

REPORT
of the
Planetary Science Subcommittee
of the NASA Advisory Council Science Committee

Washington, DC
3-4 March 2008

Introduction

The Planetary Science Subcommittee (PSS) of the NASA Advisory Council (NAC) Science Committee held its seventh meeting on 3-4 March 2008 at the Carnegie Institution of Washington in Washington, D.C. Fourteen of the 16 subcommittee members attended the meeting, and seven proposed new members of the subcommittee attended as guests.

The agenda (attached) included a broad range of presentations and discussion topics. The first day of the meeting began with a briefing by James Green, Director of the Planetary Science Division (PSD) of NASA's Science Mission Directorate (SMD), on division activities, as well as responses to PSS and NAC recommendations from earlier meetings. Doug McCuistion, Director of the Mars Exploration Program, summarized the current status of the Mars Program. Later that morning, SMD Associate Administrator (AA) Alan Stern joined the subcommittee for an extended question and answer session. Following the annual ethics briefing by Rebecca Gilchrist, the subcommittee heard from NAC Planetary Protection Subcommittee (PPS) chair Ron Atlas on PPS deliberations on a Mars Sample Receiving Facility. The subcommittee then heard presentations by chairs of the analysis groups — including the Venus Exploration Analysis Group (VEXAG), Lunar Exploration Analysis Group (LEAG), Mars Exploration Program Analysis Group (MEPAG), Outer Planets Assessment Group (OPAG), the newly formed Small Bodies Assessment Group (SBAG), and the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM). The final presentation on the first day was by Bill Bottke, chair of the Planetary System Science Management and Operations Working Group (MOWG).

The second day of the meeting began with a report on the Lunar Architecture 2 Study by Geoff Yoder, followed by a report of activities of the Outpost Science and Exploration Working Group by Kelly Snook. Subcommittee discussions filled the remainder of the morning. The afternoon session was led off by a presentation on the recently published report of the National Research Council (NRC) Committee to Assess Solar System Exploration (CASSE) by committee co-chairs Wes Huntress and Norine Noonan and committee members Scott Hubbard and Ralph McNutt. The meeting ended with a review of subcommittee findings and recommendations stemming from the two days of discussion.

General Assessment of PSD Programs

There has been a great deal of positive progress toward the achievement of important PSD goals, and both Jim Green and Alan Stern deserve community appreciation and support for their continuing efforts to maximize the scientific return from all of the division's programs. The budgetary increases to the Research and Analysis programs, the initiation of an outer planet flagship mission, and the expansion of SMD's programs in lunar science are all welcome moves that are fully responsive to past PSS recommendations. At the same time, however, the subcommittee is concerned that the current budget for the division's Mars Exploration Program is not adequate to meet the program's objectives. The PSS has additional concerns in the area of lunar exploration planning. We elaborate on each of these topics below.

Research & Analysis Programs

The PSS applauds the increases that PSD has made to the Research & Analysis (R&A)

programs in GFY 2008 and in the President's GFY 2009 budget. The total spending for R&A in 2008, at \$200.6M, is more than 40% higher than that in 2007, and the proposed 2009 budget calls for an additional 9% increase. These increases constitute a substantial restoration of the damaging cuts made to R&A across the division in GFY 2006 and 2007. The PSS endorses the continuing SMD policy, instituted by AA Alan Stern, that R&A is "off the table" when cost overruns in flight programs raise the question of where additional resources might be found.

The PSS is particularly pleased to see the strong increases in 2008 and 2009 for R&A programs in astrobiology and in lunar science. Astrobiology R&A programs, which had been cut by 50% between GFY 2005 and 2007, will see a 26% increase in 2008 and another 22% increase in the 2009 budget. R&A expenditures for lunar science – including the recent selection of Participating Scientists for the Lunar Reconnaissance Orbiter (LRO) and Lunar Sortie Science Opportunities (LSSO) investigations, the Lunar Advanced Science and Exploration Research (LASER) program jointly supported by SMD and the Exploration Systems Mission Directorate (ESMD), and the newly announced NASA Lunar Science Institute – are slated to increase from \$3.8M in 2007 to \$18.7M in 2008 and then to \$25M according to the President's 2009 budget.

Missions of Opportunity

The PSS was pleased to hear that PSD will issue a Stand-Alone Mission of Opportunity Notification (SALMON), with a first release in May 2008 and annual releases thereafter. The PSS has long called for a consideration of attractive missions of opportunity more frequently than that of Discovery Program selections, and the annual SALMON call is a very welcome response to this recommendation. The PSS endorses the broad scope of SALMON, which includes the provision of a payload instrument on a non-NASA flight mission, the participation by a U.S. scientist in a non-NASA mission, and the reuse of an existing NASA spacecraft, as well as a small complete mission. SALMON awards may provide some of the "on-ramps" envisioned to provide the levels of mission experience now required of potential Principal Investigators for Discovery, Scout, and New Frontiers missions.

Lunar Missions

The PSS supports the substantial growth in robotic lunar exploration supported by PSD. In our last report, the subcommittee had recommended that "NASA review the Lunar Precursor Robotic Program after LRO with the aim of devising innovative routes (e.g., international or commercial participation, individual state involvement) to undertake robotic exploration missions needed to initiate the next era of lunar and solar system exploration." Since the time of that recommendation, NASA selected a lunar mission (Gravity Recovery and Interior Laboratory, or GRAIL) within the Discovery Program and has announced three small strategic lunar missions: the Lunar Atmosphere and Dust Environment Explorer (LADEE), to be launched in 2011 together with GRAIL; and two landers, envisioned as part of an International Lunar Network (ILN) of geophysical stations, to be launched in 2013-2014. LADEE and ILN address two of the broad Science Goals recommended in the National Research Council (NRC) 2007 report on *The Scientific Context for Exploration of the Moon*.

Subcommittee discussion of the ILN lander concept focused on the question of power systems. Current plans, which call for solar and battery power, may not permit nighttime operation of the surface stations, and the overall longevity of the stations is uncertain. These plans are not well matched to the scientific objectives of a geophysical network, particularly one that is built up over a span of many years as NASA and international partners add stations as opportunity affords. Turning off stations at night would prevent a global network from ever achieving its full potential. The ability to locate seismic sources would be degraded from that possible with a fully operational network and would depend on time of day. Moreover, some of the most important seismic signals (e.g., deep moonquakes) are known to correlate in time with lunar tides, one of the dominant periods of which is diurnal, so turning half the network off at any given time would increase the chance of missing such correlations. Worse, information on the lunar core might be precluded, because it depends on the simultaneous operation of stations

near or above a given seismic source (to provide an accurate source location) and stations antipodal to the first group (to record waves from that source that traverse the near-center of the Moon). Therefore, **the PSS recommends that NASA take steps to develop long-lived power supplies for the development of landed networks.** An immediate beneficiary of such development will be the ILN landers, but such power supplies would benefit a Mars surface network as well. In the longer term, the lack of long-lived power supplies for lunar exploration will limit the longevity of any lunar outpost, particularly one not located in an area of nearly permanent sunlight.

Lunar Exploration and SMD

The PSS was given a thorough briefing on the efforts of the Lunar Architecture Team 2 (LAT-2) and of the joint SMD-ESMD Outpost Science and Exploration Working Group (OSEWG). The role of science in the development of lunar exploration plans and in the mapping of scientific objectives into elements of the lunar exploration architecture, although continuing to evolve, warrants additional attention. The NRC report on *The Scientific Context for Exploration of the Moon* has clearly fed into LAT-2 planning, and SMD scientists participate directly in LAT-2 and OSEWG, but further regular input from the broader lunar science community is needed.

Toward that end, the NAC in February charged the LEAG to develop a lunar science roadmap that is integrated with the exploration architecture and science program plans. The intent of this directive was to position the LEAG to provide an ongoing evaluation to the NAC of lunar architecture planning. The NAC viewed as particularly important the ability of LEAG to judge, from the perspective of the lunar science community, the associated or potential costs of executing the activities identified in the LAT-2 concept studies in a manner that will promote a good balance between goals and costs. The PSS looks forward to the completion by LEAG of the lunar science roadmap as a basis for the future evaluation of lunar exploration plans and programs. The PSS also understands that OSEWG is studying mechanisms for engaging LEAG and other representatives of the lunar science community, through workshops and commissioned studies. The subcommittee urges that a formal process for incorporating community input into OSEWG deliberations be established, and we look forward to hearing of the progress made toward that objective at our next meeting.

Discovery Missions

The PSS was pleased to hear that the next Announcement of Opportunity for the Discovery Program would be issued in GFY 2009. This line of strongly competed, non-strategic missions has provided great benefit to PSD and the planetary science community in the form of new observations from a diversity of solar system objects. A major issue for this program, however, is the availability of a launch vehicle well matched to the lift capabilities needed for this mission line. The most recent Discovery mission, GRAIL, may use the last Delta II in NASA's launch vehicle fleet, and reliance on continuing launch vehicle lines (e.g., Delta 4, Atlas 5) would involve much higher launch costs than has been assumed in setting Discovery mission cost caps. The PSS understands that Alan Stern and Space Operations Mission Directorate AA William Gerstenmaier are co-chairing a study of future options for launch vehicles, and we look forward to further information pertinent to Discovery missions when that study has been completed.

New Frontiers Missions

Regarding the New Frontiers mission line, the PSS awaits the findings of the National Research Council study on *New Opportunities in Solar System Exploration (NOSSE): An Evaluation of the New Frontiers Announcement of Opportunity*, which was expected shortly after the time of the meeting. The subcommittee hopes to hear from the NOSSE study group at its next meeting on the criteria for selection of missions and the relationship of those criteria to those that guided the decadal survey for solar system exploration.

Outer Planet Flagship Mission

The PSS was pleased to hear that NASA plans to initiate a flagship mission to the outer solar system in GFY 2009, a move that adheres to the PSD plan to alternate the targets of planetary flagship missions between inner and outer solar system objects. Studies of candidate missions—targeting Europa, Titan, and the Jovian system (Ganymede)—are underway, and discussions with other space agencies – including the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA) – indicate that opportunities for international partnership look promising. The PSD endorses NASA’s plan to down-select to a single mission target next year and to start the new outer planet mission at that time.

A critical issue for an outer flagship mission is power. The subcommittee is aware of the limited quantities of ^{238}Pu available for radioisotope power sources on future missions. NASA’s call for mission concepts to provide a flight demonstration of an advanced Stirling Radioisotope Power Source (RPS) is an encouraging step toward more efficient power sources than past radioisotope thermoelectric generators (RTGs), but the radioisotope source limitation looms nonetheless. The PSS requests that NASA clarify its plans for power source development for future solar system missions at an early opportunity.

Mars Science Laboratory

The PSD flagship mission currently under development is the Mars Science Laboratory (MSL). At our last meeting, the PSS heard of cost growth issues that threatened the elimination of several payload instruments, notably including the Chemistry Camera (ChemCam) instrument, and the subcommittee recommended that “NASA and the developers of ChemCam make every effort to ensure that this important instrument fly on the MSL mission.” The PSS is pleased that a solution was found last fall to provide sufficient funding so that ChemCam and the other instruments threatened with descoping could remain on the spacecraft.

A new set of cost growth issues now threatens the MSL mission. In late fall, the project presented NASA with estimates of more than \$100M above the then-current cost ceiling to complete the mission on schedule for a 2009 launch. Program review and an independent review team corroborated the magnitude of the increase, which stood at \$165-200M at the time of the PSS meeting. Sources of cost growth are widespread but include fabrications costs, underestimates of design complexity, and late deliveries. An important question addressed by the program was whether MSL could launch in the next available window, 2010-2011, and the assessment was affirmative. The additional cost of slipping the launch, however, was reported to be as high as \$350M. Given the cost of a delayed launch, **the PSS recommends that NASA make every effort to solve MSL’s cost growth problems in 2008 and 2009 so that the mission may remain on schedule for its 2009 launch.**

Given the strong interest at SMD and within the planetary science community in containing cost growth across all missions, MSL may offer particularly pertinent insight into factors governing cost growth in a strategic mission. The PSS requests that NASA prepare a formal assessment of the lessons learned from the history of mission cost for MSL and present the results of such an assessment to the subcommittee at the earliest opportunity.

Mars Exploration Program

The Mars Exploration Program (MEP) missions launched to date have been extraordinarily successful. The twin Mars Exploration Rovers continue to return valuable science observations after operating on the Martian surface for more than an order of magnitude longer than their design lifetimes. The Mars Odyssey and Mars Reconnaissance Orbiters continue to return spectacular imaging and remote sensing data, as does ESA’s Mars Express mission. The timely launch of the Phoenix mission promises a new landed capability to address issues of water and climate at high Martian latitudes.

The decision last year to make a Mars Sample Return mission by 2020 an overarching goal of NASA's Mars Program was a bold and creative move. Mars sample return has been a long-term goal of the space agency for more than three decades, because the ability to characterize returned samples geochemically, petrologically, and astrobiologically in terrestrial laboratories will always far surpass the ability to derive comparable information from in situ measurements. Despite the several dozen Martian meteorites now in the world's collections, there is no ability to link specific samples to specific sites on Mars, and indeed the available information on the crystallization ages of Martian meteorites suggests that the samples in our collection are not representative of Martian surface materials. The unique ability of a Mars Sample Return (MSR) mission to return well-chosen, documented samples from a diversity of scientifically interesting geological units offers the promise to advance substantially our understanding of the evolution of Mars as a planet and the conditions that have affected its potential habitability to living organisms as functions of space and time. **The PSS endorses the return of appropriately selected and documented samples from Mars as the highest-priority scientific objective for Mars exploration over the next 10-15 years.**

The Mars Program, however, has recently faced a series of challenging budgetary issues. The progressive growth in the cost of MSL has already been noted. The launch of a Mars aeronomy orbiter under the Scout Program had to be slipped from 2011 to 2013 because of a conflict-of-interest between the review team and at least one proposing organization. That slip left the program vulnerable when PSD was asked to transfer approximately \$600M over 5 years to accommodate growth in the SMD's Earth Science Program. As a result of that transfer, the Mars Program budget will drop from \$635M in GFY 2007 to about \$553M in 2008, \$386M in 2009, and \$300M in 2010. Compared with the budget expected as recently as several months ago, such a protracted reduction has substantially changed the constraints under which missions after 2013 can be envisioned and a coherent plan leading up to an MSR mission by 2020 can be accomplished.

The PSS believes, on the basis of presentations by the Mars Exploration Program Director and the Mars Exploration Program Assessment Group, that the current MEP budget for 2009-2013 is not adequate to plan and launch a scientifically compelling Mars Sample Return mission by 2020, even if major international partners for such an undertaking are recruited. This statement is made with the expectation that MSR must be preceded by strategically linked precursor missions that validate enabling technology and establish needed infrastructure (e.g., communications, sample collection). Further, the PSS was given to understand that possible launch windows for sample return missions two to ten or more years after 2020 are not as energetically favorable and would substantially restrict mission capability, although few supporting details were available at the time of our meeting. If the 2020 launch window offers the best opportunity for more than a decade, then it is imperative that steps be taken in the very near term to sharpen the definition of the MSR mission concept, secure the needed partnerships, and determine the requisite technical capabilities and precursor missions. **The PSS recommends that NASA take the necessary budgetary, partnering, and planning steps – including needed strategically linked precursor missions – to enable the launch of a Mars Sample Return mission by 2020.** We ask for an update at our next meeting on the schedule of milestones needed to meet this goal.

At the same time, the PSS requests additional information from NASA that will aid in the development of corollary recommendations. We ask that NASA present to the PSS a specific path by which technical readiness for MSR can be demonstrated in time for a 2020 launch, including the principal technological developments required in order to accomplish an MSR mission, the current stages of those developments, and the steps needed to bring those technologies to suitable readiness levels. Moreover, we request that NASA present specific plans for substantive international partnerships that recognize the scientific and technical interests of our partners yet avoid most of the administrative burdens that have been faced by the International Space Station. Finally, we ask further for a report on ongoing study of the

comparative advantages and orbital mechanical constraints for the launch of all MSR elements by 2020 versus 2022 or later launch windows.

Requirements for a Mars Sample Return Receiving Facility

The PSS heard from Ron Atlas on the rationale and some of the characteristics required for a receiving facility for returned Mars samples. The Planetary Protection Subcommittee has recommended to the NAC that NASA actively engage in the advanced planning processes necessary to accommodate the appropriate containment of samples from Mars and, further, that the agency should update existing documents and obtain specific further planning advice to prepare for Mars sample return missions. NAC has asked that the PPS and PSS bring forward an integrated set of recommendations. Toward that end, the PSS charged CAPTEM and MEPAG to discuss the PPS recommendations and other Mars sample containment and curation issues and bring forward recommendations to the full PSS at our next meeting.

Integration of Mars into Solar System Strategic Planning

In its reports from its first two meetings in May and July 2006, the PSS made the following recommendation: **“Strategic planning for solar system exploration should integrate the currently distinct plans for Mars and the Moon with those for other solar system bodies. Maintaining separate planning efforts runs the risk that intellectual gaps will arise between plans for different solar system targets and that technological and programmatic efforts will be unnecessarily duplicative. Such a synthesis of planning efforts does not imply integration at the programmatic level.”** Such an integration of planning is occurring for the scientific exploration of the Moon, but the strategic planning for the exploration of Mars has remained largely independent of that for the rest of the solar system, both within NASA and within the NRC (e.g., the decadal survey). The disadvantages of the distinct strategies have become apparent now that the Mars Exploration Program is facing budget cuts disproportionate to those of other programs in PSD, because there is no cross-cutting basis for redressing such budgetary changes within a single coherent strategy for solar system exploration.

The PSS wishes to repeat its earlier recommendation so that, as similar budget issues are encountered in future years, the PSD will have a scientifically sound, community-based strategic plan on which to rely as trades among mission candidates and program elements are considered across the entire division.

Activities of Assessment and Analysis Groups

Incoming VEXAG chair Ellen Stofan summarized current VEXAG activities and the principal issues facing the Venus science community. VEXAG considers that the Venus In Situ Explorer (VISE) mission remains a compelling candidate for a New Frontiers mission, and a Science and Technology Definition Team (STDT) for a Venus Flagship Mission study has recently been formed. The STDT, chaired by Mark Bullock (Southwest Research Institute), held its first meeting in February; an initial report is due in May, and a final report will be presented in the fall. VEXAG has also sponsored a Venus-Earth Connections Initiative, chaired by David Grinspoon (Denver Museum of Nature and Science); the group plans a briefing to PSD in May. The next VEXAG meeting will be 7-8 May in Greenbelt, Maryland. News on VEXAG activities is posted regularly on <http://www.lpi.usra.edu/vexag/>.

LEAG chair Clive Neal summarized recent LEAG activities. As noted above, LEAG has been charged by the NAC to develop a “Lunar Goals Roadmap” that maps science goals to objectives, needed observations, and measurement requirements. In response to that charge, LEAG is coordinating a community-wide effort entitled “Exploring the Moon in the 21st Century: Themes, Goals, Objectives, Investigations, and Priorities, 2008.” Candidate themes include (1) pursuit of scientific activities to address fundamental questions about the evolution of the solar system, the universe, and our place in them; (2) use of the Moon to prepare for future missions to Mars and other destinations; and (3) extending sustained human presence to the Moon to enable eventual settlement. These themes, as well as corollary and cross-cutting

themes, will be posted on the LEAG website for community feedback, and additional comments will be sought at the Lunar and Planetary Science Conference later this month and the Lunar Science Conference this July. The roadmap is scheduled to be completed by the time of the next LEAG meeting, set for 28-31 October at Cape Canaveral to coincide with the currently expected launch date of LRO. News on ongoing LEAG activities is posted on <http://www.lpi.usra.edu/leag/>.

MEPAG chair Jack Mustard summarized recent activities of the group. MEPAG's MSL Cache Science Analysis Group (SAG) has completed an assessment of how MSL caching contributes to program goals. The Next Decade SAG has been defining the scientific scope of MSR within the MEP. The Human Exploration of Mars SAG has worked on defining scientific activities that will lead to the human exploration of Mars. The Mars Strategic Science SAG has addressed the top two priorities for strategic missions prior to MSR. Most recently, a Mars Architecture Tiger Team has been crafting a next-generation MEP architecture in light of the President's budget for 2009 and out-years 2010-2013. MEPAG endorsed the current MEP architecture calling for launch of a Mars Scout and support of ESA's ExoMars mission in 2013; launch of an orbiter, rover, or network mission in 2016 depending on budget and links to MSR; and launches of two elements of MSR in 2018 and 2020. They note, however, that the most recent budget does not support such an architecture and that more limited programs consistent with that budget have an imbalanced program and major gaps in mission launches. News on MEPAG activities is posted regularly on <http://mepag.jpl.nasa.gov/>.

OPAG chair Fran Bagenal provided an update on OPAG activities. At its November 2007 meeting, OPAG tracked the progress on the four outer planet flagship mission studies. The dedicated Enceladus mission was deemed too technically challenging given the predicted difficulty with orbit insertion and maintenance for that small, irregular body. Looking beyond the next flagship, OPAG is developing the science rationale for one or more future missions, involving an orbiter and/or probes, to the Uranus or Neptune systems. The next OPAG meeting is 31 March-1 April in Boulder, Colorado. News on OPAG activities is posted regularly on <http://www.lpi.usra.edu/opag/>.

The PSS was pleased that NAC had forwarded, and NASA had acted upon, the subcommittee's recommendation to form a Small Bodies Assessment Group, and newly appointed SBAG chair Faith Vilas discussed the group's near-term plans. SBAG has formed a steering committee, and a NASA Headquarters point of contact (Mike Kelley) has been named. The terms of reference have been drafted, and the first meeting is planned to be held immediately prior to or following the *Asteroids, Comets, Meteors 2008* conference in July. Even prior to the first SBAG meeting, the steering committee provided input to James Green in advance of the International Primitive Body Exploration Working Group (IPEWG) meeting held in Okinawa in January.

CAPTEM chair Chip Shearer summarized recent CAPTEM activities. CAPTEM is continuing to plan for the preliminary examination of Stardust interstellar dust samples as well as co-sponsorship of a Stardust Science Workshop later this year. CAPTEM is sponsoring a workshop next month on Mars Sample Return that will address mission strategies and sample requirements from the perspectives of astrobiology and planetary evolution, with a particular focus on sulfates and hydrous minerals. The committee is also examining pathways toward sample return missions that would lower risk and cost and will post their findings following their next meeting this spring. News on these and other CAPTEM activities may be found at <http://www.lpi.usra.edu/captem/>.

Participating via teleconference, Bill Bottke outlined some of the activities of the Planetary System Science MOWG, one of perhaps half a dozen active MOWGs that provide community feedback to PSD R&A programs. The Planetary System Science MOWG reports to the R&A programs in planetary astronomy, planetary atmospheres, and near-Earth-object (NEO) observations. An ongoing topic of discussion within this MOWG are the future of NASA-

supported ground-based facilities, such as the Infrared Telescope Facility (IRTF) and the planetary radar facility at the Arecibo Observatory, as well as access by NASA-funded investigators to large optical telescopes (e.g., Keck, Gemini). Other topics of interest in the near term are NASA's expanded programs in suborbital observations, changes to proposal evaluation and R&A management, and several issues dealing with NASA's mandate in the area of discovering and characterizing NEOs.

As a final action, the PSS scheduled its next meeting for 23-24 June 2008 at the NASA Goddard Space Flight Center in Greenbelt, Maryland.

**Planetary Science Subcommittee Meeting
3-4 March 2008
Abelson Building
Carnegie Institution of Washington**

3 March (8:30 AM – 6:30 PM)

8:30	Welcome, Introduction of New Members, Appreciations of Departing Members & Other Administrivia	Sean Solomon, Michael New
8:45	Planetary Science Division Update <ul style="list-style-type: none"> • Impacts of 2009 President's Budget • Discovery 2006 selection • Mar Scout selection postponement • Status of New Frontiers AO • PI requirements for New Frontiers and Discovery Programs • MSR and OPF update • MSL status update • LRO status update • ExoMars update 	Jim Green, Doug McCuistion
10:30	Discussion	Sean Solomon
11:00	Discussion with the Associate Administrator	S. Alan Stern
12:15	Lunch	
1:15	Annual Ethics Briefing	Rebecca Gilchrist
2:15	Requirements for a Mars Sample Receiving Facility	Ron Atlas
3:00	Analysis Group & MOWG Reports <ul style="list-style-type: none"> • VExAG • LEAG • MEPAG • OPAG • SBAG • CAPTEM • PSS MOWG 	Ellen Stofan Clive Neal Jack Mustard Fran Bagenal Faith Vilas Chip Shearer Bill Botke
5:00	Discussion	Sean Solomon
6:30	Adjourn PSS dinner at Jaleo, Bethesda, MD	

4 March (8:30 AM – 5:30 PM)

8:30	Administrative Matters	Sean Solomon, Michael New
8:45	Report on Lunar Architecture 2 Study	Geoff Yoder
9:45	Report on Outpost Science and Exploration Working Group Activities	Kelly Snook
10:15	Discussion	Sean Solomon
12:00	Lunch	
1:00	NRC Committee to Assess Solar System Exploration	Wes Huntress
3:00	Break	
3:30	Discussion	Sean Solomon
4:30	Formulation of Recommendations & Planning of Future Meetings	Sean Solomon
5:30	Adjourn	