NASA ADVISORY COUNCIL

Planetary Sciences Subcommittee

April 4-5, 2013

Teleconference

MEETING MINUTES

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Janet Luhmann, Chair

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Jonathan Rall, Executive Secretary

Table of Contents

Prepared by Elizabeth Sheley
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Thursday, April 4, 2013

Welcome, Agenda, Announcements

The Planetary Science Subcommittee (PSS) of the NASA Advisory Committee (NAC) met via teleconference on April 4 and 5, 2013. Dr. Jonathan Rall, Executive Secretary of PSS, asked participants to identify themselves and their affiliations.

Introductions

Dr. Janet Luhmann, PSS Chair, asked the PSS members to introduce themselves and provide a brief summary of their experience.

Planetary Science Division (PSD) Status Update

Dr. Jim Green, Planetary Science Division (PSD) Director, began the update by noting that while Congress had recently passed the Fiscal Year 2013 (FY13) budget, the President's FY14 budget had not yet been delivered to Congress.

Budget and associated issues

Dr. Green explained the state of the NASA, Science Mission Directorate (SMD), and PSD budgets as of the meeting date. The FY13 budget was funded through a Continuing Resolution (CR) signed on March 26, initially giving $17.8 billion to NASA, with $5.1 billion allocated to SMD. However, with a government-wide rescission of about 2 percent, NASA will have to return some unspent money. Combined with another 5 percent reduction due to sequestration, NASA is left with a de facto budget of $16.6 billion, and SMD has $4.8 billion. NASA was still awaiting guidance on the full impact of the rescission and the sequestration.

The impact of sequestration has been a concern to many NASA stakeholders. The Agency has reduced training and travel, canceled or reduced conference participation, and curtailed new Education/Public Outreach (E/PO) activities. There are no plans for NASA to furlough employees or change its hiring policy, however. The Agency is in the process of developing guidelines for implementing these changes, some of which required clarification. The travel restrictions do apply to PSD.

SMD will respond to the impacts once they are fully known. Reductions will be absorbed primarily out of savings from several recent missions launching under the current budget, but this will not apply to all divisions. There is no anticipated impact to ongoing projects or the workforce supporting them.

Travel restrictions apply only to civil servants, the Jet Propulsion Lab (JPL), and contractors, to the extent that NASA requires or directs conference participation. The restrictions do not apply to NASA grant and cooperative agreement recipients or sub-recipients, nor do they apply to NASA contractors and subcontractors (other than JPL) that use non-NASA funds. Travel related to performance on contracts, grants, and cooperative agreements should continue. Those not told by their contracting officer or grants officer that travel is restricted are allowed to travel. The contracting officers and grants officers can provide further guidance.

Congress provided PSD with a budget of $1,415 million, an increase from FY12. The breakdown follows:

- Planetary Science Research: $192 million
- Discovery: $244 million
- New Frontiers: $175 million
- Mars: $450.8 million
- Outer Planets: $159 million

Of the Outer Planets portion, $75 million was designated to be used for the Europa mission, as laid out by the most recent Decadal Survey (DS).

These amounts do not account for the impending 2 percent rescission and 5 percent sequestration reduction. It is not clear how NASA will implement these cuts. Certain activities in NASA are considered high-priority elements and will take no reductions. PSD is not on that list of high-priority programs. Therefore, the Division will absorb some cuts. When NASA does decide how to allocate the reductions, the resulting budget will be sent by the White House and the Office of Management and Budget (OMB). OMB will then pass along the revised budget to Congress, which presumably will approve it as the budget for the rest of this year. The good news is that Congress values planetary science. No other part of NASA's portfolio received this kind of increase, only PSD.

Dr. Green was not at liberty to discuss the President's FY14 budget, as it was not due to be released until the following week.

Missions

Dr. Green next presented a graphic overview of current missions, noting which are being done in collaboration with the European Space Agency (ESA) and which are in extended operations.

The next scheduled launch is of the Lunar Atmosphere and Dust Environment Explorer (LADEE), which will measure lofted lunar dust and the composition of the thin lunar atmosphere. Science instruments include the Neutral Mass Spectrometer (NMS), Ultraviolet Spectrometer (UVS), and Lunar Dust Experiment (LDEX). LADEE will also include a laser communications technology demonstration . The projected launch from Wallops Island will occur in August or September, depending on scheduling at Wallops. This will be the first lunar mission to go up from Wallops.

The Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) is in Phase B formulation, with launch planned for 2016. This mission will visit asteroid (101955) 1999 RQ36 in October 2019. The Mars Atmosphere and Volatile Evolution (MAVEN) mission will launch in November 2013. This is a critical mission from the DS that will look at the Mars atmosphere's interaction with solar wind. The mission is on budget and on time.

The Interior Structure from Seismic Investigations, Geodesy and Heat Transport (InSight) mission is in Phase B, with its conformation slated for this fiscal year. If confirmed, the mission will look at the structure and geological activities of Mars.

NASA is a minor partner on ESA's Jupiter Icy Moons Explorer (JUICE) mission, which will launch in 2022. JUICE will first orbit Jupiter for about 2.5 years, providing 13 flybys of Callisto and 2 of Europa, and then will orbit Ganymede for 9 months. Jupiter arrival will occur in 2030, Ganymede orbit insertion in 2032, and Ganymede impact in 2033. NASA is contributing up to $100 million and has competitively selected an ultraviolet spectrometer instrument (PI Randy Gladstone) for inclusion. The Agency will also fund contributions to the Radar for Icy Moon Exploration (RIME) and Particle Environment Package (PEP).

PSD has been studying the Europa Clipper mission for some time. With the recent funding, the Division will continue Clipper preformulation activities, preliminary design, and risk reduction. There will be a NASA Research Announcement (NRA) for instrument concepts for Europa Exploration. The instruments must advance Clipper science objectives, and there may be 10 to 15 selections for a 1-year grant of $.75-1 million.

Comet observations

Dr. Green noted that the Comet ISON will travel very close to Mars on October 4, 2013. Prior to that, it will travel close to the sun. The hope is that ISON will make it through the solar transit intact, but if it is broken up, the pieces can be observed. It flies over the Earth's northern hemisphere in the winter.

PSD is assessing the potential of conducting planetary science from a stratospheric balloon, and is looking at an opportunity to observe Comet ISON through an Astrophysics Division (APD) balloon. Balloons are cost-effective, and new technology developments have made them more attractive for planetary work.

There is a new comet, Comet 2013 A1, which cuts through Mars' orbit, coming very close to the planet, within about 53,000 kilometers. Mars could pass through the comet's tail, resulting in some material on the ground at Mars. ESA's Rosetta mission will arrive at Comet Churyumov–Gerasimenko (Comet CG) in August 2014 and spend 2 years at the comet, with a lander visiting the nucleus.

Other programs
PSS has discussed the Research and Analysis (R&A) management principles, which PSD is continuing to implement. The program officers have funding targets, and the awards are selected 1 month after the review panels meet. PSD will be able to select a set of proposals now that there is a budget, though the impending cuts remain an issue. It is unlikely that R&A will be able to maintain its budget without a reduction.

The Solar System Exploration Research Virtual Institute (SSERVI) builds on the success of the NASA Lunar Science Institute (NLSI) to include all near-term targets for human exploration. SSERVI expects to select seven teams at $1-1.5 million for 5 years, with selections in a 2 to 3 year cadence. This project involves substantial collaboration between SMD and the Human Exploration and Operations Mission Directorate (HEOMD). HEOMD has identified strategic knowledge gaps that SMD can address. The focus is on planetary and exploration science, along with astrophysics and heliophysics research. The Cooperative Agreement Notice (CAN) was released in January, the panel review will occur in late July, and teams will be announced in October.

The Astrobiology program has grown out of the NASA Astrobiology Institute, and includes R&A and technology development. Dr. Green discussed the history of the Astrobiology Institute "nodes," which are organizations housing the research. There will be a call for new nodes soon. Astrobiology funding was cut in 2007, but is finally back to where it had been.

PSD is working to identify the next Advanced Stirling Radioisotope Generator (ASRG) mission. Two ASRG flight units will be completed in 2016. At the same time, PU-238 demonstration activities are going quite well, and it is hoped that there will be a baseline program by the end of the year.

Discussion
Dr. Luhmann noted that the rumor mill on sequestration has created a lot of uncertainty, and asked Dr. Green to give more detail, especially regarding R&A. He replied that planetary science is not a high priority with the Obama Administration despite tremendous support from Congress. NASA has higher priority programs that will not be cut, and therefore compensating cuts will come from lower priority programs like PSD. He could not yet say what the percentage would be. All he could do was to note that the program would be reduced below what Congress provided. An operations plan to be issued by OMB would eventually go to Congress, which would then see how the cuts are implemented. He added that Dr. Rall would provide an update on the R&A program, which might have to take some reductions.

Dr. David Draper expressed concern about the travel and E/PO reductions, pointing out that this is not a big expense that has much effect on the budget. Dr. Green explained that this is a general policy of the

Administration, and that the cutbacks in travel could be done quickly. NASA is not being singled out in this area. Many other agencies must implement employee furloughs, on the other hand, while NASA will be able to avoid them. NASA is focusing more attention on its travel and doing more due diligence in assuring Congress and the White House that the people attending meetings and conferences do indeed need to be there. There is a set of guidelines, and waivers are required for modification to those guidelines. For the Lunar and Planetary Science Conference (LPSC), the Division obtained waivers, and almost everyone who needed to go received the opportunity to attend. PSD is following a similar procedure for the American Astronomical Society (AAS) Division of Planetary Science (DPS) meeting.

As for holding meetings, there has been a lot of discussion about whether to hold the July lunar forum in person or do it virtually. PSD has never done a virtual meeting with 500 to 600 attendees, but until it is done and lessons are learned from it, the Division will not be able to state definitively whether a virtual meeting is a good idea or a bad idea. Should the lunar forum be done virtually, NASA will document what does and does not work, which will set the tone for future meetings.

There is a separate authorization required to have a meeting. This process was put in place to ensure the due diligence that some other agencies did not do in holding meetings that received national attention. NASA falls under the same rules as those agencies and must show that each meeting is necessary, with proper use of funds.

The FY13 budget passed by Congress includes $75 million to support preformulation activities for Europa. PSD has been working with JPL to make as much substantive progress as possible in anticipation of a new start for Europa. To have a new start for any strategic mission, moving from the funded preformulation to formulation phase, PSD must receive approval from the NASA Administration, the White House, and OMB, plus Congressional allocation of funds. The funding for Europa was not expected, and the appropriate parties must have time to react and see whether or not there will be a new start for Europa.

Everything in that bill will have to take a rescission and sequestration reduction. NASA has a percentage by which it must reduce, and is now distributing those reductions through the Agency. Because the total percentage reduction is at the Agency level and some elements are protected, NASA must determine where else to cut, taking a higher percentage from lower priority programs. PSD is not protected or high priority and is in the process of working out the cuts, which should be known within a month. This will affect the Division, and what is done in FY13 will affect activities in FY14. Nonetheless, Dr. Green is still hopeful about moving Discovery up from 2015 to 2014 and is doing everything he can to make that happen. The cuts will affect that, but this remains an important goal of his. Dr. Green advised the PSS members to take a look at the President's FY14 budget once it is released, and to consider having a teleconference shortly thereafter.

Dr. Nancy Chanover asked for more details about the balloon flights. Dr. Green explained that this is an exciting opportunity to do science at a relatively low cost, providing a good capability for the science community. There might be as many as 40 DS questions that PSD could answer through balloons, and the Division could address many of them in time to inform the next DS. He would like to solicit more balloon proposals, which could offer opportunities to graduate students. It is an area that is just ripe for PSD to invest in and reap benefits.

Currently, the sounding rockets come out of the Heliophysics Division (HPD) and the balloons come out of the Astrophysics Division (APD). Those divisions receive funds for infrastructure that PSD can use, and APD just obtained an increase in that area. PSD's costs are minimal compared to the infrastructure expenses. There is a proposal for a Comet ISON sounding rocket launch in November, 2013. For the ISON observation balloon proposals, PSD is working with the Applied Physics Laboratory (APL) and the

Southwest Research Institute on a payload for ISON, using an existing gondola from HPD. Based on its success, PSD may select from the next set of balloon flights, and the next call will allow proposals for that.

Dr. Jessica Sunshine asked about a new program within ASRG called M1. Dr. Green explained that M1 is not a mission that flies. Rather, it is a construct to be able to get ready for a mission, and it puts more engineering units in operation. There are no new funds involved, but it allows PSD to set up how to move forward with ASRGs in anticipation of the future. It is a Design Reference Mission (DRM).

Dr. Louise Prockter asked if moving the next Discovery mission into 2014 would result in the next New Frontiers mission moving into 2016. Dr. Green said that it was possible, and he would like to have a New Frontiers mission in 2015, but this depends on the budgets. He also noted that he wants the planetary community to constantly look at the calls that come out for technology development and propose the technology development they need in order to move forward with planetary science.

Dr. Mark Sykes noted that Dr. Green said several times that he thought that R&A would maintain its budget. Congress added 16 percent, however, and Dr. Sykes asked if Dr. Green expected that to be eliminated, which will happen if R&A drops from its existing level. Dr. Green said that there were some assumptions made that he did not state. NASA has Congressional direction to take a rescission and a sequestration reduction, and Agency management is trying to figure out how that will affect PSD. All elements of the PSD program are on table for that, and the Division is trying to protect what it can. However, there will be reductions because PSD is not a high-priority program. He could not tell them anything about the cuts, other than that they are trying to work around the mandatory $75 million for Europa. There is no direction aside from that. The new element is Europa, which was unexpected; the Division has spent only $2 million on pre-formulation studies. The amounts for Discovery and research in the Congressional budget reflect the DS.

Dr. John Rummel asked whether PSD would receive any funds from a hypothetical effort to send people to asteroids. Dr. Green replied that PSD is working hard to execute the DS, which came out last year. As any new mission concepts come up that the Division can leverage to satisfy DS objectives, PSD will work hard to do that. In answer to another question, Dr. Green said that as yet there had been no thoughts on how to accommodate students and younger scientists at the LPSC.

Dr. Jim Bell asked for an update on commercial exploration possibilities. Dr. Green explained that B612 has started development of a survey mission for Near-Earth Objects (NEOs), and PSD is interested it. There is a Space Act Agreement (SAA) stating NASA's roles and responsibilities for PSD and HEOMD. B612 wants review committees, operational tracking, and data to come into the NASA environment, but overall the NASA role is very hands-off, essentially helping to connect that mission to an existing infrastructure. This is a mission that could be of great importance to NASA in accomplishing its objectives and in opening opportunities for the community. NASA wants B612 to succeed. There are no other commercial SAAs.

The Stand Alone Missions of Opportunity Notices (SALMONs) allow PSD to solicit proposals from the community, an example being the JUICE instruments. HEOMD is also working toward potential opportunities that may come out in SALMON or R&A. As these become more real, PSD wants to get that out to the community.

Dr. Luhmann noted that there is a perception that these opportunities are not open to all comers. She asked where those people interested in cooperative agreements should go. Dr. Green responded that SMD has a future opportunities page that includes solicitations across SMD. He was not sure about HEOMD's

practices, however, and noted that PSD should work with HEOMD to get an announcement out. He said the Division would start that discussion.

Dr. Green also noted that the rescission and sequestration might affect plutonium production. When asked about the status of the extended MESSENGER mission, he said that PSD has received an extended mission proposal that was being evaluated. As yet, there have been no decision on that in part due to the rescission and sequestration, and the mission is continuing operations in the interim. He expects to know more within a month.

Mars Program Status Update

Ms. Lisa May, Lead Program Executive for the Mars Exploration Program, presented highlights and status information on Mars missions.

In the Fall of 2012, the Mars Program Planning Group (MPPG) developed Mars program reformulation options, which were presented at the previous PSS meeting. The Agency has gone forward from there. The Program received special dispensation to announce the Mars 2020 Rover ahead of the FY14 budget release. The Program was also approved to commit to the Mars Organic Molecular Analyzer-Mass Spectrometer (MOMA-MS) as NASA's contribution to the ESA ExoMars Rover in 2018. The Program is funding Electra radios and U.S. co-investigators for ExoMars Trace Gas Orbiter (TGO) in 2016.

The February 2012 Mars Exploration Program Analysis Group (MEPAG) meeting was held virtually. This was a success, though an all-virtual format will not work in all circumstances; the meeting planners should document their successes and failures. NASA is coordinating support for an Indian Space Research Organization (ISRO) mission to Mars. There is an ongoing U.S.-India discussion on civil space cooperative efforts. NASA is coordinating India's mission and the team has been working with the U.S. State Department to provide support that meets their needs and U.S. interests. These are reimbursable agreements. MAVEN takes priority in any conflicts or overlaps. This year, NASA will launch the MAVEN Aeronomy Orbiter. Plans are to launch InSight in 2016.

The Science Definition Team (SDT) for the 2020 Mars rover mission will formulate a detailed mission concept that is traceable to highest-priority, community-vetted scientific goals and objectives, while fitting within available resources and acceptable levels of risk. The SDT report will be essential in formulating the mission science goals and the associated open solicitation that is to be released in Summer 2013. The cost limits come to $100 million, including development and implementation but not surface operations.

The four charter mission objectives that are being worked through include:

- Exploration of an astrobiologically relevant ancient environment on Mars to decipher its geological processes and history;
- Search for potential biosignatures within that geological environment;
- Demonstration of significant technical progress towards the future return of samples to Earth; and,
- Provision of an opportunity for contributed HEOMD or Space Technology Program (STP) participation.

Mars will be in conjunction the entire month of April, and the rovers went into command moratorium the day of the meeting. Curiosity was to perform nominal operations, including environmental monitoring. The orbiters were to enter command moratorium on April 9, with limited over flights of the Rovers. The

orbiters were to go back on April 26, and the rovers on May 1. NASA now has infrastructure on Mars. Curiosity is returning a lot of scientific data via relay orbiters.

Ms. May presented an overview of the Odyssey mission, which is an extended mission through spring 2015. It is performing nominally, and NASA is moving it to a different orbit to help preserve its aging battery. There has been a problem on Reaction Wheel 1. As these missions age, they sometimes come back after being down for a while. NASA does a risk review every 2 years on these assets. Odyssey has completed 50,000 orbits around Mars.

Ms. May noted a project in which students collaborated on a Mars image analysis activity, which won a Science Magazine prize for inquiry-based instruction. NASA is also doing color imaging from the Mars Gale Crater. Broader color coverage provides mineral data that helps inform where Curiosity operates.

The Mars Reconnaissance Orbiter (MRO) is performing nominally. All instruments are on and acquiring data. A Compact Reconnaissance Imaging Spectrometers for Mars (CRISM) limb scan was scheduled to occur soon. Ms. Lisa May showed an image of the Mars Science Laboratory (MSL) parachute, noting that tens of thousands of citizens on Earth classify images of Spring on Mars, looking at images through the Zooniverse project where over 59,000 people have participated.

Next, Ms. May showed Recurring Slope Lineae (RSL) that might indicate potential brine flows. NASA is looking at other warm slopes to see how widespread this is. Opportunity has completed a walkabout, doing contact science at different locations. There were some "amnesia" events in the flash files, but everything seems to be functioning now. The next target for wintering over has good solar opportunities. The Opportunity rover began its tenth year on Mars and recently found some new geological features similar to the "blueberries" discovered previously. Curiosity is operating nominally on Side B.

MAVEN will answer questions about the history of the Martian volatiles and atmosphere, providing information about the nature of planetary habitability. The mission will determine the structure and composition of the Mars upper atmosphere, rates of loss of gas to space today, and the integrated loss to space through time. This should help elucidate the theories on this, and it will be interesting to see what can be correlated with Curiosity data. A key question is where the atmosphere and water went.

MAVEN will go up during a change in solar activity, and might allow investigators to see what the differences in solar activity do to the atmosphere. The spacecraft has a heritage of prior missions at NASA, enabling the team to take advantage of a lot of lessons learned, and facilitating many efficiencies and technical capabilities that have evolved over time. MAVEN is in testing, all payloads have been delivered, it is on track and on budget, and it will be shipped to the launch site in August. The launch period then opens in November, and the mission is expected to arrive at Mars in September 2014. The team has allotted 5 weeks for Mars orbit insertion and transition to the science phase.

Discussion
The plan to observe Comet ISON is not complete, but the MESSENGER team is planning an observation campaign. There are a lot of assets already available to observe ISON. Ms. May was not sure which MAVEN instruments will be turned on when the comet goes by. There will be no changes to the approach plan to make observations. MAVEN has a lot of instruments, and the operations of the spacecraft are more complicated than anticipated. Therefore, the project team is going with a very careful and measured transition plan. Given those concerns, Ms. Lisa May does not advocate for changes. However, if the review board and Principle Investigator (PI) think it is safe to adjust the plan to allow MAVEN to observe ISON, she will not object.

Dr. Luhmann asked for more detail on the Mars 2020 project and what the community might expect regarding opportunities to engage. Ms. Lisa May answered that there was a broad call, the team has been set up, and they are sorting through proposals. The final report will be issued in July. At the same time, NASA is developing an acquisition strategy for the instruments, leading to an Announcement of Opportunity (AO). Those with ideas for contributing payloads should propose, because the current thinking could be revised or refined. She was not aware that HEOMD had an equivalent of a Research Opportunities in Space and Exploration Science (ROSES) announcement.

Ms. Lisa May had no contact name at hand for the Indian mission, but noted that, in regard to planetary protection, compliance with planetary protection protocols is a requirement for NASA involvement. NASA is not collaborating on science with them, in part because ISRO's objectives are primary technical and their science planning is not robust. However, future science collaboration is possible.

Dr. Harold "Hap" McSween brought up the issue of reaction wheels, pointing out that this has been a problem. Odyssey and a number of other spacecraft that have lost reaction wheels before their design lifetimes have come to an end. He saw this as a critical issue. Ms. Lisa May explained that Odyssey was launched 12 years ago, and she was not sure whether the reaction wheel failed before the mission's lifetime was over. NASA does not always use the same vendor for this part and, to be more precise, the Odyssey reaction wheel is not broken but instead sticks in certain circumstances. NASA has regular reviews in which people can learn about issues of different spacecraft. The teams do look across programs and inform each other when issues crop up and systemic workmanship issues occur. Dr. Rall added that reaction wheels receive a lot of attention at these reviews and are discussed at length and in great detail. There are not that many vendors, but the manufacturer has changed at least once, and NASA will continue to review any issues. It may be the nature of the part.

Dr. Barbara Cohen of Marshall Space Flight Center (MFSC) said that she has seen where ISRO is interested in human spaceflight for 2020. In regard to the upcoming instrument selection, a big cost for Curiosity was instrument accommodation and handling. She asked if NASA was considering that aspect first before making selections. Ms. Lisa May said that they had, but the process is not final. There have been discussions about the best way to manage instruments, accommodation, interface, and integration, but there is no standard yet. The team is determining what they can put into the proposal package in order to avoid violating the International Traffic in Arms Regulations (ITAR).

In response to a question about extremophiles carried on a mission destined for Phobos, Dr. John Rummel said that there had been an attempt to get those to Phobos and back, but the mission in question, Phobos Grunt did not make it out of Earth orbit. Both ESA and NASA had concerns about contamination on Mars, but the placement of that container on the spacecraft would have made heat an issue for the viability of the microbes.

Curiosity Update

Dr. John Grotzinger, MSL Project Scientist, began his presentation on the Curiosity rover by noting that everything was going very well with the mission. Curiosity's primary scientific goal is to explore and quantitatively assess a local region on Mars' surface as a potential habitat for life. Dr. Grotzinger showed where Curiosity is in the Gale Crater in relation to Mt. Sharp.

Sample processing is a big issue, as it takes an enormous amount of effort to do it prudently without endangering the Rover. The team was surprised at the complexity of operating it on the Mars surface, and the vehicle still has not demonstrated all of its capabilities, such as using the 1-mm sieve. However, there is no sense that this must be done right away.

Dr. Grotzinger showed a map of where Curiosity has driven. Most interesting was the terrain called "fractured unit," which included a conglomerate that had rounded pebbles of salted composition. These were derived from the crater rim. The mission team decided to follow water down the topographic gradient and found composition similar to alkaline basalts on Earth produced by partial melting of the mantle. The section of ejecta from along the crater rim was consistent with high fractionation. This was also exciting because of its aluminum content. The PIs believe that this likely occurred deep in Mars.

In the Rocknest Scooping Campaign, the mission team sought materials that were coarser than 1 mm from the ripple's surface, and fine sand on the wall and floor of the trench. Dr. Grotzinger showed the results of the Sample Analysis at Mars (SAM) and CheMin analyses of Rocknest. There was no evidence of alteration minerals, and only a hint of sulfate at the 1 percent threshold of detection. The analyses were conducted several times with consistent results. The effort showed that SAM was consistent as well. The isotope ratios from water were also consistent. The thought is that this indicates hydrological processing evidence between the atmosphere and soil.

Curiosity's Rover Environmental Monitoring Station is taking weather readings around the clock daily. The instrument indicates that the ground temperature changes by 90°C (170 degrees Fahrenheit) between day and night, and that overnight, the ground is warmer than the air, with the reverse occurring in the morning before the ground heats up. Pressure sensor data indicate the presence of pressure tides that move around the planet, with pressure increasing later in the day. The curve varies over the course of the seasons. The radiation assessment detector shows daily variation of the radiation dose on the Mars surface, with radiation increasing during the day.

There was concern about whether ChemCam, which measured the spectra of coronation, would even work, but it does. The team was set to have a briefing soon. Mars dust carries a lot of hydrogen no matter what rock is measured. The team is seeing trace amounts of water in the atmosphere and think it is related to what they are picking up in the soil. It is a consistent measurement.

Curiosity is now exploring Yellowknife Bay, the lowest point it could access and the deepest point stratigraphically. The mudstone there is very different from sandstone, and includes a feature called "the snake" that is most likely a sandstone intrusion that squeezed up through the mudstone. This place was rich with varied features. Sheepbed rocks also contain many spherules, suggesting that water percolated through the pores. There is light-toned material cutting across the rock at different angles. Near that in the same bed are raised ridges, to be explored further after conjunction.

Dr. Grotzinger showed photos of some targets studied to prepare for drilling, and the results of brushing. The rock had very low sulfur compared to most of Mars unless the drill hit a vein, when the sulfur content went way up. More photos illustrated the 1.6 cm drill bit, drill and test holes, a scoop of an acquired sample, and the diffraction patterns. The drill powder demonstrates sustained interaction with water.

Major gases were released by the John Klein sample and analyzed by SAM, suggesting a lower degree of oxidation. The John Klein site was probably at the end of an ancient river system or intermittently wet lake bed. Mineralogy indicates sustained interaction with liquid water that was not too acidic, alkaline, or saline. Further, conditions were not strongly oxidizing. Key chemical ingredients for life are present. The presence of minerals in various states or oxidation would provide a source of energy for primitive biology. This meets the mission success criteria

Discussion
Dr. Draper asked about the basalt and the identity of a much finer-grained rock. Dr. Grotzinger said that it was not possible to go low at that texture. The best guess is that it is part of the rock and could be a chill margin from lava.

Dr. Luhmann asked what was next for Curiosity, given that the mission had accomplished its Level 1 goals. Dr. Grotzinger said that the mission will drill another hole, hoping to assess what carries the magnetite seen in ChemCam data. Another possibility is to trap some organics, which would be very difficult and which is complex enough on Earth. It would be foolhardy to commit to finding organics, but the team must be diligent in looking so that they can discuss what they tried, accomplished, and did not accomplish. There should be a background range of biological material. Dr. Grotzinger wants to talk with the team about how to raise the bar, explore for carbon systematically, possibly find something, and summarize the lessons learned. In going to Mt. Sharp, they should be able to review some habitability scenarios.

When asked if anything discovered by Curiosity has led to especially compelling science that should be done on the 2020 mission, Dr. Grotzinger said that there are always opportunities to explore. Curiosity is doing extremely well at Gale Crater. If the mission finds a strong concentration of organics, the 2020 mission might want to sample this region. What is important is the development of early sampling capabilities. While launch and landing are important, NASA is now getting past the "let's get on the ground and see what we can find" phase.

Dr. Luhmann asked if major dust storms or other environmental conditions presented challenges. Dr. Grotzinger said that the anomaly meant a lost opportunity to measure radiation from the solar event. As for dust storms, there are features that look like clear air vortices but are not lofting the dust locally. There was an opacity increase around sol 120, but as yet there have been no severe challenges. Dr. Donald Yeomans asked if the close approach of the comet next year might bring in particles that pose a danger to the mission. Dr. Grotzinger said that a team at JPL is considering those effects.

Dr. McSween brought up the issue of the time that surface operations demand of mission personnel, characterizing it as their biggest challenge. He wondered how long they can keep up the 20-hour days. Dr. Grotzinger replied that this is discussed a lot. The difficulty is that the team loses sols when taking time off. In addition, they set the tolerances quite conservatively. Many small, benign events have required replanning, and there is a great deal of slow checking of functions and verifications before moving up. The need to have ground operations in the loop slows them down. The hope is that when work is done with Yellowknife and John Klein, there can be fewer humans in the loop. In addition, the next sampling operation should be more efficient. The team is headed to increased efficiency with a 7-day operation cycle, and may also bring in more people. A larger workforce could get the mission closer to its goals. In addition, there are areas where increased depth in the engineering team might cover some of what the science team does. For example, the science team does not need to be involved in drilling. In the meantime, they have to view the longer drives as a chance for vacation.

Dr. Christopher House asked about the plan for outcrops and ridges. Dr. Grotzinger said that Curiosity is currently parked right over a drill site and might be moving up to a meter to sample materials. Drilling takes 3 weeks each time, so it is important to figure out the best use of time and effort.

In answer to another question, Dr. Grotzinger said that the radiation instrument can distinguish between what is coming from the ground versus the atmosphere. Comparisons with other data allow the team to compare spectra. The MAVEN mission will allow for further collaborative measurements. Dr. Luhmann asked if MSL will travel far enough to see sufficient variation in radiation and shielding. Dr. Grotzinger was not certain, but noted that the eventual course will take the mission 10 km toward Mt. Sharp. It is not clear whether that is far enough.

As for back-up issues, the mission team sought some measurements before going into conjunction, and wanted to have the A side prepped for the B side in case something happened during conjunction. There

is a corruption problem on the A side, and the team is still assessing the root cause. The good news is that they know where the corruption is and how to map around it; they do not need to write to that flash bank and can use the lower bank as a functional back-up. Meanwhile, the B side got a patch that will prevent a sudden problem like what occurred with the A side. The team found that there is an issue with turning things on and cascading.

R&A Update

Dr. Rall, the lead for PSD's R&A program, provided an update on ROSES submission data over a period of years. There is no significant difference in the selection rate for Centers and non-centers for SMD. However, when the data are broken out for PSD, the Center win rate is lower than that for non-centers, which tracks closely to the overall selection rate. PSD receives about 1,300 proposals annually.

Dr. Rall next showed data for individual programs, with the following highlights:

- Cassini: The number of proposals submitted is increasing over time, with a corresponding drop in the acceptance rate and the rate of new PIs funded. The average award size is relatively stable, at about $94,000 for Year 1 of a proposal.
- Outer planets: The trend is an increasing number of proposals with a stable selection rate and average award size ranges of about $80,000-115,000.
- Cosmochemistry: As both the submission rate and average awards go up, the selection rate is dropping.
- Planetary geology: Unlike the higher submission rates/lower acceptance rates combination seen in some programs, there is no obvious pattern for this program, as the number of proposals has increased while the selection rate has not changed. Dr. Max Bernstein noted that average award duration can affect some of these comparisons.
- Planetary atmospheres: The proposal rate is up, while the selection rate is down. The average award has increased to around $115,000.
- Planetary astronomy: There has been a lot of variation in award size, and the selection rates are low, below 20 percent, although some ROSES 12 numbers are not final. One issue here is that planetary astronomy funds NASA's Infrared Telescope Facility (IRTF), which is going from a grant to a contract basis. It is not certain what the impact of that change will be.
- Mars data analysis: The award size has been increasing, while the proposal rate is higher and the selection rate is lower, though it was still about 30 percent for 2012. Those awards were only announced recently.
- Mars fundamental research: The selection rate is up slightly for 2012.
- Moon and Mars analog mission activities: The proposal rate is stable, but the award size is much larger. This is a relatively small program.
- Near Earth object observations: The data are all over the place, making it hard to find a pattern.
- PSD instrument definition and development: This is always heavily subscribed and hardware-intensive, and the award size continues to grow. It has a low selection rate. The 2012 award announcements were impending.
- Planetary protection: While the budget stays flat, the other numbers show no pattern.
- Exobiology: The number of proposals is increasing, but the selection rate has not kept pace. There is a wide variation in award size, from $100,000 to $350,000.
- Sample Return Laboratory Analysis/Laboratory Analysis of Returned Samples: The data seem to be converging.
- Origins of Solar Systems: The award size has gone up, but so far this year PSD has only partly funded those proposals that were selected.

Dr. Rall added that PSD considers 30-35 percent to be a healthy selection rate. Few programs achieved that, however.

Discussion
Dr. Bernstein said that he was not sure why the Center selection rate is lower in Planetary Science, because overall the opposite is true for the other divisions such as the Earth Science Division (ESD). His personal opinion, not representing the Agency, is that some earth science researchers may have other funding sources, and that it is possible that more of them are tenured. By contrast, planetary scientists might not have other funding sources, while they also rely more on "soft" money. The Centers also have nowhere else to go. Another meeting participant said that Dr. Bernstein's impression has been confirmed in a survey.

Dr. Julie Castillo-Rogez asked for more explanation of the R&A funding that is not competed. Dr. Rall explained that IRTF consumes about $5 million per year of infrastructure costs, but it comes from the PSD R&A budget. There are other items like this, and together, they amount to a lot of money. Many of their costs will grow over time, taking more and more of the R&A budget. There is talk about pulling these mission support activities out of the R&A line and creating a separate line that would allow R&A to be just for competed projects. Astromaterials curation is an example, as it has a separate line and will not disappear. He would like to see it in another group. There is talk of having a senior review for this sort of activity. The functions are so different that they are hard to compare, however, so having them in the same review is not constructive.

Dr. Bernstein said that he could only do so much in regard to the rescission and sequestration. He is very concerned about those programs that have not yet made all of their selections or distributed their funds, because they are more vulnerable to cuts, resulting in a chronological disparity that has a negative impact on the programs that have later deadlines. The existing awards and the potential cuts later in the year might not represent the best balance. ROSES 13 is out, but there are still ROSES 12 due dates pending. There might be nothing left for the late funders.

Dr. Rall agreed that this disadvantage should not exist, but ROSES could not have a single due date with review panels happening all at once. That would be chaotic, if not impossible. This is another topic to discuss, how to avoid disadvantaging some programs that are late in the year. Dr. Luhmann asked if the affected communities could be informed about this. Dr. Christina Richey said that PSD would rather they repropose. Dr. Rall added that PSD can always un-decline.

There was additional discussion of the budget Congress just passed, with Dr. Rall cautioning against reading too much into it. He noted that Dr. Green is not sure that those numbers can be sustained in light of the rescission and sequestration. Dr. Prockter asked if the individuals receiving early career fellowships were being tracked. They are, and Dr. Rall said that they relate to the R&A program through many program elements that clearly identify early career fellows.

Dr. Sykes asked for a comparison with the funding support of R&A in APD, which has a much better performance, reflecting a policy difference. Dr. Bernstein said that there are indeed differences between the divisions, including the enthusiasm and advocacy of their respective directors. There are other differences, however. APD has fewer calls, for example.

Dr. Sykes observed that the programs with the lower selection rates often have budgets with a downward trend. The decline is noteworthy, sometimes 40 percent, and the decline in selection rates reflects that. He did not know of an effort to examine the programs individually and determine whether they should grow or decline. Dr. Rall agreed, noting that R&A does not receive what he believes is necessary for a healthy

program, despite discussions with the division director. Historically, Dr. Green has found ways to scrape up extra funds for R&A, but it is no longer so easy. OMB and Congress are also involved. The only way to make this better is to treat R&A similar to missions, establishing guidelines and setting aside reserves, which R&A does not have. It would help to remove the facilities, as well.

Dr. Bernstein added that the total cost of proposals must be paid from the program, regardless of whether or not a civil servant is involved. Dr. Rall noted that redacted budgets only lead to confusion. The union that covers NASA scientists says that salary data cannot be divulged. Some proposers always forget to cover the salaries, however. He would prefer to redact all salaries rather than just some of them. The salaries come out of program budgets. There are talks about how to pay the scientists, and all options are on the table. Scientists at centers should not have to compete for their salaries. If the civil servant salaries could come out of the budgets, it would reduce problems.

Dr. Sunshine asked how PSS might help. She thought it might empower the Subcommittee if the members knew what each program needed to reach modest health. Dr. Rall said that he would think about how to be more transparent so that PSS might evaluate the elements for each program. Dr. Bernstein agreed, noting that it would be easy to determine what it would have cost to have the selection rate be higher in previous calls. This comment was followed by a discussion of average award sizes for the various programs.

Dr. Lori Glaze pointed out that a key is the increasing number of proposals, and wondered if there might be a way to consolidate them. Dr. Michael New said that a survey conducted last year showed that 70-90 percent of investigators submitted three or fewer proposals, though Dr. Bernstein noted that that does not count co-investigators. There are no data on funding of full-time employees, either. Dr. New added that faculty often have restrictions on what they can do. Dr. Bernstein said that some of the technology programs encourage investigators to apply to one program or another but not both of two with the same due date. APD has identical due dates in order to avoid multiple submissions. Dr. Rall suggested that this topic be revisited later.

<u>JUICE</u>

Ms. Joan Salute, Lunar Quest Program Executive, explained that JUICE is ESA's first large-class mission in its Cosmic Vision program. The mission will launch in 2022 and end in 2033-34. NASA is contributing $100 million over the life of the program. Ms. Salute showed the payload model ESA developed, which includes 11 instruments. The instruments were announced on February 21, 2013, but team membership is changing, something that ESA allows, unlike NASA. The United States is providing the UVS, and contributing to the radar, and PEP instrument suite.. ESA has an aggressive schedule, with two different contractors to build the spacecraft and a down-selection planned for next year. NASA has not yet determined how to select additional co-investigators for the remaining eight instruments. The budget is an issue, and there is a need to develop a process.

Ms. Salute shows an organization chart for the mission, noting that many of those involved have experience on Heritage. Similarly, the U.S. team for RIME has strong Mars experience. PEP has six different instruments, two of which come from the United States. This is an outer planets program, but NASA is operating it through the New Frontiers program at the Marshall Space Flight Center (MSFC).

Discussion

Decisions on team members will be made within a few weeks, at which point the funding will be known. Once a process has been agreed upon, it will take about another 4 to 6 weeks.

Dr. Luhmann asked if there were any issues related to ITAR. Ms. Salute replied that some of the information NASA wanted to share is delayed due to ITAR requirements. ESA accommodated this previously by limiting its review staff for proposals. In answer to another question, Ms. Salute explained that most proposals included plans for early career scientists, at least in terms of populating the team as the years progress. NASA and ESA are aware of the need for succession planning throughout the mission, since it is so long.

Strategic Plan Briefing

Mr. Dan Woods, Director of the Strategic Integration and Management Division (SI&MD), talked with PSS about crafting the 2014 SMD Science Plan. This is a long process that takes almost a year. NASA is currently operating from the 2010 Plan and is required to provide an update every 4 years. The proposed contents will follow the layout of the 2010 Plan. The structure includes an introduction, national agenda for science at NASA, plan for science at frontiers, detailed plans by science area, and appendices. Within the plan for science at frontiers, the plan discusses principles, strategies, and challenges. Dr. Rall will be on the committee developing the 2014 Plan.

The Plan will put more emphasis on the Decadal Surveys this time, but otherwise will hold to the previous principles. The team is now visiting all of the advisory subcommittees for input and guidance. A new strategy is to design and successfully implement programs that accomplish creative science and applications. The 2010 report included six challenges; the committee has not yet identified the challenges for the 2014 Plan.

Within the Planetary chapter, there will be discussion of strategic and program elements, currently operating missions, missions in development, and future missions. There is a tight schedule to get this through reviews, and the goal is to have a first draft by June 1.

Questions identified thus far include:

- Will a document so structured serve SMD needs?
- Do sections 1-3 provide an adequate foundation for science areas?
- Are the principles, strategies, and challenges complete?
- Does the standard science chapter outline meet Division needs to communicate objectives, challenges, etc.?

There are strategic objectives for each division, as well as science goals. Strategic goals cannot be changed. They are:

- Space: expand frontiers of knowledge, capabilities, and opportunities in space;
- Understand our home planet and improve life on it; and,
- Agency excellence to serve the American public and science community worldwide.

The strategic objectives and goals for PSD have been cleared. The committee now wants PSS comments. Over the next month, Dr. Rall will write the chapter for PSD, with the goal of starting reviews in June or July. The document will go to the National Research Council (NRC) for review in August. After that, OMB clearance will be necessary. NASA hopes to release the Plan in mid-February 2014.

The SMD strategic objective for PSD is to ascertain the content, origin, and evolution of the solar system, and its potential for life on other planets. Dr. Rall listed the PSD performance goals, which grew out of the 2010 Science Plan:

1. Advance understanding of the formation of the Sun's family of planets, moons, and minor bodies.

2. Advance understanding of how the chemical and physical processes in our Solar System operate, interact, and evolve.
3. Advance understanding of the conditions capable of sustaining life beyond Earth.
4. Advance the understanding of the origins and evolution of life here to guide our search for life elsewhere.
5. Identify and characterize planetary objects and environments that pose threats to or offer potential resources for humans as we expand our presence into the solar system.

The committee would like PSS concurrence and any suggestions for changes. The first three goals reflect the DS, and all stem from the 2010 Science Plan.

Discussion
Dr. McSween observed that some of what NASA is already funding was left out, specifically the study of pre-solar materials synthesized and brought into the solar system, which is increasingly important. It was noted that these materials are modified once they enter our Solar System, an overlap with astrophysics.

It was generally agreed that the third and fourth goals overlapped and should be combined, though it was also agreed that PSS members needed time to think more deeply. Dr. Green suggested that they resume discussion the next day. It was agreed that Dr. Rall would email the draft goals to the members along with the link to the 2010 Plan. Mr. Woods offered to return the next day.

Subcommittee Discussion
With an hour left on the agenda, Dr. Luhmann opened the meeting for discussion. Dr. Prockter asked for clarification on membership of the Analysis Groups (AGs) and NAC science subcommittees. Dr. Rall explained that AG chairs had previously also served on the subcommittees. Now the chairs are being appointed separately, and the overlap is no longer a given. Of the six new PSS members, two will be AG chairs and the rest will not. However, PSS will invite the AG chairs to participate in meetings. Dr. Prockter stated that it would be good to be consistent, that is, either have all the chairs participate on the NASA PSS or none of them.

Dr. Luhmann adjourned the meeting for the day at 4:33 p.m.

Friday, April 5, 2013

Agenda Updates and Announcements
Dr. Luhmann welcomed PSS to the second day of the meeting, which was scheduled for half of the day but had the possibility of running longer. Not on the agenda was the discussion of findings, along with a 30-minute presentation from Dr. Larry Smarr on science data centers.

Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM) Report
Dr. Jeff Grossman, who manages NASA Headquarters activities on sample-related science, gave the CAPTEM report, beginning with a review of the organizational structure. There are five allocation subcommittees: Lunar, Stardust, Genesis, Cosmic Dust, and Hayabusa. There is also a Facilities Subcommittee, and CAPTEM just added a new Informatics Subcommittee. CAPTEM last met on March 23-24, 2013, and is considering a virtual meeting in the fall.

Dr. Grossman showed the recent sample allocations among the five allocation subcommittees. CAPTEM has been discussing inclusion of the Meteorite Working Group (MWG). The Antarctic meteorite collection has been managed by NASA, the National Science Foundation (NSF), and the Smithsonian Institution. NSF wants to renegotiate the arrangement, and CAPTEM is therefore discussing how to include MWG as a subcommittee with its unique functions of the Antarctic collection and the three agencies. The first joint meeting is likely in the fall.

CAPTEM established an ad hoc Informatics Subcommittee, replacing a task force, to look at interfaces with the public. This aligns with White House Office of Science and Technology Policy (OSTP) memos asking NASA to make this information more available. CAPTEM also recently took part in a task force looking at drilling for the greatest science return.

New initiatives include:

- A workshop on the Dawn mission to Vesta;
- A Stardust Crystal Mountain II workshop in 2014; and
- A special session on extraterrestrial materials curation for a meeting of the Meteoritical Society, providing that the sequestration allows the related travel.

CAPTEM plans to have an OSIRIS-REX subcommittee once there are samples to curate. Last year, the Office of the Inspector General (OIG) audit of NASA's control of astromaterials resulted in new loan agreements for all of the collections. CAPTEM received a briefing from the Johnson Space Center (JSC) on looking at organic contamination issues.

The Lunar Subcommittee has the new loan agreements in place, and the curator is exploring Computer-Aided Tomography (CAT) scans of breccias to locate clasts of great interest to the community. The Subcommittee also has a new website. For the Stardust Subcommittee, about one-quarter of the trays have been allocated and 78 interstellar cells have been scanned, which is about half.

Members of the Genesis Subcommittee recently determined how to cleave the diamond-on-silicon concentrator target. All 20 measurement objectives of the mission are now deemed possible, and some new measurements are being considered. The Cosmic Dust Subcommittee continues with collection activities and has succeeded in its attempts to get comet stream encounters, which come from bursts of comet activities. There is a new cosmic dust guidebook. Dr. Grossman noted that eventually all of the collections will have guidebooks for investigators.

The Hayabusa Subcommittee has experienced some issues. According to the Memorandum of Understanding (MOU) with the Japanese Space Agency (JAXA), NASA is to receive 10 percent of the samples, which would be about 1,500 particles at this point. However, NASA has received only 25 samples because JAXA characterizes all of its samples before sending them out, creating great delays. CAPTEM has sent JAXA a letter asking that uncharacterized samples be sent to NASA.

Dr. Grossman next presented science highlights, listing some papers and reports published on interplanetary dust particles and carbonaceous morphologies, zinc isotopes in lunar rocks, isotopic mass fractionation of solar wind, the lack of presolar grains in Stardust materials, and an unusual Martian meteorite that could reveal the fate of water on Mars.

Current issues of concern include the following:

- The impact of sequestration on curation and E/PO;
- The impact of projected delays in the next Discovery and New Frontiers AOs;
- A smooth transition to WebEx for alternate CAPTEM meetings; and

- Renegotiation of the NSF/NASA/Smithsonian agreement on the Antarctic meteorite collection, curation, and allocation. NSF is backing out of primary funding of the PI and the MWG, so CAPTEM is concerned about NSF's role.

Discussion
Dr. Lisa Gaddis sought more information about why NSF was cutting back on the Antarctic meteorite collection project. Dr. Grossman did not know definitively, but had heard that NSF management perceives that the project benefits largely come to NASA for its research programs, as NASA does most of the meteorite research. In addition, the agreement is 30 years old, out of date, and being ignored, so NSF would like to regularize it. Finally, with the government-wide funding pressure, NSF wants to see NASA support a project that NSF sees as belonging to the Agency.

Dr. Luhmann asked if the Antarctic meteorite collection is being affected by climate issues. Dr. Grossman replied that this is a possibility. The collections are required to be kept under ambient conditions to prevent organic contamination, and rising temperatures might change the ambient conditions, affecting the nature of the samples. It was suggested that while there are currently no citizen scientist opportunities, this might be an interesting direction if E/PO recovers funding.

Dr. Grossman explained that the 2010 OSTP memo told agencies to make as much data available online as possible. The data are not in the Planetary Data System (PDS), but are archived on the astrocuration website. Dr. Luhmann noted that the longevity of those archives depend on the individual organizations supporting them.

Dr. William McKinnon said that he had been told that weather patterns in the Antarctic have caused more snowfall in collection areas, and the project must collect what is revealed, not what is under snow. Dr. Grossman agreed that that has been a problem.

<u>Outer Planets Assessment Group (OPAG) Report</u>
Dr. McKinnon presented the OPAG update. The Group met January 10 and 11 in Atlanta, where the members heard the final report from the Europa SDT. The Europa mission was a DS recommendation, and OPAG discussed other DS recommendations extensively. The meeting also developed eight findings.

The Outer Planets Program appears to be in good shape. Cassini is operating well at Saturn, and New Horizons and Juno are en route to their targets. The looming dark cloud is that outer Solar System exploration has long timelines, and those are in jeopardy. There is still no plan to follow up on Galileo and Cassini, for example. In the DS, the highest non-Mars priority was a mission to explore Europa. At the close of 2017, both the Cassini and Juno missions will have burned up at end of their missions, Voyager will be past Pluto, and no spacecraft will operate at the giant planets and their satellites for 13 years. NASA will cede its leadership in outer planet exploration. The fiscal situation affects this, but if austerity is policy, it will be difficult to resume outer planet exploration.

The Europa mission concept that has emerged is a Clipper, at a cost of $2 billion amortized over a 20-year lifetime. It is a multiple fly-by mission. A tremendous opportunity now presents itself, and NASA must recognize this. OPAG believes that NASA must seize this opportunity to maintain leadership.

Dr. McKinnon next presented the findings:

1. Europa Clipper: "OPAG strongly encourages NASA to recognize this opportunity and begin work on the Europa Clipper. OPAG wishes to be informed at the earliest opportunity of NASA's plans for the monies appropriated by Congress for Europa mission formulation and/or pre-formulation

activities. Further, OPAG wishes to be informed at the earliest opportunity of NASA's long-range plan for formulating the Europa mission described in the FY13 budget law."

2. Cassini extended mission: "OPAG continues to strongly urge that NASA fund Cassini at the level required to safely operate the spacecraft and to obtain and analyze the data necessary to accomplish the science objectives of the entire Cassini Solstice Mission." Dr. McKinnon noted that a senior review endorsed the entire Cassini mission. The notional portion, which has not yet been funded, is of very high value.
3. NASA participation in JUICE: "OPAG strongly endorses NASA's stated support of $100M for ESA's JUICE mission. Given the long-term nature of this (and other) Outer Planets missions, OPAG urges NASA to consider measures in the years ahead that will allow for greater participation in JUICE by younger U.S. scientists — some of whom may only be in grade school at the present time! Given the lifetime of the JUICE mission, the budgetary strictures of today may not be applicable years hence."
4. New Frontiers program opportunities: "Given ongoing uncertainties in the planetary budget, and the possibility that budgets will be reduced in the future by ongoing sequestration, OPAG suggests that NASA ask the NRC Committee on Astrobiology and Planetary Science (CAPS) to advance a midterm consideration." There is concern that there may only be one New Frontiers opportunity in the decade covered by the survey, and not the two mission opportunities the DS recommended.
5. Discovery in the outer solar system: "OPAG suggests NASA begin working to assess lessons learned from the recent past AO experiences and begin considering appropriate adjustments to the next Discovery AO. OPAG for its part has convened a working group to submit recommendations to NASA along these lines."
6. Pu-238 restart: "OPAG strongly supports PSD efforts to have the Department of Energy (DOE_ restart Pu-238 production with funds appropriated by Congress. OPAG further supports making ASRGs available in the next Discovery and New Frontiers calls."
7. Thermal protection systems for outer planet probes: "OPAG particularly encourages NASA to incentivize the adoption of entry-probe technologies needed for Outer Planet missions including instrumentation to monitor the performance of the thermal protection systems."
8. Technology for outer planets: "OPAG encourages PSD to work with the Space Technology Mission Directorate (STMD) and with Space Communications and Navigation to advocate for Outer Planet technology development under their auspices."

Ground-based measurements indicate that there is spectral evidence for an ocean on Europa, with hydrated magnesium chloride and sulfates detected on the trailing hemisphere. Such an ocean may be less oxidized than commonly assumed. Spectroscopists are busy confirming or refuting these data. In addition, it is now known that the north pole of Saturn is a cyclonic vortex.

Discussion

Dr. House asked for more information about efforts to study the ice giants. Dr. McKinnon said that it is difficult to reach them, so there is no ice giant mission on the New Frontiers list. In the DS, the third-ranked large mission would be to an ice giant, after Mars and Europa. Both of the latter are responsive to the DS and fiscally responsible. If those missions could move forward, an ice giant would be the next in the queue. There is a working group in OPAG looking at whether there are other ways to explore the ice giants. In Europe, they are looking at whether the next M-class mission could go to an ice giant. The ice giants have not been forgotten.

<u>Lunar Exploration Analysis Group (LEAG) Report</u>

Dr. Jeff Plescia discussed the recent activities of LEAG. There may be some additional members invited to join the LEAG executive committee, in part to better represent the particle and fields communities.

LEAG held its annual meeting at the Goddard Space Flight Center (GSFC) on October 22-24, 2012, with about 120 attendees and 60 abstracts. Participants learned about Chinese and Russian plans to visit the Moon, strategic knowledge gaps, and more. The next meeting will be in October 2013 at the Johns Hopkins University Applied Physics Lab (APL).

LEAG identified Strategic Knowledge Gaps related to lunar exploration scenarios, which were sent to Dr. Michael Wargo, HEOMD's Chief Exploration Scientist. A Drilling Advisory Group cutting across LEAG, CAPTEM, and the Small Bodies Assessment Group (SBAG), developed a list of planetary drilling applications at the request of Dr. New.

A workshop on the lunar highlands crust was held in conjunction with CAPTEM, the Lunar and Planetary Institute (LPI), and NLSI on July 13-15, 2012, in Bozeman, Montana, with about 50 abstracts. There is now more uniform data from both sides of the Moon, providing a global picture of the moon in detail. Upcoming workshops will address small lunar missions, human lunar mission scientific planning, and an update of the lunar roadmap. LEAG hopes to develop a better feel for what lunar missions would require, what science would be done and why, the timelines, and other elements.

General issues include that LEAG is concerned about funding and the future of LASER, given that LADEE will launch soon. A lot of data are in from the Lunar Reconnaissance Orbiter (LRO), which leads to the question of whether there might be a more focused data analysis program. Another concern is ensuring scientific coordination with HEOMD. Anything done on the Moon relates to both exploration and science, and LEAG wants to get the optimum benefit for both.

LRO is now circling the Moon in a stable orbit that could last another 10 years or even longer. Dr. Plescia described the Russian laser retro reflector that was found and is now back in use. There is a place on the Moon that is one of coldest places in the solar system, even colder than Pluto. Some of the data on the ice have detection issues. There is also ongoing discussion about the location and fate of volatiles, and other issues. Ultimately, there will need to be a landing to answer these questions.

The Gravity Recovery and Interior Laboratory (GRAIL) mission just concluded after orbiting two satellites at the Moon to look at gravity. Dr. Plescia showed the resulting gravity map, which investigators are trying to coordinate with the crustal map. The bulk density of the crust is relatively low. There are also questions about ejecta, which could be contamination from spacecraft debris or materials from below the lunar surface.

Discussion
Dr. Plescia explained that the two GRAIL satellites were co-orbital when they hit the surface, landing 2 or 3 km apart. Dr. Chanover asked about the role of private industry in LEAG. Dr. Plescia explained that industry representatives attended meetings to connect with commercial space activities. The connection with commercial space has not been very effective thus far. Dr. Wargo said that LEAG operates from a template of exploration, science, resources, and commerce. The commercial side contributes more in LEAG's lunar exploration roadmap, especially in the area of sustainability. Having the commercial sector on LEAG was a way to have a handoff to them from NASA, allowing NASA to move to other destinations and also have a place to support commercial efforts.

The planetary drilling and acquisition workshop in May is by invitation only and will refine a rubric for drilling. The process will be to take a list of high-priority scenarios and sort them according to the rubric, then go into each of those "bins" to determine what needs to be done for each of them. There will be representation from the NASA centers, Federally Funded Research and Development Centers (FFRDCs) and the drilling companies, plus interests from Europe and Russia.

Venus Exploration Analysis Group (VEXAG) Report

Dr. Glaze, Associate Chief at NASA's Planetary Geodynamics Laboratory, presented the update on VEXAG activities. VEXAG had a general meeting in November, 2012, followed by a small workshop in January, 2013, that addressed upper atmosphere science and technology. The workshop outlined key questions in Venus science that are unique to the atmosphere above cloud level. A summary should be available soon. In February, the Group posted a draft update to its goals, objectives, and investigations document. There was a town hall at the March LPS meeting, and VEXAG's new website just went live.

There has been a slight restructuring of VEXAG, resulting in three long-term groups addressing goals and exploration sites, technology development, and early career scholars. Another three topical analysis groups were chartered for 2013 to address the Venus exploration roadmap, competed missions and ROSES, and international collaborations.

Dr. Glaze summarized five findings from the November meeting, in which VEXAG encouraged PSD support of:

1. Entry Technology development;
2. Participating Scientist programs for Venus Express and Akatsuki;
3. Access to NASA assets capable of unique observations (Hubble, Goldstone, balloon-borne) and continued support for investigators proposing to use these assets for Venus studies;
4. A follow-up conference on Comparative Climatology of Terrestrial Planets, to occur in 2014 or 2015; and
5. The International Venus Exploration Working Group, with official NASA involvement in this international group, which it currently lacks.

In addition, the November meeting passed seven resolutions:

1. Update the goals, objectives, and investigations document;
2. Prepare an integrated Venus exploration roadmap;
3. Endorse a range of Discovery-class missions that address high-priority investigations identified by VEXAG;
4. Encourage study of the DS Venus climate mission concept;
5. Encourage ASRG validation with the planned M-1 mission (VEXAG is concerned about rumors that the next Discovery call will effectively exclude Venus);
6. Endorse planetary observations from stratospheric balloons; and
7. Endorse the January 2013 Upper Atmosphere Science and Technology Interchange Meeting (UA STIM).

The top priority is to update the goals, objectives, and investigations for Venus exploration. The list was last updated in 2009, and since then there have been new findings and concepts. VEXAG would like the revision to be completed well before the Discovery AO. In parallel, a separate document of technologies for Venus missions will be prepared as a companion. The first draft of the prioritized list of investigations is complete, and the team is now getting community feedback and revising the list. The plan is to obtain more community feedback in order to have a final draft by November.

The second priority is to prepare an integrated Venus exploration roadmap, led by Dr. Ellen Stofan, who was on the DS team. Some material did not make it into the final DS, so VEXAG will build on that with the goals, objectives, and investigations document. There will be opportunities for international involvement. The roadmap team has started to group items into measurement suites that would constitute logical mission steps. The goal is to complete it before the next Discovery AO, with the final version available by December.

There is still a very active mission in ESA's Venus Express, which can go well into 2015. The investigators are still hoping to demonstrate aerobraking. There has been coordination of observation campaigns for ground-based observations simultaneous with orbiter observations. Akatsuki will have a fly-by in 2015 and possible orbit insertion in 2016. There is some interest among international agencies to discuss a Venus mission study with NASA.

Dr. Glaze listed upcoming activities:

- May 7, a comparative climatology symposium at NASA Headquarters to follow up a meeting held last June in Boulder, Colorado. VEXAG hopes to inform headquarters program managers about studies that may fall between disciplines.
- Nov 19-20, VEXAG meeting at NASA Headquarters;
- Nov 20-21, VEXAG technology workshop;
- Early to mid-2014, Venus exploration sites workshop that would look at how to address investigations;
- 2014/15, a second comparative climate of the terrestrial planets workshop.

Discussion
Dr. Chanover noted that a CAPTEM conference in Annapolis, Maryland, in June sounds similar to the climatology symposium. Dr. Glaze was aware of it and is in contact with the organizers, who are very supportive. There is a lot of overlap, and she would like to see VEXAG participation.

There has been international cooperation with this kind of mission, and there is a big Venus conference in Sicily in June. Several VEXAG members are unaffected by the recent government travel restrictions, and at least a couple will be giving papers there. Others are likely to attend as well. Dr. Glaze added that there is nothing new on volcanoes lately. The Venus Express mission has identified atmospheric variability above what is random, but this has not been determined to be volcano-driven.

Dr. McKinnon asked the extent to which the DS is adequate for Venus. Dr. Glaze said that it is fine and she has no complaints. Since 2009, there have not been any huge changes in the big questions about Venus. VEXAG still wants to think and reassess, however. The new Exploration Roadmap will contain better supporting text than what was in the previous version.

Dr. Castillo-Rogez asked about the rumor concerning ASRGs and the next Discovery call. Dr. Rall said that he has not heard any such rumor. Discovery will likely pick a mission based on the best science.

<u>SBAG Report</u>
Dr. Sykes began his presentation by discussing the February 15, 2013, meteorite explosion over Chelyabinsk, Russia. This was a half-megaton explosion, which was very big and injured more than 1,500 people. He hopes to see a sample soon. On the same day, another object not that much bigger did a flyby of Earth. If it had hit a satellite, it could have put a lot of debris into an orbit with a profound effect on our geosynchronous orbit. Small bodies fly through the near-Earth environment all the time.

The comet coming close to Mars in October 2014 is in the "dinosaur killer" class. There is a 1/10,000 impact probability. From a planetary defense standpoint, there would be very little that could be done if it came near Earth. We might be able to destabilize the orbit or take some other actions, but there are high-impact events about which we could do little due to time and capacity.

Recent activities include the January 14-16 SBAG meeting, SBAG8, where there was discussion of human exploration and the role of NEOs. A representative from China discussed the successful flyby in which China's Chang'e flew past Toutatis. There were also discussions of Comet ISON, mission/facility updates, the Antarctic Search for Meteorites (ANSMET) transfer report, and the annual PDS report. More specifically, participants talked about PDS access and the need to set up an active relationship to ensure that PDS meets the needs of the small bodies community.

Dr. Sykes presented a findings summary:

1. Comet ISON: PSD should support a coordinated observation campaign;
2. Balloon investigations should be funded through mission and technology programs;
3. There is continuing concern about Discovery program priorities and NASA plans to follow DS recommendations relevant to it. The original goal of the program was to select two missions every 18-24 months.
4. The cost differential between JAXA and NASA NEO sample return missions should be studied and inform Discovery opportunities and assumptions of risks. This shows what fantastic science can be achieved by small missions that assume some risk. SBAG believes PSD should investigate what can be done below the Discovery cost cap and encourage people to propose these missions.
5. Congratulations were extended to China on its flyby of Toutatis.
6. The lack of priority for a NEO survey mission is puzzling, since it is critical.
7. ANSMET is an important asset whose transfer to NASA requires community input to ensure its long-term viability.
8. International partners have significant interest in both scientific and human missions to NEOs, and there should be coordination on this.

An SBAG steering committee meeting at LPSC on March 20, 2013 produced additional findings:

1. There is concern about the removal of AG chairs as automatic members of PSS.
2. There is a need for a Dawn@Ceres Participating Scientist (PS) Program, which will require about a 15-month lead time between the ROSES Amendment and funding. This suggests that time is of the essence to get a PS in place before Dawn arrives at Ceres in April 2015.
3. The "capture an asteroid" mission proposal has serious open questions bearing on its credibility. SBAG found it more entertaining than enlightening, then learned that NASA was seriously looking at it without the participation of asteroid experts. The lack of transparency and review raises serious questions about NASA's process and seems peculiar.
4. A NEO survey mission continues to be crucial for identifying a human mission target, with substantial benefit to science and planetary defense. Final objectives and requirements need to be informed by peer-review and would benefit from public comment by subject matter experts. Open competition for a survey mission is essential.

Discussion

Dr. Green explained that PSD wants a NEO survey and has an SAA with B612 that allows NASA the opportunity to participate in a mission that B612 develops. This is a frugal way to support the capability. If NASA does not fund something, NASA does not control it, however, so there are limits to what the Agency can do in regard to the B612 mission. Dr. Sykes said that SBAG has serious questions about the B612 mission and would like to see an assessment of whether it will happen. Dr. Green replied that the Administration is very supportive of commercial activities. This could be productive and important, and it should be given a chance.

Dr. Green added that the Chinese flyby of Toutatis was a great repurposing of their mission, but he wondered if anyone was getting access to their data. Dr. Sykes said that this is not happening, partly because China does not have access to NASA data and feels it is unfriendly. He wondered why JPL is

blocking China. Dr. Green replied that this is wrapped up in politics. Prior to a change in attitude by the Administration, NASA visited China to discuss making data available and archived.

Dr. Green added that the last two Discovery missions have been risky. Putting anything on Mars is not without risk, which shows that the program is living up to its purpose of tackling and overcoming risks. Offering ASRGs in Discovery is not without risk as well. Dr. Sykes suggested that the idea might be to determine which risks have been avoided that should have been embraced. Dr. Green said that the program has progressed nicely from flybys to other activities. He appreciates the point that cheaper missions are worth consideration. Dr. Sykes replied that this is certainly part of the broader discussion. There is a hyper-sensitivity to heritage that should be discussed.

Dr. Yeoman said that he would hate to have the B612 effort rule out other missions competed in the Discovery program. Dr. Sykes agreed, stating concern that emphasis on B612 could result in nothing. They are supposedly trying to get NASA to pay for entire mission and not be a privately funded enterprise.

Dr. Yeoman asked if there were a process for a swap of Hayabusa and OSIRIS samples. Dr. Green said that NASA is working with JAXA to provide support on Hayabusa 2 like the Agency did on Hayabusa 1. The sample exchange is on the table, and NASA hopes to complete the MOU before the launch. It would be beneficial to have participating scientists on Hayabusa 2, and he would like to provide an update at the next SBAG meeting.

When asked if anyone knew the funding level NASA had committed to the effort to capture an asteroid, Dr. Sykes said that it was $100 million in 2014, with one-third of that coming from PSD. The lack of discussion on the rationality of the mission was a matter of concern. Dr. Green said that all that had been discussed was a study, and it was not known as to whether it was in the FY14 budget. Dr. Sykes replied that it seems expensive when there is so much free expertise available. The larger point is about the failure to engage the expert community before studying the concept.

Dr. Wargo said that there are different aspects of a study involving elements that the small bodies community would not have expertise to handle but that NASA and its centers can handle. In broader study, there is a need for additional capabilities. Dr. Sykes said that if the purpose is to retrieve a small asteroid, which he characterized as "a silly thing," it was not clear that it makes sense to do a study of deploying a high-power solar array. Dr. Wargo replied that if NASA is looking at other capabilities of a high-power solar array, there are potential uses beyond asteroid retrieval. Dr. Yeomans pointed out that the effort is being described as asteroid retrieval. He understood that there are various objectives. Dr. Wargo said that this is an internal study by NASA. It does not make sense to have this speculative conversation until the details are available. Dr. Sykes reiterated the point that the subject matter experts were not consulted.

MEPAG Report

Dr. Lisa Pratt, MEPAG Chair, presented an update on the Group's recent activities. There are a lot of assets orbiting Mars or actually on the ground. In December, there was an announcement of a 2020 Mars Rover based on the success of the MSL Rover. Also in December, Dr. Green became the Mars Exploration Program Acting Director. In January, an SDT was formed in response to a NASA call. Since then, budget issues have dominated the discussion, and MEPAG changed its February meeting to a virtual format. That was done through Adobe Connect and went very well.

The March LPSC meeting hosted many activities related to Mars, including an extremely vigorous debate on the new Mars meteorites. The new Federal travel guidelines affect participation at future meetings,

however. The Eighth International Conference on Mars is being postponed, and other ways of maintaining contact are being examined.

Dr. Pratt next reviewed some of the Mars Rover highlights presented at the meeting the previous day, and discussed a series of new papers on what happens during the Mars Spring with dune erosion via dry ice. The data are showing that Mars has more similarities to Earth than originally thought. Thousands of citizens help classify the images of Spring on Mars. Citizen volunteers help in many ways since there are not enough funded scientists to do this work.

The February MEPAG meeting addressed budget issues, updating the science community on SMD's plans for Mars, and various updates and plans for responses. The meeting highlighted the need to increase MEPAG and HEOMD communication to support human exploration. For a virtual meeting, the length of 4 hours seemed about right. In assessing the format, there were many comments of praise, but it was also noted that it is difficult to stay engaged that long in a virtual meeting. Much science results from casual interactions. However, the virtual meetings can supplement the face-face meetings.

Concerns remain about the Federal travel restrictions. People are willing to do what is needed but worry that international visibility is reduced. Many competed missions rely heavily on contacts, and the community wants to be able to work effectively.

Considerations for the near future include the SDT report, a future face-to-face meeting that will probably take place in FY14, and 2020 Mars Rover opportunities. MEPAG members think it is important to be visible in collaborating with HEOMD. Four topics recur:

- RSLs and other evidence of an active ground hydrologic cycle;
- Modern-day habitability (extant life?);
- Planetary protection for Mars activities; and
- Impact of deliquescence and oxidation by perchlorates on caching samples.

Discussion
In answer to a question, Dr. Pratt said that there was talk at LPSC about NASA becoming a launch-oriented "taxi service," which would put U.S. scientists at a disadvantage compared to the international community. Dr. Green explained that NASA is pursuing more minor partnerships like the one with JUICE. He does not foresee NASA offering a launch vehicle as a contribution during this decade. As for NASA involvement in ESA's M-class missions, Dr. Green said that NASA negotiates the Agency's role before the ESA down-select. NASA is not committing to be a major partner on ESA missions. In regard to competitions, proposers must look at the AOs for guidance on foreign contributions. It is up to the PI to propose in compliance with the AO.

Dr. Luhmann asked how the Mars community feels about the DS. Dr. Pratt said that since the SDT is being conducted quietly, no one knows what they are going to recommend. She assumes that caching will be part of that and it will respect the DS findings. It is too early to tell. She also hears a lot of people say that the community did not know about RSLs as the DS was being developed, and therefore it is unclear how the DS would respond.

<u>Information Technology Infrastructure Committee (ITIC) Presentation</u>
Dr. Larry Smarr, ITIC Chair, explained that when looking at Information Technology (IT) infrastructure improvement, the problem is that NASA has very distributed data repositories. He has looked at a number of these. There is an issue of whether data should be cloud-based. He also studied what other agencies have in the way of IT infrastructure.

ITIC submitted the following recommendation to the NAC:
"NASA should formally review the existing national data cyber-infrastructure supporting access to data repositories for NASA SMD missions. A comparison with best-of-breed practices within NASA and at other Federal agencies should be made."

Dr. Smarr discussed the details of NASA's science-related IT capacity. There is a huge increase in the amount of data being generated by missions, along with more and more computational astrophysics, yet the science part of NASA never seems to be organized to have the right IT infrastructure to support their missions. Although there is a new class of supercomputers, NASA does not have that pipeline. In addition, the White House left NASA out of a large data initiative, which says to policymakers that addressing large data needs is not a top priority at NASA. This is becoming a policy issue, and NASA is falling behind. ITIC would like to see this become a higher priority of the NAC.

Discussion
Dr. Green sought clarity on the recommendation. Dr. Smarr said that there should be a joint task force between ITIC and the NAC Science Committee. Dr. Green pointed out that each SMD division has its own infrastructure to access data that are archived. PDS has distributed nodes all over the country. With that said, he would support leveraging higher bandwidth to get better access to that data. From that perspective, he wanted to know what the proposed review should do. Dr. Smarr replied that the issue becomes what could be improved to enable more science. PSD's distributed model is a good one, but it is not what all the divisions are using. He would like to see the best systems, especially as this becomes more about super-networks than supercomputers, with no artificial barriers to comparing data.

Dr. Green explained some of the PDS activities, such as adding to some of the models to do more simulations. He suggested having the PDS Management Council (MC) talk to Dr. Smarr directly to determine how to benefit from activities of other agencies and to start a dialogue that would move the system in the direction Dr. Smarr proposed.

Dr. Smarr noted that the NAC was meeting later in the month. By then, all four SMD divisions will have heard his presentation and can coordinate on best practices. Dr. Green said that having a set of questions for the PDS MC would be helpful, and offered to have that set up before the upcoming NAC meeting.

Dr. Luhmann said that she worried about users being neglected in some of the discussions within IT circles. She wondered if emphasis should be on taking this to the next level or finessing what they already had. Dr. Green said that he envisioned a set of questions that PSD could send out to the user community in order to establish a basis for comparison with the other three SMD divisions. The need for data across divisions is well established, so the effort should focus on how best to access common sets of data.

Regarding industry involvement, Dr. Smarr said that there are interested cloud providers. His question is how well are the users being supported to get science quickly, then disseminate it to the public. The point would be to get the user voice driving this. The Office of the Chief Information Officer (OCIO) would like to see more science infrastructure under its control, and he disagrees with that approach.

Dr. Gaddis asked about data transfer and compression. Dr. Smarr said that some people have looked at this. Compression is less of an issue. The problem is that those are the wide area networks, and people on the edges have less ease of access. Today it costs $400 to switch 10 gigabits, compared to $80,000 in 2005. However, no one seems to think it is their job to optimize it. NASA is not doing it. The most important thing is for the PSS members with ideas on this topic to get those ideas to the chair of the NAC Science Committee before the next meeting.

PSS Findings and Recommendations

Several PSS members provided alternative wording for the PSD strategic goals to be included in the 2014 SMD Science Plan:

1. Advance the understanding of the formation from presolar and nebular matter of the sun's family of planets, moons, and minor bodies.
2. Advance the understanding of the chemical and physical processes at work in our solar system and how they evolve over time.
3. Advance the understanding of conditions capable of sustaining life in the solar system, including on our own planet Earth.
4. Identify and characterize planetary objects and environments that pose threats to, or offer potential resources for, humans as we expand our presence into the solar system.

Dr. Mary Voytek of NASA said that the goals must avoid jargon, which would exclude some of the language in the revisions. There is no requirement to be all inclusive. The team took a month to write these, shorten them, and make them understandable to the layperson. Dr. Rall added that the language cannot exceed 12th grade level. An example of the target audience is the House of Representatives staff.

Dr. Draper still thought that two bullets emphasizing life was one too many. Dr. Voytek said that that had been considered, but the combined goal does not reflect what PSD does. The focus on habitability does not have to include life. Dr. Luhmann said that the staff have certain insights as to the likely readers and what they want or need to hear. PSS was asked for feedback and gave it. Nor was there consensus on the revisions that PSS proposed. She thought the discussion pointed to the need for an astrobiology AG, however, since a big part of the program is engaged in this. PSS does not adequately hear about this at Subcommittee meetings. If there is no AG forthcoming, PSS needs more focused reporting on this area in order to stay informed. Dr. Voytek agreed to take care of this.

Dr. Luhmann concluded that the team now had PSS feedback and can consider it, then revise as works best. Dr. Rall added that individual PSS members can send revisions to him, though they could not continue talking as a group outside of the formal meeting.

Findings

Dr. Luhmann said that PSS could draft their findings to forward to Dr. Green. These will be posted on the website and used in her presentation to the NAC Science Committee. She said that she would polish the findings off line and send them out for further editing via email, which is allowed under FACA rules.

Following are the main points:

1. Acknowledge all the parties who participated in getting the restoration of the Planetary FY13 appropriations. There are remaining concerns as to effects on the budget of the sequestration and rescissions, including travel and E/PO.
2. R&A programs are still struggling, and sequestration and rescissions could further erode selection rates, particularly in program elements with late-in-the-year due dates.
    - Dr. Rall noted that Dr. Green had said that it would be hard for him to envision not affecting R&A with the cuts.
    - Dr. Prockter raised the issue of where else to take the funding cuts. Dr. Luhmann said that, historically, this is not something that PSS would address. The point of the finding was to focus on the late-selected proposals. PSS has limited insight into a lot of the PSD expenditures, and therefore cannot target specific expenditures.
    - She added that since all PSS members have research funding, it would be inappropriate to recommend specific alternative cuts. This is a finding about R&A.

3. The prospect of minimizing delays in the solicitation of Discovery and New Frontiers AOs is a good thing and the PSS advocates for this.
    - There are concerns regarding foreign collaboration. Dr. New, the Lead Discovery Program Scientist, said that foreign contributions cannot exceed one-third of the cost. It is left to the proposal teams to work that out. There was discussion about the percentage and whether there was a need for fewer restrictions. It was agreed that this would be addressed at the next meeting.
    - The finding was informally restated as wanting the Discovery and New Frontiers AOs to be a year earlier.
4. PSS recommends combining New Frontiers 4 and 5 mission candidates for the next New Frontiers solicitation. (This should be an agenda item for next PSS meeting.)
5. The $75M appropriation in FY13 for preformulation/formulation of a Europa mission is good but there is no clear path, i.e., no specific language from NASA committing to a mission.
6. Mars 2020 should be responsive to the DS particularly with regard to sample return, and should also optimize the interaction with HEOMD while serving as an opportunity to improve our interactions.
7. A NEO survey mission is important. PSS requests a briefing from B612/Sentinel project and the PSD Planetary Defense Officer at the next PSS meeting.
    - Dr. Luhmann noted that SBAG has raised the issue multiple times. Dr. New explained that NASA did not select the mission. B612 came up with it and asked NASA for assistance, which the Agency agreed to. It is possible that this is not the mission that NASA would choose to fly, but PSS might not have standing to weigh in on it. NASA is not providing that much in the way of support to B612.
    - Dr. Luhmann said that it remains a concern of SBAG, especially in light of the fact that community input is less than they wanted. PSS could get a briefing on it. Others agreed that PSS was in the dark and needed more information.
    - Dr. Rall suggested that B612 and NASA both give briefings. Others agreed.
    - There was a sense that transparency is lacking here, as well as NASA's investment of limited resources in what some considered a weak concept.
8. Encourage PSD and SMD to make use of the PSS and the AGs' expertise, including SBAG for NEO issues as an example.
9. There should be a PDS briefing at the next PSS meeting.
10. There should be an astrobiology briefing at the next PSS meeting.
11. There should be an HEOMD/Joint Robotic Precursor Activity (JRPA) briefing at the next PSS meeting.
12. There should be an R&A update on the Planning, Programming, Budgeting & Execution (PPBE) FY15 process at the next PSS meeting.

Dr. Luhmann asked PSS members to react quickly to the impending emails and edits, as the NAC Science Committee meeting was soon.

She thanks everyone for their participation, and asked that they send her and Dr. Rall any ideas they might have for topics at the next meeting. Dr. Rall said that there would be a need for a short teleconference after the budget comes out, possibly in early May. He would find dates for the next meeting.

The meeting was adjourned at 2:30 p.m.

Appendix A
Attendees

Subcommittee members
Janet Luhmann, University of California, Berkeley, *Chair, Planetary Science Subcommittee*
Jonathan Rall, NASA, *Executive Secretary*
Julie Castillo-Rogez, Jet Propulsion Laboratory (via WebEx)
Nancy Chanover (pending member), New Mexico State University (via WebEx)
David S. Draper (approved; AA letter pending), Johnson Space Center (via WebEx)
Lisa Gaddis (pending member), U.S. Geological Survey
Mihaly Horanyi (pending member), University of Colorado (via WebEx)
Christopher House (pending member), Pennsylvania State University (via WebEx)
Louise Prockter, Johns Hopkins University Applied Physics Laboratory (via WebEx)
Paul Steffes, Georgia Institute of Technology
Jessica Sunshine, University of Maryland (via WebEx)
Donald Yeomans (approved; AA letter pending), Jet Propulsion Laboratory (via WebEx)

NASA attendees
James Green, NASA HQ, *Director, Planetary Science Division*
Max Bernstein, NASA HQ
Doris Daou, NASA HQ
T. Jens Feeley, NASA HQ
Bobby Fogel, NASA HQ
Lori Glaze, NASA GSFC
Jeff Grossman, NASA HQ
Deidre Jurand, NASA HQ
Lisa May, NASA HQ
Michael New, NASA HQ
Sarah Noble, NASA HQ
Marian Norris, NASA HQ
Christina Richey, NASA HQ
Joan Salute, NASA HQ
Mitch Schulte, NASA HQ
Brook Varew, NASA GSFC
Mary Voytek, NASA HQ
Michael J. Wargo, NASA HQ
Dan Woods, NASA HQ

Non-NASA attendees
Linda Billings
Mengwei (Andrew) Chen, Lockheed Martin
Steve Mackwell, USRA LPI

Webex
Bill Adkins, Adkins Strategies
Brent Archinal, U.S. Geological Survey
Michael Aye, UCLA
Fran Bagnal, University of Colorado
Jim Bell, ASU
Robert Cataldo, NASA Glenn Research Center
Kaitlin Chell, Caltech
Mengwei Chen, Lockheed Martin
Stephen Clark, Space Flight Now
Barbara Cohen, NASA MSFC

Dominick Conte, Independent
Rolf DeGroot, European Space Agency
Lamont DiBiasi, Southwest Research Institute
Serina Diniega, NASA JPL
Cynthia Dinwiddie, Southwest Research Institute
Richard Dissly, Ball Aerospace
Casey Dreier, Planetary Society
Mark Fonda, NASA Ames
Leslie Gertsch, Missouri University of Science and Technology
Tommy Gray, Planetary Science Institute
Jeff Grossman, NASA HQ
John Grotzinger, NASA JPL
Candy Hansen, Planetary Science Institute
Scott Hovarter, Lockheed Martin
Jeff Johnson, APL
Gordon Johnston, NASA HQ
Bradley Keelor, British Embassy
John Keller, NASA GSFC
Michael Kelley, NASA
Kurt Klaus, Boeing
Malcom Ko, NASA Langley
Rob Landis, NASA HQ
Melissa Lane, Planetary Science Institute
Dan Leone, Space News
Mackenzie Lystrup, Ball Aerospace
John McCarthy, Orbital Sciences
Alfred McEwen, University of Arizona
Melissa McGrath, NASA MSFC
William McKinnon, Washington University
Hap McSween, University of Tennessee
David Millman, Private Investor
Jeff Morgenthaler, PSI
Karron Myrick, Bear Technologies
Noah Petro, NASA GSFC
Jeff Plescia, Johns Hopkins Applied Physics Lab
Michael Poston, Georgia Tech
Lisa Pratt, Indiana University
Thomas Prettyman, Planetary Science Institute
Kim Reh, JPL
Jaime Reyes, Independent
Miriam Riner, PSI
James Roberts, APL
John Rummel, East Carolina University
Joan Salute, NASA HQ
Amy Simon, NASA
Larry Smarr, University of California, San Diego
Mark Sykes, Planetary Science Institute
George Tahu, NASA
Michael Toston, Georgia Tech
Gregg Vane, APL
Anne Verbiscer, University of Virginia
Richard Vondrak, NASA
Catherine Weitz, PSI
Alexandra Witze, Nature
June Zakrajsek, NASA
Richard Zurek, NASA JPL

Appendix B
Membership Roster

Janet Luhmann, Chair
Space Sciences Laboratory
University of California, Berkeley

Jonathan A. R. Rall, Executive Secretary
Planetary Science Division
Science Mission Directorate
NASA

Julie Castillo-Rogez
Jet Propulsion Laboratory

Nancy Chanover (Pending member)
New Mexico State University

David S. Draper (Approved-waiting on AA letter)
Astromaterials Research and Exploration Science Directorate
NASA Johnson Space Center

Lisa Gaddis (Pending member)
U.S. Geological Survey

Mihaly Horanyi (Pending member)
University of Colorado

Christopher H. House (Pending member)
Pennsylvania State University

Louise Prockter
Space Department
Johns Hopkins University Applied Physics Laboratory

Anna-Louise Reysenbach
Department of Biology
Portland State University

Paul Steffes
School of Electrical and Computer Engineering
Georgia Institute of Technology

Jessica Sunshine
Department of Astronomy
University of Maryland

Donald Yeomans (approved-Waiting on AA letter)
Jet Propulsion Laboratory

Appendix C

Presentations

1. *PSD Status Update* , Jim Green
2. *Mars: The Search for Life*, Lisa May
3. *Curiosity: Results from the Mars Science Lab*, J. Grotzinger
4. *R&A/ROSES Update*, Jonathan Rall
5. *JUpiter ICy moons Explorer Mission (JUICE)*, Joan Salute
6. *CAPTEM Report*, John Grossman
7. *OPAG Report*, William McKinnon
8. *LEAG Report*, Jeff Plescia
9. *VEXAG Update*, Lori Gaze
10. *SBAG Report*, Mark Sykes
11. *MEPAG Report*, Lisa Pratt
12. *Information Technology Infrastructure Committee (ITIC) Briefing*, Larry Smarr

Appendix D

Agenda

Planetary Science Subcommittee Meeting
April 4-5, 2013
NASA Headquarters
Washington D.C.

Thursday, April 4

8:30 – 8:45 a.m.	Welcome, Agenda, Announcements	J. Luhmann/J. Green/J. Rall
8:45 – 9:00	Introductions	All
9:00 – 10:15	PSD Status Update	J. Green
10:15	Break	
10:30 – 11:30	Mars Program Status Update	L. May
11:30	Lunch	
1:00 – 2:00 p.m.	Curiosity Update	J. Grotzinger
2:00 – 2:45	R&A	J. Rall
2:45 – 3:15	Q&A Missions	All
3:15	Break	
3:30 – 4:00	JUICE	J. Salute
4:00 – 5:30	Strategic Plan Briefing	J. Rall
5:30	Adjourn	

Friday, April 5

8:30 – 8:45 a.m.	Agenda Updates & Announcements	
8:45 – 9:15	CAPTEM Report	J. Grossman
9:15 – 9:45	OPAG Report	W. McKinnon
9:45 – 10:15	LEAG Report	J. Plescia
10:15	Break	
10:30 – 11:00	VEXAG Report	L. Gaze
11:00 – 11:30	SBAG Report	M. Sykes
11:30 – 12:00	MEPAG Report	L. Pratt
12:00	Lunch	