**NASA Advisory Council**
**Planetary Science Advisory Committee**

**February 28–March 1, 2023**

**Hybrid Meeting**

**NASA Headquarters**
**Washington, D.C.**

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Serina Diniega, Chair

Stephen Rinehart Digitally signed by Stephen Rinehart Date: 2023.04.11 15:33:34 -04'00'

Stephen Rinehart, Executive Secretary

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February 28, 2023

Welcome/Around the Table

Planetary Science Advisory Committee (PAC) Executive Secretary, Dr. Stephen Rinehart, opened the first 2023 meeting of the PAC. PAC Chair, Dr. Serina Diniega, offered initial remarks and introduced the day's agenda.

Planetary Science Division (PSD) Update

Dr. Lori Glaze, Director of the Planetary Science Division (PSD), provided an update, beginning with recent changes in the Science Mission Directorate (SMD) leadership. Ms. Sandra Connelly had briefly served as Acting Associate Administrator (AA) for SMD; Dr. Nicola Fox has now stepped in as the new AA. Ms. Connelly has returned to her position as Deputy Associate Administrator (DAA) for SMD. Mr. Eric Ianson and Ms. Joan Salute have returned to their permanent positions in PSD as well. There are a few new names and faces at PSD: David Smith, Lina Carrington, Shahid Aslam, Curtis Williams, Andrew Maynard, Debra Hernandez, Kenneth Hansen, and Jose Chavez. The current PSD fleet counts a total of 40 missions; the two most recent mission completions are the highly successful Double Asteroid Redirection Test (DART), and the Mars InSight lander, which finally ran out of power in December 2022 after an extended mission.

The President's Budget Request for 2024 (PBR 24) has not been released yet. The 2023 budget has been passed, but NASA has yet to complete the Operating Plan. The top level number for Fiscal Year 2023 (FY23) as appropriated, is $3.2B, which is $40M over the PBR, but accompanied by $60M worth of direction. NASA will address the $20M delta through the Operating Plan. The budget indicates continued strong support for Mars Sample Return (MSR), the Lunar Discovery and Exploration Program (LDEP), the lunar rover Volatiles Investigating Polar Exploration Rover (VIPER), and the Commercial Lunar Payload Services (CLPS) program. PSD has seen a staggering increase in funding over the past decade.

The Mars Perseverance Rover continues to do a phenomenal job and has set down the first backup cache for MSR at a safe landing spot named Three Forks, which is near the base of an ancient river delta. The samples collected thus far are very diverse in nature: volcanic, sedimentary, mudstone, sandstone, etc. The expectation is that Perseverance will continue to collect samples and deliver them to the Mars Sample Retrieval Lander at the appropriate time.

Ms. Joan Salute continued the briefing, first noting that Dr. Adriana Ocampo has retired after 50 years with NASA. Ms. Salute provided the latest details on the Lucy mission: The spacecraft's solar array is still not completely latched, but the mission team has decided there will be no more attempts for the foreseeable future, as the spacecraft is doing well otherwise. Lucy successfully took images of the DART impact, and has been assigned to carry out a fly-by of a Trojan asteroid, Polymele. Lucy's original target has been renamed Dinkinesh; the spacecraft now has nine targets.

The Psyche asteroid mission is now scheduled to launch between October 5 and 25 of this year, with the spacecraft arriving at the asteroid in August 2029. NASA has been working hard to address staff availability issues at the Jet Propulsion Laboratory (JPL). Psyche has been fully staffed for a while, but the Agency is continuing to pay close attention to the issue. A Division Program Management Council (DPMC) was held to confirm the new Phase-E cost based on the 2023 launch. In addition, Janus has been removed from the Psyche launch manifest as it was determined that the mission's science requirements could not be accomplished under the new launch/trajectory circumstances. The 2023 funding for Janus is intact, but beyond that there is no further funding for the mission.

The Europa Clipper is still on track for launch in October 2024, while the ATLO schedule has had to be reworked several times. Seven of the nine instruments have been delivered, and the mission schedule is still on track. The US Poet Laureate has been tasked to write an original poem for the Europa Clipper, which will arrive at Jupiter in 2030. The European Space Agency (ESA) mission to Jupiter, JUICE, will have its first launch opportunity on April 13, 2023; JUICE will arrive at Jupiter just after Clipper, its payload includes three instruments with NASA contributed hardware. JUICE is good to go, with no pressing issues.

Dr. Glaze addressed the 2022 Senior Review results for the New Horizons (NH) mission. The team had submitted a multidisciplinary proposal, which included Astrophysics and Heliophysics science. The proposals were also reviewed in an APD Senior Review, and by a special Heliophysics panel. It was determined that some important new science was to be gained, but there is no new Kuiper Belt Object (KBO) to fly by, thus PSD and HPD are coordinating on a potential extended mission; the two divisions are planning to release a request for information (RFI) to the community to identify science that can be done with the mission's payload. The RFI will be coming out fairly soon. Dr. Diniega asked if NH was being treated as an observatory. Dr. Glaze said the NH operations team will remain the same; the intent is to compete new science. The RFI is not a competition or procurement; NASA is simply looking for ideas. Asked if NH would likely move to HPD to be managed, Dr. Glaze noted that while HPD is releasing the RFI, the science is not limited to Heliophysics.

Dr. Glaze presented some highlights in Research and Analysis (R&A): ROSES-2023 is out, the No Due Date (NODD) programs are continuing, and Data Management Plans (DMPs) have transitioned to Open Science and Data Management Plans. An expanded list of research facilities has been made available to ROSES proposers. A triage process may be followed by some program elements during peer review. Dr. Glaze emphasizes that proposal pressure is still down, so now is a good time to propose. The SMD Scientific Information Policy (SPD-41a) is applicable to all new grants starting in ROSES-2023, and all new missions. NASA is trying hard to socialize the policy, and has/will be presenting Town Halls on the subject at the American Geophysical Union (AGU) and Lunar and Planetary Science Conference (LPSC) meetings.

NASA has streamlined the "science nugget" process; emailed PowerPoint slides will no longer be accepted. All PSD nuggets must be accompanied by a publication and be submitted to the website: [https://science.nasa.gov/researchers/PSD-Science-Nuggets]. Dr. John Grant asked how one might discover the fate of a submitted item. Dr. Glaze said that science nuggets would be challenging to trace, but noted that they are used in presentations, are sent "up the chain" to the 9$^{th}$ floor, and that they are also critical to the government performance (GPRAMA) reporting process. Dr. Lindsay Hays added that they also provide a good way for Program Officers to share information. Dr. Glaze said the intent of the website is to reduce the pressure on the submitters. Dr. Shannon Curry asked how Headquarters balanced press releases against science nuggets, in terms of science return. Dr. Glaze said that if an item is high-profile enough to occasion a press release, it typically renders the need for a science nugget redundant.

The New Frontiers #5 (NF5) draft Announcement of Opportunity (AO) was released in January; the comments deadline is March 3, 2023.

The third Principal Investigator (PI) Launch Pad will be held on the Ann Arbor campus of the University of Michigan in July of this year; applications are due on April 14. The PI Launchpad has been very well received, and has elicited much participation from the Planetary community. The Here to Observe (H2O) pilot program, aimed at underserved undergraduate institutions, went very well in its first two years, particularly with the partnerships between the Dragonfly mission and Virginia State University (VSU), and the Europa Clipper and the University of Puerto Rico, both of which have been continued. NASA is looking to broaden the scope of H2O; more details will be released in the Spring.

Other items to watch this year in PSD: Of nine CLPS launches on the manifest, three look like they will launch this calendar year in the Summer-Fall timeframe. ESA's JUICE launch is expected in April, Bennu samples are coming back to Earth in September, the Psyche launch is scheduled for the Fall, and NASA will be celebrating the 30th anniversary of the Discovery program with various events, such as symposia.

Dr. Glaze addressed PAC findings and recommendations:

***Finding 1: Mission Review Process***
Dr. Glaze acknowledged that NASA concurs with the philosophy that a Red grade in a review is indeed Red, and should not be massaged with other positive observations to produce a Yellow grade. NASA is considering changing expectations of Standing Review Boards (SRBs) through work in the Program Management Improvement Office), which is assessing lifecycle success indicators.

***Finding 2: VERITAS Delay Decision***
Dr. Glaze detailed the NASA response, first describing the three documented criteria that must be met before a VERITAS restart: JPL must successfully address issues raised in the Psyche IRB report (the first part of this underway and NASA/SMD plans to review JPL again on the IRB issues in 2024). Second, PSD must secure funding in the appropriate years for the VERITAS mission re-start. PSD is aware of the Budgetary Decision Rules in the Decadal Survey and will carefully consider this input for future planning and budgeting processes. Third, the NISAR and Europa Clipper missions must stay on schedule for their respective launches.

Dr. Hope Ishii asked if there were any information on what will happen with VERITAS development in the meantime. Dr. Glaze said PSD would be funding the science team at a minimal level, to keep them communicating, but there are no funds for additional engineering tasks at this time, and NASA will continue to meet with the relevant international partners, to be transparent and maintain the relationships. Dr. Ishii asked if there were a real risk of VERITAS not being stood up. Dr. Glaze said she thought both the PAC and the Analysis Groups (AGs) have laid out their thoughts clearly, and that she felt strong personal support for the mission, but the question is more "when" than "if." Dr. Kandis Lea Jessup asked when the funding for VERITAS would be available? Dr. Glaze said the mission timeline would be the same as with any other project in SMD or PSD: after the data is assessed in Spring 2024, it will be included in the FY25 budget request: that is the budget the VERITAS team must give input to. Dr. Grant asked, given the schedule for the 2025 budget, who would make the decision to move forward if international partners indicate that they can participate. Dr. Glaze said the project maintains relationships with the PIs and the international agencies; there will be a conversation if there are issues. She did not expect much to change during the next couple of months with regard to the international partners; she thought that they would have what they need. Dr. Ishii asked how JPL was addressing issues in the Psyche IRB report, and how other JPL missions are being prioritized. Ms. Salute noted that one of the bottom line concerns of the IRB was that there was too much work for the staff available, hampering JPL's ability to maintain schedule on current commitments. NASA decided that JPL will not get new missions until this assurance can be given. The situation will not impact any NF5 plans. Dr. Glaze provided a caveat, in that NASA and JPL were looking at near-term challenges. The expectation is that by the time there is a NF5 selection, JPL will be very well posed to meet the challenge. Ms. Salute said that JPL will hold a review in March on Psyche specifically, and two weeks later, will address the institutional findings. Dr. Jessup asked if those workforce metrics are itemized in the IRB report. Ms. Salute said that workforce models change all the time, and that NASA is asking whether JPL can live within the schedule and cost parameters, and whether they have enough of the right people with the right expertise. Dr. Walter Kiefer asked how the VERITAS re-start played into the funding phasing. Dr. Glaze said that the challenge will be addressing the phasing in the FY25 internal budget process, and what it means for the Discovery

program. She could not comment on that issue until NASA gets into the budget process. Ms. Salute said PSD had been probing into different communities through Agency-level activities; Centers and industry have been doing their own report cards. Dr. Glaze said that NASA had asked the IRB to do outbriefs on its results, and that many industry representatives have shown great interest in the results, recognizing that there is broad internal and external interest on the outcomes. Dr. Diniega noted that some of the PSD missions have done their own assessments, and asked if these would these be reported out and applied to other missions. Dr. Glaze said that JPL is looking across the entire Center, and not just at PSD missions, and expected those results to be made public. Ms. Salute said she did not know the plans for either the Applied Physics Laboratory (APL) or Goddard Space Flight Center (GSFC) to report.

***Finding 3: Deep Space Network (DSN) Update***
Dr. Glaze emphasized that PSD has no control over DSN, although she did note that NASA is conducting several DSN studies. PSD has suggested that this finding be submitted to the NASA Advisory Council (NAC). PSD advocates for DSN the best it can, as does SMD.

***Finding 4: Sample Data Curation***
Dr. Glaze thanked the PAC for its recommendation and agrees that data generated by the sample analysis community should be incorporated into the Planetary Data Ecosystem (PDE). The intended repository for astromaterials data, AstroMat (astromat.org), began its initial development phase in 2019 and has continued to expand and increase its functionality. PSD intends to continue to fund AstroMat, increase its capabilities and user functionality, and store data generated by the sample analysis community. In addition, AstroMat was named the required repository for the latest Apollo Next Generation Sample Analysis (ANGSA) call, which was the direct result of community feedback.

***Finding 5: Inclusion Plan Requirement***
Dr. Glaze noted that PSD feels the PAC recommendation is already consistent with current SMD/PSD planning. Dr. Michael New commented that the ROSES-23 call has a single set of requirements for inclusion plans across all five divisions of SMD. He noted that the recommendation has a bit of a dilemma, in that it is difficult to be very specific and very flexible, simultaneously. At the moment, PSD is leaning toward flexible. The inclusion plan must be reflective of the team (and thus would be quite different for a one-person team vs. a 30-person team). If the requirements are too specific, it can be a box-ticking exercise, and PSD wants to avoid that. Dr. New welcomed suggestions about the language of the calls in ROSES23. Dr. Ishii commented that if the plans are going to be used for proposal selectability, metrics must be very specific. Dr. New said the inclusion plans are not being used as a criterion for selectability in ROSES23; it will take a few years to implement this (as had been done with data management plans).

***Finding 6: Community Inclusion in Science Strategies***
Dr. Glaze summarized the PSD response, noting that the MEP team has developed a draft Architecture Strategy Overview for 2023–2044, based on inputs from across the planetary and Mars science communities (Decadal Survey, KISS workshop, multiple SAGs, low-cost workshop, Moon2Mars objectives, etc). Community comments will be solicited on this draft strategy. In addition, PSD and ESSIO continue to develop an Integrated Lunar Science Strategy.

***Finding 7: Astrobiology Research Coordination Networks***
Dr. Glaze reported that PSD appreciates the finding and will continue to provide RCN briefings at PAC meetings, as appropriate.

***Finding 8: NSF Collaboration and Antarctic Search for Meteorites Program (ANSMET)***
Dr. Glaze relayed PSD's appreciation for this recommendation and agrees that open communication with the NSF, especially regarding critical work funded by NASA, but requiring NSF coordination and

support, is extremely important. NASA PSD will continue to work closely with the NSF on these and other partnership activities. Furthermore, SMD has been working with the NSF Office of Polar Programs on a variety of issues regarding access to the Antarctic and will be attempting to re- establish a joint working group to provide a forum for the two agencies to exchange information and explain priorities.

Astrobiology and RCNs

Dr. Mary Voytek presented an update on Astrobiology. The first item centered on recent responses to the most recent Decadal Survey, *Origins, Worlds, and Life* (*OWL*), in particular section 22-17, which recommends a dedicated focus on subsurface research and technology, and ocean worlds. NASA has been evaluating proposals in this area, and much work is being funded in subglacial, etc topics. In addition, language on Mars subsurface research has been added to the Habitable Worlds Scope of Program; PSD will be monitoring responses.

NASA has responded to *OWL* recommendation 22-18 (accelerate the development and validation, in relevant environments, of mission-ready, life detection technologies), and is continuing to work with the Planetary Exploration Science and Technology Office (PESTO), while integrating Astrobiology experts into all mission stages. The Future of the Search for Life (FoSL) workshop, a two-week activity, showed that NASA may need to start even earlier in engaging astrobiologists and engineers, thus a New Early Career Astrobiology Opportunity has been created, the goal of which is to introduce Early Career "astrobiologists" to missions, from inception and conceptualization to planning, development, and operations. The initial offering will use the Utilize Know Innovation Inc. IdeasLab model to bring together 30 graduate students in August of this year.

This year, NASA intends to use the annual Planetary Science Summer School (a NASA Science Mission Design School), which is held at JPL, to try to reach out to Astrobiology students and also engage these summer school students through a workshop approach. In January 2022, NASA collaborated with Brook Nunn (University of Washington) in developing the workshop 2022 Mission to Detect Life. The goals of the workshop included instrument capabilities/limitations, experimental design, sample management on site, data analysis, and how to communicate findings to the public, in addition to learning how to interact (network) with one's peers. The annual conference, AbGradCon 23, will be held in San Diego, May 22 to 25 of this year, hosted by the Scripps Institute of Oceanography. Dr. Voytek briefly reviewed Astrobiology program goals as a preface to the RCN reports.

*Network for Life Detection (NFOLD)*

Dr. Heather Graham reported on NFOLD, which is now four years old. NFOLD's goals are: advancing the science and technology required to search for life beyond Earth; building a cohesive life detection community; and integrating life detection science from inception to operations. NFOLD is dedicated to advancing life detection strategy and capability, catalyzing collaboration, supporting NASA programs and missions, and fostering community development, by promoting catalysis of ideas and interaction, and community discourse relevant to life detection. At present, NFOLD is trying to get more life detection feedback to the analysis groups, such as the Outer Planets (OPAG) and Mars Exploration Program (MEPAG) groups. Brook Nunn, Alfonso Davila and Dr. Graham comprise the NFOLD co-leads. There are 47 Steering Committee (SC) members, all of whom serve as connections between RCNs with astrobiological significance. The range of work of SC members includes ocean worlds, biosignatures, Mars, Enceladus, and Europa. NFOLD has many organic geochemists and instrument developers. Dr. Graham presented a number of science nuggets, including the work of search pattern theorists; components of sea life; analog studies (polar microbes, how tools operate in analog environments); mission data analysis; and assessing standards of evidence (e.g. Allan Hills meteorite).

NFOLD supports consortium activities such as monthly meetings which cycle between mission-focused Think Tank events and a committee-focused forum; office hours for co-leads to brainstorm and plan group activities; special events that address a topic requiring community discussion; and Early Career-

focused events that provide interaction between senior researchers and up-and-coming talent.

Think Tank activities (which may be seen on the NFOLD YouTube page) have the goals of promoting internal feedback and refining life detection activities. NFOLD also holds forums to provide mission-focused life detection advice from seasoned researchers (Enceladus is the most recent focus). Recent workshops include Standards of Evidence for Life Detection workshop, focused on community guidelines for reporting biosignature detection; the FoSL workshop, which explored connections between life detection science and technology; and an Ocean Worlds Analog Field Site Assessment workshop. Early Career Council activities, such as journal club and informal research discussions, conference practice talks, and writing workshops, social media engagement and blogging, are ongoing. Dr. Graham noted that the Early Careers are quite engaged. Dr. D'Arcy Meyer-Dombard asked if there were any formalized process for engaging the AGs. Dr. Graham said that efforts were in process to get the SC members more engaged with the AGs, and also mentioned that many of the new Early Career researchers are new to NASA itself. NFOLD calls them the "NASA Newbs" and is offering them some peer mentoring. Dr. Graham added that NFOLD would like to see more biologists, to complement the RCN's abundance of analytical chemists; NFOLD would also like to help break down the siloes between research and technology, and hold more candid conversations about data collection.

*Prebiotic Chemistry and Early Earth Environments (PCE3)*
Dr. Karen Rogers gave an update on PCE3, the goal of which is to investigate how small molecules in the early Earth environment gave rise to life. How did the "canonical nucleotides" of DNA and RNA get chosen, e.g.? Prebiotic chemistry involves the study of how molecular precursors formed monomers and then polymers, in the context of an evolving planet, including the interaction of prebiotic mechanisms with the impact history of Earth, interior/exterior exchange, crustal evolution, and planetary surface and orbital dynamics, all changing over time. The study of the evolution of life is a complicated problem that needs disciplinary breadth. Dr. Rogers noted that NASA's original vision and declaration of policy and purpose in some ways parallels the principles of life detection pathways. PCE3 also explores the role of delivery of exogenous material to planets. PCE3 can help inform other missions as to what kind of conditions might lead to the rise of life, while other missions can inform us of what early Earth looked like. A few examples of research on the PCE3 team include Korenaga's work suggesting that hotspot volcanism and impacts could have given rise to exposed landmass in Earth's early history. A paper by Naraoka *et al*. (*Science* 2023) centered on delivery of chemical building blocks and planetary scenarios for synthesis; there are a vast number of organic molecules (also containing nitrogen and sulfur) being found on meteorites, which is leading to ideas of what kind of water-rock interactions can give rise to organic molecules. A recent paper by Elsila *et al*., on carbonaceous chondrites, describes how meteorite-delivered amino acids might have contributed to prebiotic life. In a series of recent papers, it was shown that the abundance of amino and hydroxy acids (plus a wet-dry cycle) could support a mechanism that can produce a depsipeptide, demonstrating how an environmentally driven selection process could promote this type of chemistry on exoplanets.

The community at large is openly invited to sit on the PCE3 Steering Committee. PCE3 has held two community-wide workshops: Building a New Foundation (2021), and Nano-to-Cosmic Studies of Complex Systems (2022). It also has a continuing seminar series; over 100 people have been showing up every three weeks, over the last two years, which speaks to the interest of the community-at-large, and is really bringing cross-disciplinary discussions to the fore. There is also the TIPCEE program; these are mini-workshops held on a quarterly basis, comprised of half-day pre-recorded talks on specific, provocative topics, with the goal of correcting data and helping drive new collaborations. The next one will be on the impact of impacts: hydrothermal origins vs. "RNA world."

Dr. Diniega asked if there were any areas in PCE3 that could be better connected. Dr. Rogers noted that filling out the disciplines is coming naturally, and more early Earth folks have been coming in. However,

the Steering Committee could still use more geologists. PCE3 seeks to work more across the disciplines, and now as the community is maturing, it is getting easier to reach across the RCNs, especially through the TIPCEE models. Dr. Rogers felt the RCN was going in the right direction. Dr. Graham felt that NFOLD was out of the "crawling stage," too. Asked how the RCNs are funded, Dr. Voytek explained that each RCN is made up of individuals who receive funding through NASA's competed programs. RCN members are also funded through other divisions beside PSD. RCNs are grass-roots organizations that have connections to Headquarters points of contact, and they receive funding through TWSC proposals to Headquarters. The RCN Steering Committees are made up of people who self-nominate, and whose research has been selected by NASA. In addition, all the RCNs have affiliate status; they share publications, etc. Most important is that the RCNs can identify areas where mission goals and objectives can be moved forward. All the workshops are open. In theory, the RCNs are open to anyone. Dr. Graham added that RCNs function as a professional society, and that there are many non-professionals who are interested in participating in RCNs; however the RCN's internal discussions are confined to the professionals. Dr. Rogers said that in PCE3, the co-leads of the Steering Committee are trying to facilitate any useful and informative activity across the community, and to provide a platform for people to play under a specific scientific umbrella. The intent is to keep the barriers pretty low and make the RCNs open to everyone. Dr. Voytek added that in PSD proposal calls, there are now RCN buttons to choose, if desired. Dr. Diniega asked how the RCN impacts are being measured. Dr. Voytek said each RCN holds mid-term reviews with program scientists and management, which measure the number of white papers, participants in missions, and new proposals. Following the mid-term review, there is a peer review; this is being done right now for one of the RCNs. After that, each RCN will do any required course corrections. Dr. Voytek described the tremendous enthusiasm in the RCNs, reflected by the fact that they are heavily subscribed to by Early Career researchers, because they have time and energy. Dr. Graham added that the NFOLD Early Career group is self-selected, and is made up of mostly graduate students. Dr. Rogers said that PCE3 is trying to launch a proposal incubator workshop to cross-pollinate between disciplines and career stages. Asked how workshops are supported, Dr. Voytek said that travel and lodging funds for IdeasLab are covered, and that NASA is now looking to support graduate students and researchers who have not yet participated in missions.

Mars Exploration Program

Ms. Tiffany Morgan, Deputy Director of the Mars Exploration Program (MEP), presented some highlights. Perseverance left a cache at the Three Forks delta site, marking the end of its initial surface work; the goal henceforth is to diversify the sample collection as much as possible. The rover continues on its way to the top of the delta. The results of the Mars Architecture Strategy Overview, currently under review, can be expected at the next MEPAG and PAC meetings, for the purpose of soliciting community feedback. Mars Data Analysis Program (MDAP) proposals are in mid-review, with selections expected by mid-April.

As MEP evolves, it is important to note that the Mars orbiters are aging, and are all well beyond their original estimated lifetimes. They continue to provide valuable data and infrastructure capabilities that need to be maintained, as demonstrated by a HiRise image of an impact that was later correlated with a 4.0 marsquake, which was detected by the InSight lander at the same time as the impact. This illustrates the continuing importance of imagery to the correlation of data. In the meantime, the business landscape is changing, with broadened international participation, expanding industry interest and capability, and preparing for human presence at Mars via the Moon2Mars vision. Ms. Morgan offered a sneak preview of the Mars strategy: its 2024–44 program science goals are to explore the potential for martian life, discover dynamic Mars (system science of geologic and climatological processes), and perform complementary science supporting the human exploration of Mars. The MEP Draft Strategy will include a focus on achieving Decadal-class science (MSR, search for life), refreshing the communication and imaging infrastructure at Mars, and investing in technology priorities that map to science objectives (EDL,

subsurface access, surface mobility). A few key tenets of the strategy are to maintain the program of record, leverage opportunities, and take advantage of changing landscapes.

MEP international interests include a potential collaboration with ESA's Rosalind Franklin mission, which is the renewed ExoMars mission, now set to launch in 2028; any NASA participation will be subject to the availability of U.S. funding. NASA also continues to discuss the International Mars Ice Mapper (IMIM) mission with a number of partners, including JAXA.

Ms. Morgan gave a status of the assets at Mars. Mars Odyssey (remaining propellant now estimated at 4 kg +/- 2 kg, at a usage of 1 kg/year) is beginning its ninth extended mission (EM). MAVEN experienced a safe mode event due to an IMU event in February; this orbiter has begun its fifth EM. The Mars Reconnaissance Orbiter (MRO) has had no safe mode events since November 2022. The Ingenuity helicopter has just completed 46 successful flights and is currently scouting the way ahead for Perseverance; its activities have been optimized to not interfere with Perseverance operations. In December, a flight software hazard avoidance upgrade was uploaded to the Ingenuity helicopter, and successfully tested. As of 26 February, the Perseverance rover is heading to Tenby, hoping to find fine-grained rocks.

Dr. Michael Meyer addressed the Delta Top campaign being undertaken by Perseverance as it explores another set of sediments, in an area that is a little bit younger than previous samples; afterwards the rover will head west to the channel that feeds the delta, the site of marginal carbonates, and then up over the rim of Jezero Crater to more ancient terrain. These are big accomplishments. There is now a fantastic set of samples; all the primary samples are now on board Perseverance, with tubes left on the ground as backup. There has been some discussion of the Bear Wallow as a superior sample to investigate, as it might contain a clast(s).

The Sample Receiving Project (SRP), formally established at Johnson Space Center in December 2022, is involved in ongoing studies to determine a sample receiving facility modality. Required environmental studies are on track, and the ESA collaboration continues as the agencies share data and plan activities going forward. The Mars Science Laboratory (MSL) Curiosity rover is exploring Marker Band Valley and continues to climb Mt. Sharp. Curiosity has analyzed 42 rock and soil samples, and created 36 drill holes. MAVEN observed two different types of ultraviolet aurorae simultaneously, after a solar flare in August; MAVEN had been prepared to take data. The events took place at the end of dust storm season on Mars.

MRO recently produced some important observations: as it was looking at polar layers, it saw some blocks of ice had tumbled down slopes. There is now an automated process in place to observe this phenomenon. There seems to be interannual variability in ice blocks that have been spotted in this area, and the team is curious to see what will happen in years to come.

Dr. Joe Westlake asked how Mars strategic planning interacted with the Decadal Survey. Ms. Morgan said MEP uses the DS as an input into the strategy. Dr. Meyer noted that the Survey also recommended the Mars strategy to begin with. Dr. Westlake asked what science was to be had from the planned orbital infrastructure refreshment. Mr. Ianson said that the infrastructure includes relay, imaging, and meteorology functions, all of which are part of the Mars Strategy. Dr. Diniega asked about plans for inspiring future generations, and other ways of enabling more diverse participation. Ms. Morgan said that MEP was planning more enabling opportunities than just increased flight opportunities. Mr. Ianson added that one of the basic principles of the Mars Strategic Plan is to more actively work to broaden diversity in participation. Dr. Diniega asked if ESA would be hosting a collaborative Participating Scientist (PS) program. Dr. Meyer thought there was such a program but didn't have details. Ms. Morgan noted that the

ESA MOMA instrument on the ExoMars rover has a PS program. Dr. Glaze gave the caveat that NASA negotiates such programs with its international partners.

Mars Sample Return (MSR) Update

Mr. Jeff Gramling presented Mars Sample Return (MSR) planning details, beginning with the establishment of the Three Forks cache. He said that MSR is working some mechanical and load issues (with respect to the CCRS/ERO interface) as it moves to KDP-C and is also making some changes in how some Planetary Protection issues are addressed. The Mars Ascent Vehicle Propulsion System (MAPS) PDR went well in January, and is on its way to closing out TRL-6 criteria.

Dr. Meyer addressed potential MSR landing sites, as Perseverance has now collected the full complement of sample types the community had determined to be important. The team hopes to answer questions about the radiation absorption of the materials, the nature of Mars dust (whether it is physically irritating, e.g.), engineering (how long will seals last?) and other questions surrounding human exploration. The Sample Integrity Working Group (SIWG) is providing a forum for discussing sample integrity and science-related issues as they arise. Discussions continue on how to break the "chain of contact," for backward planetary protection. A conservative estimate is that there will be 20mg of dust on the exterior of the Orbiting Sample (OS) container. The question is how this contamination can be managed and what potential risks exist. The current intent is to use UV sterilization on the exterior of the OS container; an independent panel will review the approach. MEP is launching a series of studies on high-UV irradiation that would be capable of sterilizing the exterior of the OS, but which would also ensure that the samples themselves remain unaffected. Dr. Meyer felt it would take about six months to determine whether UV sterilization represents a viable approach.

The MSR Campaign Science Group (MCSG) recently examined the timeline for SRP. The schedule is pretty tight. MCSG has reduced a list of about 20 instruments to six, which will serve sample safety assessment, sample curation, and science functions. MEP will start up a Measurement Definition Team (MDT), much like an Science Definition Team (SDT), which will allow the community to propose instrumentation that will go into the sample receiving facility (e.g., electron microscopes). NASA will issue a call, details of which may be ready by the time of the LPSC. Questions remain on how to open sample tubes to get the gases, and to get the sample itself out. MEP expects to hear soon from the Sample Receiving Facility Contamination Panel, as well as from some R&D efforts for SRP.

Mr. Gramling reported on the Sample Retrieval Lander (SRL) hardware and testing accomplishments, including drop tests and thermal protection system tests. The Sample Recovery Helicopter (SRH), an Ingenuity-like rotorcraft to be used for MSR, will have ground mobility and stereo vision capabilities. TRL-6 progress for the Mars Ascent Vehicle Propulsion System (MAPS) Stage 1 Solid Rocket Motor and Supersonic Splitline (SSSL) is ongoing, and is expected to be achieved by March of this year. National Environmental Policy Act (NEPA) compliance status and key milestones. The path to KDP-C (Confirmation) will require the completion of a number of sub-element PDRs, including those for the Earth Return Orbiter (ERO) and the SRH (completed in 2022). In terms of backward Planetary Protection, Dr. Meyer said MEP has been talking to UV experts, though not necessarily those with planetary expertise, as well as representatives from the Centers of Disease Control (CDC), and the Astrobiology RCNs. Dr. Lindsay Hays commented that there are some activities that are starting to converge, and that there are representatives from the RCNs who are on the MCSG, thus they do recognize there are common goals. Dr. Meyer noted that abiotic signatures have been part of the discussion.

*ExoMars/Rosalind Franklin*

Dr. Jorge Vago presented a briefing on the ESA ExoMars mission, which was unable to launch due to geopolitical issues. ESA is building a new lander for the mission. ESA really needs NASA help at this point, to replace a number of elements that Russia had agreed to provide previously. Not all countries are

equally enthusiastic about ExoMars. ESA will need to prove that it can launch the mission in 2028. Scientific pillars of ExoMars include identifying a promising surface outcropping that will enable the lander to collect samples at depth, below the degradation horizon, in order to reach organic materials in a good state of preservation. It has been shown that the biochirality of amino acids can be preserved in such conditions, and the chirality can survive for billions of years if not destroyed by radiation. It will be necessary to drill at least 1.5 m into the surface to allow the MOMA instrument to detect amino acids. Artificial Intelligence (AI) techniques, Raman and laser-desorption instruments, and two dimensional mass spectrometry will enable a good template for biosignature patterns. ExoMars is looking for a landing site rich in phyllosilicates, with a 3.9-billion year old delta, which might represent a site on the edge of what was once a large body of water. Oxia Planum is a candidate landing site; it is 200M years older than the site Perseverance is currently investigating. The launch window opens in October 2028, for a landing on Mars in 2030, in the Spring (at the end of dust storm season), which will provide good solar coverage. Dr. Vago thought the mission science was still very compelling and timely, in concert with the Decadal Survey recommendations to investigate the deeper subsurface of Mars, and important and informative for MSR, and the Mars Life Explorer mission.

Dr. Ishii asked if the table of priorities for analysis could be updated on the fly. Dr. Vago affirmed this. Dr. Conor Nixon asked if the various analyses of microbes at depth had been tested with different matrix/regolith. Dr. Vago said this had not been done, but it is known that the landing site has been covered with meters of material that have been slowing eroding over time. The mission does realize the ramifications. Dr. Westlake, noting that PAC has expressed support for ExoMars in the past, asked about the potential scope of NASA contributions. Dr. Vago said that ExoMars could use a number of radioisotope thermal units, and other contributions.

Dr. Diniega asked if there were any plans for supporting the analysis between the (NASA and ESA) missions. Dr. Glaze said that PSD would be getting the funding lines in order, to accommodate data analysis for ExoMars, should the mission move forward.

Dr. Westlake commented that UV radiation on the Mars surface is much higher than on Earth, and questioned whether UV radiation would be a useful technique for sterilizing the OS. Dr. Meyer said other sterilization methods are too hot, and that while UV has not yet been adopted as a Planetary Protection procedure, MEP plans to do the experiments and stand up an independent panel to see whether it will work. Dr. Diniega asked if community input from the workshop had been included in considerations about sample caches. Dr. Meyer said that the sample workshop was conducted before all the samples had been collected, and that the project appreciated the community input. He said there was only one sample that was different from what had been recommended by the community, and that the decisions had also been vetted by the MSR Campaign Science Group. Asked about the facility modality study, Ms. Morgan noted that the outbriefs are with the architecture and engineering firms, and that the modality studies are only to determine feasibility. The science investigations will eventually be conducted by the science community; there is also a draft RFI in progress for additional facility/site options.

Asked about the MSR MDT, Ms. Morgan explained that the MDT will recommend the measurements/equipment for the SRF; afterward, a call will go out for the types of measurements that can be done at the SRF and for samples that can leave the facility. This will not be a call for analyses done outside the facility; it is just a first step for planning ahead of time.

Dr. Ishii commented that MSR is using a lot of JPL resources, and asked how MSR is responding to the Psyche IRB report, and what the impact on VERITAS might be going forward. Mr. Gramling noted that JPL is responding to staffing issues, and that NASA has been working the situation with JPL management. Dr. Ishii said her concern was linked to the interdependence between missions and staff at JPL. Dr. Glaze said PSD was assessing the situation monthly, across all the projects, to make sure JPL

has the resources to do what it needs to do with regard to NISAR, Clipper, and MSR. NASA will also look at it at the institutional level in March of this year. Dr. Ishii asked if other missions were being held to the same restrictions as VERITAS. Dr. Glaze said that until NASA can confirm changes are being made at JPL, any missions at JPL would be restricted. Responding to a particular rumor, Dr. Glaze noted that NEO Surveyor had been directed to JPL for quite some time, well before the Psyche IRB. She added that the decision on VERITAS had been difficult and was the result of having no good options—the missions that are farther along must take a higher priority than new missions and projects or AOs. Cancelling a new AO does not address near-term resource issues. VERITAS is already selected and therefore will be prioritized over newer missions.

Dr. Westlake said it would be nice to know what the risks going forward after the MSR KDP-C; there are also impacts to the budget, and the risks of Psyche are less expensive than those associated with Clipper or MSR. Dr. Glaze said that SMD is giving guidance to all the Centers, and if Clipper falls off schedule, it will have a greater impact; the Agency is not picking on JPL. Dr. Grant asked whether a Clipper slip would still impact other missions. Dr. Glaze commented that if something happens that is not related to IRB issues, and is completely unrelated to the VERITAS restrictions, it will be very expensive, and will have much more far-reaching effects. Dr. Diniega said there were concerns in the community about PIs who will be affected by things beyond their control. Dr. Westlake offered kudos to the science on display in MSR. He asked for clarification as to Perseverance onboard samples vs. samples left on the surface (paired samples). Dr. Meyer said the plan is to have a total of 31 samples; when it's time for the SRL to land, preferably close to Perseverance, 30 samples is the total that can be carried back. If Perseverance fails, there are ten samples on the surface at Three Forks, which can be retrieved by the lander.
Dr. Diniega requested an outbrief on the PDR for MSR.

Research and Analysis (R&A) Update

Dr. Rinehart briefed the PAC on R&A activities, noting first that there is a call out for people interested in working at Headquarters as a detailee or an IPA. There is also a call for nominations for new PAC members, particularly with expertise in habitability and sample science. All PAC member terms have been extended by three months, to 31 December. There is no specific news on ROSES22; all due dates have passed, save for the Artemis III Geology Team. Notification for the Development and Advancement of Lunar Instrumentation (DALI) proposals is imminent, but there is a slight delay in the Martian Moons eXploration Participating Scientist Program Martian Moon as NASA coordinates with JAXA. Selection rates have been generally quite good. Proposal pressure is still down, continuing an 18-month trend. Dr. Rinehart requested that community members email him personally to tell him why they are not proposing. FINESST continues a slight downward trend; 216 proposals submitted this year, down from 230 last year. The No Due Date (NoDD) program is starting Year 3. PSD is planning a review, and has revised some metrics to include times to notification and proposal quality. Dr. Rinehart solicited feedback from the PAC on metrics.

ROSES23 is out; Open Science (SPD-41) applies to all ROSES23 calls. All divisions are writing supplemental documents to clarify things for the community; the documents will be available some time in March. An expanded list of facilities are now included on the ROSES website [[https://science.nasa.gov/researchers/planetary-science-enabling-facilities.]] There will be a small expansion of the use of triage beyond NoDD programs, and all programs are being moved to shared inboxes (e.g. HQ-LARS@mail.nasa.gov). Dr. Rinehart issued a reminder of the rules on NoDD (one may submit at any time), duplicate proposals, and compliance. For proposals, all critical team members must be registered in NSPIRES. Compliance checking scripts are now available at: [[ https://github.com/nasa/ROSES-Compliance-Checking-Tools/blob/main/README.md]]. It was noted that these scripts do not provide a guarantee.

The use of just-in-time budgets in the Discovery Data Analysis Program (DDAP) is in its second year; verbal feedback on both sides thus far has been positive. However, 65% of PIs said they either did or had to do a full budget, while 29% said they did not have to. Dr. Rinehart took this data to conclude that there is very little savings of time overall, but he felt the use of just-in-time budgets was still a good way to reduce barriers to participation; he added that PSD can't make institutions take advantage of the offer. PSD will continue to track data; proposal pressure for DDAP is now down for two years running.

Dr. Rinehart gave a brief primer on Assessment/Analysis Group (AG) Working Groups, urging PAC members to read "PAC 101," which explains the purpose and function of the PAC and provides context for the AGs. At any time, an AG can choose to create a WG. Multiple AGs can also get together and form a cross-AG WG, without authorization from NASA. As a best practice, PSD asks that each WG create a charter (stated purpose), and identifies a natural end date, if possible. The WG should also report through the AG(s) that sponsored it, as it helps to ensure the WG is responsive to the needs of the AG, promotes awareness of issues, and helps build a larger base of support for WG findings. These WGs may be asked to report to the PAC, but generally will not be asked to. Dr. Glaze agreed with Dr. Rinehart's points, and that the WG should have a thing to do (such as that might be defined by Terms of Reference). Dr. Diniega noted that in the context of a cross-AG WG on Ocean Worlds, there are two types of cross-cutting groups, one at the bottom of an issue, and the other is an umbrella type. An umbrella issue dilutes the value of the connections between siloes and tends not to be served well by a cross-AG WG.

Dr. Rinehart presented a snapshot of the R&A budget, noting that the R&A program includes contributions from many different portfolios. In ROSES22, R&A got $10M it was not expecting in mid-year. In FY23, funding was kept to that level, but PSD swapped some funding for 2024 money, internally. The budget looks like it will be lower, but it's not, it's just a matter of re-phasing.

Dr. Rinehart displayed the proposal review process for Headquarters Program Officers (POs), commenting on how critically review panels depend on community contributions. Virtual reviews remain the norm, and they have many advantages; however reviewers need to be open and honest about their time commitments up front, and other obligations such as family commitments, so schedules can run smoothly. During a recent retreat, PSD identified an issue with time commitments, and since that time has been trying to get the issue into people's awareness.

Triage is used for some R&A proposals, and has been used at SMD for ages (Hubble Space Telescope since its inception, etc). Triage, in this instance, simply means that proposals that score Good or below are not discussed at the panel. The PIs who have scored thusly do get a concatenated review that provides feedback useful for improving the proposal in the future. Triage eliminates about 20% of proposals at very small impact to PIs. PSD is starting to use triage with other programs; the Lunar Data Analysis Program (LDAP) is next. Dr. New added some context, including the fact that three individual reviews are done for triage purposes, and that the PO looks at the reviews to determine whether they are useful. Decent mail-in reviews have been hard to come by, however. A secondary motivation for triage was to help improve proposal reviews, since reviewers know that their pre-panel feedback may be given to the PI. If a proposal is triaged, this is made clear to the PI in their notification letter. Dr. Westlake noted that harsh reviews to Early Career researchers can be cruel and unusual; "kinder and gentler" may be better for ensuring the future of the community. Dr. Grant felt that PIs should be treated equally, regardless of whether they are senior or Early Career. Dr. Rinehart said that LDAP will be both dual-anonymous peer reviewed (DAPR) and triaged, and he did not anticipate any issues. Dr. Nixon commented that some program selection rates are quite high (DALI), and asked if NASA re-allocates funds to target a certain number of proposals. Dr. Rinehart said the general answer is "No," as it would promote divisiveness in the community. Specific to DALI, that program is not part of the PSD/SMD R&A portfolio; it is funded out of a lunar line. Dr. Jennifer Glass asked, now that proposal pressure is lower, how necessary triage really is. Dr. Rinehart noted that while proposal pressure is down, it is harder to find reviewers, and that

saving time is still good for everybody. PSD is just looking for ways to reduce the burden on the community and the POs. There are exceptions, like the Interdisciplinary Consortia for Astrobiology Research (ICAR), which is too broad for triage. Dr. Voytek said that all of Astrobiology is interdisciplinary, and that NASA needs to watch trends in research as well. Proposals around a single discipline tend to elicit similar responses.

Public Comment
Dr. Whitehead: concern about the risk of MAV, the first launch from another planet, for MSR. MSR representatives were not present to answer.

Julie Rathbun: offered comments about the cross-AG WG out of OPAG, which didn't have an end-date, specific goal, etc. Dr. Rinehart agreed overall with the comments, however he did think the group coalesced around a concrete goal, i.e., writing white papers for the Decadal Survey. Dr. Diniega said the writing of papers was only a side quest, and that the WG was built around a broader purpose. Dr. Glaze said that the SMD cross-divisional IDEA WG, which identifies specific activities in the form of short-, medium-, and long-term objectives, could be a good model for any cross-discipline AG WG. Dr. Jessup felt there was confusion about structure and communication, such as identifying who presents to the PAC on behalf of the WG. In addition, how do we make sure the group is perpetual and effective? Dr. Glaze said the WG communication can be a letter with findings that is presented on behalf of all the AGs; or every AG can present the same finding. She felt there was strength behind findings that are endorsed by multiple AGs. Dr. Rinehart agreed that consensus is incredibly powerful for building communities and support for ideas.

Christina Viviano asked if there was a worry that triage would narrow proposal grade ranges. Dr. Rinehart said that every proposal is judged on its own merit; if the proposers are doing the job as specified, triage should not matter. Dr. Jessup was more concerned about maliciousness or exhaustion. Dr. Rinehart felt that triage was safer, as scores are independent, and did not feel that triage opens new opportunities for abuse.

Amanda Hendrix asked how community feedback will be used as a metric in the NoDD programs, Dr. Rinehart said he was considering if a survey to determine community reception would be possible, but that anecdotally, 90% of comments received have been positive thus far.

Amanda Hendrix asked if the R&A budget numbers can be provided rather than just presented as pie charts. Dr. Rinehart said he used sand charts at the end of each fiscal year, and that actual numbers are not presented as a matter of course.

Sue Smrekar expressed concern for the future of VERITAS. Dr. Glaze said that there is no guidance on what budget overguides should be for the new submission; the intent is to understand what the needs are for the 2025 re-start. Again, at the time of the decision to delay VERITAS, there were a variety of challenges to address: COVID, supply chain, the decision to continue Psyche, and resource requirements at JPL. This is why NASA is asking the project to come forward to identify what resources they need. With respect to Earth Science missions, NASA will need to see how IRB findings are being responded to, before committing to any additional work.

PAC Discussion
Dr. Nixon asked how budget bands (small, medium, large) worked, with respect to DDAP, and how they affect the review process. Dr. Rinehart said proposers should look at workforce and instrument needs, and not worry about travel funds. The panel has to do a reasonable assessment based on labor and any special equipment; budget bands are adequate for this. Proposers are told: when in doubt, go "one bin" higher. Asked if social scientists will be part of the NoDD assessment, and whether demographic data would be

examined, Dr. Rinehart said that the numbers are so small, so far, there is no statistical difference. Dr. New noted that data analytics will do this eventually, hopefully in time for Dr. Rinehart's evaluation. Dr. Rinehart said that NSF found that smaller institutions were applying to NoDD programs, but that there was no hard evidence that it does good or bad; he remained optimistic that NoDD reduces barriers.

Dr. Diniega asked if a change in procedure could mitigate "distractions" in panel reviews. Dr. Rinehart said that while there is a need to be understanding of unexpected events, reviewers would do well to communicate early and clearly, and honor commitments. He noted that Henry Throop had put together a scheduling tool that seems to be useful. Dr. Meyer-Dombard said she had heard some negative commentary from a group chief about her having to step out for child care. Dr. Rinehart said that if the incident had not been a surprise, she should inform the PO. He noted that a recent proposal took 20 hours of discussion time, which was also unreasonable. Dr. Jessup said that, personally, she would like to hear that there are consequences for negative behavior. Dr. Meyer-Dombard suggested such incidents be communicated in the plenary. Dr. Rinehart noted that it is not possible to ban people from serving on panels; there are Codes of Conduct, but enforcement is challenging. Dr. Lisa Danielson said she would welcome feedback on individuals, which could be presented to the institution, formally or informally.

Dr. Glass suggested the PAC issue a finding on removing triage from interdisciplinary program proposals. Dr. Diniega suggested other findings on RCNs and the resources they are creating, with formal channels for sharing information with Mars scientists. Dr. Nixon felt that there was a higher "bandwidth" for in-person vs. online panels. Dr. Rinehart noted that side conversations shouldn't happen during panels, and that asynchronicity can be leveraged, but that overall, virtual vs. in-person interaction remains a philosophical discussion.

Dr. Diniega suggested a finding containing language on a no-later-than 2030 launch of VERITAS. Dr. Kiefer commented that the PAC wrote a clear finding on this issue at the last meeting, and was not sure there was enough information to change the finding significantly. Dr. Westlake suggested a finding on support for an ongoing ESA collaboration in planetary missions, noting that there also large risks in the planetary portfolio which will set the stage for missions going forward. Dr. Jessup agreed the PAC should watch the guard rails in the portfolio, and also requested that the SMD IDEA working group present to the PAC.

March 1, 2023

Planetary Defense Coordination Office (PDCO)

Mr. Lindley Johnson provided an update on the Planetary Defense Coordination Office (PDCO), as it continues to assess, search for, detect, track, characterize, and mitigate impact hazards, in concert with other federal agencies and international partners.

Dr. Kelly Fast discussed the distribution of Near Earth Object (NEO) survey telescopes throughout the world, helping to put pieces in place to expedite discoveries and response. The NEOWISE satellite is still operating, doing more characterization than discovery. In 2022, there were 123 known close approaches of an NEO within one lunar distance, with one estimated to be 53m (Tunguska size), and 21 as large as the objects that impacted Chelyabinsk. In 2023, there were 11 close approaches, two within the distance of geosynchronous satellites, and one known impactor, which occurred on 12 February, named 2023 CX1. Discovered by a survey telescope in Hungary, the object was reported to the Minor Planet Center. The JPL Center for Near-Earth Object Studies (CNEOS) Scout System flagged a coming impact and warned PDCO. ESA's NEO Coordination Center similarly flagged the coming impact. About four hours prior to impact, the location was narrowed down to northern France. The meter-sized object created a fireball that was captured on many cameras, and provided an excellent test of planetary defense capabilities. The object also produced meteorites that were recovered, which will help identify its origins.

Thus far, over 31,000 NEAs have been discovered, 852 that are over 1 km in size. Over 2000 of those NEAs are in the potentially hazardous category. Discovery rates remain fairly flat; over 3100 asteroids were discovered in 2022, of all sizes, including about 450 that are 140 m or larger. The UN Office of Outer Space Affairs coordinates with the International Asteroid Warning Network (NASA), and Space Missions Planning Advisory Group (SMPAG; ESA); these two collaborations meet twice a year. IAWN has 50 signatories from 20 countries. Mr. Johnson noted that Dr. Fast also acts as coordinator for IAWN on behalf of NASA, and that SMPAG, chaired by ESA, currently has 18 member agencies. Three agencies are currently observing SMPAG, and will probably join the group in the near future.

Dr. Fast reported recent major PDCO milestones: the Dimorphos orbital change, post-DART impact, is now measured at 33 minutes. Papers will soon be released, and presentations are planned for the LPSC meeting. At the end of November 2022, the NEO Surveyor mission passed KDP-C and is now ramping up to full development on instrumentation. The current agreement is for a launch readiness date no later than June 2028. NASA is participating in an interagency study, as recommended by the Decadal Survey and others, on deep space interplanetary radar. A new evaluation is being conducted on the population of NEAs that are 140 m and larger. Currently, the population is thought to be 25,000 total, with 57.7% not found. The NEO Surveyor is expected to cut the remaining discovery time in half.

The OSTP-led Planetary Defense Interagency WG is conducting a midterm review of the 2018 National NEO Preparedness Strategy and Action Plan. NASA has been working with them for about a month. In addition to the five original goals in the 10-year plan, a goal of better interagency collaboration has been added. Near-term activities in Planetary Defense include the IAA Planetary Conference (Vienna, April 2023) and the Apophis T-6 Years workshop scheduled for early May, a virtual activity. The Small Bodies Assessment Group (SBAG) will likely be involved in the workshop. Dr. Westlake asked if NEO Surveyor had the people and resources it needed. Mr. Johnson said that with the passage of KDP-C, the mission is now officially on the slate. Planetary Defense has been getting a lot more attention since the successful DART mission, thus people are reassessing the support that will be needed. Mr. Johnson was optimistic that the mission would get what it needs. Dr. Glaze agreed that the Decadal Survey support and successful DART mission has brightened the funding outlook; NEO Surveyor will also be part of the broader look at missions at JPL, and is still a high priority. Asked what level of autonomy NEO Surveyor have will have, Mr. Johnson said it would operate much like NEOWISE (highly automated), although Surveyor will be much more dynamic and capable than NEOWISE. Dr. Fast commented that ground-based optical surveys are biased to albedo and visible brightness, and NEO Surveyor will be looking at IR, which will not have that bias. Mr. Johnson added that the interagency study on deep space interplanetary radar has begun to ramp up with NSF, the US Space Force, and other agencies; it will be midsummer before the study produces output. Dr. Diniega said the Small Bodies community is very interested in the study. Mr. Johnson said that currently, the action team is in the midst of SME technical briefings on current technologies, as well as science. The final report will be publicly available.

PAC Discussion

The PAC discussed potential findings. Dr. Westlake asked what could be done to help NASA assess it's the health of its workforce, to allow PSD to get ahead of ramping budgets. Dr. Glaze said the bigger SMD-wide question, is that there may be a way to push on what NASA/SMD is already aware of. There is a finite workforce, and an increased budget can mean increased work. Dr. Glaze noted that the IRB report identified the movement of experts from NASA to new commercial space companies; she said she was hearing that the attrition is slowing down, but it's another dimension to think about when thinking about attracting and retaining the workforce at NASA. Mr. Ianson commented that there are many exciting things happening outside of NASA that make it difficult for NASA Centers to compete with industry; this observation supports the solution of increased partnering with commercial space. Dr. Glaze said NASA had been more limited by restrictions on hiring at Headquarters, but is now doing better at

attracting highly qualified candidates. Dr. Shannon Curry noted that succession planning is a huge struggle, on the academic side especially, and is not helping the community at all.

Lunar Discovery and Exploration Program

Dr. Joel Kearns addressed elements of the Lunar Discovery and Exploration Program (LDEP), which span science instrument delivery, the lunar VIPER rover, the Lunar Reconnaissance Orbiter (LRO), and Lunar Trailblazer. LDEP is kicking off concept studies for recommended missions. LDEP is in the middle of the Payloads and Research Investigations on the Surface of the Moon (PRISM-3) solicitation, which is going very well. The PRISM-4 call will follow next year. The first two CLPS lander providers are making great progress. There are three NASA payloads scheduled to be delivered to the lunar surface on the first three CLPS missions; two by Intuitive Machines, and one by Astrobotic. Intuitive Machines will hold their first launch in June 2023, and if successful, their next flight will go in November 2023 (Lunar Trailblazer). Much work is being done on the Artemis III Geology Team. A Science Definition Team (SDT) will be stood up for the Endurance-A mission. Of the CLPS deliveries scheduled for 2023 to 2026, bankruptcy has prevented one delivery, and NASA is working on delivering the payloads for that delivery on future CLPS deliveries. Other payloads and instrument suites are complete, and just need identification of launch opportunities. Five CLPS deliveries to the South lunar pole are planned for 2023–2026.

Dr. Kearns presented a status of Lunar Trailblazer and VIPER. The Lunar Thermal Mapper and High-resolution Volatiles and Minerals Mapper instruments are complete and have been delivered for integration on the spacecraft, which is scheduled to launch in November 2023. VIPER is now targeting November 2024 for delivery to the Moon; its Systems Integration Review (SIR) was conducted in December 2022. The VIPER landing site has been named for Melba Mouton, a NASA mathematician who worked during the Apollo era. The LDEP website is now live, and will point to data in the archives. It has been determined that the Endurance-A mission instrument complement is not optimized and will be considered in the SDT. Lunar sample return is being considered in several ways, including buying samples as a service, or in cooperation with international partners.

Dr. Sarah Noble introduced the Integrated Lunar Science Strategy. The strategy will include input from a National Academies study that will explore a number of non-polar human destinations on the Moon. JPL is also conducting a study to better define the Endurance-A mission concept, and a joint Lunar Exploration Analysis Group (LEAG)/Extraterrestrial Materials Analysis Group (ExMAG) study on Artemis Samples will be instigated. The successful flight of Artemis I has prepared the way for Artemis II, a crewed mission that will swing around the far side of the Moon, to prepare for an Artemis III landing on the Moon in late 2025. To get ready for Artemis III, NASA has stood up an internal Artemis science team, and is soliciting for a competitively selected geology team (including a Participating Scientist team), and competitively selected payload teams. Dr. Noble reiterated the roles of the internal vs. competed teams: the internal team ensures the architecture/systems can support science; provides an interface between NASA and competed teams to maximize science return; and provides program level strategic planning for mission-to-mission continuity. The competed team is focused on Artemis III sortie and develops mission science objectives for that sortie; supports training as needed; provides real-time operations support; conducts the preliminary examination of samples, and writes the post-mission geology report. The internal team recently acquired a Contamination Control Scientist, and is looking to fill a Curation lead role (currently Acting).

The Artemis Training Team is now fully integrated with NASA Flight Operations, and has begun to execute basic geology and planetary science training for the new Astronaut class. The team has completed development of a Lunar Fundamentals training course that will serve as the foundational class and prerequisite for future lunar training. Science activities continue to be integrated in numerous facility- and field-based testing environments. The joint EVA Test Team 3 (JETT-3) Artemis III analog test has helped to define roles and responsibilities for the Science Evaluation Room (SER) and was able to check off

many top priorities in the LEAG Analog Objectives for Artemis (AOA) document. There was a JETT-3 session at LPSC. Much progress is being made in developing new software systems for the Artemis era, as well as advanced informatics such as spacesuit augmented reality for crewed EVAs. Thirteen potential landing regions for Artemis III, announced last summer, are being assessed; the next Lunar Surface Science Workshop (LSSW), focusing on the science that can be done at those locations is coming up on April 4 to 5—this will be a critical chance for the lunar community to weigh in on the subject.

Asked about the number of members in the Artemis internal and competed teams, Dr. Noble said the internal team has about 10 people, and the competed between 10 and15, with another 8 to 10 Participating Scientists, the latter of whom will probably meld in with the competed team. Asked if there was any new information about access to Chang'e 5 or future Chang'e 6 lunar samples, Dr. Glaze said that the situation remains that participation with China in this program is not possible. Asked if any work is focused on pressurized rovers, Dr. Noble said that SMD supported the Desert Research and Technology Studies (D-RATS) analog in a small way last year, but at present is focusing more on JETT simulations to answer near-term questions. NASA is currently working on Lunar Terrain Vehicle (LTV) requirement documents, aimed at commercial providers to be delivered for Artemis V; this LTV is meant to be a long-lived (10-year) rover, capable of up to a 10-km traverse with humans, and can also be teleoperated from Earth. It will be outfitted with some science instrumentation; ROSES23 has a teaser call out for LTV instruments. Mobility options are also being considered for nonpolar sites. Asked about ShadowCam results, Dr. Weider said there were some first light images, and to stay tuned. She added that an extended mission was in planning for ShadowCam, which will be supported by ESSIO (similar to that of LRO). Dr. Brent Barbee noted that ShadowCam will provide important insights for future missions, as Artemis III will not involve exploration of large permanently shadowed regions (PSRs).

Dr. Westlake asked if any Lessons Learned (LLs) were being applied to PRISM, Dr. Kearns said that LLs were being incorporated on how to work with companies in buying a fixed-price service, and the development of complex instrument suites (from PIs). Much has been learned about technical interfaces, delivery schedules, and what sort of science data can be accomplished through PRISM calls. NASA is beginning to put more performance requirements on the lunar deliveries, such as survive-the-night capabilities. With time, the intent is to make the opportunities more capable to enable high-value science. Asked if less expensive vehicle procurement was being factored into the contracts, Dr. Kearns confirmed that the program is looking at both sides. In addition, when NASA contracts with a company, it tells them what it is buying; lunar samples can be purchased in this way. NASA could also choose to fly along with a commercial mission and collect specimens in this way. On an upcoming Japanese mission to the moon, the company will retain ownership of some mineral samples, and NASA will pay for them.

SMD IDEA Activities

Dr. Eric Holmes, Ms. Juana Sosa, and Dr. Kim Barnette presented aspects of SMD-wide IDEA activities. Dr. Holmes described the now two-year-old SMD IDEA vision as a commitment to actualizing the work environment, trying to change the culture, making IDEA a normal way of doing business, and recognizing the barriers. At its inception, the SMD IDEA WG formed seven subgroups around five strategic priorities, that have been since winnowed down to five subgroups. NASA has partnered with a contractor that brings the subject matter expertise to achieve the goals of IDEA, as there is much science behind the organizational dynamics. The SMD IDEA WG has two-year terms which are staggered to allow continuity and the input of new ideas and new voices. The WG also has Senior Executive Service-level sponsors in SMD who are assigned to each subgroup.

Ms. Juana Sosa, co-chair of the SMD IDEA WG, addressed the IDEA goals of ensuring directorate-wide awareness of division-level efforts to increase coordination and sharing of best practices, and to achieve comprehensive representation of efforts in agency reporting data calls. Examples of PSD IDEA activities include developing partnerships with historically excluded communities via the Here to Observe (H2O)

program pilot. H2O has had a successful pilot that paired Clipper scientists and engineers with University of Puerto Rico, a Minority Serving Institution (MSI), and Dragonfly scientists and engineers with Virginia State University, an Historically Black College and University (HBCU). SMD internal and external IDEA efforts include creating a template Code of Conduct for mission teams, and holding monthly conversations on IDEA concepts (the latest was on microaggressions). A mentorship pilot program was created in 2022, with 22 participants. There are 75 current members in the WG, up from 41 in January 2021, and an increased use of the IDEA Central SharePoint site (over 11,000 visits to date). IDEA has also launched an external facing website:[science.nasa.gov/about-us/idea]. Dr. Diniega asked if there were a community point of contact (POC) for these efforts. Dr. Holmes said that "going to the lead" is the current structure, but that he would be willing to identify a community POC. Dr. Jessup noted that many associations like AGU and AAAS do similar outreach, and that NASA should help people to tune in to these conversations (re: monthly conversation on microaggressions); there may be a way to open these recordings for training materials. Dr. Holmes said that NASA can also put the charts, studies, and resources on the public websites, and that it is also important to show the human beneath the scientist. Dr. Glaze suggested that the IDEA WG consider a shared mailbox to facilitate communications.

Dr. Curry commented that it might be useful to include IDEA items, such as Codes of Conduct (CoC), in a welcome package for newly selected PIs at NASA, to help overcome the "echo chamber" effect. Dr. Glaze cautioned that the IDEA CoC is very new and is still under discussion. The intent is to provide examples, and any CoC must not cross legal boundaries. There are some IDEA elements that are outwardly focused. Over the last two years, NASA has been looking at itself, and agrees it is ready to talk more about the outward-facing components. Dr. Jessup suggested that the WG consider a 2.5-year term, as it takes about a year to get up to speed in a new position. Dr. Holmes welcomed the suggestion, because civil servants have the IDEA activity in addition to their regular duties. NASA must be mindful of burnout, and needs to think about resourcing this effort. Thus far the IDEA vision has run on commitment and emotional content; the concept should be inserted into a work plan. There is also value in having a relationship with contractors that hold similar values. Dr. Barnette said she had received an invitation to give a briefing to the NASEM Committee on Astrobiology and Planetary Science (CAPS). Dr. Diniega asked if there were LLs being incorporated on teams or inclusion plans. Dr. Holmes said that whenever the WG takes on any endeavor, it brings in the expertise to deal with it, as it is tricky to evaluate oneself. This process is meant to uncover blind spots, and it has been great to have an outside entity to advise NASA through this growth period. Dr. Diniega asked if specific areas have been identified for further application of outside expertise. Dr. Barnette said NASA was considering a shared services model. Dr. Diniega suggested having a centralized POC.

Dr. Diniega asked if the group had looked at the Psyche IRB report, as it describes issues with communication flow, the failure to speak up, and psychological safety. Dr. Holmes and Ms. Sosa had not read the report, but intended to. Dr. Holmes noted that there is now an inclusion plan community of practice, which held a workshop in November, that produced guidelines and requirements for submitting an inclusion plan. Psychological safety was discussed during the workshop; now it is an issue of getting the information out there. Many issues that are being found in SMD also apply to the broader community. Dr. Glaze thought the IDEA WG would benefit from reading the IRB report, as it contains much useful input and contributions from social science. Dr. Holmes noted that there is an increasing recognition that social science can help NASA become a better organization. Dr. Diniega encouraged the WG to share IDEA at LPSC and other community events. Asked about a Culture Climate survey, Dr. Holmes said the survey had included SMD and the contractor workforce, and had attempted to measure the level of psychological safety at NASA, to see whether IDEA efforts are changing the environment. Dr. Glaze commented that the survey required 18 months of dedicated effort to open it up to contractors; cutting through the red tape was no mean feat. Dr. Diniega said that this speaks to the idea of funding for this important work. Dr. Barnette said the survey questions are publicly available, as is the presentation that the IDEA WG had given to the NAC. There were 20 questions on the survey relating to safety to belong,

learn, contribute, or challenge, along with voluntarily shared demographics (GS level, race, gender, engineer, scientist, etc.). Dr. Barnette took an action to put the survey questions on the IDEA website. Dr. Ishii asked if there was a funded effort for internal NASA folks for IDEA. Dr. Glaze said IDEA had started as a small volunteer effort; since then, the leadership has been discussing making resources/time available for people to do this work, and has talked about bringing in a dedicated person, trying to figure out a way forward. Dr. Jessup offered to write a finding to support this effort.

Discussion

The PAC discussed succession planning. Dr. Westlake suggested codifying reverse mentorship plans; he suspected the lack of R&A proposals reflects the passing of research titans. He added that mission and instrument development is getting squeezed in the Discovery program. Dr. Glaze noted that within the last Discovery call, and the draft New Frontiers call, there is a requirement for deputy PIs for mentoring or reverse mentoring, to grow leadership; PSD is now seeing this in proposals that are coming in. NASA Senior Reviews are also encouraging succession plans for extended missions, to help give mission experience to young researchers. Two recent missions, MAVEN, and OSIRIS-APEX, are good models. PSD is open to other ideas. Dr. Westlake suggested providing opportunities for more structured training for PIs. Dr. Glaze said NASA has a science development tool, and is looking at roles that encourage higher-level leadership (taking on detail opportunities, external community leadership roles. Dr. Rinehart said there was mentorship training as well. Dr. Nixon commented that there are only few opportunities for Deputy PIs in Discovery and New Frontiers, a good reason to get the SIMPLEx program back on track.

## Analysis Group Updates

*Outer Planets Analysis Group (OPAG)*

Dr. Amanda Hendrix, OPAG Chair, presented a status. More moons have been discovered at Jupiter and Saturn, (a total of 95 and 83, respectively). A search for chairs of the Ocean Worlds Working Group (OWWG), a joint effort with the Small Bodies Analysis Group (SBAG) and the Network for Ocean Worlds (NOW) RCN, has been stood up. Chairs will be chosen after the LPSC meeting. OPAG supports the cross-AG IDEA WG reporting at the PAC at least once a year. Dr. Hendrix reviewed the fourth finding from the November 2022 OPAG meeting, which encourages NASA to consider updating the New Frontiers AO according to *OWL*: briefly, OPAG encourages NASA to consider updating New Frontiers target lists based on scientific, as opposed to schedule-based, considerations, as OPAG is concerned that, depending on the timing of future AOs, rigid assignment of mission themes to specific New Frontiers opportunities may not follow the scientific intent of the *Origins, Worlds, and Life* decadal survey. OPAG also has concerns with the draft NF5 AO, and is assembling feedback and submitting responses to Curt Niebur. OPAG may suggest that NASA do more PMCS studies throughout the decade to prepare for New Frontiers concepts and challenges. OPAG also has concerns about potential ESA contributions due to the fact that there is currently no program library, and NASA has stated that it will not begin to populate it until April. Proposers will be unable to design missions without knowing specifics of potential hardware contributions. OPAG is also concerned that the NF5 draft AO indicates that only launch vehicles with 4-m fairing options are free; there are no current vehicles with 4-m fairings that are capable of supporting Outer Planets missions. A possible resolution would be for NASA to post launch vehicle performance curves in the NF Library as soon as possible and to clarify the cost structure for available launch vehicles, with a consideration that does not disadvantage Outer Planets missions (fairing size, high C3 performance, delivered mass). In addition, OPAG is concerned about the Phase A–D cost cap. The Phase E cost cap, OPAG's number one priority, causes bias against Outer Planets (OP) missions, is new for NF5, and indicates a new reserve posture. Although OPAG understands that NASA wants to control cost, these conditions penalize missions with longer cruise phases, typical of OP missions. OPAG has concerns with radioisotope power supply (RPS) planning, and the draft language for radioisotope heater unit costs (up to $56M in extra cost, prohibitive for OP missions). The NF target list was also a topic of discussion,

with some in the community considering in favor of opening the ocean worlds targets or at least broadening the focus on Enceladus science more generally instead of just focusing on search for life. In response to a comment, Dr. Glaze said that Enceladus showing up as both a New Frontiers mission and as a directed mission underscored its scientific importance.

*Mercury Exploration Analysis Group (MExAG)*
Dr. Steve Hauck presented. Four Steering Committee positions will be open for nominations later this spring, and MExAG has just confirmed the next Chair as Carolyn Ernst. MExAG has been focused on completing its first science goals document, and had its last annual meeting in February of this year, which boasted great attendance. Half of the 47 presentations came from Early Career researchers. The meeting agenda included discussions of IDEA and support for Early Career researchers. MExAG issued a finding on the Discovery program, expressing disappointment with the Psyche mission and its negative impact on other PI-led missions. The finding also noted that MExAG is the sole AG community that must rely on Discovery for exploration and that any delay or reductions in the Discovery AO cadence will disproportionately impact opportunities for exploration of Mercury. MExAG's second finding centered on the Decadal Survey mission assessment process, and concluded that NASA should ensure full disclosure of the real drivers of risk and cost for these missions. MExAG issued a third finding simply expressing gratitude for the Planetary Decadal Survey. MExAG is in support of broadened representation in naming conventions for celestial bodies and locations, and has noted the existence of an open letter to the IAU about these naming conventions. Upcoming Mercury events include a third Bepi-Colombo flyby in June.

*Mars Exploration Program Analysis Group (MEPAG)*
Dr. Aileen Yingst presented; MEPAG held a virtual meeting on 27 February, and will hold a face-to-face meeting in April. There are no findings at this time. MEPAG observations include support for VERITAS over a new AO, as the MEPAG believes the Discovery program should prioritize already selected missions before new AOs. There is also concern in the community about incorporating science into the Moon and Mars programs; NASA should buy down risk by talking early and often with stakeholders. MEPAG feels there is an urgent need for a communications infrastructure plan at Mars because orbital assets are aging. Orbital assets will be particularly important for the success of the MSR mission. The MEP Strategy is still being reviewed; MEPAG will hear more about this in the April meeting. Vicky Hamilton will assume the role of new Chair in April.

Dr. Diniega asked if the expectation was that the infrastructure will not be covered by the strategy plan. Dr. Yingst said the infrastructure concern has been pressed on for more than five years. A member of MEP confirmed that infrastructure is indeed being included in the MEP Strategic Plan. Dr. Diniega asked if the current science input process for sample return has been successful. Dr. Yingst said that that particular question has not been posed to the community, and took it as an action item to bring to the April meeting.

*Exoplanet Program Analysis Group (ExoPAG)*
Dr. Laura Schaefer reported. A number of ExoPAG members will be rotating off in April, and applications for replacement are being reviewed. Activities since the last PAC meeting include monthly Early Career member meetings; reviews of the Science Gap List, and the Exoplanets in Our Backyard workshop (the last one was held in November 2022). The Great Observatory Maturation Program workshop II was held in October; the ExoExplorer Program has been helping to elevate the visibility of Early Career researchers. ExoPAG has been discussing Open Science at NASA at some length, and has stood up a Cross-PAG Science Interest Group (SIG) to support IROUV GOMaP-related activities. In addition, the ExoPAG SAG 23 will examine the subject of exozodiacal dust and its impact on observations. The ExoPAG 27 meeting was held in January. The next meeting, ExoPAG 28, will be held in conjunction with the 55$^{th}$ Division of Planetary Sciences meeting in San Antonio, TX, in late September. The ExoExplorers Program holds public talks every 3$^{rd}$ Friday. A survey of APD on zero

proprietary periods has just closed— early results indicate that community feels that Early Career and teaching institution folks are disadvantaged by the absence of proprietary periods. Dr. Diniega asked if there were any issues with decreased accessibility for the DPS meeting. Dr. Schaefer said this was a good concern to bring up. Responding to a question about zero proprietary periods, Dr. Schaefer said the concern is more about unscrupulous use of early data (being scooped). Dr. Jessup felt the issue was having sufficient time to analyze the data, which smaller institutions tend to not have (both time and tools). Dr. New asked if Dr. Schaefer had any sense of how often scooping has happened, and also reminded the PAC that Open Science is the result of an Executive Order. Dr. Schaefer said that survey results are not yet available, but that there has been some anecdotal evidence of scooping.

*Extraterrestrial Materials Analysis Group (ExMAG)*
Dr. Barbara Cohen reported. The ExMAG has brought on many new members, and has created a newly named microparticle subcommittee. The Group has a new secretary, Michelle Thompson, and is moving back to a single meeting per year, to be held in the Spring; this year the ExMAG will have its first annual meeting in person in April, face-to-face for members and virtual for the community. ExMAG has also brought on a nonvoting, early-career member to run social media. Subcommittees will be starting to issue short annual reports on the state of community and collections. ExMAG is in the process of revitalizing the Mars Subcommittee, complementary to the MSR project and cross-tied with MEPAG. At the last meeting, members talked about submitting comments to SPD-41a, and is planning a continuing extended discussion of this issue. ExMAG issued a finding that continues to encourage NASA to explore a path to permit sample exchange and reciprocal sample loans between NASA and CNSA. This will become even more urgent as China's Chang'E-6 mission will return material from the South Pole-Aitken (SPA) basin. ExMAG also issued a finding thanking the PAC for elevating the ANSMET criticality. Dr. Ishii asked if MSR had been receptive to the new ExMAG subcommittee, Dr. Cohen said that MSR has not called on the AG for engagement. She mentioned that the MSR program would be standing up a project-like committee that will produce science goals and sample analysis tasks. Dr. Glaze agreed that Dr. Cohen made a good point, but reiterated that MSR is a NASA/ESA partnership. Dr. Cohen agree to take MSR concerns off-line.

*Mapping and Planetary Spatial Infrastructure Team (MAPSIT)*
Dr. Brad Thomson presented, reporting that MAPSIT's main finding is positive; i.e. the introduction of data management plans (DMPs) into science and mission proposals has been a success. MAPSIT further observes that inclusion plans may not lend themselves to a template format, but that clarifying evaluation metrics will help proposers write better plans. Upcoming activities include the 6$^{th}$ Planetary Data Workshop, to be held in June in Flagstaff, AZ, and the Planetary Geology Mappers' Meeting in October in Pittsburgh, PA. Dr. Grant asked why MAPSIT considered DMPs a success. Dr. Thomson said that the plans made it clear to proposers that making useful and accessible data is a high priority for NASA; he said he had heard more positive than negative feedback on the subject.

*Venus Exploration Analysis Group (VEXAG)*
Dr. Noam Izenberg presented an update, beginning with a re-emphasis on some points about VERITAS: only a total of 15 workforce members would be required at peak development of the mission, thus VEXAG is asking PAC to endorse a VERITAS launch in 2031, with re-start in 2025, and to prioritize VERITAS over a new Discovery call. VEXAG also finds, in light of the ROSES23 call, that there should be a precursor science investigation for the Discovery (PSI-D) R&A program, and a new Cloudtech R&A program to support investigations of planets with atmospheres. VEXAG is standing up a Venus Strategy Study Analysis Workgroup, and would like the PAC to discuss and support the strategy as it develops, as well as to endorse related PCMS concepts. Dr. Izenberg closed by reiterating Inter-AG Caucus findings on VERITAS; i.e., it appears that Headquarters supports VERITAS, but it is still unclear what hoops need to be jumped through to enable the re-start and the launch. Dr. Kiefer asked what the suggested funding levels were for R&A lines. Dr. Izenberg said that something along the lines for what had been done for

the Europa Clipper would be suggested for PSI-D ( $1–3M). For the HOTTech (and CloudTech) program, the funding should be roughly the same magnitude as the previous program.

*Lunar Exploration Analysis Group (LEAG)*
Dr. José Hurtado presented. LEAG has released the Continuous Lunar Orbital Capabilities Specific Action Team (CLOC-SAT) report; its overarching findings call for a follow-on to LRO, continuity of integrated lunar capabilities, and a variety of measurement approaches. The report discusses all approaches in the context of Decadal-level science, presented as why, what, and how "tensors." The document is being discussed heavily in the community. LEAG has two requests for the PAC; the first is to encourage continued engagement between NASA and the CLPS providers. LEAG continues to advocate for a CLPS capabilities roadmap to advance science and technology issues, and feels these efforts will be helpful to all the stakeholders. LEAG encourages open pathways for long-lived lunar surface presence, which will require some smoothing of regulatory pathways. LEAG also requests that the PAC approve the encouragement of NASA to implement high-priority science missions to the Moon, regardless of other lunar activities. LEAG feels it is important to reassure the community that the Moon has profound science goals apart from human exploration interests. Dr. Ishii expressed concern that no lunar missions had been submitted to NF5. Dr. Glaze noted that since NF5 has had one target missing, which is Venus. This absence sends the converse message that lunar targets are on the list. She said she didn't know how much more clearly she could say that. Dr. Glaze felt this was a misconception from within the community and asked Dr. Hurtado to talk to Clive Neal. Dr. Kearns supported Dr. Glaze's comments.

*Small Bodies Analysis Group (SBAG)*
Dr. Lori Feaga presented a summary of recent SBAG activities. The Steering Committee approved a Code of Conduct, which is posted on the SBAG website. A leadership search is in progress for the Ocean Worlds inter-AG WG. SBAG held its last meeting in January, in hybrid format, and which included two invited talks from Early Career presenters.

Dr. Feaga presented a number of findings:

- To ensure continued usability of the Arecibo radar data, SBAG recommends that NASA work with NSF to promptly establish a mechanism by which to preserve the data as well as necessary processing software and systems, including identifying an appropriate organization for hosting them and more importantly the responsible agency for supporting the endeavor.

- SBAG recommends that NASA PSD compile the historical data for all competed missions to date and assess the full scope of mission delays, look for the root causes, and determine any common themes. Once NASA PSD has analyzed the data, SBAG encourages them to share their findings with the community.

- SBAG requests NASA support for US participation in ESA's Hera mission to the Dimorphos/Didymos system, which will explore the result of the DART mission; there is currently no mechanism to do so.

- SBAG endorses the findings outlined in the SBAG Apophis Specific Action Team (SBAG Apophis SAT) report and encourages the community to identify a path forward for a coordinated remote sensing campaign that would take advantage of the unique 2029 close encounter of Apophis with the Earth. Report may be found at: https://www.lpi.usra.edu/sbag/documents/Apophis_SAT.pdf

Asked if SBAG was requesting a Planetary Data Ecosystem (PDE) collaboration, Dr. Feaga said she had heard from several radar data users that there are only a few servers to support data. Dr. Glaze supported this idea, as there is a big effort under way to archive ground-based data. Dr. Feaga noted that funds had been discontinued for Arecibo staff in August.

Dr. Westlake felt the second SBAG finding (rationale for mission delays) is a far-reaching ask, as it seems it would have to be a very large study. Dr. Diniega said she was not sure what to ask of PSD in this regard. Dr. Feaga commented that no one in SBAG could come up with a clear statement, and wanted to be able say something in support of VERITAS, given that mission delays are inherently detrimental: Are all Discovery-class missions in more peril of being delayed, because of risk stance and cost caps? Is there a trend to help the community make a decision? Dr. Glaze offered the observations that MAVEN, OSIRIS-ReX, and Lucy delivered under cost. InSight was delayed due to technology; Psyche had challenges with late delivery of software. The issues surrounding the delays were so much more than the money or technical challenge—neither of these missions were delayed because of budget. The VERITAS delay occurred due to the Psyche IRB findings, and a budgetary concern. In addition, Headquarters announced a delay for Dragonfly soon after its selection. Dr. Feaga said that SBAG really wants to understand better what is causing the initial delay, to have more information for planning. Dr. Kiefer felt it would be nearly impossible to pull clear lessons from the "archeology" of past delays; he did not think a longitudinal study would be useful.

Discussion

The PAC briefly discussed the nature of comments to be made in response to the New Frontiers 5 AO, and some restrictions surrounding the mention of specific programs.

PAC discussed potential findings on how to assess workforce health WF, including SMD IDEA WG expertise in thinking about workforce aspects, SMD support for IDEA personnel, including funding, and developing a plan for retaining radar data processing results from the Arecibo facility.
Dr. Kiefer suggested a finding in support of the ExoMars mission. Dr. Curry felt that OPAG findings should be elevated. Dr. Diniega noted that OPAG's concerns had been aired multiple times, and had also been part of the input to the NF5 draft AO.

SMD Standing Review Board (SRB) Process

Ms. Shannon Fitzpatrick presented an informational briefing on the NASA lifecycle reviews, Standing Review Board (SRB) touchpoints to the reviews, and the Psyche IRB findings. An SRB is an advisory body that is responsible for NASA life cycle reviews (LCRs). They are independent from the program or project they are under, and go through great rigor to eliminate any conflicts of interest. The LCR Convening Authorities (CAs) are the explicit customers of the SRB, and the program or project under review is the implicit customer of the SRB. The schedule of work performed by the SRB should support the needs of those customers. The SRB conducts the LCRs and can provide recommendations, but the SRB members and consultants-to-the-board do not impose requirements on, make decisions for, or direct the program or project.

The SRB authority depends on project categories, varying from Center Director up to Division Associate Administrator. The SRB Chair is typically a leader and a recognized expert that has relevant flight experience. The SRB Review Manager (RM) manages the SRB content and schedule of work, and writes the Terms of Reference (ToR), which defines the scope of the SRB, schedule, and ground rules for conduct. The SRB Review Manager and Chair work to smooth out tensions between the Board and the project or mission The Deputy Chair of the SRB is often chosen to provide consistency across the life cycle of the mission, increase diversity, and provide mentorship opportunities.

Ms. Fitzpatrick briefly described the steps followed to form an SRB. According to the NASA Life Cycle Review chart from NPR 7120.5, NASA wants the Chair and Review Manager to be in place by the Mission Confirmation Review (MCR). The SRBs come in at numerous points during the life cycle but there are stretches during the mission life cycle where there are fewer SRB activities. Currently, NASA is examining how to get more touchpoints between those reviews. These touchpoints could be inform SRB check ins and having SRBs engaged between lifecycle reviews. The SRB looks at the global culmination of the mission, while an IRB does a deep dive on a specific problem. The IRB scope is finite, while SRB has broader scope. The IRB issues a report to the Convening Authorities (CAs) as their deliverable.

Ms. Fitzpatrick addressed the December 2022 PAC finding on SRB shortcomings relating to the Psyche IRB and the Psyche delay, saying she had chatted with the Psyche SRB Chair. There are now some process improvements in place. What is critical is that they are now communicating much more frequently, being invited to more reviews, and importantly, there are now weekly meetings with the SRB Chair, the Program Executive and Mission Manager. She noted also the deleterious effect of the pandemic, which greatly reduced face-to-face interactions. SMD had already developed an SMD SRB Implementation Plan before the Psyche IRB, but the Division has taken it further since the results of the Psyche IRB, and is doing deeper dive snapshot reviews after the LCRs. Other Agency SRB process improvements include forming SRBs early in the mission life cycle, and holding SMD SRB Community of Practice Quarterlies to foster open and transparent dialogue between SRB chairs and SMD leadership, discuss lessons learned, best practices, and suggestions for improvements.

Ms. Fitzpatrick noted that there have been some nonconcurrences in the general conversation about SRBs. Dr. Kiefer suggested holding LCRs by phase, noting a practice specific to Discovery, where phase A people write concept study reports, and immediately go to phase B once the mission has been selected. Ms. Fitzpatrick acknowledged the point. Dr. Westlake commented that the content of the System Requirements Review (SRR) is to determine the details of requirements. Dr. Grant said Psyche concerns had been identified at the Preliminary Design Review (PDR); why weren't they heard? Ms. Fitzpatrick said the management structure did not accept some concerns, which has been a wake-up call for some implementing Centers. Dr. Grant asked if changes are being applied to all SRBs. Ms. Fitzpatrick said that some of these visits/reviews are not being codified in TORs, and this has been a subject of discussion in the Community of Practice meetings. NASA is also kicking back on some appointments of SRB participants because it knows there is too much on their plates. The Psyche SRB Chair says that people have been very engaged on both sides; it's still too early to tell, but it looks like it's going in the right direction just from an experience in a recent review. Dr. Ishii asked how deeper dive snapshot reviews are being assessed. Ms. Fitzpatrick said snapshot reviews are done within 48 hours of review, and the information is conveyed to the SRB Chair, who is not afraid to poke at technical areas. Ms. Fitzpatrick felt the snapshot reviews were very effective at providing a deep view of both programmatic and technical issues. Asked how NASA ensures that snapshot reviews are sufficiently technical, Ms. Fitzpatrick said that NASA was not getting rid of expertise, but just being more aware of bringing in individuals who can get a more global view. Dr. Westlake encouraged getting SRB members with expertise into the peer review process. Ms. Fitzpatrick recounted a mission on which she served as Program Executive. The mission had been having propulsion system issues, so SRB SMEs were pulled into every review because of issues that threatened the Critical Design Review (CDR). Dr. Diniega asked if there were a process to follow if the mission has delays due to re-phased funding. Ms. Fitzpatrick said the best practice would be to have more reviews in a re-phase situation, and would take that idea back to the leadership.

Dr. Westlake commented that the SRB briefing had fully addressed the PAC finding. Dr. Diniega asked about efforts to assess the effectiveness of the SRB improvement process. Ms. Fitzpatrick said NASA wanted to identify the metric, and the appropriate time to identify it.

Public Comment

Darby Dyar asked why an additional stipulation for the restart to the VERITAS mission had been added now. Dr. Glaze responded that the three stipulations had been provided during the initial release/response to the Psyche IRB findings. [Note that since the PAC meeting, this answer was recognized to be in error. For full details of the VERITAS restart requirements, see PSD Update slides 29–31: https://science.nasa.gov/science-pink/s3fs-public/atoms/files/20230228-PAC-Glaze-FINAL-update.pdf].

Bill McKinnon asked about the astrophysics component of the New Horizons future. Dr. Glaze said that PSD is collaborating with APD (as well as HPD) on the future of the mission and that the RFI will be open to everyone.

Findings and Recommendations Discussion

PAC members discussed findings on the PSD RCNs, reiterating positive comments, and considering a recommendation for more formalized avenues between RCNs, particularly between Mars Sample Return and Astrobiology. Dr. Glass noted that PAC hears from the AGs at every meeting, and asked why the RCNs were heard from sporadically. Dr. Diniega said the PAC had been talking about doing something different with the AGs. Dr. Rinehart said the RCNs are not AGs and should not be treated as such, and that briefing frequencies were debatable. Dr. Voytek felt it important to bring the Astrobiology perspective to the fore; the question is just one of cadence. She added that there is currently a call for a Senior Scientist for Astrobiology. Dr. Kiefer observed that most PAC meetings need more time for discussion and wondered if the cadence for RCNs could be lower. Dr. Diniega tabled the subject in favor of a closed meeting discussion.

The PAC discussed MEP progress, and while it supported engagement with ESA's ExoMars mission, did not raise the issue to the level of a finding. The PAC did consider the effects MSR cost or schedule overruns that may affect other PSD missions. Dr. Westlake agreed that MSR could have great impacts on other missions. Dr. Curry suggested pointing out that MSR needs a lot of oversight, so it doesn't eat everybody's lunch. Dr. Westlake said the finding should reflect the general anxiety in the community over large missions. Dr. Rinehart said that the larger Federal framework (GAO and OMB) has the ultimate oversight here. Dr. Curry felt the finding should reflect the desire of the community to have awareness of mission status. Dr. Jessup suggested finding language regarding program line impacts on PSD. Dr. Grant added that the request should be for a heads-up on those events that may have an impact on the rest of NASA. Dr. Ishii commented that the PAC should need to be careful to stay in its lane, but agreed it should be informed when risk spills over. Dr. Kiefer said it was worth noting that MEP briefs the PAC for at least an hour at every meeting. Dr. Westlake said it would be nice to know more details about such things as passing PDR. The PAC generally concurred with this statement.

Dr. Grant asked if it would be valuable to get an update on VERITAS in June. Dr. Glaze, said there should be a scorecard on progress, but there will be no budgetary information until the PBR in Spring 2024. Dr. Glaze said she would also provide a Mars/MSR update in the Fall (when MSR will be going through PDR). Dr. Diniega suggested a finding on whether MSR is on track. Dr. Glaze felt the PAC should keep the VERITAS status on top of the radar, and then make a finding at the Spring meeting that would require a response from PSD. Dr. Kiefer seconded the idea. The PAC confined the finding language to a request for a report on VERITAS at the June meeting of the PAC.

The PAC discussed a general finding on cross-AG WGs, recommending that PSD should work out clarifications. Dr. Jessup commented that the goal is to invite them to come to PAC meetings to clarify what they do.

The PAC discussed a finding on the health of the PSD work force, recognize current challenges as they relate to NASA goals and missions going forward. The PAC recommendation was to request results of the assessment, and to involve SMD IDEA WG expertise in the process.

The PAC discussed SMD/PSD support of IDEA, in terms of the importance of this work being reflected in actual compensation for the work. Dr. Jessup suggested a recommendation to bring in a NASA hire for IDEA.

Dr. Danielson thought that a finding on increased cadence for PI-training workshops should have a solid IDEA component because of the importance of future leadership training.

The PAC discussed a finding on the importance of Planetary radar data in the context of the Arecibo facility.

A PAC finding on triage in R&A proposals was tabled for the interim.

Dr. Diniega adjourned the meeting at 6:02pm.

## Appendix A
Attendees

Planetary Science Advisory Committee
Serina Diniega, **Chair,** Jet Propulsion Laboratory
Brent Barbee, NASA Goddard Space Flight Center
Shannon Curry, University of California, Berkeley
Lisa Danielson, Los Alamos National Laboratory
Jennifer Glass, Georgia Institute of Technology
John Grant, Smithsonian Institution
Kandis Lea Jessup, Southwest Research Institute
Walter Kiefer, Lunar and Planetary Institute
Hope Ishii, University of Hawaii
D'Arcy Meyer-Dombard, University of Illinois at Chicago
Conor Nixon, NASA Goddard Space Flight Center
Joseph Westlake, Johns Hopkins University Applied Physics Laboratory
Tyler Robinson, Northern Arizona University
Stephen Rinehart, Executive Secretary, NASA Headquarters

Attendees at Headquarters
Serina Diniega
Joseph Westlake
Conor Nixon
Justin Tilman
Jorge Vago
Eric Ianson
Joan Salute
Michael Meyer
Tiffany Morgan
Jeff Gramling
Kandi Jessup
Michael New
Lindsay Hays
Lori Glaze
John Grant
Shoshana Weider
Stephen Rinehart
Kelly Fast
Sarah Noble
Joel Kearns
Eric Holmes
Juana Sosa
Kim Barnette
Shannon Fitzpatrick

Webex Attendees
Adrian Brown
Alana Johnson
Alexandra Witze
Amanda Hendrix
Andrea Riley
Anne Verbiscer
Azita Valinia
Barbara Cohen
Becky McCauley-Rench

Bill McKinnon
Brad Thomson
Brent Barbee
Caleb Scharf
Darby Dyar
David Millman
David Smith
Debra Hernandez
David Smith
Ed Rivera-Valentín
Edmonia Caldwell
Elaine Denning
Eric Holmes
Erica Montbach
Erwan Mazarico
Erwan Mazarico
Flora Paganelli
Jack Kiraly
James Lochner
Jeffrey Grossman
Jemma Davidson
Joan Zimmermann
John Brown
Jose Hurtado
Jose Ramos
Julie Rathbun
Justin Filiberto
KC Hansen
Kim Reh
Kinsey Flanders
Kurt Retherford
LaJuan Moore
Laura Schaefer
Lewis Groswald
Linda Billings
Linda Karanian
Lindsay Hays
Lisa Gaddis
Lori Feaga
Louise Prockter
Lynnae Quick
Marcia Smith
Martha Gilmore
Meagan Thompson
Megan Ansdell
Michael Lienhard
Michael Mischna
Mike Fanelli
Mitchell Schulte
Nick Lang
Noam Izenberg
Pamela Millar
Patrick Taylor
Phil Scott
Prajkta Mane
R Aileen Yingst
Richard Zurek
Rick Davis
Rob Landis
Robert Collom
Ryan Watkins
Stacey Cunningham
Steven A. Hauck
Sue Smrekar
Sylvie Espinasse
Tibor Balint
Tom Statler
Vicky Hamilton
Aaron Burton
Alberto Fairén
Alexander Pavlov
Ashlee Wilkins
Azita Valinia
Carl Gelderloos
Cesare Grava
Chris Dateo
Christina Viviano
Dave Murrow
David Beaty
David Hollibaugh Baker
David J. Smith
Doris Daou
Doug Isbell
George Tahu
Griffin Reinecke
Heather Graham
Jason Callahan
Jeff Foust
Jeff Johnson
John Rummel
John Whitehead
Jose Chavez
Karen Gelmis
Krista Soderlund
Kunio Sayanagi
Laura Ratliff
Lisa May
Lynnae Quick
Megan Gorham
Melissa Kirven-Brooks
Michael G. Wilson
Michela Munoz
Michelle Viotti
Mike Kelley
Monty Di Biasi
Nick Saab
Paul Voosen
Ramon da Paola
Richard Rogers
Richard Zurek
Rob Landis
Karyn Rogers
Scott Edgington
Scott Hovarter
Shane Stone
Stephen Clark
Storm Rosser
Tammy Dickinson
Teresa Jensen
Theresa Carta
Thomas Widemann
Tiffany Morgan
Timothy Lyons
Van Kane
Zhengwei Hu

**Appendix B**

Agenda

**NASA Planetary Science Advisory Committee (PAC) Meeting**

**February 28 & March 1, 2023**

**NASA Headquarters (3D42) and WebEx**

**Agenda**

**Day 1: February 28, 2023**

| Item & Speaker | Length (minutes) | Time (Eastern) |
|---|---|---|
| **Welcome/Around the table**<br>Stephen Rinehart | 5 | 10.00–10.05 |
| **Planetary Science Division (PSD) Update**<br>Lori Glaze and Joan Salute | 60 | 10.05–11.05 |
| **Additional Q&A/Discussion**<br>PAC Members | 15 | 11.05–11.20 |
| **Astrobiology Update**<br>Mary Voytek | 10 | 11.20–11.30 |
| **Astrobiology Research Coordination Network (RCN) reports**<br>Network for Life Detection (NFOLD) and Prebiotic Chemistry and Early Earth Environments ($PCE_3$) | 50 | 11.30–12.20 |
| **Additional PAC Q&A/Discussion**<br>PAC Members | 20 | 12.20–12.40 |
| **Lunch** | 60 | 12.40–13.40 |
| **Mars Exploration Program (MEP) Update**<br>Tiffany Morgan, Michael Meyer | 30 | 13.40–14.10 |
| **Mars Sample Return Update**<br>Jeff Gramling, Michael Meyer | 30 | 14.10–14.40 |
| **ESA ExoMars Update**<br>Jorge Vago | 30 | 14.40–15.10 |
| **Additional PAC Q&A/Discussion**<br>PAC Members | 30 | 15.10–15.40 |
| **BREAK** | 30 | 15.40–16.10 |
| **Research & Analysis (R&A) Update** | 45 | 16.10–16.55 |

| | | |
|---|---|---|
| Stephen Rinehart | | |
| **Additional PAC Q&A/Discussion**<br>PAC Members | 15 | 16.55–17.10 |
| **Public Comment Period*** | 30 | 16.55–17.25 |
| **Additional PAC Discussion**<br>PAC Members | 50 | 17.10–18.00 |
| **Adjourn Day 1** | | 18.00 |

*Comments and questions from the public may be provided, via WebEx, during the Open Comment Period (30 minutes). PAC members will consider these comments starting at 17.10.

**Day 2: March 1, 2023**

| **Item & Speaker** | **Length (minutes)** | **Time (Eastern)** |
|---|---|---|
| **Welcome/Around the table**<br>Stephen Rinehart | 5 | 10.00–10.05 |
| **Planetary Defense Coordination Office (PDCO) Update**<br>Lindley Johnson/Kelly Fast | 30 | 10.05–10.35 |
| **Additional Q&A/Discussion**<br>PAC Members | 10 | 10.35–10.45 |
| **Lunar Discovery and Exploration Program Update**<br>Joel Kearns & Sarah Noble | 30 | 10.45–11.15 |
| **Additional Q&A/Discussion**<br>PAC Members | 15 | 11.15–11.30 |
| **Science Mission Directorate (SMD) Inclusion, Diversity, Equity, and Accessibility (IDEA) Activities**<br>Eric Holmes, Juana Sosa, Kim Barnette | 30 | 11.30–12.00 |
| **Additional PAC Q&A/Discussion**<br>PAC Members | 30 | 12.00–12.30 |
| **Lunch** | 60 | 12.30–13.30 |
| **Assessment/Analysis Group (AG) Updates** | 120 | 13.30–15.30 |

| | | |
|---|---|---|
| AG Representatives<br>1. OPAG<br>2. MEXAG<br>3. MEPAG<br>4. ExoPAG<br>5. ExMAG<br>6. MAPSIT<br>7. VEXAG<br>8. LEAG<br>9. SBAG<br>Additional Q&A | | <br>13.30<br>13.40<br>13.50<br>14.00<br>14.10<br>14.20<br>14.30<br>14.40<br>14.50<br>15.00 |
| **BREAK** | 30 | 15.30–16.00 |
| **SMD Mission/Standing Review Board (SRB) Processes**<br>Shannon Fitzpatrick | 30 | 16.00–16.30 |
| **Additional PAC Q&A/Discussion**<br>PAC Members | 15 | 16.30–16.45 |
| **Public Comment Period*** | 30 | 16.30–17.00 |
| **Additional PAC Discussion**<br>PAC Members | 75 | 16.45–18.00 |
| **Adjourn Day 2** | | 18.00 |

*Comments and questions from the public may be provided, via WebEx, during the Open Comment Period (30 minutes). PAC members will consider these comments starting at 16.45.

## Appendix C
## PAC Membership

- Serina Diniega, Chair – Jet Propulsion Laboratory
- Stephen Rinehart, Executive Secretary – NASA Headquarters
- Brent Barbee – NASA Goddard Space Flight Center
- Shannon Curry - University of California, Berkeley
- Lisa Danielson - Los Alamos National Laboratory
- Jennifer Glass – Georgia Institute of Technology
- John Grant – Smithsonian Institution
- Hope Ishii – University of Hawaii
- Kandis Lea Jessup – Southwest Research Institute
- Walter Kiefer – Lunar and Planetary Institute
- D'Arcy Meyer-Dombard – University of Illinois at Chicago
- Conor Nixon – NASA Goddard Space Flight Center
- Tyler Robinson – Northern Arizona University
- Joseph Westlake – Johns Hopkins University Applied Physics Laboratory

## Appendix D

Presentations

1. Planetary Science Division Status Report; *Lori Glaze, Joan Salute*
2. Astrobiology and Research Coordination Networks; *Mary Voytek, Heather Graham, Karen Rogers*
3. Mars Exploration Program; *Tiffany Morgan, Michael Meyer*
4. Mars Sample Return, *Jeff Gramling, Michael Meyer*
5. Rosalind Franklin (ExoMars); *Jorge Vago*
6. Research and Analysis Update; *Stephen Rinehart*
7. Planetary Defense Coordination Office; *Lindley Johnson, Kelly Fast*
8. Lunar Discovery and Exploration Program (LDEP); *Joel Kearns, Sarah Noble*
9. SMD IDEA Activities; *Eric Holmes, Juana Sosa, Kim Barnette*
10. Analysis/Assessment Group Updates
    - OPAG; *Amanda Hendrix*
    - MExAG; *Steven Hauck*
    - MEPAG; *Aileen Yingst* *é*
    - ExoPAG; *Laura Schaefer*
    - ExMAG; *Barbara Cohen*
    - MAPSIT; *Brad Thompson*
    - VEXAG; *Noam Izenberg*
    - LEAG; *José Hurtado*
    - SBAG; *Lori Feaga*
11. SMD Mission Standing Review Board Processes; *Shannon Fitzpatrick*

## Appendix E

Chat Transcript

Public Q&A

Feb 28

John Whithead:

Thanks to ESA for the inspiring presentation. It would make sense for JPL to build a lander for ExoMars (helicopters could accompany Rosalind) and postpone MSR until the MAV can be fully flight tested high above Earth, like they test the EDL parachutes. New launch vehicles often fail on the first try, so Mars is not the ideal place for the first MAV launch.

John Whitehead:

If Jeff Gramling is still here: In the March test at Edwards, which of the DM-1 parts will be flight-weight (nozzle, motor case, steering actuators)? Will the nozzle be swiveled during firing, and will the test start at a Mars-relevant temperature? Will the thrust vector be measured, both magnitude and direction?

Julie Rathbun:

As a co-chair of the cross-AG IDEA Working Group, I am curious about the "definition" of Working Groups as shared in Dr. Rinehart's slides. The IDEA group was formed out of OPAG when they realized that they were making recommendations/findings about IDEA and realized that these issues affect ALL the AGs and not just OPAG and thus, a group that could coordinate with the entire community was necessary. We (this group) do not have a short term specific goal nor a natural end date. TBC in another question

Julie Rathbun:

Inclusion is a major goal of NASA, not the sort of sub-AG issue that Stephan is discussing. As such, what sort of group should the cross-AG IDEA WG be?

Christina Viviano:

With triage, do we worry that the reviewers will be less likely to take advantage of the full grade range, and thus proposals grade ranges will be even more narrow?

John Whitehead:

Serina, thanks for acknowledging my comments. I was hoping that my whole first comment could be read aloud for all the PAC members to hear (at least please share my words with John Grant today, as he might be interested).

Amanda Hendrix:

NoDD assessment: if you use community feedback as a metric (which would be great!) how will those data be collected?

Amanda Hendrix:

The cross-AG IDEA WG addresses issues for ALL AGs, not just a couple. It's an umbrella group, to use Serina's words. I think in this instance (not for all WGs) it's appropriate for the IDEA WG to report directly to PAC.

Amanda Hendrix:

Is it possible to provide R&A budget numbers rather than just showing PIE charts? If we want to track R&A budgets and the funds are sprinkled throughout several pie wedges, it gets challenging. (Or maybe budget numbers are posted somewhere?) thx

Sue Smrekar:

Necessitating a budget OVERGUIDE for VERITAS makes it extremely difficult to get funds to restart VERITAS. The amount of funding removed from VERITAS is ~12% of the Psyche delay cost impact. If the goal is to launch VERITAS after a ~3-yr delay, why remove its budget? Does this assume that NISAR and CLIPPER will slip? Will Earth Science missions now be contingent on SMD mission success? Why is VERITAS, with its small workforce footprint at JPL, the only mission with a start contingent on other missions?

March 1

Darby Dyar

The original stand-down for VERITAS was tied to issues called out by the Psyche IRB relating to JPL workforce, and budget. As of yesterday, an additional stipulation has been added, namely that NISAR and Europa Clipper stay on schedule. Why is the goalpost moving now?

Bill McKinnon

If you have time, regarding the presentation on the NH RFI, the HQ view on the Planetary & Helio components of the KEM2 Senior Review proposal were given. Could you state the HQ view on the Astrophysics component. Was it not considered valuable? (Sorry if this is another Lori question)!