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

Tempe, Arizona
26 February 2007

Introduction

The Planetary Science Subcommittee (PSS) of the NASA Advisory Council (NAC) Science Committee met for the fourth time on 26 February 2007 in Tempe, Arizona. A total of 14 of the 18 subcommittee members participated in the meeting, either in person or via teleconference. Because the subcommittee chair was stranded by a snowstorm and could participate only by teleconference, the meeting was chaired by the subcommittee vice-chair, Fran Bagenal.

The agenda (attached) included a number of presentations and discussion topics. On the morning of the first day of the meeting, James Green, Director of the Planetary Science Division (PSD), Science Mission Directorate (SMD), updated the subcommittee on Division activities and responses to PSS and NAC recommendations from earlier meetings. Michael Meyer, Mars Exploration Program Lead Scientist, summarized current status and planning in that program; Doug McCuiston, Director of the Mars Exploration Program, supported the discussion via teleconference.

The afternoon featured presentations, by the respective analysis or assessment group chair, on recent activities of the Venus Exploration Analysis Group (VEXAG), Lunar Exploration Analysis Group (LEAG), Mars Exploration Program Analysis Group (MEPAG), Outer Planets Assessment Group (OPAG), Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM), and Field Exploration Analysis Team (FEAT). The subcommittee adjourned for an hour to hear a presentation and question and answer session by NASA Administrator Michael Griffin. The subcommittee reconvened for a final discussion session to evaluate the day's findings and to prepare recommendations for transmittal to the NAC Science Committee.

The PSS meeting was followed by a four-day NAC-sponsored Workshop on Science Associated with the Lunar Exploration Architecture at which PSS members played active roles. PSS findings and recommendations made at that workshop are not treated in this report but will be incorporated in a report by the workshop executive committee that summarizes the integrated outcomes from that meeting.

Leadership of the Planetary Science Division

The PSS was pleased that James Green had been appointed PSD Director, effective 22 February 2007, and that James Adams had been named the PSD Deputy Director. As we have noted in earlier reports, Dr. Green readily appreciates all of the issues facing the Division, and he has made notable progress on several of them with his characteristic energy, enthusiasm, and problem-solving creativity. Dr. Green's report that additional staff positions had been filled within PSD and that searches previously on hold were again active was also cause for encouragement.

Discovery and Scout Programs

The PSS applauds the announcements, on 31 October 2006 and 8 January 2007, respectively, of mission candidates for the Discovery and Mars Scout Programs. The Phase A funds awarded to a total of five mission candidates and six missions of opportunity in the two programs should ensure the healthy continuation of both programs and provide exciting opportunities for new scientific discovery.

New Frontiers Mission Candidates

At its September meeting the PSS recommended that a process be put into place for regularly updating potential targets for New Frontiers missions before each New Frontiers Program competition, and this recommendation was forwarded by the NAC to NASA. The PSS was therefore pleased to hear that PSD will request that the National Research Council's Committee on Planetary and Lunar Exploration (COMPLEX) carry out a study, based on the solar system decadal strategy, for criteria and principles to guide the selection of mission candidates. The PSD plans to develop a list of perhaps five mission candidates and communicate that list to the scientific community by the end of this fiscal year.

Flagship Missions

At its September meeting the PSS recommended that in-depth studies be carried out to evaluate mission concepts and technologies for potential outer solar system missions as soon as feasible, and the NAC forwarded this recommendation to NASA. The subcommittee therefore applauds several actions taken by PSD to respond to this recommendation. Studies were initiated on 1 October 2006 to evaluate if a mission to either Enceladus or Titan could fit within the New Frontiers Program line and achieve the primary science objectives for that target body. Science Definition Teams (SDTs) were named this past January to study potential flagship missions to Europa, Ganymede, Enceladus, and Titan. The SDT studies are scheduled to be completed this fall and will form the basis for strategic planning for the next outer planet flagship mission.

The PSS also encourages the PSD to broaden the consideration of future flagship missions to other solar system targets of high priority to the planetary science community. VEXAG, in particular, has recommended that the study of a flagship mission to the surface of Venus would help to identify those technology investments that, if made in the near term, would enable such a mission to be feasible thereafter.

Missions of Opportunity

At its September meeting the PSS recommended that PSD should consider opening opportunities for mission of opportunity (MOO) proposals on a more frequent basis than that of Discovery and Scout Program announcement releases. PSD developed this concept further and presented it to the SMD Management Council (SMD-MC) for approval. Although receptive to this idea, the SMD-MC has deferred a decision on this issue until the new SMD Associate Administrator is in place. The PSS looks forward to hearing of further progress on this issue at its next meeting.

Research and Analysis Programs

At each of its previous meetings, the PSS recommended that efforts be made to restore the damaging cuts to NASA's Research and Analysis (R&A) budgets in PSD in fiscal years 2006 and 2007. The subcommittee was therefore heartened to learn of several actions that constitute progress toward addressing this issue. An internal PSD retreat held on 20-21 December 2006 among PSD leadership and R&A Program Officials resulted in a new policy, announced on 20 February 2007, that streamlines the notification and award procedure for many of the most highly rated proposals. The retreat also identified those R&A programs most in need of funding augmentations on the basis of proposal pressure and low success rates. Equally importantly, the PSS was pleased to learn that two new R&A programs had been initiated for Lunar Advanced Science and Exploration Research (LASER), jointly supported by the Exploration Systems Mission Directorate (ESMD), and New Horizons at Jupiter Data Analysis. The former program is responsive to earlier PSS recommendations that PSD take steps to ensure that data from past and future lunar missions are fully utilized, and the latter program will permit the community to take maximum advantage of the New Horizons flyby of the Jupiter system that occurred during the same week as the subcommittee meeting. In addition to these two new programs, a partial restoration of $5.8M has been made to R&A funding levels in fiscal year 2007.

Notwithstanding these clear signs of progress, there remain areas of concern:

• The PSD is carrying a large number of distinct R&A programs, and the process of managing the reviewing, selecting, and reporting of the ~1000 individual grants is taxing to the Program Officials and to the community members tasked to serve on review panels.

• One of the responses to program cuts taken by a few PSD R&A Program Officials has been to levy across-the-board reductions in all grants, but this approach drives the community to increase the number of proposals submitted, reducing time spent on science in support of NASA objectives and stressing the proposal evaluation process even further.

• Some mission data analysis is carried out within mission budgets, but mission cost growth can come at the expense of delayed data analysis and archiving, inadequate scientific analysis, and consequent additional burdens on the R&A programs.

• Whereas data analysis programs are in place for most ongoing and recent missions, planning efforts for future missions would benefit from renewed analysis of data from older missions, such as Magellan at Venus and Voyager at the outer planets and their satellites.

It is the sense of the PSS that the PSD and the community would benefit by greater visibility of R&A program information, including the posting of statistics on proposal success rates and award levels and searchable lists of award titles, abstracts, and reports. The PSS looks forward to hearing of further progress on the above issues, as well as toward restoring overall budget levels, in future reports on the PSD R&A portfolio.

PSD Budget Flexibility

The PSS is concerned that contingency funds within the PSD budget appear to have fallen to levels too low to permit the ready solution of the type of problems that often occur with development and flight programs. Further, without some flexibility in the budget the Division may be unable to follow up effectively on scientific discoveries or to take advantage of opportunities for cooperative endeavors. Discussion of the budget flexibility issue drew the subcommittee again to the subject of "taxes" that have been levied on the PSD but are not readily apparent in the publicly presented budget.

In an effort to identify the full spectrum of pressures on budget flexibility, the PSS therefore repeats a recommendation made in our report from the May 2006 PSS meeting:

• *To enable the accurate tracking of support for PSD science programs, cost increases associated with the transition to full-cost accounting at NASA centers, "corporate" charges, and capital outlays (e.g., for construction of buildings) should be itemized and should not be counted as contributors to growth in science budgets. Further information on such costs should be provided to the PSS at a future meeting*.

We suggest that the next subcommittee meeting might be an appropriate opportunity to address this topic.

Closure of the Arecibo Radar

The radio telescope at Arecibo, Puerto Rico, has provided unique information about asteroids, comets, satellites, and solid planets. Arecibo has the highest angular resolution of all radio telescopes and provides the most complete and accurate data on the sizes, shapes, and rotation rates of near-Earth asteroids. Arecibo has provided the best current information on the nature of polar deposits on the Moon and Mercury. Observations made from Arecibo, some made together with observations at a second telescope, have led to fundamental improvements in knowledge of the rigid-body motions of the inner planets, including recently the first observation of the forced librations of Mercury, a result that constrains that planet to have a fluid outer core.

The Arecibo Observatory has been supported primarily by the National Science Foundation (NSF) and managed by Cornell University. A senior review of astronomical facilities supported

by NSF, however, recently recommended that support for Arecibo be reduced to a level at which the facility's radar capability will have to be shut down, perhaps as early as the end of this calendar year. Such a closure would constitute a serious and permanent loss of capability to radar astronomy in support of NASA planetary science objectives.

• *The PSS recommends that PSD convene, within the next two months, a small group of planetary science experts to evaluate the science that would be lost by closure of the Arecibo radar capability. On the basis of that evaluation, PSD should make a timely decision whether funds should be sought to maintain the continued operation of the Arecibo radar facility beyond this calendar year and at what level of support.*

Technology Investment

The PSS is encouraged by the attention now being devoted to technology issues within PSD. Nonetheless, there are areas of concern. Technology development funds are limited, and an assessment is warranted of those technologies that are most urgently needed for near-term missions, technologies that are common to multiple mission objectives (e.g., sample return), and technical readiness levels of technologies already identified as critical. These issues extend to scientific instrumentation, particularly to instruments that could substantially augment the scientific return from missions expected within the next few years.

The PSS repeats a recommendation made in May 2006: *At some future meeting, a fuller discussion of technology needs for future missions and the costs of those technologies should be scheduled. Instrument development programs should be included in that discussion.*

We further suggest that the next PSS meeting would be an appropriate time to schedule such a discussion.

International Collaboration

At its September meeting, the PSS was asked for guidance on a situation involving a selected PI-led mission (Juno) for which an international partner was offering to contribute an additional instrument as well as several spacecraft subsystems. After offering general guidelines for PI-led missions facing this issue, the PSS acknowledged that situations could arise in which the offer of spacecraft components or subsystems, if accepted, would reduce mission risk or enable full mission success criteria to be achieved by a cost-capped mission. The subcommittee further advised that in such a situation the decision whether to accept the coupled offer is programmatic rather than primarily scientific and that a thorough review of scientific merit, technical accommodation, cost impact, and mission risk impact should be made prior to rendering such a programmatic decision.

On the basis of these recommendations the PSD developed a protocol for review and approval in such situations, and the specific offer from the international partner on the Juno mission was accepted.

There is now a need for broad communication of PSD expectations regarding the role and timing of international collaboration on competed missions. The PSS suggests that the "Discovery at 15" workshop planned for 19-20 September 2007 include a thorough discussion of this topic. The PSS encourages the Division to disseminate these expectations through other community meetings as well.

Closely related are the International Traffic in Arms Regulations (ITAR) and their impact on cooperation and communication with international partners in space missions. The PSS endorses plans for a community workshop on this topic.

Activities of Assessment and Analysis Groups

VEXAG co-chair Janet Luhmann reported that the group's top priority is the creation of a "community consensus" on Venus science priorities and technology development needs for future missions. The group also provides a forum for establishing connections among

representatives of international Venus mission teams (the European Space Agency's Venus Express, NASA's MESSENGER, the Japan Aerospace Exploration Agency's Venus Climate Orbiter, and the VESPER mission now under consideration by the Discovery Program). As an outcome of its most recent meeting in January, VEXAG brought forward four recommendations. The first is to initiate a Venus Data Analysis Program in order to exploit fully the results from the Venus Express mission and MESSENGER Venus flyby observations. The second is to initiate a study of a flagship mission to the Venus surface or near surface at the earliest opportunity (see above). The third recommendation is that a Venus In Situ Explorer (VISE) be retained as a candidate mission in the next call for proposals to the New Frontiers Program. The fourth is that NASA should invest in technologies needed to operate a spacecraft in the extreme environment near the Venus surface. News on VEXAG activities is posted regularly on http://www.lpi.usra.edu/vexag/.

LEAG chair Clive Neal, although able to participate in only a portion of the meeting via teleconference, prepared a presentation on recent LEAG activities. The group has constituted an Executive Committee to help manage requests made to the group by NASA Directorates, NAC, and NAC's committees and subcommittees. LEAG oversaw the analysis and report to ESMD of objectives for lunar exploration within the core themes of science and lunar habitation. The former activity was in part the result of a specific request from PSS that LEAG provide a scientific prioritization of the planetary science objectives developed by the Lunar Architecture Team as input to the deliberations of the Workshop on Science Associated with the Lunar Exploration Architecture. News on LEAG activities is posted regularly on http://www.lpi.usra.edu/leag/.

MEPAG chair Ray Arvidson described the status of group activities and the outcomes of the group's most recent meeting in January. A Science Analysis Group (SAG) has been chartered to assess options for the Mars Science Orbiter mission and to complete a final report of its findings by 15 May. Other SAGs are being organized to analyze mission options for 2016-2018 and to assess opportunities for lunar exploration activities to "feed forward" to Mars exploration. MEPAG is working with ESMD and SMD in a Mars Architecture Working Group to establish design reference missions for eventual human missions to Mars. MEPAG is also revising its goals document and leading a discussion among science teams from planned Mars lander missions (Phoenix, Mars Science Lander, and ESA's ExoMars) to exchange information and protocols for organic blanks to be used in astrobiology investigations. News on MEPAG activities is posted regularly on http://www.mepag.jpl.nasa.gov/.

OPAG chair Fran Bagenal reported that the group is enthusiastic in their support of the formation of SDTs for flagship missions to Europa, Titan, Enceladus, and Ganymede. OPAG endorses an Announcement of Opportunity in the New Frontiers Program by late 2008 and looks forward to the recommendations by COMPLEX of New Frontiers mission candidates. In recognition of its charter to assess NASA's programs to explore all bodies in the outer solar system, OPAG has formed a primitive body working group to evaluate what can be expected to be learned about such bodies from current and planned missions and ground-based observations over the coming 5-10 years. OPAG reiterates the need for investment in key technologies that will be critical to future outer planets mission, including power systems, aerocapture technology, and communication systems. News on OPAG activities is posted regularly on http://www.lpi.usra.edu/opag/.

CAPTEM chair Chip Shearer described the group's role in the allocation of extraterrestrial material, including lunar samples, Stardust and Genesis samples, and cosmic dust samples. Further, CAPTEM provides expertise and guidance to NASA in the area of curation both of the current sample collection and of future samples to be returned from the Moon, Mars, and other bodies. The group also sponsors sample-oriented workshops and other initiatives and most recently co-sponsored with MEPAG and the Lunar and Planetary Institute two scientific meetings, a Workshop on Martian Sulfates as Recorders of Atmosphere-Fluid-Rock Interactions

(October 2006) and a Workshop on Early Planetary Differentiation (December 2006). News on CAPTEM activities is posted regularly on http://www.lpi.usra.edu/captem/.

FEAT chair Arthur Snoke introduced activities of the team through a white paper, prepared by NAC chair Harrison Schmitt with the assistance of FEAT members. The white paper described the rationale for a Planetary Field Exploration Project to develop a new astronaut-training program in field geology and related lunar surface activities.

Planetary Science Subcommittee Meeting Agenda
February 26, 2007
Fiesta Inn Resort
2100 South Priest Drive
Tempe, AZ 85282

26 February (8:00 AM – 6:00 PM)

8:00	Welcome & Administrative Matters	Fran Bagenal, Michael Meyer
8:15	Planetary Science Division Update • Program overview • Overview of Discovery selections • Outcome of divisional R&A retreat • Update on NEOO transition • Update on integration of DSN into SOMD • Effects of possible NSF shutdown of Arecibo • Outcome of NEO Analysis of Alternatives • Impact of new SSE Roadmap • FY07 and FY08 budget outlook • Overview of outer solar system concept studies. • PSD responses to PSS & NAC recommendations	Jim Green
9:45	Break	
10:00	Mars Exploration Program Update • Program overview including discussion of budget situation • Overview of Mars Scout selections • Current planning for 2013 launch opportunity • Analysis of loss of MGS: causes and effects	Doug McCuistion
11:00	Discussion	Fran Bagenal
12:00	Lunch	
1:00	Analysis Group Reports • VEXAG • LEAG • MEPAG • OPAG • CAPTEM • FEAT	 Janet Luhmann Clive Neal Ray Arvidson Fran Bagenal Chip Shearer Art Snoke
3:30	Presentation by NASA Administrator	
4:30	Discussion and Preparation of Recommendations	Fran Bagenal
6:00	Adjourn	