The COSPAR Panel on Planetary Protection

Panel on Planetary Protection Membership

Chair: Athena **Coustenis** (planetology)

Vice-Chairs: Niklas **Hedman** (UNOOSA, space law) & Gerhard **Kminek** (ESA, Earth sciences)

- Nine members appointed by space agencies:

China/CNSA	Jing **Peng** (engineering)
France/CNES	Michel **Viso** (astrobiology)
Germany/DLR	Petra **Rettberg** (microbiology, astrobiology)
India/ISRO	Praveen **Kumar** K (engineering scientist)
Italy/ASI	Eleonora **Ammannito** (planetologist)
Japan/JAXA-ISAS	Masaki **Fujimoto** (space plasma physics)
Russia/IKI	Vyacheslav K. **Ilyin** (microbiology, medicine)
UKSA	Karen **Olsson-Francis** (astrobiology, microbiology)
USA/NASA	James **Green** (plasma physics, astrobiology)

- Nine scientists representing the COSPAR Scientific Commissions

Olivier **Grasset** (FR, geodynamics, planetology)

Peter **Doran** (USA, Hydrogeology, Extreme Environments)

Olga **Prieto-Ballesteros** (ES, geology, astrobiology)

Kanyan **Xu** (CN, microbiology, biochemistry)

Maria-Paz **Zorzano** (SE/ES, astrobiology, biophysics)

Alex **Hayes** (USA, planetology)

Akiko **Nakamura** (JP, experimental physics)

François **Raulin** (FR, chemistry, planetology)

Maxim **Zaitsev** (RU, astrochemistry, organic chemistry)

- Ex-officio member: Colleen **Hartman**, NASEM SSB & ASEB Board Director

COSPAR planetary protection policy

The policy must be based upon the most current, peer-reviewed scientific knowledge, and is there to enable the exploration of the solar system, not prohibit it.

The COSPAR Panel on Planetary Protection is to develop, maintain, and promote the COSPAR policy and associated requirements that must be achieved to protect against the harmful effects of forward and backward contamination and to guide compliance with the Outer Space Treaty ratified today by 110 nations, 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.

Scope and Objectives of the COSPAR Panel on Planetary Protection

- 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.
- 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 with the private sector.

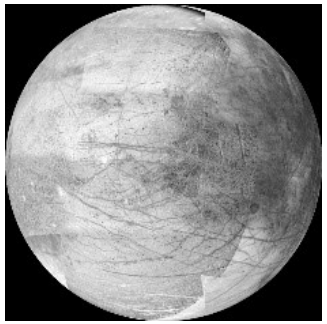
Since its restructuring in mid-2018, the Panel has had 5 meetings (July 2018; Jan. 2019, Dec. 2019, June 2020, Nov. 2020) and about 30 telecons between PPP Leads and parts of the Panel+ COSPAR Leaderships.

*New COSPAR Policy updated official document published in August 2020: Space Res. Today **208**, 10-22. https://doi.org/10.1016/j.srt.2020.07.009.*

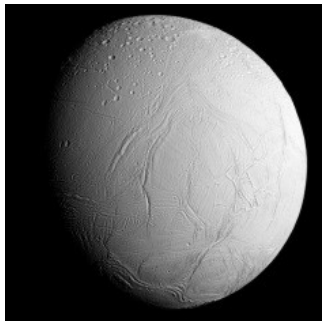
The COSPAR Panel on Planetary Protection: https://cosparhq.cnes.fr/scientific-structure/ppp

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 partly on the NAS-SSB 2012 Icy Bodies Report
- The ESA PPWG submitted a written assessment of the PPOSS recommendation to COSPAR
- COSPAR was involved throughout the multi-year-long process and at the end updated the requirements for missions to Europa and Enceladus



Credit: NASA/JPL/Galileo



Credit: NASA/JPL/Cassini

"Planetary protection: New aspects of policy and requirements", 2019. Life Sci. Space Res. 23
&
The International PP Handbook: Dec. 2018

Martian Moon Explorer (MMX)

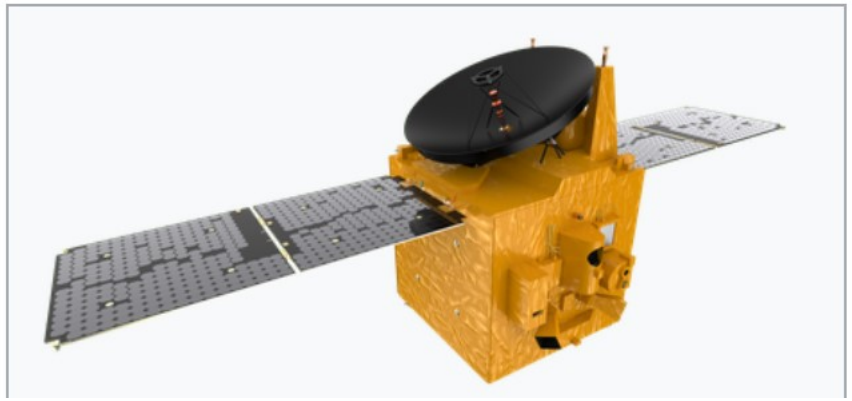
In 2019 ESA and JAXA studied sample return missions from Martian moons Phobos and Deimos

- ESA, NASA and JAXA supported scientific activities to evaluate the level of assurance that no unsterilized martian material naturally transferred to Phobos (or Deimos) is accessible to a Phobos (or Deimos) sample return mission, followed by an independent review by the NAS-ESF
- Outcome was presented to the ESA Planetary Working Group (PPWG) and to COSPAR
- COSPAR was involved throughout the process and assigned a planetary protection category for the MMX mission (outbound Cat III and inbound Cat V: unrestricted Earth return)

Reporting to COSPAR

It is recommended that COSPAR members inform COSPAR when establishing planetary protection requirements for planetary missions, and *also* that COSPAR members 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.

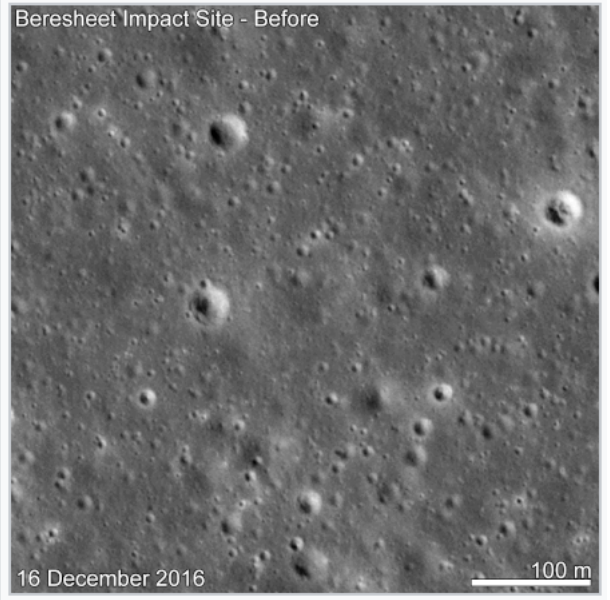
Emirates Mars Mission



Al-Hamal UAE mission Project manager had sent us a pre-launch planetary protection report (164345 rev. A) that we validated as compliant with the COSPAR PP Policy.

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

1. *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*
2. *The probable composition (identification) of the bioburden for Category IV missions, and for Category V "restricted Earth return" missions*
3. *Methods used to control the bioburden, decontaminate and/or sterilize the space flight hardware*
4. *The organic inventory of all impacting or landed spacecraft or spacecraft-components, for quantities exceeding 1 kg*
5. *Intended minimum distance from the surface of the target body for launched components, for those vehicles not intended to land on the body*
6. *Approximate orbital parameters, expected or realized, for any vehicle which is intended to be placed in orbit around a solar system body*
7. *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) on a planetary surface*



Crash site of Beresheet (LRO)

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 Article IX of the Outer Space Treaty

Planetary protection categories and requirements are not cast in stone and evolve over time as new information becomes available, i.e. check the latest version at the start of a new project

- *Planetary protection technologies are for cleaning and sterilizing spacecraft and handling soil, rock and atmospheric samples. Precautions are taken against introducing microbes from Earth.*
- *At the same time, when the samples are returned to Earth, there is need to avoid backward contamination and preserve our biosphere Hot topic: sample receiving facilities*

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

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

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

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

Category V: Two subcategories exist - unrestricted Earth return for solar system bodies deemed by scientific opinion to have no indigenous life forms, and restricted Earth 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

Planetary protection categories

Category I: Flyby, Orbiter, Lander: Undifferentiated, metamorphosed asteroids; others TBD

Category II: Flyby, Orbiter, Lander: Venus; Moon (with organic inventory); 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, Orbiters: Mars; Europa; Enceladus; others TBD

Category IV: Lander Missions: Mars; Europa; Enceladus; others TBD

Category V: Any Earth-return mission.
"Restricted Earth return": Mars; Europa; Enceladus; others TBD
"Unrestricted Earth return": Venus, Moon; others TBD

†Additional analysis is required.

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

PPP Publications

- Coustenis, A., Kminek, G., Hedman, N., 2019. The challenge of planetary protection. *ROOM Journal,* issue #2(20), June 2019, 44-48.
- Coustenis, A., Kminek, G., Hedman, N., Ammanito, E., Deshevaya, E., Doran, P.T., Grasset, O., Green, J., Hayes, A., Lei, L., Nakamura, A., Prieto-Ballesteros, O., Raulin, F., Rettberg, P., Sreekumar, P., Tsuneta, S., Viso, M., Zaitsev, M., Zorzano-Mier, M.-P., 2019. The COSPAR Panel on Planetary Protection role, structure and activities. *Space Res. Today* 205, DOI:10.1016/j.srt.2019.06.013.
- Raulin, F., Coustenis, A., Kminek, G., Hedman, N., 2019. Preface to the special issue "Planetary protection: New aspects of policy and requirements". *Life Sci. Space Res.* 23, 1-2. *See also the whole issue.*
- Fisk, L., Worms, J-C., Coustenis, A., Hedman, N., Kminek, G., 2020. Introduction to the new COSPAR Policy on Planetary Protection. *Space Res. Today* 208, August 2020.
- The COSPAR Panel on Planetary Protection, 2020. COSPAR Policy on Planetary Protection. *Space Res. Today* 208, August 2020, Pages 10-22. DOI: 10.1016/j.srt.2020.07.009.
- The COSPAR Panel on Planetary Protection, 2020. Planetary Protection Policy: For sustainable space exploration and to safeguard our biosphere. *Research Outreach* 118, 126-129. DOI: 10.32907/RO-118-126129.

+ Numerous presentations by all members in international meetings

+ inputs to the press in many countries

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