NASA ADVISORY COUNCIL

Planetary Science Advisory Committee

December 6, 2019

Teleconference

MEETING MINUTES

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Anne Verbiscer, Chair

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Stephen Rinehart, Executive Secretary

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Friday, December 6, 2019

Opening, Announcements, around the Table Identification

Dr. Anne Verbiscer, Chair of the Planetary Science Advisory Committee (PAC) of the NASA Advisory Committee (NAC), welcomed the members to the teleconference and took roll. She explained that Dr. Lori Glaze, Director of NASA's Planetary Science Division (PSD), had a slight schedule conflict necessitating a small change in the agenda.

PSD R&A Status

Dr. Stephen Rinehart, PAC Executive Secretary and PSD Acting Director for Research & Analysis Programs, explained that not much had changed since the previous PAC meeting, in October. The Research and Analysis (R&A) program had caught up from the shutdown earlier in the year. NASA is operating under a Continuing Resolution (CR) for the Fiscal Year 2020 (FY20) budget, which puts PSD's R&A under the same budget profile as FY19 and constrains the Program due to an unexpected cut that year. Therefore, R&A has had to take a temporary 15 percent reduction in all programs, with this reduction taking the form of some proposals receiving the designation of "selectable." With a final budget, these could become "selected," though that is not guaranteed. PAC had talked about rebalancing R&A and PSD is still discussing this internally. However, it would be premature to do anything before there is an appropriation.

The Research Opportunities in Space and Earth Sciences 2018 (ROSES 18) decisions were among the items delayed by the shutdown. Dr. Rinehart expects things to move faster now. He noted that the Korean Pathfinder Lunar Orbiter (KPLO) is on hold at the moment. For ROSES 19, the 15 percent cut has been applied, so the selection numbers may improve except for programs with non-R&A funding (such as the New Frontiers Data Analysis Program (NFDAP)). A number of other selections are imminent.

Looking ahead at ROSES 2020, the Solar System Observations (SSO) program is splitting into two programs: SSO and Yearly Opportunities for Research in Planetary Defense (YORPD). The Rosetta Data Analysis Program (RDAP) is now part of the Discovery Data Analysis Program (DDAP). R&A will evaluate data management plans as part of intrinsic merit, though as minor strengths/weaknesses only. This is to comply with data transparency requirements.

The Interdisciplinary Consortia for Astrobiology Research (ICAR), successor to the Astrobiology Institute, has a call out, with Step 1 proposals due at the end of January. PSD hopes to make awards in the fall. The call has three areas of emphasis: exoplanet system science; prebiotic chemistry and early Earth environments; and earliest cells and multicellularity. Future potential topics are yet to be determined. The Planetary Major Equipment/Facilities (PMEF) solicitation was cancelled for ROSES 19 because of the funding cuts. PSD may need to re-evaluate how this area is funded. The expectation is that once there is an appropriation, R&A can revisit some of the TBDs from ROSES 18. For the Exoplanet Research Program (XRP), the NASA Science Mission Directorate (SMD) made selections regardless of which Division would pay, funding the best proposals with funds from all four divisions, including PSD. Review panels are now also jointly run and the program is moving towards panels that are more topically centered. The YORPD solicitations will be yearly and go beyond simply replacing near-Earth object (NEO) observations.

PSD Status Report

Dr. Glaze joined the meeting and thanked the PAC members for their time. She began the PSD update by showing the fleet chart and reviewing the status of Mars Sample Return (MSR) activities. NASA is working closely with the European Space Agency (ESA) to see if there is a possible enabling partnership,

and the two agencies are moving forward on some joint studies of mission architecture. NASA held an acquisition strategy meeting to identify which parts of the architecture would be built by NASA, industry, and international partners. ESA is committed to developing the Earth Return Orbiter. Recent studies will help NASA and ESA to make an informed decision in late 2019/early 2020. Significantly, ESA has had its role approved, with funding, by the authorizing ministry. The work will include development of the fetch rover. Meanwhile, NASA needs Congress to pass a budget in order to proceed with making plans.

Three Small Innovative Missions for Planetary Exploration (SIMPLEx) Phase A selections were made, including one in collaboration with the Heliophysics Division (HPD). New Frontiers 4 selected Dragonfly; the next New Frontiers call will be released in the fall of 2022. Discovery 2019 selections may be announced in January (most likely February). A Request for Information (RFI) is out seeking research that falls in the gaps between current SMD solicitations. This request is in response to community feedback regarding potential gaps across SMD for inter- and cross-disciplinary research. Responses will inform planning for covering such gaps (e.g. through identification of appropriate solicitations), while ensuring alignment with NASA and SMD plans. The full text of the RFI and response instructions are on the NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES).

In preparation for the upcoming planetary Decadal Survey (DS), PSD solicited concept studies through the Planetary Mission Concept Studies (PMCS) Program in NSPIRES, which resulted in some great ideas. The Division is funding 11 of the 54 proposals received. Results will go to the National Academy of Sciences (NAS) for consideration by the DS committee. Those whose proposals were not selected are encouraged to submit a white paper to the DS panel, which will consider all ideas and use the white papers to examine gaps. Dr. Glaze reviewed the white paper process, which is led by the National Academies of Sciences (NAS) Space Studies Board (SSB). The format will be similar to that for the last DS, which is on the NAS website. The LPI website for community collaborations is open, at https://www.lpi.usra.edu/decadal_whitepaper_proposals/index.cfm

Upcoming activities related to the DS include: a American Geophysical Union (AGU) town hall, to be held the following week with NAS SSB; early career workshops/webinars, with dates to be determined; a Lunar and Planetary Science Conference (LPSC) town hall led by NAS SSB; and a PMCS status workshop and meetings at LPSC. These events are intended to inform the community of the process and how they can participate. PSD will have a status workshop for concept studies to get feedback from the science community, as well.

Dr. Glaze next addressed the Senior Review (SR) subcommittee-related findings, along with the NASA responses:

1. At the last PAC meeting, the Committee supported the subcommittees' report, and agreed with the ratings.
2. PAC sees insufficient science justification for continuation of Mars Express (MEX) funding.
3. There was also a recommendation for an Unassigned Future Expenses (UFE) pool on the Mars Reconnaissance Orbiter (MRO) and Mars Science Laboratory (MSL).
4. There is concern that some data access tools will not be available when some missions cease operations.

Dr. Glaze said that PSD has communicated with the Lunar Reconnaissance Orbiter (LRO) team that the Division intends to fund the mission as requested. PSD is still in the process of communicating funding decisions to the Mars teams. Some had good justifications for over-guides, but PSD does not have all of those funds. NASA is taking the UFE finding into consideration. The Mars orbital data website finding will be incorporated into a broader effort.

PAC also had a finding about travel restrictions on mission-funded contractors. NASA is working with the Office of the Chief Scientist (OCS) for a more permanent reduction of these restrictions. There was also a finding on the Near Earth Object Camera (NEOCam), indicating concerns about the possibility of losing some science in the change from PI-led to directed missions. PAC requested a detailed explanation of the directed mission's leadership plan and structure. NASA agrees that there is a need to build on the science and technology knowledge developed during NEOCam Phase A and extended Phase A. The Agency is working to clarify roles and responsibility to ensure Level 1 (L1) requirements will be met and will provide updates on the concept progress and plans.

The final recommendation, which also went through the Science Committee, had to do with MSR Ground Element coordination, recommending that NASA engage the Curation and Analysis Planning Team for Extraterrestrial Material (CAPTEM) in the process of any future sampling activities on Mars. This is something NASA has been thinking about, and the MSR Sample Planning Group (MSPG) has been working it with the Johnson Space Center (JSC). The intention is to pull in members of the community, including CAPTEM representatives, once MSR is in formulation.

Dr. Dana Hurley asked about the status of the proposed Mercury assessment group (AG). Dr. Glaze said that PSD has reviewed all the AG charters and is drafting one for Mercury. She hopes to have more information after the AGU meeting. She does not anticipate a significant change in the AG structures, though some are more tightly organized than others; the looser ones will likely be adjusted. She would like the AGs to report through PAC, so they can discuss things openly in the community and bring their findings through PAC.

Regarding organization of the Planetary DS, NASA is still in talks with NAS. Once the task statement is approved, PSD will make it available. She advised community members to focus on the science and missions they think need to be done. The timeline is essentially to have the task in place in January – which is a target – and open the website for white papers around February, then announce a chair around March.

Senior Review

Mr. William Knopf, the lead program executive for mission operations, explained that PSD is still writing direction letters for five of the six missions in the 2019 Planetary Mission Senior Review (PMSR), the LRO team having already been informed. The decisions on the Mars missions are pending. For 2020, there will be an out-of-sequence SR for InSight and Juno. This SR will not include the Kuiper Belt extended mission (New Horizons), which is extended to 2021. The Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) mission is still in the prime phase. PSD's final decisions are subject to availability of funds.

There were a lot of lessons learned from the 2019 PMSR. Because the SR was done as a Federal Advisory Committee Act (FACA) review, it was extremely difficult to construct a Mars panel of unconflicted experts – and five of the six missions under review were Mars projects. If SMD issues approval, PSD plans to do the 2020 review by following the approach taken by HPD for its most recent SR. While it was premature to discuss this approach, it would obviate a lot of the lessons from the 2019 SR.

The PMSR panelists did not have uniform technology and engineering experience, which the 2020 SR will rectify by adding panelists with engineering and operations expertise. Project teams also largely ignored questions sent by panelists prior to the face-to-face presentations. Therefore, the 2020 panel will ask questions in real time at these presentations, and the questions must be addressed to the panel's satisfaction before conclusion of the face-to-face meeting. The plan is to not ask the questions in advance. An improved template in NSPIRES should help simplify the review process for the panels. There will be

a page limit for appendices going forward, as proposers have been putting many pages of critical content in the appendices, creating a burden on reviewers.

Mr. Knopf showed the notional schedule of the 2020 PMSR, which is already a bit late. The plan is to ask the flight projects for proposals in January, give them 2 months to respond, have the panel meet in April, and report to PSD in early May. PSD will then brief PAC in June.

Dr. Hurley suggested sending the questions in advance and beginning the face-to-face meetings with them. Mr. Knopf said that that was being discussed. The key was for the teams to understand the importance of addressing the questions. He also confirmed that the upcoming SR is for InSight and Juno only. Dr. Glaze added that for those two missions, this will SR will set up 2-year extended missions to get them onto the same cycle as the other extended missions. Mr. Knopf further explained that OSIRIS-REx will not be subject to review until after the sample return, probably in 2022. However, when that SR occurs, the spacecraft will still be moving and presumably operating, so the science team could have other ideas about what to do with it. Those ideas will require some sort of review. Dr. Glaze noted that on New Horizons, it will take until the end of the mission's funding and beyond to get all of the data back. It has been suggested that the team see if they can identify another target. The mission would then be included in the 2022 SR after a no-cost extension.

Dr. Aki Roberge asked if there has there been a coherent analysis of the potential impact of Starlink on the detection of NEOs. Mr. Knopf replied that that is being discussed from an interference standpoint. The internal NASA discussions tend to indicate more likelihood of issues with crowding rather than with the Ka or Ku bands. Dr. Glaze said that in regard to noise in the observational sky, PSD has had preliminary discussions with APD and others at NASA on how it will affect their work. Dr. Roberge thought it would be advisable to quantify the impact of Starlink on the Congressional mandate to identify NEOs. Dr. Glaze said that she was unaware of anyone doing such an assessment. She took an action to speak with the planetary defense officer to see if that is a study NASA should do.

Dr. Rinehart noted that Dr. Amanda Mainzer had been formally recused from the SR discussion.

STScI Dual Anonymous Review

Dr. Claus Leitherer explained that the Hubble Space Telescope (HST) has had a perceived gender bias in proposal selections. In order to address this, the Space Telescope Science Institute (STScI) has tested a scheme that appears to work in eliminating the bias, which has drawn interest from SMD. HST is approaching Cycle 28. With reviews typically done each spring, about 1,000 proposals come in each cycle, seeking observing time and archival research funding. There are two rounds of reviews, the first of which gives preliminary grades to cull the bottom 40 percent of the proposals. The next set of panels, usually seven or eight, will rank the proposals and make recommendations to the STScI director, who makes the final decisions on who receives observing time funding. STScI is not a government agency.

Dr. Leitherer cited a 2014 paper that analyzed success rates for male and female proposers, the result being that men had a higher success rate than women; this was statistically significant over time, though not for each individual year. International comparisons also show female proposers at a disadvantage. Science categories presented some large differences, but only a single area showed even a slight female advantage. STScI sought to address this.

HST proposals are confidential, so to illustrate the changes, Dr. Leitherer used some of his own proposals. In Cycle 21, the format started off on the first page with the name of the PI rather than the science information. In Cycle 22, the template moved the PI name from the front page to the second page, using the initial of the PI's first name. Panelists usually knew who the PI was, however. The next change was with Cycle 24, which had the team members listed in alphabetical order and the PI not specified. This

format was used through Cycle 26. Finally, in Cycle 26, there were no team member names listed, making the proposals essentially anonymous to the point where proposers were instructed not to review themselves. Where proposals needed to reference team members' own published work, that information was also anonymized.

It was noted that Dr. Rinehart had to leave the room for a moment. Dr. Michael New of SMD served as Designated Federal Official (DFO) in his absence.

Dr. Leitherer explained that the community has complied with the changes for the most part. A survey soliciting feedback drew 19 responses in favor of the change, 16 mixed, and 26 opposed. There were notable seniority and gender differences in responses. The more senior respondents of both genders were less enthusiastic than their less experienced counterparts. The senior respondents' main concern was that early career investigators lack the right background for the work. To address this, STScI reveals the names of proposers at the end of the review, after the evaluation scores are registered and cannot change. If there is a concern about experience, panelists can weigh in at that point, but so far this has not happened. This method has been used through two cycles, with all proposals seeking use of an existing telescope and existing data.

Cycle 27 had female proposers at a slightly lower success rate than their male counterparts, but this follows Cycle 26, in which the female success rate was slightly higher than that of the males. The jury is still out, therefore. The average age of the successful PI has been lower by 2-3 years, however. Feedback indicates that the panels like that the focus is now on the science rather than on the proposer.

Dr. Robin Canup asked what the closest PSD analog to HST might be. Dr. New replied that data analysis programs are probably most similar to time allocation committees because the data are available and the tools are likely to be equally distributed. Dr. Roberge stated her appreciation for the effort, noting that the preliminary trends seem to be good. Dr. Leitherer said that community support is building. A few relatively senior members are upset and refuse to participate. It was observed that although two cycles is a small sample, the oscillation is what one would want. Dr. Leitherer said that the longer STScI does this, the more support they see. The majority is behind this effort now. It was observed that there has been a similar effect with anonymizing orchestra auditions.

Dr. Lynn Carter pointed out that she hears potential panelists say that they will know who the proposers are. She asked about the feedback on this from the reviewers. Dr. Leitherer said that when reviewers tried to guess, they were mostly wrong. In a few cases, the work is very specialized, but in the vast majority, it is hard to guess. Dr. Canup asked about institutional conflicts. Dr. Leitherer explained that STScI asks proposers to provide a list of persons they consider close collaborators or conflicted individuals, which the Institute takes into consideration. STScI will not actively assign a reviewer with a PI from the same institution, but they can be panelists. The intent is to have the best experts, and often that means competitors or collaborators.

<u>SMD Plans Dual Anonymous Reviews</u>

Dr. New began by noting that most SMD divisions' R&A programs have selection rates of 25-30 percent. In addition, between one and two thirds of selected PIs are new to the solicitation in which they have been selected. An examination of R&A program metrics by division shows that APD is the fastest for "time to notification." One factor could be the proposal due dates in the four divisions, which tend to be concentrated in the latter half of the year. Dr. New therefore advised thinking about spreading out the due dates to break some of the log jams and even out the work flow.

To address perceived issues with the R&A programs, SMD is conducting two pilot studies. Either or both could fail, and failure is acceptable as a study outcome. The first pilot study extends the dual anonymous

reviews just discussed, in order to determine if it is possible and value-added to remove identifying information in proposals from reviewers when looking at the science merit. All of the APD Guest Observer (GO) programs are adopting this approach starting with ROSES 2019. Dr. New wants to test a range of types of programs in order to see where and how this study breaks. To that end, he has asked each division to put up one program that receives 100-150 proposals. The program officers are working on a team, led by Dr. Dan Evans of APD, to determine metrics and methodologies. Dr. New pointed out that the Federal government has more rigorous conflict-of-interest (COI) standards than those at STScI. NASA will roll the tests out in ROSES 2020, preparing the community through workshops and talks at AGU and other events. For proposals that are not focused on data analysis, NASA needs to know what facilities and instruments proposers have access to. In the dual anonymous reviews, SMD will ask proposers for a separate file with team member identities, facilities, etc., which will be revealed after science merit has been determined. The science merit evaluation cannot be changed after the information is revealed.

Moving to the topic of high-risk, high-impact (HR/HI) research, Dr. New explained that a 2018 SMD study found that about 10 percent of all proposals were considered HR/HI, and these had a higher-than-average selection rate. However, the community remains skeptical, so SMD will be trying a new process in which the NSPIRES cover page will have two text boxes asking why a proposal might be considered high-impact and/or high-risk. The type of risk being considered here is reputational, about ideas rather than the feasibility of the technologies. Panels will be charged with reading the justifications, then stating whether or not they agree or not. Some of these proposals will be selected on their own, but those that are not selected will be given a second chance. Three times per year, each division will be able to put three unselected and verified proposals into a special pool, to be evaluated solely on their potential impact and intellectual risk. The SMD Associate Administrator (AA) will then select a small number of the proposals for funding.

In conjunction with the University of Arizona (UA), SMD recently held the first PI Launchpad, aimed at researchers and engineers who need information about where to start in the proposal development process. Of 195 applicants, SMD and UA selected about 40; the Heising-Simons Foundation paid all costs. Goals were to lead participants from their science questions through the key elements of proposals, assist in the early stages of team formation, and provide networking opportunities. The feedback has been that this event went quite well; a STEM equity consultant is evaluating the surveys for more detailed information. Another of these workshops is being planned to take place at the University of Michigan in Spring 2020. There will also be short briefings at AGU and other events for aspiring PIs who are earlier in the process.

Dr. Canup said that she was very intrigued to learn that SMD is taking on the dual anonymous reviews, but she expects it to be a challenge on 3-year grants. She encouraged SMD to think about the second stage, after identification of the PI. For this to work, panels do require an assessment of the PI and the team's ability to complete the proposed work, including the capacity to adapt when the project is not going as anticipated. She told of a PI who writes very good proposals but conducts shoddy science. On the flip side, very difficult work could be rated higher if panels knew that an all-star PI was involved.

Dr. New explained that NASA panels never rank order proposals, they only give scores. He understood what Dr. Canup was saying. He wanted it on the record that panels will be required to discuss team qualifications, and all of her concerns will be aired. He also countered her example by stating that he knows of a bad proposal that was saved solely because of the PI's reputation. Dr. Canup said that she has seen that as well, though there is less of it. Separating the steps will help correct that. Dr. Roberge urged changing the STScI process as little as possible, given how much effort went into it. A separate discussion and evaluation for feasibility is good, but she would not have the panels re-evaluate science merit. Dr. New agreed. The intent is to separate discussions of science merit from discussions of expertise and track

record. Dr. Canup cautioned that the effect on young researchers could go in the other direction. She feels that panelists are supportive of young PIs, so she worries that removing the ability to do so could be harmful. It was noted that NASA program officers can correct that.

Dr. Rhonda Stroud asked about the metrics for success. Dr. New explained that in 2017, SMD looked at inferred gender and did not see gender bias. Although the Directorate is collecting more data, he is not sure there is, in fact, a systematic gender bias. There are many good reasons to do dual anonymous peer reviews, but he wants to make sure the process does not create problems. If SMD has major systematic biases, they may be in the direction of seniority and institutional, but he does not think there is gender bias. It was noted that the single HST proposal category with gender parity was in Planetary. Dr. New explained that the two sociologists who worked with STScI have been contacted and may be pulled into the SMD work.

MEPAG

Dr. Aileen Yingst, Mars Exploration Program Analysis Group (MEPAG) Chair, provided an update. In addition to the Executive Committee, MEPAG has a goals committee. The MEPAG Executive Committee had meetings in July and August, and the MEPAG community held a virtual meeting in November that focused on the Planetary Protection Independent Review Board (PPIRB) report and drew 110 participants. At this meeting, MEPAG also congratulated two PIs for having Planetary Mission Concept Study proposals funded. They heard a report from the Mars program; an update from the Mars Architecture Strategic Working Group (MASWG); a report on the Chinese space program; and the extant life conference report. MASWG is looking at future Mars exploration architectures and mission concept feasibility going to 2035; they received 53 one-page mission concept papers. The extant life conference is of interest to a significant segment of the community. MEPAG is now gearing up for the DS with a goals document that should be available in April. The Group is also assisting the community in responding to the Planetary DS by discussing how to do white papers, collaborate, etc. Lead authors are directed to an LPI site, and a GoogleDocs form is available as a workspace. There has been progress with NASA in addressing key concerns, such as MSR, the lack of program definition for other Mars science, and extended missions.

CAPTEM

Dr. Kevin McKeegan explained that CAPTEM is both an advisory group and a standing committee for the review of proposals for allocation of extraterrestrial materials. A new subcommittee on MSR is in the planning phase. This subcommittee will have two chairs, one of whom will be in Europe and the other in the United States. CAPTEM overall is increasing its international membership. The most recent meeting, held in November, was virtual. However, there are enough issues that CAPTEM sees a need for two face-to-face meetings each year, and possibly additional virtual meetings. The increased international participation will include the Japanese Space Agency (JAXA) along with ESA. A lunar subcommittee for the Artemis campaign will define contamination control issues, among others. Asteroid sample return is awaiting the OSIRIS-REx plan. CAPTEM also plans to contribute to the Planetary DS on sample return and analysis. Dr. Justin Filiberto will work across the AGs on diversity and inclusion. CAPTEM had nine women and five men at the time of the meeting. Among ongoing issues for PAC is Mars curation facility preparation. CAPTEM looks forward to working with the MSRWG on defining requirements.

LEAG

Dr. Samuel Lawrence, Chair of the Lunar Exploration Analysis Group (LEAG), noted that he will be transitioning out over the next year. The Group plans a virtual symposium on future missions and instrument concepts in on February 7, 2020. The 2018 findings are now on the LEAG website, as is the Survive the Night LEAG/Solar System Exploration Research Virtual Institute (SSERVI) meeting report. The LEAG community is very happy with the PSD response to recent issues with lunar sample studies in the SSW program, and deeply appreciates PSD responsiveness and willingness to constructively engage

on the issues that recently arose. A joint CAPTEM/LEAG special action team will address Artemis sampling and curation. The Group is hosting white papers for the Planetary DS and working on DS responses. New Views of the Moon 2 chapters are under review.

The October LEAG Annual Meeting in Washington, D. C. focused on preparation for the Planetary DS and planning for Project Artemis, with excellent participation from across NASA and the research and commercial communities, with over 300 attendees. The LEAG meeting generated a number of findings. Dr. Lawrence presented a preliminary set of draft findings to the PAC and which are summarized below. [**Note: The findings have since been finalized, with some changes from what was presented to the PAC, and are now available with background information on the LEAG website** (https://www.lpi.usra.edu/leag/meetings/2019_Findings_Final.pdf)]

1. The low notional mass for lunar samples as part of the Artemis program needs to be increased to be more in line with previous LEAG+CAPTEM reports. Automatic sample return should be developed as a capability to augment human lunar sample returns.
2. LEAG strongly supports Phase 2 of the Artemis program – a permanent presence on the lunar surface by 2028 – which has immense scientific and societal value.
3. A set of realistic goals and objectives is needed for a resource prospecting campaign and ISRU demonstration
4. The Moon also has vast amounts of resources beyond the presumed polar volatile deposits (i.e., regional pyroclastic deposits), and true long-term sustainability will require their use.
5. LEAG urges NASA to ensure that the potential to achieve high-priority planetary science and exploration objectives is fully realized by leveraging all lunar mission opportunities as part of a well-defined, coherent strategic vision.
6. LEAG is strongly committed to the New Frontiers mission priorities being set by the Decadal Survey process. However, LEAG recommends that more flexibility in implementation of the important science goals of the SPA-SR mission be permitted for New Frontiers 5.
7. Leadership of NASA and its commercial partners should take concrete steps to promote greater diversity.
8. The LEAG community has expertise that should be actively leveraged in all NASA strategic planning for lunar exploration (such as the recent plan for sustainable lunar exploration ordered by the National Space Council, and any others that may be requested in the future).

OPAG

Dr. Jeff Moore reported that the Outer Planets Assessment Group (OPAG) had updated its goals document, which is posted on the website. He then reviewed findings from OPAG's last meeting:

1. NASA should include Enceladus on the New Frontiers 5 target list.
2. OPAG encourages NASA to continue investing in new instrument and technology development supporting ocean worlds exploration.
3. OPAG recently learned that Juno has fallen behind on its Planetary Data System (PDS) delivery schedule. The Group invites a regular report on all such mission deliveries to the PDS.

Other OPAG activities include GoogleDocs sites for the community to write and post white papers. Dr. Moore listed upcoming meetings at LPI. Dr. Verbiscer asked whether Enceladus was already on the New Frontiers 5 list. Dr. Glaze explained that there is some ambiguity, and to that end, PSD has engaged NAS on the issue.

MAPSIT

Dr. Jani Radebaugh explained that the Mapping and Planetary Special Data Infrastructure Team (MAPSIT) has put together a roadmap for Planetary Spatial Data Infrastructure (PSDI). Spatial data are valuable but not always accessible, or are processed in nonstandard ways. The goal for the PSDI is to ensure that data are discoverable, accessible, and usable. It is not an application, but rather a structure

around which data are obtained and served. PSDIs are built around foundational data products, and data products are not always made by missions. A short summary of the roadmap identified the needs to ensure that data are of high quality, usable, discoverable, and accessible, with PSDIs that are maintained. These will require data tools, technologies, and expertise. The roadmap is on the website, and MAPSIT is using it as a basis to help get funding by working with the AGs. A trial run with the Small Bodies Assessment Group (SBAG) took place in the spring. The roadmap is helping MAPSIT to strategize how to start building an overarching PSDI and location-based PSDIs.

VEXAG

Dr. Noam Izenberg discussed Venus Exploration Assessment Group (VEXAG) activities. Near-term goals include support for the Planetary DS and bringing together the community in a vision to build a Venus program. With more than 500 members on its list, VEXAG is actively working to obtain science community input and expand the visibility of Venus science. The three main science needs are to understand the planet's early evolution and the implications for Venus-sized exoplanets; understand Venusian atmospheric composition and dynamics; and understand both the geologic history of Venus and its current surface-atmosphere couplings.

The 17th meeting of VEXAG, in November, offered summaries of missions that are related/adjacent, posters, a field trip, and tutorials. The plan is to conduct more tutorials at future meetings. At this point, there are 35 VEXAG white papers in development for the Planetary DS. February will see the Exoplanets in Our Backyard meeting, held jointly by VEXAG, OPAG, and EXOPAG. There have been 81 abstracts submitted. The hope is to foster and build new collaborations among scientists in the solar system and exoplanet communities.

The Venus small mission opportunities and Venus Gravity Assists Science Opportunities (VeGASO) documents are due for updates. In January, VEXAG plans to finalize preliminary findings that were still being edited at the time of the PAC teleconference.

SBAG

Dr. Bonnie Buratti explained that SBAG seeks broad planetary science community input on small bodies and missions to small bodies. The current goals document was last updated in 2016 and is now being revised, with new material on in situ resource utilization (ISRU), diversity, and NEOs. SBAG hopes to post the document on its website by the end of the year. ISRU will become the basis for a fourth goal, in addition to the existing goals of conducting big science on small bodies, defending planet Earth, and enabling human exploration. Dr. Buratti listed some of the major small bodies missions and referred to the findings of the last SBAG meeting, available on the website. There will be a January meeting in Pasadena, at which there will be an overview of missions, NASA manager presentations, an open mic session, kickoff of the Planetary DS effort, and community input. The big questions for the DS were presented at the last PAC meeting. SBAG wants to produce fewer than a dozen broadly supported white papers, with science-based criteria, and have some joint white papers where there is overlap with other AGs.

Dr. Timothy Lyons wondered about the volume of white papers going to the Planetary DS panels, and Dr. Hurley was concerned about the possible need for evaluations. Dr. Izenberg said that VEXAG has tried to match up those with related ideas and encourage people to cosign what they found interesting. At the same time, the Group did not feel it was their part to endorse or discourage any ideas. OPAG did the same. Dr. New said that he was not sure it was the AGs' job to coordinate or make decisions. The Astronomy and. Astrophysics DS (Astro2020) has had about 650 white papers submitted. It is reasonable to have people look at a spreadsheet for existing papers, but it is not the role of the AGs to screen. Dr. Glaze added that the AGs provide a good bulletin board service in connecting people. However, she thought their role was to facilitate, rather than to drive or direct. She encouraged them to be careful. She

sympathizes with the urge to be respectful of those on the DS panel, which is a demanding, time-consuming job.

Public Comment
An opportunity was provided for members of the public to speak, but no one came forward.

Findings and Recommendations Discussions
Dr. Verbiscer asked if any PAC members had additional questions for Dr. Glaze. Dr. Hurley wondered if the DS charge, which was still in development, might address NASA's cross-divisional effort and processes. Dr. Glaze said that she could not speak to that, but she feels strong support for cross-divisional work. Dr. New noted that the Astronomy and Astrophysics DS has no explicit language on this in its statement of task, which is complicated by the involvement of National Science Foundation (NSF) and the Department of Energy (DOE). He plans on conducting a NAS survey looking for opportunities across the divisions, but only after the Planetary DS is complete.

Dr. Francis McCubbin asked for clarification on research that falls into gaps or sits on the time boundaries between programs. Dr. Glaze said that the effort is not restricted to cross-divisional work, but rather seeks work that is not fully addressed by existing programs. Most program officers believe they can help sort things into the right programs, but those who feel otherwise are encouraged to respond to the RFI.

Dr. Glaze next explained that PSD's R&A selection rates are lower than those of other SMD divisions as a function of funding, award size, and number of proposals. Dr. New added that PSD proposals can have field work, which is expensive. Dr. Glaze added that the Division is trying to find ways to bolster funding, while looking at the balance of existing programs. Dr. New noted that selection rate is not a great metric on its own, as it is a factor of things NASA cannot control. Dr. Glaze assured PAC members that this situation is not a matter of R&A money getting diverted elsewhere.

Dr. Verbiscer then turned to findings and recommendations. Dr. Stroud wanted a finding on dual anonymous reviews, to express support for the quantitative analysis of the impact that STScI had, and to note concern for getting it right in PSD. She thought it was hard to figure out the best way to translate it to the planetary community. Dr. Verbiscer agreed.

Dr. Stroud also noted the long delays in funding for facilities and equipment. While she was aware that this was constrained by the budget, she still wanted to express concern and have a finding to encourage mapping of NASA's priorities and Congressional funding. Dr. Mainzer sought a finding to encourage SMD to engage with social science professionals in the dual anonymous effort. Dr. Verbiscer agreed. There was a question about additional research areas for ICAR. Dr. Roberge asked for information on upcoming topics. Dr. Rinehart said that five topics are listed on NSPIRES for the current call. Dr. New added that the next ICAR will have another set of topics, yet to be determined. It was agreed that there was not material for a finding.

Regarding Starlink and the Large Synoptic Survey Telescope (LSST), there is an American Astronomical Society (AAS) working group on the topic. PAC's interest is in NEO, LSST, and ground-based observing in support of NASA missions. There was also a suggested finding on the RFI for the gap research, but it was felt that Dr. Glaze covered that topic. Dr. Carter said that it would be good to know the New Frontiers 5 call topics so that proposers could prepare, but it sounded like that effort was in progress.

Dr. Stroud asked if there was a need for a finding on the PI Launchpad Dr. Roberge expressed interest in seeing the results from the external evaluator; as Dr. New said that he expects to present it, it was agreed that there was no need for a finding. Dr. New added that SMD hopes to do about two of these per year,

with the next one likely at the University of Michigan in the spring of 2020, and the fall location to be determined.

It was agreed that Dr. Roberge would write the finding on Starlink, Dr. Stroud the one on facilities and equipment funding, and Dr. Mainzer the dual anonymous finding. Dr. Verbiscer said she would circulate the draft findings over the next week or so. She also wanted to discuss dates for the next PAC meeting. The consensus was for March, but no specific dates were determined; a poll would go to the members to help find the optimal time.

Dr. Verbiscer then thanked PSD for the presentations.

Adjourn
The meeting was adjourned at 5:18 p.m. EST

Appendix A

Participants

Committee members
Anne Verbiscer, University of Virginia, *Chair, Planetary Science Advisory Committee*
Stephen Rinehart, NASA, *Executive Secretary*
Robin Canup, Southwest Research Institute
Lynn Carter, University of Arizona
Justin Filiberto, Lunar and Planetary Institute
Dana Hurley, Johns Hopkins Applied Physics Laboratory
Timothy Lyons, University of California – Riverside
Amanda Mainzer, University of Arizona
Francis McCubbin, NASA Johnson Space Center
Aki Roberge, NASA Goddard Space Flight Center
Rhonda Stroud, U.S. Naval Research Laboratory

NASA attendees
Lori Glaze, *Director, Planetary Science Division*
Doris Daou, PSD
Elaine Denning, SMD
Michael New, SMD

WebEx participants
Charles Acton
Fran Bagenal
Bonnie Buratti
Rob Campen
Julie Castillo
Brett Denevi
Monty DiBiasi
Serina Diniega
Robert Fogel
Casey Hansen
Grace Hu
Noam Izenberg
Kelsey Krafton
William Knopf
Lilly Larsen
Daniel Lawrence
Samuel Lawrence
James Lochner
Dillon Mancini
Delia Santiago Materese
Kevin McKeegan
Bob McMillan
Bonnie Meinke
Michael Meyer
Jeff Moore
Jani Radebaugh
Kurt Retherford
Christina Richey
Tony Rikehart
Joan Salute
George Tahu

Megan Thompson
Thomas Thompson
Ashlee Wilkins
Lisa Wood
Richard Zurek

Appendix B
Membership Roster

Anne Verbiscer, Chair
University of Virginia

Stephen Rinehart, Executive Secretary
Planetary Science Division
Science Mission Directorate
NASA

Robin Canup
Southwest Research Institute

Lynn Carter
Department of Planetary Sciences
University of Arizona

Justin Filiberto
Lunar and Planetary Institute

Chris German
Department of Geology and Geophysics
Woods Hole Oceanographic Institute

Justin Hagerty
U.S. Geological Survey

Dana Hurley
Planetary Exploration Group
Johns Hopkins Applied Physics Laboratory

Timothy Lyons
University of California – Riverside

Amanda Mainzer
University of Arizona

Francis McCubbin
NASA Johnson Space Center

Aki Roberge
Exoplanets and Stellar Astrophysics Laboratory
NASA Goddard Space Flight Center

Britney Schmidt
School of Earth and Atmospheric Sciences
Georgia Institute of Technology

Rhonda Stroud
Materials Science and Technology Division
U.S. Naval Research Laboratory

Appendix C
Presentations

1. Planetary Science R&A Update, Stephen Rinehart
2. Planetary Science Division Status Report, Lori Glaze
3. Senior Review, William Knopf
4. STScI Dual Anonymous Review, Claus Leitherer
5. *SMD Plans Dual Anonymous Reviews*, Michael New
6. *MEPAG*, Aileen Yingst
7. *CAPTEM*, Kevin McKeegan
8. *LEAG*, Samuel Lawrence
9. *MAPSIT*, Jani Radebaugh
10. *VEXAG*, Noam Izenberg
11. *OPAG*, Jeff Moore
12. *SBAG*, Bonnie Buratti

Appendix D
Agenda

Planetary Science Advisory Committee Teleconference
December 6, 2019

Friday, December 6, 2019, 1:00 p.m. – 5:30 p.m.

1:00 Opening, Announcements, Around the Table Identification	
1:05 PSD Status Report	L. Glaze
1:35 PSD R&A Status	S. Rinehart
1:50 Senior Review	B. Knopf
2:10 STScI Dual Anonymous Review	C. Leitherer
3:00 SMD Plans Dual Anonymous Reviews	M. New
3:30 MEPAG	A. Yingst
3:40 CAPTEM	K. McKeegan
3:50 LEAG	S. Lawrence
4:00 MAPSIT	J. Radebaugh
4:10 OPAG	J. Moore
4:20 VEXAG	N. Izenberg
4:30 SBAG	B. Buratti
4:40 Findings and Recommendations Discussions	
5:30 Adjourn	