SBAG
SMALL BODIES ASSESSMENT GROUP

Welcome & Report

SBAG 7, Pasadena CA
June 10-11, 2012

Mark V. Sykes
Planetary Science Institute

Recent Activities

- SBAG 6 held January 17-18, 2012 in Washington DC – First meeting since being jointly chartered by SMD and HEOMD. TOR posted on SBAG website.
- White paper describing a SB component of a NASA Exploration Science Institute finalized and posted.

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- Tasked to identify SKGs for implementing asteroid mission scenarios and architectures for human exploration. SAT established (Rivkin, Lead).
- Co-sponsor of PSAG to define precursor activities necessary for human missions to Mars (Phobos/Deimos focus).
- RAT (Roadmap Action Team) working to condense and structure materials.

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- Planetary Science Subcommittee telecon, February 23, and meeting, May 8-9, 2012.
- New committee members selected for cycling on this August.

Some Events Since SBAG 6

- President's FY13 budget proposal cuts planetary 20%, more in outyears.
- Discovery call delayed (latest selection imminent).
- Successful ACM conference in Niigata, Japan (May 16-20, 2012).
- Commercial ventures moving forward – B612, Planetary Resources Inc.

Review of SBAG 6 Findings

Finding 1. The SBAG is pleased that the PDS Small Bodies Node is developing an interface to search the numerous and diverse data sets related to small bodies. The Data Ferret has a nice interface for returning information about data on individually identified objects. At present, this is limited primarily to asteroid data and needs to include its comet data holdings. The ability to conduct more sophisticated SQL-type queries is very desired, as is a means of intelligently sifting through large volumes of imaging, spectral and other data accumulated by spacecraft for individual objects (e.g., Eros, Hartley 2, and in the near future Vesta) – perhaps using tools similar to those available for searching data on Mars and the Moon. We request regular updates on these tools at our SBAG meetings.

PDS SBN will begin giving annual reports to SBAG on its activities, including tools under development. It wants to use SBAG as a means of getting feedback to improve its services to the small bodies community.

Finding 2. The B612 initiative to build a largely privately funded NEO survey telescope is potentially exciting. However, before NASA invests any of its limited resources in supporting this venture, there should be an external peer review of the mission design to ensure that it will satisfy NASA needs, which need to be articulated first, and that those needs are cost-effectively addressed. If the level of needed investment by PSD is equivalent to a Discovery MoO or Discovery mission, then such support should be sought through open competition from those programs.

We welcome B612 at our meeting today, and look forward to hearing about their plans.

Finding 3. Any contribution of instruments or sampling systems by NASA to the ESA Marco Polo mission should be subject to open competition among potential providers.

NASA Budget Update

Budget Authority, dollars in millions	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	Notional FY 2014	FY 2015	FY 2016	FY 2017
NASA FY 2013	**18,448.0**	**17,770.0**	**17,711.4**	**17,711.4**	**17,711.4**	**17,711.4**	**17,711.4**
Science	**4,919.7**	**5,073.7**	**4,911.2**	**4,914.4**	**4,914.4**	**4,914.4**	**4,914.4**
Planetary Science	**1,450.8**	**1,501.4**	**1,192.3**	**1,133.7**	**1,102.0**	**1,119.4**	**1,198.8**
Planetary Science Research	158.8	174.1	188.5	222.5	233.4	231.7	230.3
Planetary Science Research and Analysis	122.3	122.3	125.3	130.1	133.5	134.6	135.5
Other Missions and Data Analysis	24.0	27.4	38.8	64.6	72.1	69.5	66.9
Education and Directorate Management	4.6	4.0	4.0	7.3	7.3	7.1	7.4
Near Earth Object Observations	7.8	20.4	20.5	20.5	20.5	20.5	20.5
Lunar Quest Program	130.2	139.9	61.5	6.2	0.0	0.0	0.0
Lunar Science	61.7	66.7	17.3	3.7	0.0	0.0	0.0
Lunar Atmosphere and Dust Environment	64.5	70.4	41.4	2.5	0.0	0.0	0.0
Surface Science Lander Technology	4.0	2.8	2.8	0.0	0.0	0.0	0.0
Discovery	192.0	172.6	189.6	242.2	235.6	193.8	134.3
Other Missions and Data Analysis	192.0	172.6	189.6	242.2	235.6	193.8	134.3
New Frontiers	213.2	160.7	175.0	269.8	279.6	259.9	155.1
OSIRIS-REx	4.9	110.3	137.5	228.8	224.2	202.1	44.9
Other Missions and Data Analysis	208.3	50.5	37.5	41.0	55.4	57.8	110.1
Mars Exploration	547.4	587.0	360.8	227.7	188.7	266.9	503.1
MAVEN	160.6	245.7	146.4	37.6	17.3	5.3	0.0
Other Missions and Data Analysis	386.8	341.4	214.4	190.1	171.4	261.6	503.1
Outer Planets	91.9	122.1	84.0	80.8	78.8	76.2	76.3
Outer Planets	91.9	122.1	84.0	80.8	78.8	76.2	76.3
Technology	117.3	144.9	132.9	84.6	85.9	90.9	99.6
Technology	117.3	144.9	132.9	84.6	85.9	90.9	99.6

Status Summary

FY11	**FY12**	**FY13**	**FY14**	**FY15**	**FY16**	**FY17**
1450.8	1501.4	1192.3	1133.7	1102.0	1119.4	1198.8
		1292.3	Senate - +$100M to Other Mars missions (supporting MSR)			
		1400.0	House - +$3.5M R&A, +115.4M for Discovery & NF, +$88M Mars/other flagship			

SB-related R&A programs

	FY08	FY09	FY10	FY11	FY12 (LPSC)	%(12/11)
Planetary Geo. & Geophys.	15.06	12.233	10.044	12.116	12.539	3.5
Cosmochemistry	16.23	10.57	11.67	12.331	14.506	17.6
Planetary Astronomy (PAST)	10.52	10.685	9.963	9.045	10.163	12.4
Planetary Atmospheres (PATM)	8.78	9.898	8.753	8.915	9.1	2.1
Planetary Inst. Def & Dev (PIDDP)	10.68	11.375	10.086	9.235	10.946	18.5
Origins of the Solar System (Origins)	5.7	6.395	5.267	5.272	7.118	35
NEO-WISE/NEO	0.243	1.918	1.8	0.66	0.276	-58.2
Sample Ret Lab Inst & DAP (SRLIDAP)	6.72	11.945	3.947	10.693	9.513	-11
Discovery DAP (aka PMDAP)	3.68	4.041	2.094	2.516	3.5	39.1
Dawn PSP			0.555	1.67	1.71	2.4
Cassini DAP	6.5	5.8	4.035	5.527	5.61	1.5
Outer Planets Research (OPR)	6.67	7.698	7.922	11.998	11.88	-1
NEOO	5.02	3.701	5.8	7.848	20.435	260
Hayabusa PSP	0.224	0.178	0.259	0.304	0	-100

Discovery and New Frontiers Update

Discovery Proposal Due Date	Missions Flown	Delta-Time (months)
	NEAR, Pathfinder, Lunar Prospector	
October 1994	Stardust	
December 1996	Genesis, Contour	26
June 29, 1998	Deep Impact, MESSENGER	18
August 18, 2000	Dawn, Kepler	26
July 16, 2004	No Selections	47
April 5, 2006	GRAIL	21 (68)
September 10, 2010	Pending	53
2015		52+

May 5, 2011 – Three Discovery proposals selected for further study

Interior Exploration Using Seismic Investigations, Geodesy, and Heat Transport (InSight) would study the structure and composition of the interior of Mars and advance understanding of the formation and evolution of terrestrial planets. Bruce Banerdt of NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif., is principal investigator. JPL would manage the project. [Editorial note: This previous post describes a two station Mars geophysical network, while the short description for this candidate proposal suggests it may be for a single station.]

Titan Mare Explorer (TiME) would provide the first direct exploration of an ocean environment beyond Earth by landing in, and floating on, a large methane-ethane sea on Saturn's moon Titan. Ellen Stofan of Proxemy Research Inc. in Gaithersburg, Md., is principal investigator. Johns Hopkins University's Applied Physics Laboratory in Laurel, Md., would manage the project.

Comet Hopper would study cometary evolution by landing on a comet multiple times and observing its changes as it interacts with the sun. Jessica Sunshine of the University of Maryland in College Park is principal investigator. NASA's Goddard Space Flight Center in Greenbelt, Md., would manage the project.

FINAL SELECTION TO BE MADE SHORTLY!

May 5, 2011 – Three proposals for technology development

Primitive Material Explorer (PriME) would develop a mass spectrometer that would provide highly precise measurements of the chemical composition of a comet and explore the objects' role in delivering volatiles to Earth. Anita Cochran of the University of Texas in Austin is principal investigator.

Whipple: Reaching into the Outer Solar System would develop and validate a technique called blind occultation that could lead to the discovery of various celestial objects in the outer solar system and revolutionize our understanding of the area's structure. Charles Alcock of the Smithsonian Astrophysical Observatory in Cambridge, Mass., is principal investigator.

NEOCam would develop a telescope to study the origin and evolution of NEOs and study the present risk of Earth-impact. It would generate a catalog of objects and accurate infrared measurements to provide a better understanding of small bodies that cross our planet's orbit. Amy Mainzer of JPL is principal investigator.

All three Small Bodies related projects!

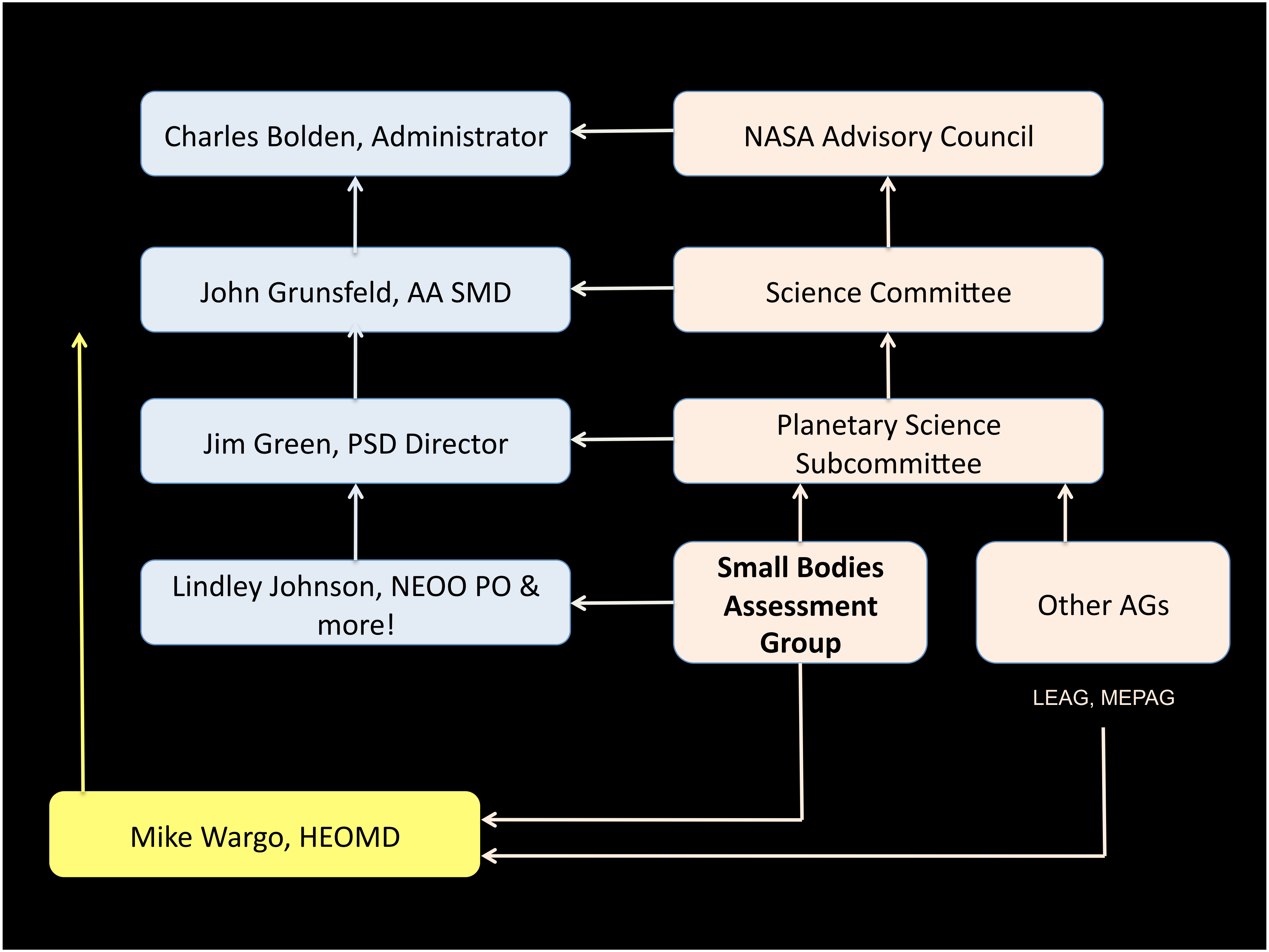
New Frontiers

New Frontiers Proposal Due Date	Missions Flown/ To be Flown	Delta-Time (months)
April 6, 2001	New Horizons	
February 13, 2004	Juno	34
July 31, 2009	OSIRIS-Rex	65
2016		66+

Decadal Recommendations for NF4:

Comet Surface Sample Return
Lunar South Pole-Aitken Basin Sample Return
Saturn Probe
Trojan Tour and Rendezvous
Venus In Situ Explorer

Planetary Science Subcommittee Report


Charles Bolden, Administrator
NASA Advisory Council
John Grunsfeld, AA SMD
Science Committee
Jim Green, PSD Director
Planetary Science Subcommittee
Lindley Johnson, NEOO PO & more!
Small Bodies Assessment Group
Other AGs
LEAG, MEPAG
Mike Wargo, HEOMD

May 8-9, 2012
NASA HQ

- NASA would support the B612 asteroid survey mission through the use of the Deep Space Network, as well as providing assistance with data analysis and archiving.
- Draft Cooperative Agreement Notice (CAN) of a joint PSD/HEOMD institute (follow on to the NLSI) ready for release at the NLSI Lunar Science Forum July 17-19.
- Much discussion of R&A program health, decreasing selection rates, workload on program officers, combining program reviews.
- Top concerns included slowing cadence of Discovery and New Frontiers
- Recommendations to Jim Green not yet finalized, but soon.

These meetings can be attended by Webex. MVS will work to put out more consistent notices on the PEN.

Roadmap Action Team Report

Mark Sykes, Julie Castillo-Rogez, Amy Mainzer, Anita Cochran

The challenge of taking ~200 pages of input covering all aspects of small bodies exploration and structuring it into strategic goals/objectives/requirements, the classes of activities that address those requirements, technology and programmatic needs, and ultimately our priorities. Then make it dynamic.

APPROACH:

Identify Strategic Goals. [Now]

By mid-September:

- Generate initial draft of objectives that address each goal, the requirements needed to address each objective and a description of the activities that would allow us to fulfill those requirements.
- Outline Roadmap document including the above and special sections discussing cross-cutting aspects such as R&A and Technology.
- Post on SBAG website and invite SBAG community input to modify and expand to make more complete.

By mid-November:

- Incorporate the community input.
- Generate bullet points for prioritizing activities.
- Post results for more community comment.

At January 2013, SBAG 8

Discuss and finalize prioritizations.

Modifications to the Roadmap will arise as new discoveries, new knowledge, other accomplishments dictate. It is suggested that proposed modifications will be vetted by the Steering Committee, offered to the community for comment, and decided at the following SBAG meeting in open discussion.

STRATEGIC GOALS FOR SMALL BODIES EXPLORATION

SG-A: Determine the inventory of small bodies in the solar system [and about other stars?] and what processes are active in and among them. [Characterize what exists now]

SG-B: Determine how small bodies originated and evolved and what was their role in the origin and evolution of the Sun's family of planets and satellites [as well as planets about other stars?]. [Characterize the past]

SG-C: Understand the role of small bodies in the origin and evolution of life in the solar system. [Life]

SG-D: Determine the hazards posed by small bodies and how can those hazards be mitigated. [Hazards]

SG-E: Support human activity in space and the extension of human presence to other bodies in the solar system. [Resources]

Sample Expansion:

SG-C: Understand the role of small bodies in the origin and evolution of life in the solar system. [Life]

Water and carbon compounds necessary to life on Earth are thought to have arisen from asteroids and comets dynamically scattered into Earth-crossing orbits (REF). Many of these bodies or fragments of these bodies exist today in the asteroid belt and beyond as well as within meteorites and hold important clues to how life arose on Earth.

Ice-rich dwarf planets may possess subsurface oceans (REF). This raises the question of whether these objects could represent reservoirs of life today and also a source of life in the early solar system.

Impacts of asteroids and comets on Earth are known to have affected the evolution of its life.

Objective C-1. Determine the prebiotic components of asteroids and comets and the endogenic and exogenic processes by which they arose.

Objective C-2. Determine the dynamical evolution of small bodies in the solar system, and how this may have delivered astrobiologically important material to Earth and Mars.

Objective C-3. Determine if dwarf planets are or were potential incubators of life.

Objective C-4. Determine if Phobos and Deimos contain Martian material of astrobiological significance.

Sample Expansion:

Objective C-2. Determine if dwarf planets are or were potential incubators of life.

Requirement C-2-1. Thermal modeling of dwarf planet interiors to determine if internal processes could have resulted in the formation of water lenses persisting over all or some fraction of the age of the solar system.

Work by McKinnon (), suggests that all ice-rich dwarf planets may have interior liquid water oceans. Such modeling needs to be updated as more information about these objects

Requirement C-2-2. Determine if dwarf planet ocean chemistry can support the evolution of life.

Interior models for these objects have not accounted so far for the complex chemistry predicted by cosmochemical models that may involve methanol, clathrate hydrates, nitrogen and methane ices, and organics. The products of aqueous chemistry accompanying melting and differentiation may thus be extremely rich, or extremely poor due to kinetic inhibition, but in any case it is poorly constrained at present. Activities would include experimental simulation of hydrothermal environments based on cryogenic volatiles, characterize the thermodynamics and kinetics of fluid-flow interactions in these systems. Investments would need to be made in cryogenic (LHe- and LN2- based) facilities.

Requirement C-2-3. Determine if there is evidence for liquid water in dwarf planets in the past or present.

Spectroscopic observations by large aperture telescopes may detect evidence evaporites on the surface of dwarf planets.

Insitu imaging of the dark surface of Ceres by Dawn could reveal evidence of recent emergence of water (bright evaporates, which could also be spectrscopically identified). Future missions to Ceres with surface penetrating radar could detect interior water lenses or oceans directly, magnetometers could detect influences on the solar wind by ionic currents within interior circulating liquids.

OTHER ITEMS FOR SBAG 7 (Wednesday)

Date for June meeting (SBAG 9).

Meeting planning calendar (T-X for hotel, duration, agenda items).

Procedure for soliciting and appointing new committee members.

Findings.