

COSPAR Panel on Planetary Protection
Open Session
3-4 December 2019
Minutes¹

PARTICIPANTS

PANEL

Athena COUSTENIS, Panel Chair
Gerhard KMINEK, Panel Vice-Chair
Niklas HEDMAN, Panel Vice-Chair
Eleonora AMMANITO, Panel Member
Elena DESHEVAYA, Panel Member
(remote participation)
Peter DORAN, Panel Member
Masaki FUJIMOTO, Panel Member
Olivier GRASSET, Panel Member
James GREEN, Panel Member
Alex HAYES, Panel Member
Lei LI, Panel Member
Akiko NAKAMURA, Panel Member
(remote participation)
Olga PRIETO BALLESTEROS, Panel
Member
Francois RAULIN, Panel Member
Petra RETTBERG, Panel Member
Michel VISO, Panel Member
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David SMITH, NASA
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Steve SQUYRES, Blue Origin
Alan STERN, SWRI, USA
Elizabeth TURTLE, JHUAPL (remote
participation)
Paul WOOSTER, SpaceX (remote
participation)

APOLOGIES

P. SREEKUMAR, Panel Member
Maxim ZAITSEV, Panel Member

¹ All presentations delivered at the meeting, as well as the speech of the Director of the Office for Outer Space Affairs made during the opening of the meeting, are available for access at United Nations Office for Outer Space Affairs and can be requested from Niklas Hedman (niklas.hedman@un.org).

3 December 2019

Welcoming remarks by Director UNOOSA + logistics and general information
(S. Di Pippo, N. Hedman)

Welcome remarks made by the Director of the Office for Outer Space Affairs underscored the connections between the Committee on the Peaceful Uses of Outer Space (COPUOS), the Office for Outer Space Affairs (UNOOSA) and COSPAR, and also highlighted recent Committee work on space exploration and innovation, Near-Earth objects and planetary defence and space resources.

Introduction by the Chair of the Panel and tour de table

The Chair remarked on how the Panel's structure and work have changed in past years, and welcomed the participation of members of the private sector. She flagged that the next meeting of the Panel will take place in Sydney at the COSPAR General Assembly and recalled how the last meeting had focused on the JAXA Martian Moons eXploration (MMX) mission. Also noted that the Panel's work needs to be dealt with seriously through a series of studies and scientific arguments that may take time, while at the same time being swift to respond to requests from space-faring entities.

1. Planetary protection requirements/guidelines for the Moon

(Discussion item with positions of Space Agencies to be presented, G. Kminek)

G. Kminek reviewed planetary protection requirements for missions to the Moon. The Moon was previously categorized as Cat. I, but a decade ago it was changed to Cat. II. It was recalled that COSPAR meetings in 2004 and 2008 had discussed the change in categorization. Under Cat. II there are no technical planetary protection requirements, but there are documentation requirements, including an organic inventory of materials with a total mass greater than 1 kilogram.

In the discussions, L. Pratt noted that NASA finds the current categorization challenging with non-US payloads. Artemis 1, for instance, had 13 secondary cube satellites. There is now a one-pager that lays out a broad list using commercial names. This will be turned into a formal form, but NASA is willing to share the document already now, as it simplifies the job of the payload managers.

The Panel discussed how organic inventory information is not available for all historical missions to the moon and how permanently shadowed areas on the Moon are actually quite a number of individual craters in the polar regions and not one large area.

G. Kminek noted that ESA had already reached out to the ESA PP Working Group about discussing a change in the requirements. Initial responses indicated that several European scientists are not overly concerned about terrestrial organic contamination compromising their science (primordial chemistry), though it was not a comprehensive survey. There was also some discussion about future graveyard regions on the Moon (i.e. instead of dumping used propulsion stages anywhere on the Moon or in lunar orbit, have a dedicated region on the Moon to dump all these elements that are no longer

operational/useful – similar to the graveyard-orbits in Earth-orbit). ESA provided written input to the panel leadership recommending a broader scientific consultation at COSPAR Scientific Commissions B and F before any change to the categorization and/or requirements for missions to the Moon are proposed.

There is also some urgency if a change is to be made, as commercial providers will target the Moon's polar regions in the next years, and it needs to be clear what is expected.

J. Green presented an overview of NASA's lunar programme. He flagged Space Policy Directive 1, 2017, with the intent of reinvigorating human space exploration. He noted NASA has been charged with landing a human being on the Lunar South Pole by 2024.

Short updates on other lunar missions were provided. Highlights included:

- Esprit refueller, European contribution to the Gateway;
- JAXA - See slides on JAXA structure and on missions;
- Viper Lunar Rover being developed, not as a part of CLIPS, but NASA's own;
- Heracles, now renamed E3L;
- China - Chang'E 5 is a sample return mission expected to be launched in 2020. Chang'E 6 will be a south pole sample return mission; Chang'E 7 a South pole surface composition environment Chang'E 8, also to south pole and will have 3-D printing using lunar regolith. It was also noted that China has a Planetary Protection Committee. China also has international calls for much of their work.
- CNES - Will provide an instrument to Chang-E 6;
- ASI - Mostly contributes through ESA and other collaborations;
- UK Space Agency - Committed to working with ESA and the Lunar Gateway;
- Blue Origin - Blue moon lander, will be capable of bringing multiple metric tons to the surface.

2. Missions to Mars

(Inputs from all agency representatives)

[NASA] J. Green reported that Curiosity is currently climbing Mt. Sharp and will compare clay and sulphate layers. The story of water on Mt. Sharp will help explain Mars' ability to support life. Curiosity is currently in the clay taking measurements. It has detected anomalies (seasonal variations) in O₂ measurements. The data has just been published, and there is more work to do to understand it. He also reported that InSight is also on the Mars surface, and several types of quakes have been measured. InSight has a weather station, allowing for a weather report on Mars.

J. Green further reported that the Mars 2020 Rover naming contest has just closed. J. Green further reported that the Mars 2020 Team and Rosalind Franklin Team went to Western Australia and looked at oldest rocks on Earth. They examined microfossils and stromatolites and will look for areas on Mars like this. The rock record is a mechanism to examine past life on Mars. J. Green shared the concept of a Human Exploration Zone, which would be defined (200 kms in size). Missions would land in one area, live in another, and designate other areas of scientific interest.

[ESA] G. Kminek provided an update on the Trace Gas Orbiter (ESA/ROSCOSMOS), which is planetary protection Cat. III. It is operational, launched in 2016 with science having started in 2018. He also reported on BepiColombo (ESA/JAXA), planetary protection Cat. II, which was launched in 2018. He noted that Solar Orbiter, planetary protection Cat. II, was an ESA mission to be launched from the US, and the planetary protection certificate is to be issued this month. He also noted ExoMars 2020 is a planetary protection Cat. IVb mission.

[CNSA] L. Li provided an update on China's first Mars mission (mission name is yet to be determined). The launch is to be next year, at nearly the same time as other Mars missions. CSA has a Planetary Protection Committee, and considers the mission planetary protection Cat. IVa. CSA expects to launch in July/August, spend three months in orbit, and then decide the most appropriate site for landing. China has a special team doing microbiology testing and a report will be issued on bio burden around two months before the launch. It was explained that the mission's communication architecture uses Chinese ground stations only.

[JAXA] M. Fujimoto provided an update on MMX. He also recalled that the Emirates Mars Mission (orbiter) will be launched by a Japanese launcher. NASA has reviewed the planetary protection aspects for the UAE mission and issued a formal concurrence letter.

During the discussions, the Panel was informed of parachute challenges within the ExoMars 2020 mission.

3. Mars sample return program and SSAP

(Information item, J. Green, G. Kminek)

J. Green provided an overview of NASA Mars missions. He reported that the MSR Science Planning Group, established by ESA and NASA, addresses both science-related attributes of a sample return facility and how partners are given equitable access to samples. He noted a large majority of MSR-related science investigation could be performed on sterilized samples, which means samples can go to uncontained laboratories. He also noted that the scientific community prefers that sample-related investigations, as possible, be performed outside of containment. He noted that while sample science receiving facilities present challenges, they are manageable. He flagged that sample science can be effectively internationalized, but samples need to be treated as one collection.

During the discussions it was noted that sample access will be by way of competition. There is also value in the people who will be doing the analysis being involved in sample selection. It was noted that JPL and NASA HQ have put together a sterilization Working Group and that in the next years there will be a lot of testing. The fallback position remains the use of heat, as more is known about it. Mars analogue materials are already being used to try sterilization treatments.

G. Kminek presented the Sample Safety Assessment Protocol and the Sample Safety Assessment Protocol (SSAP) Working Group set up by COSPAR. The Working Group includes planetary protection specialists, but also public health experts. It was felt that

any Protocol should be data-driven and responsive to measurements. Returning a witness and drillable blank to Earth was considered critical. Wind-blown dust should be considered and risk assessments must take into account what will be done with the sample. G. Kminek reported that more work of this working group is planned for 2020, with a final reporting at the COSPAR Scientific Assembly in Sydney.

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4. Human exploration of Mars – status report from the 3rd COSPAR Workshop (Information item, G. Kminek)

G. Kminek reported on human exploration workshops and the natural transport of contamination on Mars. It was noted that robotic precursor activities are needed in preparation for human missions to Mars and that microbial and human health monitoring is vital.

During the discussion, it was noted that there is a lack of funding for microbiological research and there was a plea for international funding for fundamental microbiological research.

5. Discussion of previous day's items (Moon, Mars)

J. Green reported back from NASA on M2020 RSS PS. Twenty percent of proposals were foreign, which is fewer than expected. Selection was based solely on merit. NASA and ESA are discussing the next steps concerning another call and lessons learned are being discussed.

6. The Hague International Space Resources Governance Working Group (Information item, J. Rummel)

J. Rummel provided an update on the Hague International Space Resources Governance Working Group and the work undertaken to provide a framework for future use of space resources. He noted that the Working Group enjoys broad international representations – about 20-25 members with lots of observers – but there are only one or two scientists.

I. Marboe supplemented the presentation from the international law perspective.

In the discussion the concept of water as a resource was raised, as the usual focus is on mining of minerals. It was also noted that the Netherlands will likely bring the outputs of the Hague International Space Resources Governance Working Group to the Legal Subcommittee of COPUOS this spring through the development of a formal working paper by the Netherlands.

7. Orientation on commercial/industry interests in planetary exploration

(Information item, inputs from any private sector attendees)

S. Squyres intervened from the viewpoint of Blue Origin, noting that Blue Origin takes planetary protection very seriously and plans to be a good steward. The company is currently focusing on the Moon and NEOs. The New Glenn vehicle will soon be tested with the aim of very large payloads to GEO. The Blue Moon (BM) lander is being developed using a new engine (BE7) with a fuel-based power system providing the ability to go to the near and far sides of the Moon. BM may also be used for cargo services. S. Squyres commented that he is the lead on planetary protection matters at Blue Origin.

P. Wooster intervened on behalf of SpaceX, noting that the company is focusing on enabled transport/cargo delivery, up to 100- metric tonnes per vehicle. SpaceX is also actively working on overall vehicle, Starship system. As regards timelines, cargo missions to Mars will take place at earliest in 2022. Planetary protection has been worked through for Red Dragon missions to Mars. For Starship, it will be quite different from an organizational perspective.

8. Orientation on Tardigrades: Why are they being used in research? Discussion on their inclusion in missions and inventory information

(Information item, P. Rettberg)

P. Rettberg presented on tardigrades. They are aquatic invertebrates with a fixed number of cells, 8 legs and 2 eyes. Fossils records tell us that they are 520 million years old. They can go into a cryptobiosis state and can survive both high and low temps and space vacuum. ESA has done space experiences with many conditions. Findings include that the next generation from those that survived experiments they were not changed. Radiation resistant genes have also been found. They were present on Phobos Grunt and Beresheet missions.

During the discussion it was recalled that COSPAR had communicated with the Israeli Space Agency as regards Beresheet. A reply was received that a foreign entity added the tardigrades prior to launch without prior notification.

The Panel noted the entity, the Arch Foundation registered in the USA, and that the resin that the tardigrades on the Beresheet mission were packed in can preserve organics.

The Panel found that this example is a wake-up call to remind all actors of the importance to observe planetary protection requirements and to monitor their implementation. The responsibility for space activities conducted by non-governmental entities was important to observe in this regard. In this specific case no harm was done but if it would have been a mission not to the Moon but to Mars the situation would have been serious.

9. Planetary protection on Dragonfly – the Titan mission

(Information item, E. Turtle, by Skype)

E. Turtle provided a detailed update on Dragonfly. Titan is classified as planetary protection Cat. II. Titan has been imaged down to a scale of a few hundred meters, and there isn't an expectation of cryovolcanic activity at the Dragonfly landing site. The life limiting factor is the heat output from the MMRTG.

During the discussion questions arose about thermal contamination of water samples. It was explained that as much of the heat as possible is being used in the interior of the lander. External temperature will not be much hotter than the ambient temperature and therefore not able to liquefy water. In connection with wind speed, Titan is generally pretty calm. Weather activity forms dunes in a few strong weather events depending on the time of year. Seismometer will have a windshield, as well as "geofoams" on the skids. The Panel also discussed how sticky is the icy surface. It is not thought to be particularly sticky, otherwise one would not see dunes.

As Dragonfly is staying around the equator that are not many planetary protection concerns, at least at this juncture. The chances of interacting with liquid water are very, very low, however the panel suggested that at some point the Dragonfly team should be asked to perform a thermal simulation of the impact of those RTGs if they get in full contact with the water ice of Titan in case of uncontrolled landing. It seems clear that surface water ice will be important in the future of Titan exploration.

10. Planetary Protection Independent Review Board (PPIRB)

(Information item, A. Stern)

A. Stern shared that the report was released on 18 Oct. 2019 and included 80 findings and recommendations. It is an independent report delivered to NASA. The recommendations are made with a 3-4 year horizon in mind. It was recommended that NASA reassess planetary protection guidelines at least twice per decade; that NASA should set up a standing forum for emergent planetary protection issues; that NASA should clarify its policy for exercising planetary protection authority, as it is not a regulatory agency; and that NASA could link planetary protection to future business. NASA should work with the Administration & Congress to find an appropriate agency, as there is a need to have a one-stop-shop.

The study recommended that NASA should study how much of the Moon could be recategorized. Also, how much of Mars should be Cat. II instead of IV, establishing 1) high priority astrobiology zones and 2) human exploration zones. Planetary protection categorization should be a part of site selection, and planetary protection requirements for ocean world exploration should also be reassessed.

The report noted that, as regards Mars sample return, the sample receiving facility is behind the rest of the mission architecture. As regards sending humans to Mars, NASA needs to expeditiously develop planetary protection guidelines and publish them. Current policies for Cat. V are felt unrealistic for human missions. All of backward contamination needs to be thought through in a more detailed way. Long transit time back to Earth could, for instance, be considered a quarantine.

It was noted that there is a wide spectrum of opinions on human missions to Mars and returning those people to Earth. There is a need for public education on true risks, emphasizing how low those risks actually are.

During the discussions it was decided that COSPAR should provide inputs on the report to the Publication Board.

C. Hartmann and D. Smith recalled how this report will be evaluated by a NAS committee before returning to NASA SMD/AA and then to COSPAR. It was decided that COSPAR would send a letter with comments to Joe Alexander, chairing this committee to express the view point of the PPP on the report and to make a number of clarifications.

11. LSSR special issue on planetary protection

(Information item, F. Raulin)

F. Raulin highlighted Life Science in Space Research Vol. 23 November 2019, the special issue on planetary protection, which has 12 papers from COSPAR 2018 PPP sessions and a preface. It was noted that the journal is now recognized by MedLine.

12. Planning of COSPAR Assembly 2020

(Discussion item, All)

A. Coustenis noted that the Planetary Protection Panel will have a business meeting of one or two half days during the General Assembly in Sydney. It is also an opportunity for project and mission reports. Major missions will have launched by August, so it would be opportune time to discuss. The Planetary Protection Panel will encourage representatives from future missions to use the COSPAR GA as a venue/opportunity to report and seek PP advice.

It was decided that COSPAR will send letters underlining the importance of panel members being present at the GA and therefore to facilitate their travel to Sydney.

13. A.O.B, and concluding remarks

There was overall agreement that the Panel meetings are important and are finding their way forward in the new format.