Workshops

The ESA WS Planetary Protection Requirements for future exploration missions Workshop

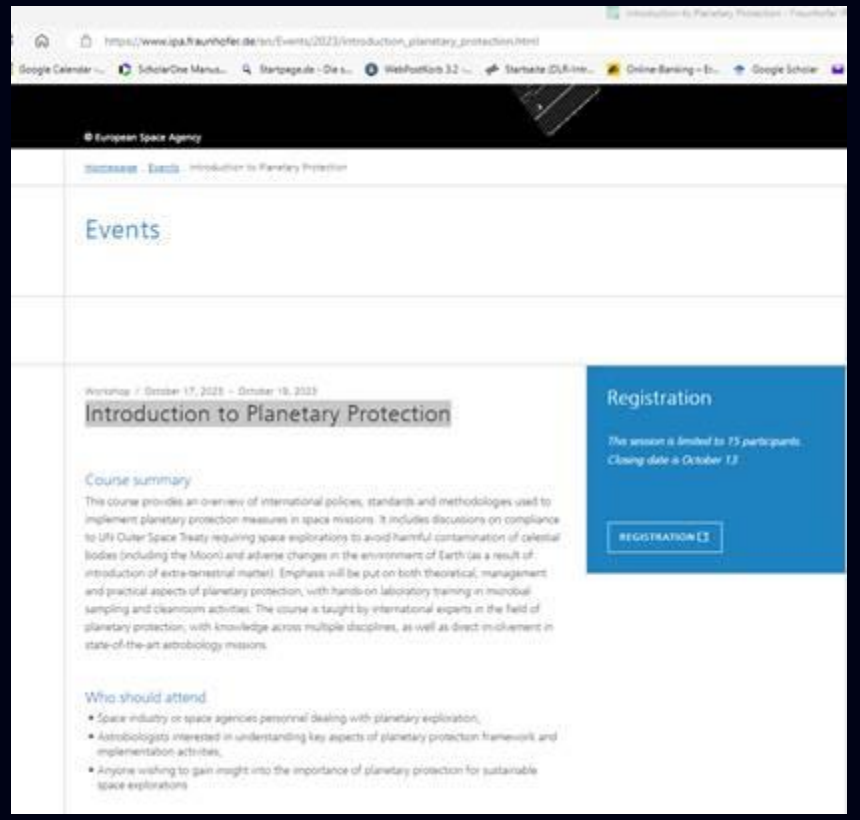
Organised by S. Sinbaldi, presentation by P. Rettberg

XIX International School of Astrobiology «Josep Comas i Solà». Searching for Life on Ocean Worlds with a lecture titled: Planetary Protection considerations for ocean worlds.

https://www.uimp.es/agenda-link.html?id_actividad=65EI&anyaca=2023-24

Talk by O. Prieto-Ballesteros

ESA PP course 'Introduction to Planetary Protection' (Fraunhofer Institute, Stuttgart)



Organised by S. Sinbaldi, presentations by N. Hedman & P. Rettberg

COSPAR PPP activities 2023

GeoBerlin 2023 conference

Plenary discussion on "plenary discussion about PP 'Should we colonize Mars? by P. Rettberg

VAAM (Association for General and Applied Microbiology) workshop 'Big Bang… Microbes!

Plenary discussion on "plenary discussion about PP 'Should we colonize Mars? by P. Rettberg

The ESA metagenomic Workshop

Talk by K. Olsson-Francis

COSPAR PPP activities 2023

EANA 2023

Talks on Planetary Protection
by P. Rettberg & K. Olsson-Francis

The International Mars Exploration Working Group (IMEWG)

invited talk about 'Planetary protection' by K. Olsson-Francis

NASEM CoPP Meeting, 20 Oct. 2023,

Presentation of PPP by N. Hedman, A. Coustenis & P. Doran

OPAG Meeting, 29 Nov. 2023,

Presentation of PP Icy Worlds Policy new suggestions by A. Hayes

Recent communications (extract)

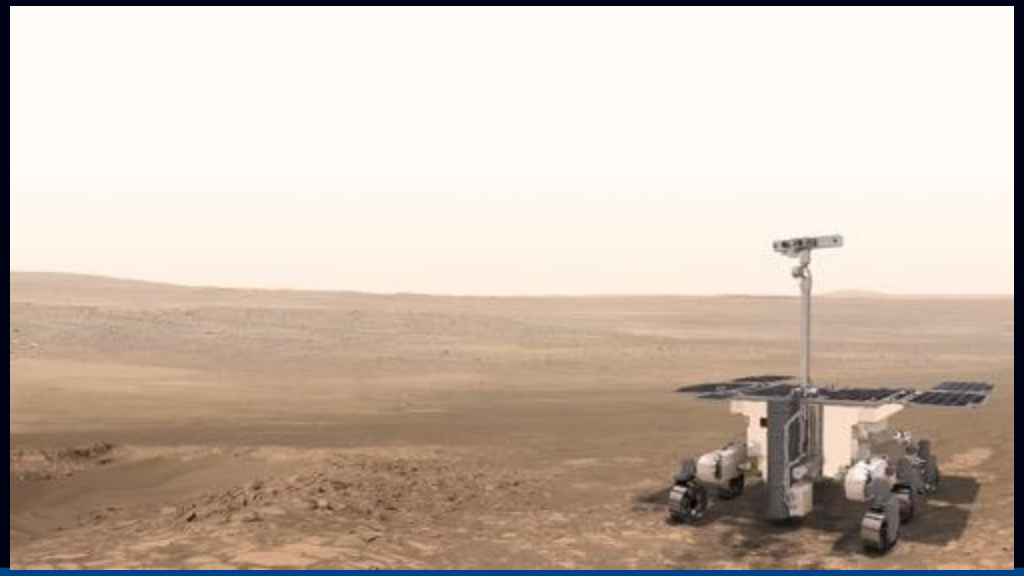
- Coustenis, A., the COSPAR Panel on Planetary Protection, 2022. The COSPAR Planetary Protection Policy: Ensuring the Sustainability of Scientific Investigations in Outer Space. 2022 International Symposium On The Peaceful Use Of Space Technology-Health (IPSPACE 2022). Beijing, Chine, 18-20 November.
- Hedman, N., Coustenis, A., the COSPAR Panel on Planetary Protection, 2022. The COSPAR planetary protection policy: ensuring the sustainability of scientific investigations in space. United Nations/China 2nd Global Partnership Workshop on Space Exploration and Innovation, 21-24 November.
- Coustenis, A., 2023. Planetary Protection. Space Education & Strategic Applications 2023 Conference: Islands in Space: From Skylab to Gateway. 21-22 September.
- Rettberg, P., Olsson-Francis, K., Benardini, J. N., Sinibaldi, S., Seasly, E., Sephton, M., Carter, J., Al Shehhi, O., Ammanito, E., Coustenis, A., Doran, P., Fujimoto, M., Grasset, O., Groen, F., Hayes, A., Hedman, N., Ilyin, V., Kumar, K.P., Mirrisset, C. E., Mustin, C., Peng, J., Prieto-Ballesteros, O., Raulin, F., Suzuki, Y., Xu, K., Zaitsev, M., 2023. The habitability of Mars and planetary protection - what do we need to know to avoid an unwanted contamination? EANA 2023, Madrid, Espagne, September
- Olsson-Francis, K., Benardini, J. N., Sinibaldi, S., Seasly, E., Sephton, M., Carter, J., Al Shehhi, O., Ammanito, E., Coustenis, A., Doran, P., Fujimoto, M., Grasset, O., Groen, F., Hayes, A., Hedman, N., Ilyin, V., Kumar, K.P., Mirrisset, C. E., Mustin, C., Peng, J., Prieto-Ballesteros, O., Raulin, F., Rettberg, P., Suzuki, Y., Xu, K., Zaitsev, M., 2023. A New Era For Planetary Protection: The Probabilistic Approach. EANA 2023, Madrid, Spain, September
- Coustenis, A., 2023. Planetary Protection. Space Education & Strategic Applications 2023 Conference: Islands in Space: From Skylab to Gateway. 21-22 September.
- Coustenis, A., Hedman, N., Doran, P., the COSPAR Panel on Planetary Protection, 2023. Cospar planetary protection policy : recent advances. 74th International Astronautical Congress (IAC 2023), Baku, Azerbaijan, 2-6 October.

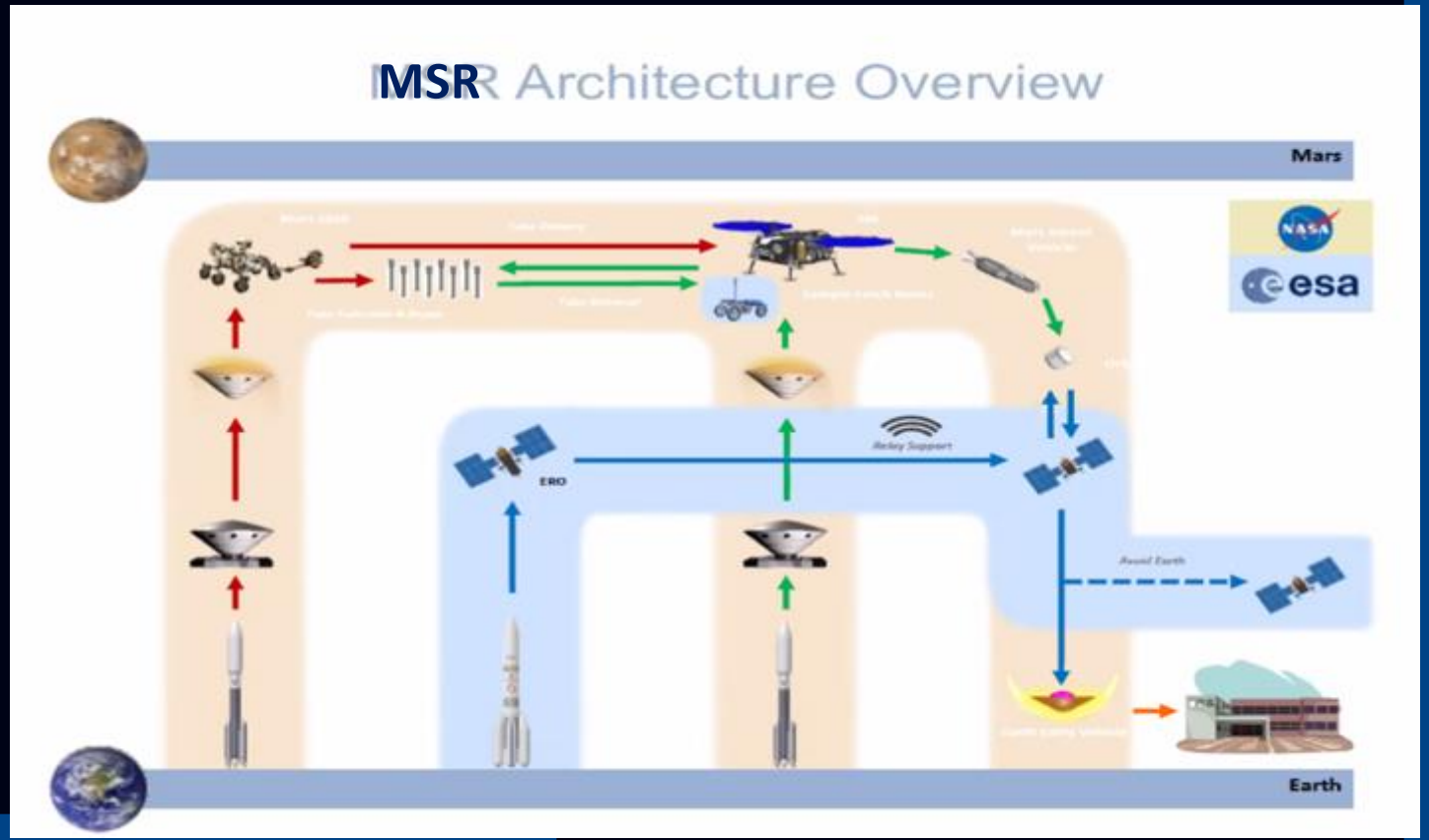
Current considerations

After Venus and small bodies…

- Martian Robotic and human Exploration *(Olsson-Francis et al., 2023; Spry et al., in review)*
- *MSR & ExoMars + other missions to Mars : PPP gets regular reports and will be a major item in future meetings.*

ExoMars Rosalind Franklin Rover





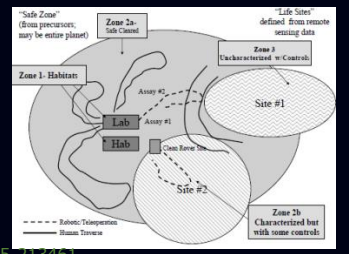
Planetary Protection requirements

Principles for Human Missions to Mars

- The intent of the planetary protection policy is the same whether a mission to Mars is conducted robotically or with human explorers
- Planetary protection goals should not be relaxed to accommodate a human mission to Mars, i.e. they become even more directly relevant to such missions—even if specific implementation requirements must differ. Human exploration of Mars will require additional planetary protection considerations to those for robotic missions.
- Safeguarding the Earth from potential back contamination is the highest planetary protection priority in Mars exploration
- The greater capability of human explorers can contribute to the astrobiological exploration of Mars only if human-associated contamination is controlled and understood

Credit: ESA

Credit: NASA/Apollo 17



Credit: NASA/CP-2005-213461

Establish engineering requirements through a series of NASA and COSPAR co-sponsored workshops on Planetary Protection for Human Missions to Mars to address knowledge gaps for planetary protection in the context of future human missions to Mars.

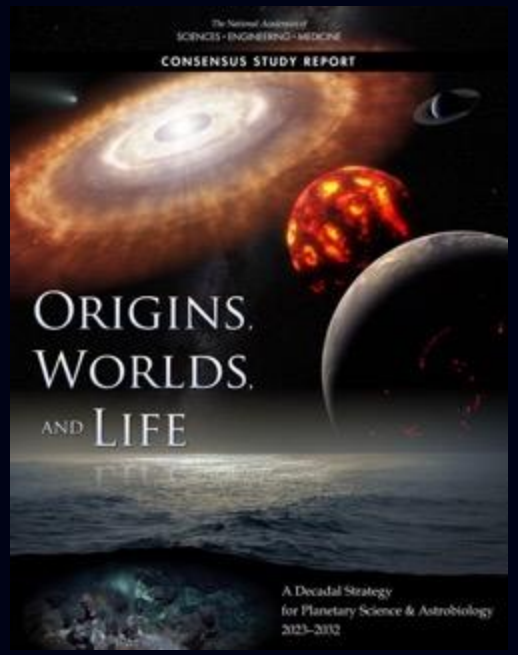
Mars Human exploration

- These interdisciplinary meetings considered the next steps in addressing knowledge gaps for planetary protection in the context of future human missions to Mars. Reports from these workshops are posted under Conference Documents at https://sma.nasa.gov/sma-disciplines/planetary-protection/.
- A report was issued after the June 2022 COSPAR Meeting on "Planetary Protection Knowledge Gaps for Crewed Mars Missions" (*Spry et al., 2022*) and represented the completion of the COSPAR series. This report aims to identify, refine, and prioritize the knowledge gaps that are needed to be addressed for planetary protection for crewed missions to Mars, and describes where and how needed data can be obtained.
- The knowledge gaps addressed in this meeting series fall into three major themes: "*1. Microbial and human health monitoring; 2. Technology and operations for biological contamination control, and; 3. Natural transport of biological contamination on Mars." (Kminek et al., 2017)*
- This approach was consistent with current scientific understanding and COSPAR policy, that the presence of a biological hazard in Martian material cannot be ruled out, and appropriate mitigations need to be in place. The findings will be published in *Spry et al. (2023, submitted to Astrobiology)* with COSPAR support. This paper will highlight the scientific measurements and data needed for knowledge gap closure, updating and completing in more detail the material previously presented in the *Spry et al. (2021)* Planetary Science Decadal Survey white paper **(https://doi.org/10.3847/25c2cfeb.4a582a02).**

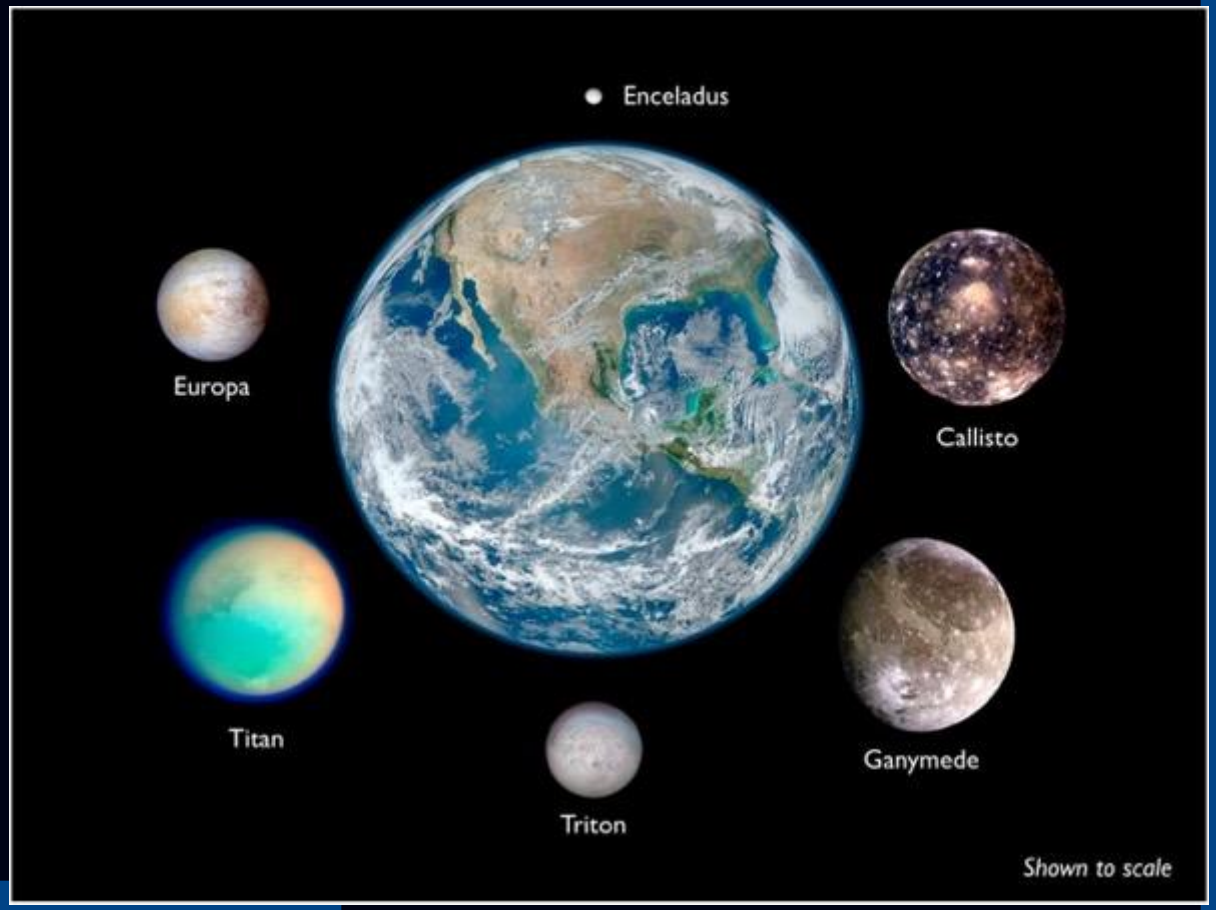
Future considerations

After the updated Policy published in Aug. 2021, the Panel is considering new needs for guidance in space exploration.

- More Mars…
- Icy Worlds (& Ceres)
- PP policy editorial review and restructuring

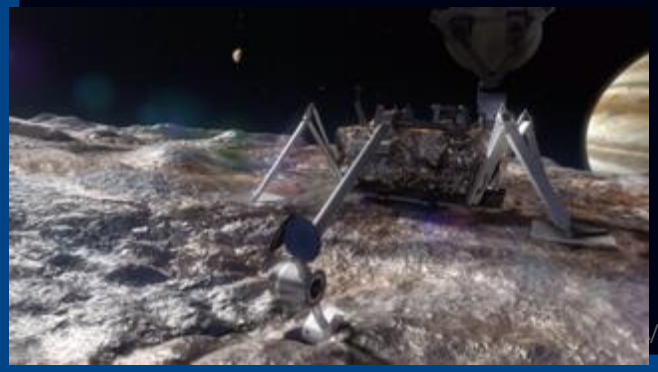


Some themes have been showcased in the OWL and Voyage 2050.



Planetary Protection of the Outer Solar System (PPOSS)

- Project led by the European Science Foundation, funded by the EC with DLR/Germany, INAF/Italy, Eurospace, Space Technology/Ireland, Imperial College London (UK), China Academy of Space Technology and NAS-SSB
- Recommended a revision of the planetary protection requirements for missions to Europa and Enceladus, based based partly on the NAS-SSB 2012 Icy Bodies Report and on an ESA PPWG recommendation
- COSPAR was involved throughout the multi-year-long process and at the end updated the requirements for missions to Europa and Enceladus



Published in

Space Res. Today (2020) 208

"Planetary protection: New aspects of policy and requirements", 2019.

***Life Sci. Space Res.** 23*

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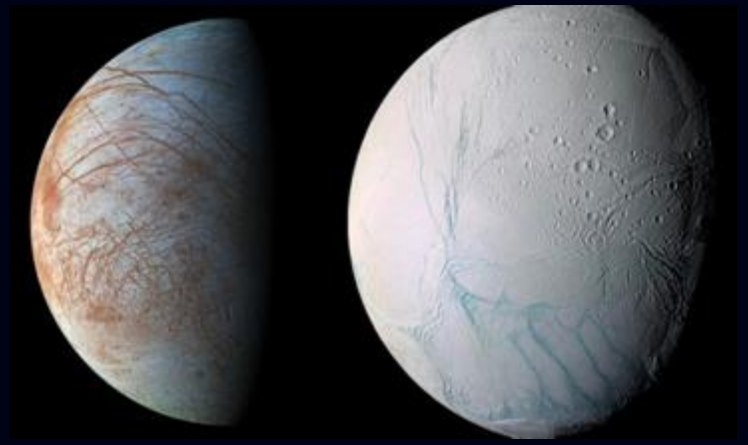

Europa *Enceladus*

- *Category III and IV: Requirements for Europa and Enceladus flybys, orbiters and landers, including bioburden reduction, shall be applied in order to reduce the probability of inadvertent contamination of a Europan or Enceladan ocean to less than 1 x 10-4 per mission*
- *The probability of inadvertent contamination of a Europan or Enceladan ocean of 1x10-4 applies to all mission phases including the duration that spacecraft introduced terrestrial organisms remain viable and could reach a subsurface liquid water environnement*

Planetary Protection of the Outer Solar System (PPOSS)

THE INTERNATIONAL PLANETARY PROTECTION HANDBOOK

by

Gerhard Kminek (ESA, Noordwijk, The Netherlands), Jean-Louis Fellous (COSPAR, France), Petra Rettberg (DLR, Germany), Christine Moissl-Eichinger (Medical Univ. Graz, Austria), Mark A. Sephton and Samuel H. Royle (Imperial College London, UK), J Andy Spry (SETI Institute, CA, USA), Hajime Yano (ISAS/JAXA, Japan), Toshihiro Chujo (formerly JAXA, now Tokyo Institute of Technology, Japan), Diana B. Margheritis (Thales Alenia Space, Italy), John R. Brucato (INAF, Italy), and Alissa J. Haddaji (formerly COSPAR, now Harvard University, MA, USA)

An online-only supplement to *Space Research Today*, volume 205

"Planetary protection: New aspects of policy and requirements", 2019.

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& The Internl PP Handbook: Dec. 2018

Credit: NASA/JPL/Galileo

- *Policy should include a generic definition of the environmental conditions potentially allowing Earth organisms to replicate*
- *implementation guidelines should be more specific on relevant organisms*
- *implementation guidelines should be updated to reflect the period of biological exploration of Europa and Enceladus*
- *implementation guidelines should acknowledge the potential existence of Enhanced Downward Transport Zones at the surface of Europa and Enceladus.*

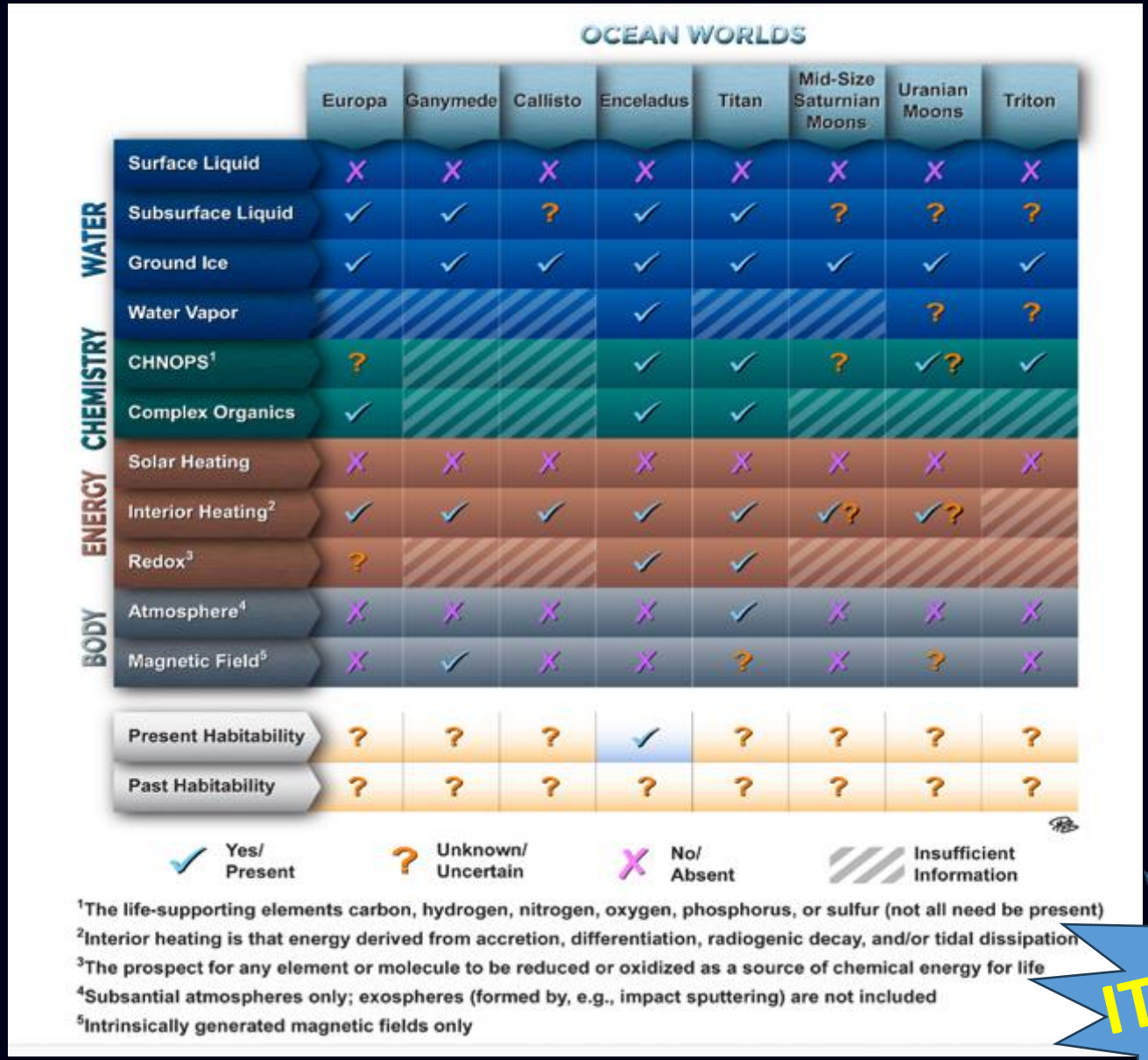
Future items for consideration

After the PPOSS study, the Panel is considering the

Future exploration of Icy Worlds and Ceres

The Panel has been working on a thorough review of the current knowledge for Icy Moons+Ocean Worlds (Icy Worlds: *outer solar system moons and dwarf planets like Pluto, but not more primitive bodies*:) and is making proposals for better coverage in the Policy

(Doran et al., submitted for publication)



ITEMS 5-6

Modified from NASEM Decadal. OWL, Courtesy of P. Byrne

COSPAR PP Policy editorial review and restructuring process

Objective is to enhance the understanding and clarity of the Policy and associated guidelines for consistency and transparency by:

- Clarifying the status of the Policy as a non-legally binding international standard;
- Quoting both OST Article VI and IX;
- Adding a chapter clarifying the role and function of COSPAR PPP;
- Restructuring the Policy and associated guidelines with explanatory text, including graphics/tables on:
  a) Planetary protection process overview (categorization and corresponding guidelines);
  b) Planetary protection categories in relation to target bodies;
  c) Guideline specification;
  d) Appendix with terms and definition;
  e) Appendix with reporting process.

ITEM 7

Review undertaken by a small group: PPP Leadership with NASA, ESA and some scientists members. To be presented to full PPP Meeting in April 2024.

Reporting to COSPAR

It is recommended that spacefaring entities inform COSPAR when establishing planetary protection requirements for planetary missions, and *also* that they provide information to COSPAR within a reasonable time not to exceed six months after launch about the procedures and computations used for planetary protection for each flight and again within one year after the end of a solar-system exploration mission about the areas of the target(s) which may have been subject to contamination.

Reports should include, but not be limited to, the following information:

- *The estimated bioburden at launch, the methods used to obtain the estimate (e.g., assay techniques applied to spacecraft or a proxy), and the statistical uncertainty in the estimate*
- *The probable composition (identification) of the bioburden for Category IV missions, and for Category V "restricted Earth return" missions*
- *Methods used to control the bioburden, decontaminate and/or sterilize the space flight hardware*
- *The organic inventory of all impacting or landed spacecraft or spacecraft-components, for quantities exceeding 1 kg*
- *Intended minimum distance from the surface of the target body for launched components, for those vehicles not intended to land on the body*
- *Approximate orbital parameters, expected or realized, for any vehicle which is intended to be placed in orbit around a solar system body*
- *For the end-of-mission, the disposition of the spacecraft and all of its major components, either in space or for landed components by position (or estimated position) on a planetary surface*

Planetary protection:
For sustainable space exploration and to safeguard our biosphere

- COSPAR maintains a non-legally binding planetary protection policy and associated requirements to guide compliance with the UN Outer Space Treaty. The COSPAR Policy is the only international framework for planetary protection

- COPUOS in its 2017 report noted the long-standing role of COSPAR in maintaining the Planetary Protection Policy as a reference standard for spacefaring nations and in guiding compliance with the Outer Space Treaty

The Policy will continue to be updated but not in a rushed process. We give thorough consideration to all arguments and scientific inputs and make an informed decision

In the meantime, there is need for community input on science findings and research reserves regarding recent reports: Studies/Survey/Workshop/Focused conferences?

Future meetings and activities

Archiving of reports: getting organized in the web site

Future meetings :

- 6-7 December 2023 in Vienna
- Week of 22 April 2024 in London, UK

Workshops, open and closed sessions

Next COSPAR General Assembly : 13-21 July 2024, Busan, South Korea

https://cosparhq.cnes.fr/scientific-structure/ppp

PPP Recent publications (extract)

https://cosparhq.cnes.fr/scientific-structure/panels/panel-on-planetary-protection-ppp/

- The COSPAR Panel on Planetary Protection, 2020. « COSPAR Policy on Planetary Protection ». *Space Res. Today* 208, Aug. 2020
- The COSPAR Panel on Planetary Protection, 2020. « Planetary Protection Policy: For sustainable space exploration and to safeguard our biosphere ». *Research Outreach* 118, 126-129.
- Coustenis, A., Hedman, N., Kminek, G., The COSPAR Panel on Planetary Protection, 2021. "To boldly go where no germs will follow: the role of the COSPAR Panel on Planetary Protection". *OpenAccessGovernment,* July 2021
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- Coustenis, A., The COSPAR Panel on Planetary Protection, 2021. « Fly me to the moon: Securing potential lunar water sites for research ». *OpenAccessGovernment,* Sept. 2021
- Olsson-Francis, K., Doran, P., et al., 2023. The COSPAR Planetary Protection Policy for missions to Mars: ways forward based on current science and knowledge gaps. *LSSR*, 36, p. 27-35.
- Zorzano M-P., et al., 2023. The COSPAR Planetary Protection Requirements for Space Missions to Venus. *LSSR*, 37, 18–24.
- Coustenis, A., et al., 2023. Planetary protection: Updates and challenges for a sustainable space exploration. *Acta Astron.*, 210, 446-452. https://doi.org/10.1016/j.actaastro.2023.02.035
- Coustenis, A., et al., 2023. Planetary Protection: an international concern and responsibility. Frontiers in Astronomy and Space Sciences, *Front. Astron. Space Sci. 10:1172546.* .