COSPAR Panel on Planetary Protection

Position Paper *on* Planetary Protection Requirements for Icy Moons

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NASA Planetary Protection Subcommittee
8 December 2015

Motivation

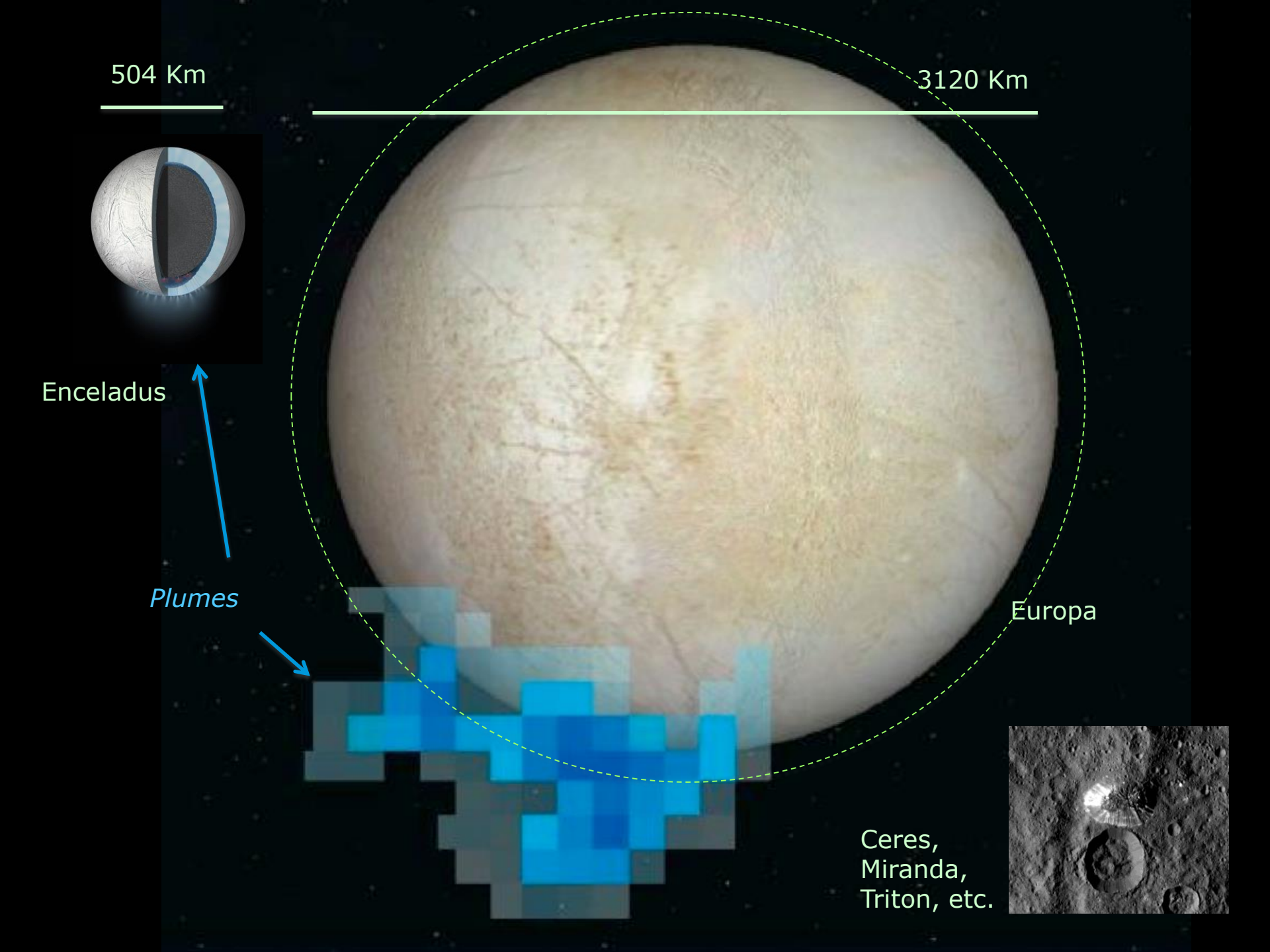
Comes from the international scientific community with a convergence of similar interests in Japan, Europe and the USA:

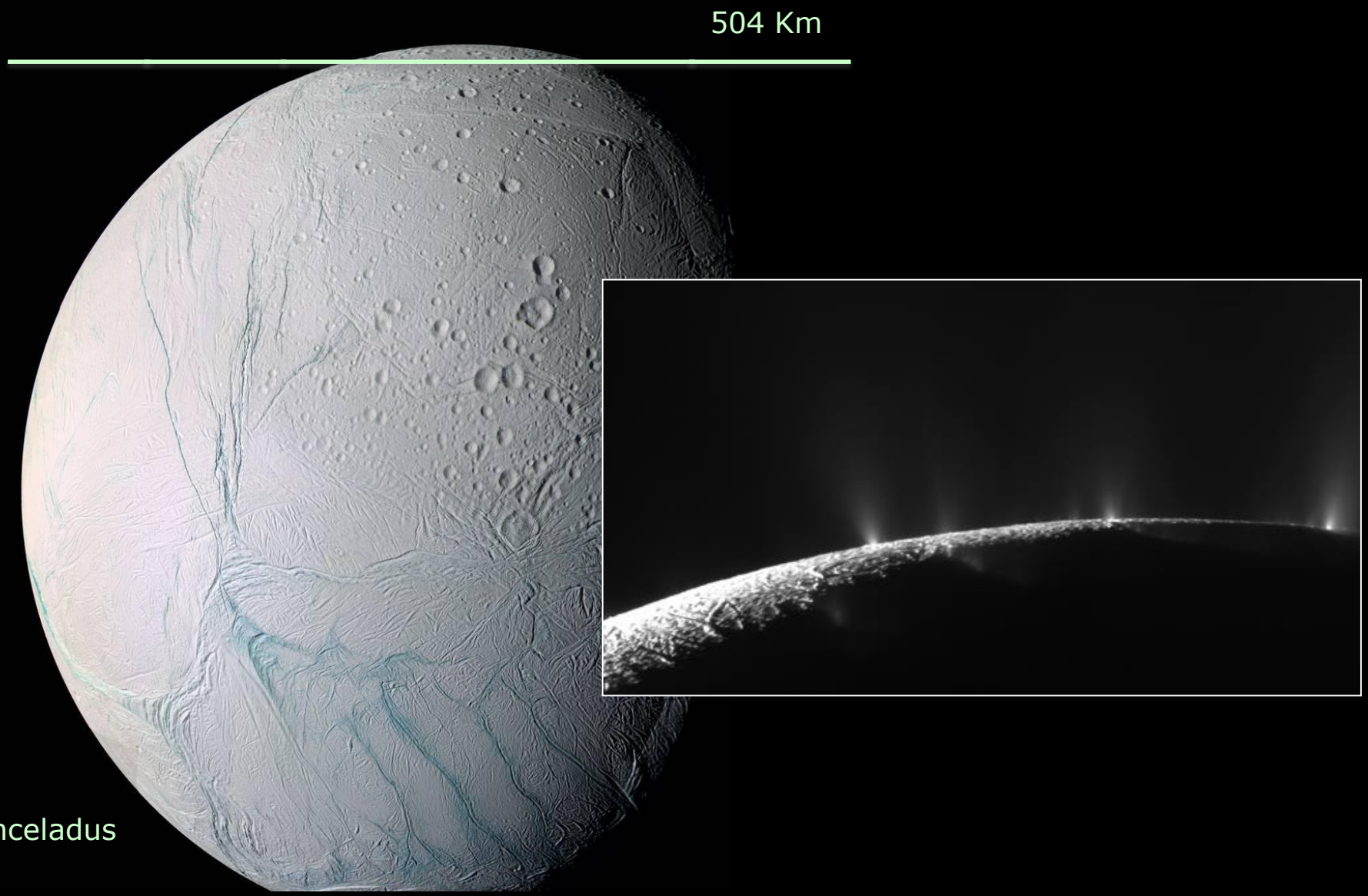
•Formation of a working group on Outer Planet sample return / planetary protection requirements by ISAS, Japan

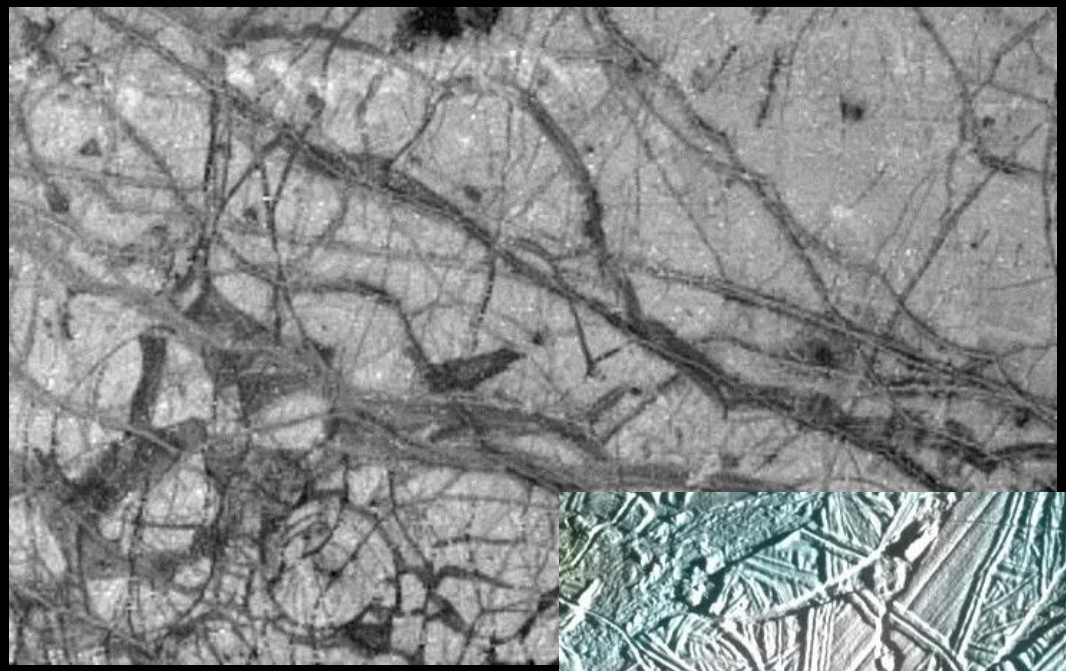
•Selection of a European Commission Horizon 2020 Project entitled Planetary Protection for Outer Solar System bodies (PPOSS), to begin in early 2016

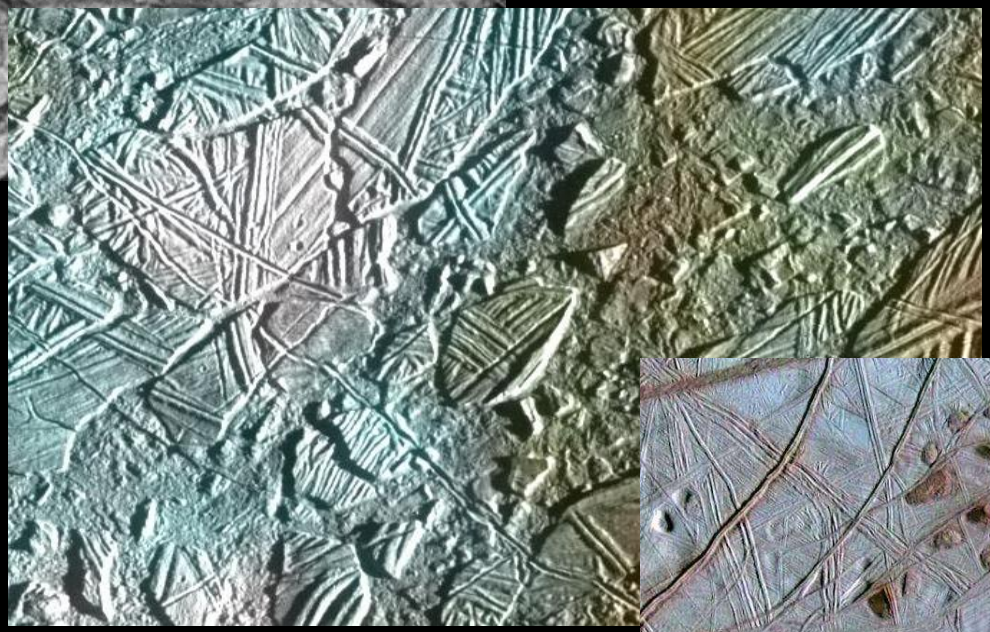
•Road-mapping by US teams of science, technology, and policy needs for Outer Planet sample return in preparation for the next US Decadal Survey

While the ultimate goal of such community initiatives is to have a program of Outer Planet missions successfully implemented, the community recognises that establishing planetary protection requirements early and with expert scientific input will provide a solid basis on which to consider mission architecture trades.


504 Km
3120 Km
Enceladus
Plumes
Europa
Ceres,
Miranda,
Triton, etc.


504 Km
Enceladus





Europa

NASA/JPL/University of Arizona/University of Colorado

COSPAR Bern Colloquium

- Meeting Purpose:
  - Prepare an update to the COSPAR Bureau and Council of the COSPAR Planetary Protection Policy for Mars Special Regions
  - Provide the input for a position paper on planetary protection requirements for sample return from icy bodies
- Endorsed by the COSPAR Bureau and supported by ISSI
- Date and location: 22-24 September 2015, International Space Science Institute, Bern, Switzerland
- MSO: Dr. G. Kminek DO: Dr. V. Hipkin

The Colloquium (cont.)

- Consultation between the COSPAR Panel on Planetary Protection and the COSPAR Scientific Commission B identified an urgent need to establish planetary protection requirements for missions bringing samples to Earth from the plumes of Saturn's moon Enceladus
  - ✧ The Enceladus mission, and a Europa plume sample return, represent a mission-type not explicitly referenced in current COSPAR Planetary Protection Policy*
- The proactive community initiative and engagement of COSPAR Scientific Commission B and F were warmly welcomed by the COSPAR Panel on Planetary Protection

*ref. COSPAR's Information Bulletin, *Space Research Today*, Number 193, August 2015)

The Colloquium (Attendees)

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Earth Return Planetary Protection Categorization for Enceladus

- The 2009 COSPAR workshop on "Planetary Protection for Outer Planet Satellites and Small Bodies" issued a recommendation to add Enceladus to Planetary Protection Category III and IV.
  - These categories cover fly-by, orbiter, and landed missions "to a target body of chemical evolution and/or origin of life interest and for which scientific opinion provides a significant chance of contamination which could compromise future investigations".
- This recommendation was subsequently adopted by COSPAR and introduced in the COSPAR Planetary Protection Policy

- The 2009 COSPAR workshop, however, did not cover Earth return missions.
  - Due to the increased interest in taking samples from the plumes of Enceladus and bringing them to Earth, this issue had to be addressed.
  - Based on the Planetary Protection Category III and IV assignment for missions to Enceladus (i.e. chemical evolution and/or origin of life interest) and the response of 'no' or 'uncertain' to all six questions described in the COSPAR Category Requirements for Small Solar System Bodies for sample return mission,
- The participants of the colloquium recommend to add Enceladus to the list of target bodies for a Planetary Protection Category V, restricted Earth return.

Planetary Protection Requirements for Enceladus

- In line with the current Planetary Protection Category III/IV for mission to Enceladus and with the recommended Earth return planetary protection categorization for Enceladus, the participants of the colloquium **recommend** to extend the current Planetary Protection Category III/IV/V Requirements for Europa also to Enceladus.

- To clarify the time period for which the probability of contamination applies, it is **recommended** to add the following sentence:

  The probability of inadvertent contamination of $1x10^{-4}$ applies to all mission phases including the duration that terrestrial organisms introduced by a spacecraft remain viable and reach the sub-surface liquid water environment.

Planetary Protection Requirements for Enceladus

- The requirements for sample return from Europa (and Enceladus) have been copied from the relevant set of requirements for Mars. The requirement covered in the first bullet refers to a level of contamination not described for Europa (and Enceladus):

Unless specifically exempted, the outbound leg of the mission shall meet the contamination control requirements given above.

- For Mars this refers to the requirements for Planetary Protection Category IVb. The reason to have biological contamination control requirements in the frame of sample return requirements is explained in the second part of the requirement in bullet 1:

This provision should avoid "false positive" indications in a life-detection and hazard-determination protocol, or in the search for life in the sample after it is returned. A "false positive" could prevent distribution of the sample from containment and could lead to unnecessary increased rigor in the requirements for all later Europa missions.

Planetary Protection Requirements for Enceladus

- In line with this explanation and the overall COSPAR Planetary Protection Policy statement *"The conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardized"*, a biological contamination requirement for Europa (and Enceladus) *in-situ* life-detection and sample return missions is missing and has to be established.
  - The participants of the colloquium **recommend** papers to be invited on this topic for the next COSPAR Scientific Assembly in 2016 for the joint Scientific Commission B, F and Panel on Planetary Protection session B.06 to address this issue and propose wording for an adequate biological contamination requirement.

- It is **recommended** to consider plumes as part of the Europa (and Enceladus) environment that warrant the same level of caution in the frame of sample return requirements as the surface and sub-surface.

Related Items

- In order to avoid misunderstandings and to properly reflect the Planetary Protection Category V policy statement "The Moon must be protected from back contamination to retain freedom from planetary protection requirements on Earth-Moon travel", it is recommended to modify the 3rd bullet in the sample return missions from Europa (Enceladus):

  No uncontained hardware that contacted material from Europa, Enceladus or their plumes, shall be returned to the Earth's biosphere or the Moon.

- In order to keep the trade-space open for different mission and trajectory options, it is recommended to modify the 4th bullet in the sample return missions from Europa (Enceladus):

  Reviews and approval of the continuation of the flight mission shall be required at three stages: 1) prior to launch from Earth; 2) prior to a manoeuvre to enter a biased Earth return trajectory and 3) prior to commitment to Earth re-entry.

- All recommended modifications to the Planetary Protection Category III/IV/V Requirements for Europa are in Appendix 1.

Implementation of Planetary Protection Requirements

It was generally recognised that evaluating the individual terms in the overall probability of contamination of an europan ocean is challenging and would benefit from further work and guidance. In this context, the priority for further work is for the following factors:

- Response of organisms to the conditions of high velocity impacts
- Physical exchange processes for transport from the surface to the sub-surface
- Survival of organisms during transport from the surface to the sub-surface

Conclusions

The following **policy updates** to the current COSPAR Planetary Protection Policy are **recommended**:

- Addition of Enceladus to the list of target bodies for a Planetary Protection Category V, restricted Earth return
- Extension of the current Planetary Protection Category III/IV/V Requirements for Europe also to Enceladus
- Specific updates to individual requirements

Further development of the COSPAR Planetary Protection Policy is **recommended** to address the level of biological contamination requirement for Europa (and Enceladus) *in-situ* life-detection and sample return missions.

Further research and guidance are **recommended** on the following aspects:

- Response of organisms to the conditions of high velocity impacts
- Physical exchange processes for transport from the surface to the sub-surface
- Survival of organisms during transport from the surface to the sub-surface

Questions?

European Commission Horizon 2020
Planetary Protection for Outer Solar System Bodies
(PPOSS)

- The PPOSS project was selected in a European Commission Horizon 2020 call to begin in early 2016 with a duration of 3 years. The PPOSS project will deliver a whitepaper providing recommendations for improvement of the COSPAR Planetary Protection Policy for outer solar system bodies. The effort and focus this project provides is a considerable opportunity for new work to improve the current policy.
- The COSPAR organisation is a partner in this project to ensure recommendations can be discussed and co-ordinated through the COSPAR Panel on Planetary Protection and the COSPAR Planetary Protection Policy approval processes.
- Colloquium participants included partners in the PPOSS project.
- The PPOSS project may be especially well placed to recommend a definition of a broader class of bodies with regional or global liquid water environments, and recommend clarifications and simplification of the current language for outer planets requirements in the COSPAR Planetary Protection Policy.

COSPAR Planetary Protection Policy*

- COSPAR maintains and promulgates a planetary protection policy for the reference of spacefaring nations, both as an international standard on procedures to avoid organic constituent and biological contamination in space exploration, and to provide accepted guidelines and requirements in this area to guide compliance with Article IX of the UN Space Treaty

- The COSPAR Planetary Protection Policy is the basis for national and international planetary protection standards

- The current COSPAR Planetary Protection Policy describes requirements for different planetary protection categories depending on the type of mission, the target body and the type of scientific investigations

*ref. COSPAR's Information Bulletin, *Space Research Today,* Number 193, August 2015).