

Findings and Resolutions from VEXAG Meeting #14  
November 29 - December 1, 2016 meeting

Findings

Finding #1

**VEXAG again requests a reassessment of the Venus flagship described in the 2011 Planetary Science Decadal Survey (PSDS), before the next Decadal Survey convenes in 2020.** The Venus Climate Mission (VCM) was ranked below the Ice Giants flagship, whose detailed study is nearing completion. VCM was ranked equally with Enceladus, which is now a key target in the new Ocean Worlds program. Therefore a Venus flagship mission concept will now also benefit from more detailed study in order to provide a framework to the 2020 deliberations. Driving factors include (1) advancements in instrument maturity that would decrease mass and cost, (2) new concepts in aerial platforms that could enable greater vertical mobility or directed flight, (3) innovation in geophysical techniques and technology that could expand the scope of orbital, aerial, or landed science, (4) the impact of the imminent Discovery selections and upcoming New Frontiers as well as international competitions, and (5) new observations of extrasolar planets that frame Venus in the context of the question: “Does Earth-sized mean Earth-like?”

Finding #2

**VEXAG reaffirms its endorsement of the Venus Gravity Assists Science Opportunity (VeGASO).** We appreciate that the BepiColombo (BC) mission has already agreed to operate its science instruments during the Venus flybys, and we encourage continued science dialogue about the forthcoming Venus gravity-assist opportunities provided by Solar Probe Plus, Solar Orbiter, Europa Multiple-Flyby Mission, and other future missions. VEXAG suggests that a simple two-step sequence is the most efficient path to VeGASO implementation. Beginning with BC, the flight project first issues a Proposal Information Package (PIP) that would describe (in greater detail than the VeGASO report), the spacecraft trajectory and operating parameters and capabilities of the instruments. Next, NASA and ESA would issue concurrent Participating Scientist (PS) calls that would propose science consistent with the PIP, and selections would be coordinated between NASA and ESA. VEXAG recommends this path to ensure that the best possible detailed science justification for potential investigations rests directly with the proposers. VEXAG will encourage participation by interested US scientists at a VeGASO splinter meeting during the BepiColombo Science Working Team in May 2017.

### Finding #3

**VEXAG appreciates recent support from the Planetary Science Division for international science participation and strongly encourages the continued support of these opportunities for collaboration.** The VEXAG community is excited by the science results from the Akatsuki mission to Venus and the involvement of NASA's Participating Scientists in this mission. VEXAG continues to support NASA participation in future international partnerships including mission collaboration and participating scientist programs such as the upcoming European Space Agency's M5 opportunity. Continued NASA support of the COSPAR International Venus Exploration Working Group will facilitate the needed dialogue among other international partners including ESA, JAXA, IKI, and ISRO.

### Finding #4

**VEXAG encourages NASA to support efforts that engage a broader cross-section of the US science community in the Russian Venera-D mission.** We are encouraged by the imminent release of the first report of the Venera-D Joint Science Definition Team and we anticipate continued advancement on this effort. We appreciate NASA's support of VEXAG's May 2017 Workshop on Venus Science Priorities for Modeling and Experiments, which will include a program component for Venera-D.

### Finding #5

**VEXAG encourages NASA to continue its investment in facilities, instruments, and technology maturation that critically enable Venus missions, and we further encourage identification of novel opportunities to deliver these assets to Venus.** VEXAG appreciates NASA's significant investment in facilities like GEER and VICI and the Homesteader, MatISSE, PICASSO, and especially HOTTech programs. VEXAG strongly endorses SmallSat and CubeSat development and the goal of their regular integration into future launches. In particular, VEXAG encourages NASA to consider development of a standardized infrastructure for Venus communications relay (such as the UHF protocols for Mars) that could be sized for such spacecraft. Such a relay could facilitate long-lived surface operations or secondary payload drop-off at Venus.

### Finding #6

**VEXAG encourages NASA to form a cross-divisional research program for Comparative Climatology of the Terrestrial Planets (CCTP).** It is essential to understand Venus, Earth, and other solar system worlds in the context of

exoplanets, and to leverage our detailed knowledge of Earth and our solar system to understand new data on exoplanets. Understanding Venus and other worlds in the context of solar/stellar forcings is, by its very nature, an interdisciplinary endeavor. Collaborations with the Earth climate research community have already provided important expertise and tools to understanding Venus and other worlds. These synergies have been evidenced at prior CCTP meetings. CCTP meetings have been a model of cross-divisional support and other cross-divisional programs (NAI, NLSI/SSERVI, NeXSS) have been successful. It was our understanding that a relevant new program element was forthcoming and we urge NASA to implement this important opportunity.

#### Finding #7

**VEXAG encourages coordination between SMD and HEOMD to study the synergies presented by the human Path to Mars.** Venus flyby trajectories offer unique elements of the delta-V vs mission-duration trade space for heavy lift to Mars of piloted missions and human-infrastructure elements. This enables unique opportunities for Venus science – akin to VeGASO described above – for deployed payloads and human-in-the-loop flyby investigations. Further, Earth-Venus-Earth flyby missions can also provide these science benefits while testing <1-yr interplanetary flights on the human spaceflight on the Path to Mars.

#### Finding #8

**VEXAG encourages PSD support for upcoming opportunities and initiatives, including travel support to international conferences specifically for young career scientists** in the following Venus-relevant meetings supported by VEXAG:

- a. Workshop on Venus Science Priorities for Modeling and Experiments, May 2017, Cleveland, Ohio.
- b. 5<sup>th</sup> International Dunes Workshop, May 2017, St George, Utah.
- c. 15<sup>th</sup> VEXAG meeting, October or November 2017, Location TBD.
- d. CCTP3 Conference, Summer 2018, Atlanta, Washington/Baltimore, or Boston
- e. Potential Targets Workshop 2018 or later.

#### Resolutions

VEXAG will encourage Venus science community participation in the following meetings:

- Interplanetary Probes Workshop 14, The Hague, June 2017
- European Planetary Science Congress (EPSC), Riga, Latvia, September 2017.
- ESLAB Comparative Aeronomy Conference ESTEC, Noordwijk, Netherlands, May 2018
- COSPAR, Pasadena, California, July 2018

- International Venus Conference, Japan, Sept 12-15 2018.

VEXAG recognizes the upcoming mid-term review of the 2011 Planetary Science Decadal Survey and resolves to develop appropriate input from Executive Committee deliberations and community input via the VEXAG website, Venus Town Hall at 2017 LPSC, and Workshop on Venus Science Priorities for Modeling and Experiments.

Because of the accessibility of Venus and the potential value to science and infrastructure there, VEXAG resolves to provide input to the NASA SmallSat and CubeSat requests for information through web forms advertised to the community.

VEXAG recognizes the importance of long-range planning and resolves to contribute one general abstract and solicit specialized abstracts for the Planetary Science Vision 2050 Workshop to be held at NASA HQ early in 2017.