Planetary Science Subcommittee Report to NAC Science Committee

NAC SC Meeting via Webex
November 2, 2015

Janet Luhmann for PSS

Planetary Science Subcommittee Meeting

October 5 and 6 2015

NASA Headquarters

Washington D.C.

Agenda items of interest in addition to usual PSD briefings:

Big Data ....(E. Smith)
NExSS .... (J. Rall)
SMD Education CAN Selection……..... ..(K. Erickson)
NEOO Program and ARM Updates ……. (L. Johnson)
Mars Exploration Program …………………...(J. Watzin)
Mars 2020 Project Update ..…………………..(K. Farley)
Mars 2020 Landing Site Selection and Returned Sample Science ....(M. Meyer)
COSPAR……………………………………...(G. Vane)
AAAC Report On Proposal Success Rates...(K. Stassun)

PSS Findings Summary: October 5-6, 2015

Mars 2022 Orbiter

A Mars 2022 orbiter, inserted into the overall plans for Mars exploration, indicates a large and complex mission set merging goals of human exploration, technology demonstration, and planetary science. Coordination across multiple NASA Directorates will be necessary for funding the proposed mission architecture without placing an undue burden on other Planetary Science missions.

PSS Findings Summary: October 5-6, 2015

Discovery and New Frontiers

The selection of five Discovery missions for Phase A study, leaving open the possibility that 2 missions may be selected for flight, makes significant progress toward returning to the 24 month cadence for Discovery recommended in the Planetary Decadal Survey. We also applaud the commitment from the PSD to release New Frontiers Announcements of Opportunity #4 and #5 during this decadal cycle, as similarly recommended.

PSS Findings Summary: October 5-6, 2015

Assessment of Reorganized R&A

The PSS has requested open access to information on funded R&A Program proposals, including titles, areas, selection rates, and statistics on time to funding. This information is needed to both address community concerns regarding the outcomes of R&A Program restructuring, and to provide insight into R&A activities. Given current difficulties in assembling such information due to lack of tools, PSS requests resources be allocated to program managers to set up a database and software for regularly mining this information.

PSS Findings Summary: October 5-6, 2015

AG Status

Planetary Science AGs (assessment/analysis groups) provide an effective conduit for communication between PSD and the scientific community. Their summaries presented at PSS meetings foster discussion of concerns and topics of broad interest, in the context of scientific progress reporting. We encourage continued opportunities for participation of the AGs in the PSS.

PSS Meeting full text Findings are posted at:
www.lpi.usra.edu/pss/

Agenda items for next PSS meeting (22-23 Feb. 2016):

- Information on CAPS Decadal Survey plan and on NRC ‘Survey of Surveys’ Report
- Update on Planetary Protection Subcommittee activities and plan for June 2016 joint session
- Update on Education CAN activities and plans
- Update on NExSS activities and plans
- Update on PSD cubesats plans

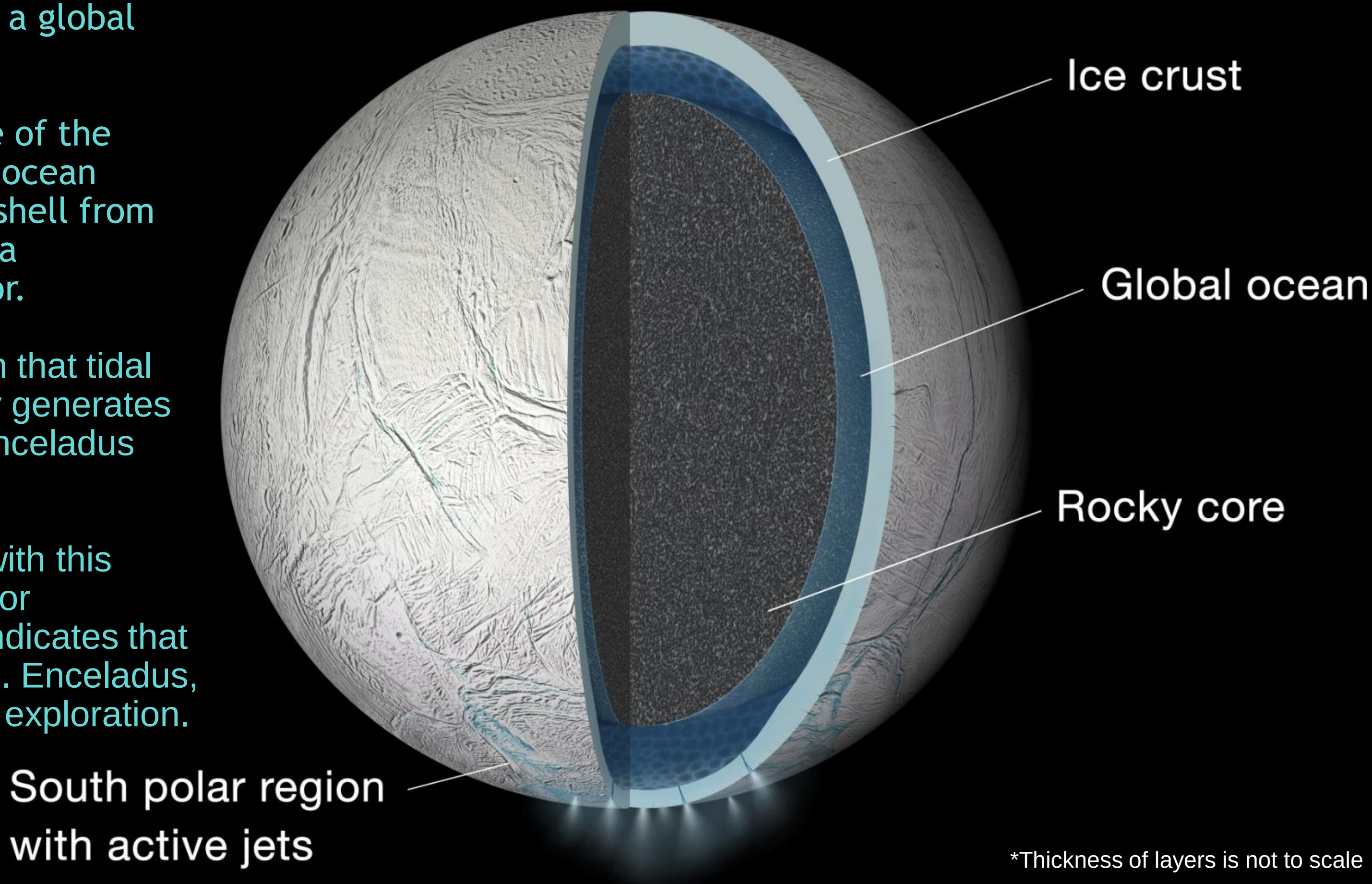
AGs (Assessment Groups): PSD Community Contributions

Selected Science Highlights

Global Ocean Inside Enceladus

- Cassini imaging observations of Enceladus' rotation and its wobble (libration) as it orbits Saturn revealed the presence of a global ocean[1].
- Explaining the magnitude of the wobble requires a global ocean separating the outer ice shell from the interior. It rules out a completely frozen interior.
- A global ocean may mean that tidal flexing by Saturn's gravity generates much more heat inside Enceladus than previously thought.
- This discovery, together with this year's discovery of seafloor hydrothermal activity[2,3], indicates that ocean could be long-lived. Enceladus, the "ocean world," invites exploration.

Press Release - http://1.usa.gov/1NDHVlV



*Thickness of layers is not to scale

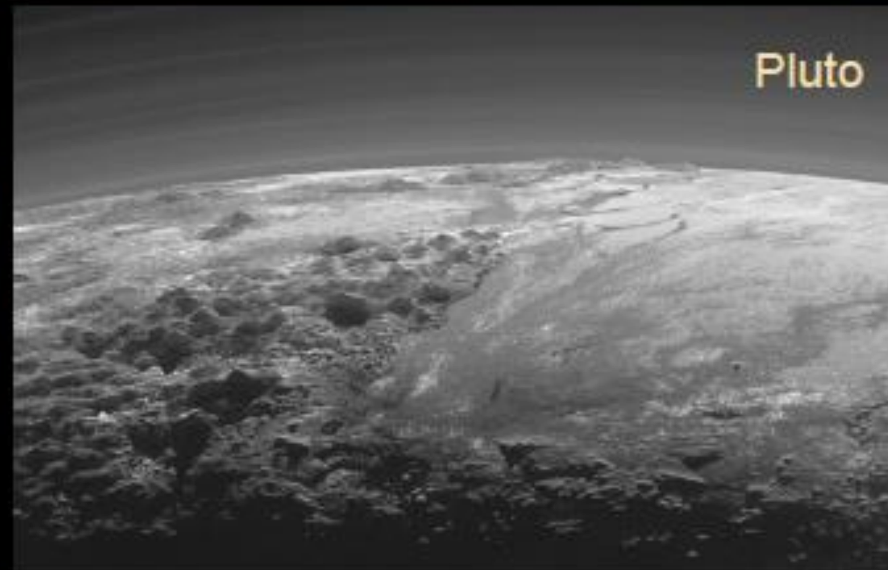
[1]"Enceladus's measured physical libration requires a global subsurface ocean," P.C. Thomas, et al., 2015. doi:10.1016/j.icarus.2015.08.037

[2]"Ongoing hydrothermal activities within Enceladus," Hsu et al., Nature, 519, 207-210, 2015.

[3]"Possible evidence for a methane source in Enceladus' ocean," Bouquet et al., Geophysical Research Letters, 42, 1334-1339, 2015.

New Horizons Encounters Pluto

On July 15, 2015, New Horizons encountered the dwarf planet Pluto and its family of five moons. The flyby was the first investigation by a spacecraft of an object in the Third Zone, the collection of small icy bodies at the orbit of Neptune and beyond that are neither gaseous or terrestrial planets, but a third type of object that may represent the building blocks of the Solar System. A bright region informally named Tombaugh Regio dominates the surface. Pluto also has multiple haze layers in its atmosphere.

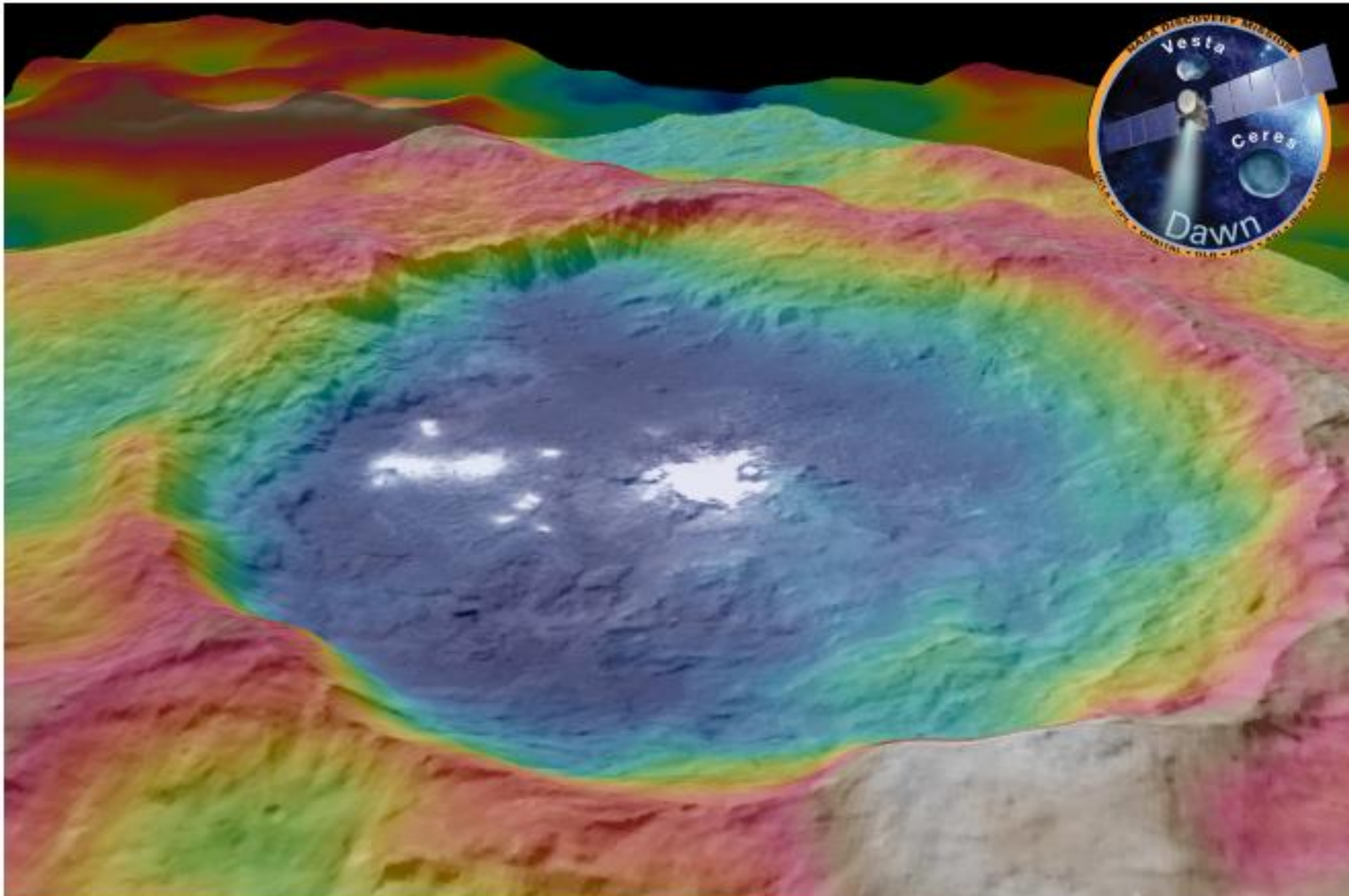


Pluto

Charon

The figure above shows that Pluto exhibits a surprising range of geologic processes and landforms, including nitrogen glaciers, tall mountains, and chaotic regions. Many areas are crater-free, but a very dark equatorial region appears to be older and more cratered than the rest of Pluto.

Charon also is surprisingly geologically complex, with a dark polar region and many faults on its surface.

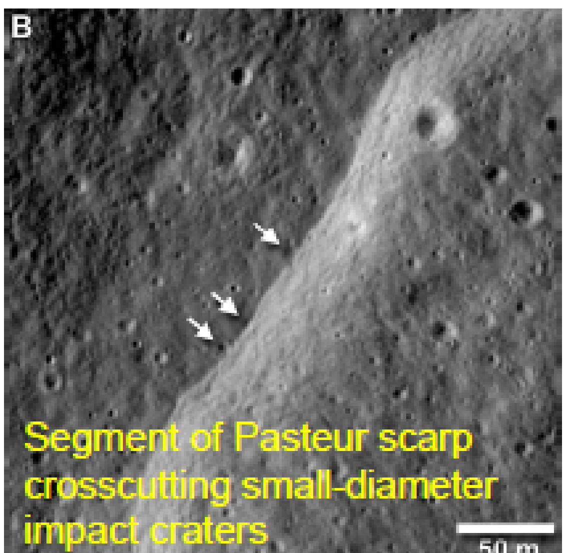


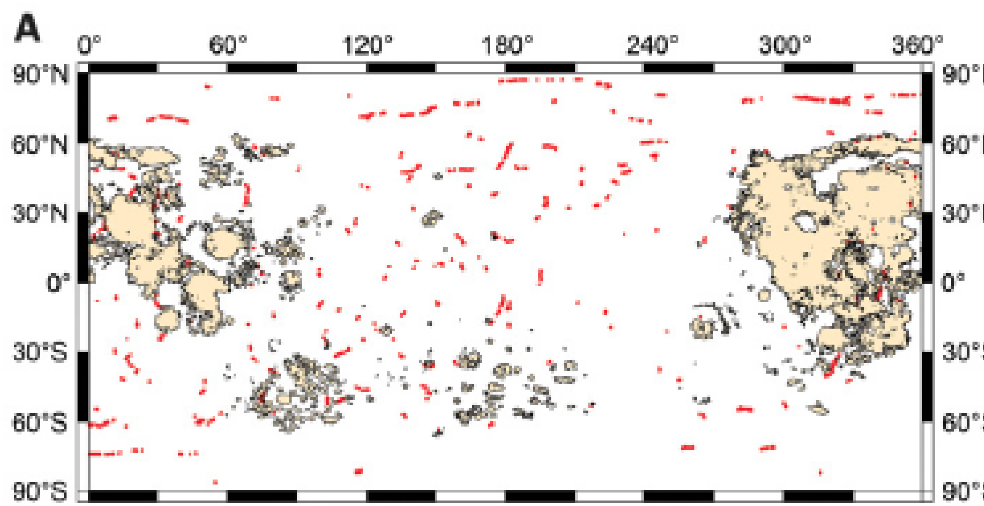
Mysterious bright spots in Ceres' 92-km Occator crater may be salt deposits from the interior.

Global thrust faulting on the Moon and the influence of tidal stresses

Thomas R. Watters, Mark S. Robinson, Geoffrey C. Collins, Maria E. Banks, Katie Daud, Nathan R. Williams, and Michelle M. Selvans (2015) *Geology* **43**, 851-854.

- LROC images – 3200 lobate thrust fault scarps on the Moon.
- Estimated to be <50 Ma and maybe actively forming today.
- Non-random distribution consistent with late-stage global contraction.
- Present-day tidal stresses potentially activate these thrust faults.
- Possibly produce the enigmatic shallow moonquakes recorded by Apollo, some of which had body wave magnitudes ≥5.





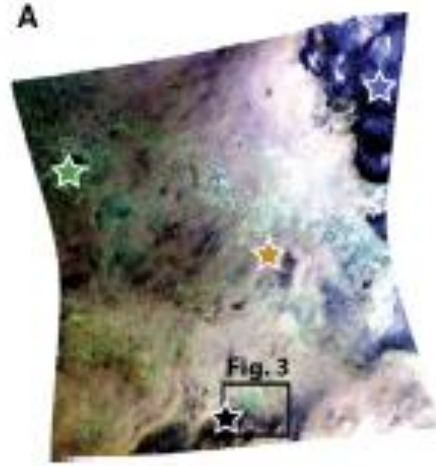
Map of digitized locations of lobate scarps on the Moon

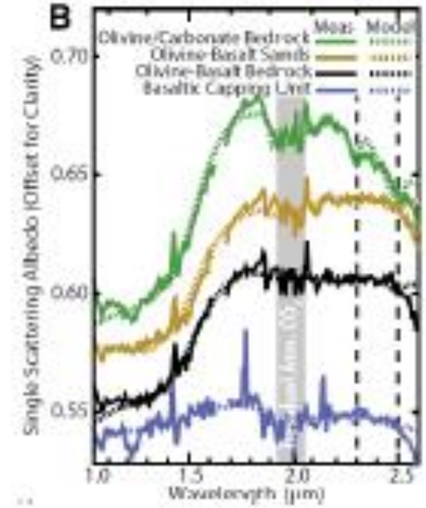
News from Mars

GEOLOGY

Carbon sequestration on Mars

Christopher S. Edwards[1*] and Bethany L. Ehlmann[1,2]





Nugget 2: Olivine-rich basalt surrounding the Isidis impact basin has been partly altered to carbonate by reacting with atmospheric CO_2. This is the largest carbonate-bearing rock unit known on Mars but it represents less than 2x the amount of CO_2 in the present atmosphere, suggesting that water-formed features on early Mars either formed in a thin atmosphere or that a thicker atmosphere was lost to space.

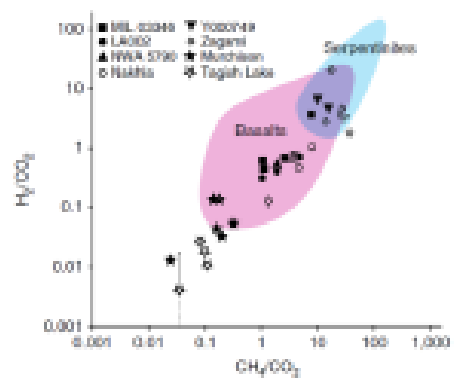
nature COMMUNICATIONS

ARTICLE

Received 19 Sep 2014 | Accepted 1 May 2015 | Published 16 Jun 2015 | DOI: [illegible] | OPEN

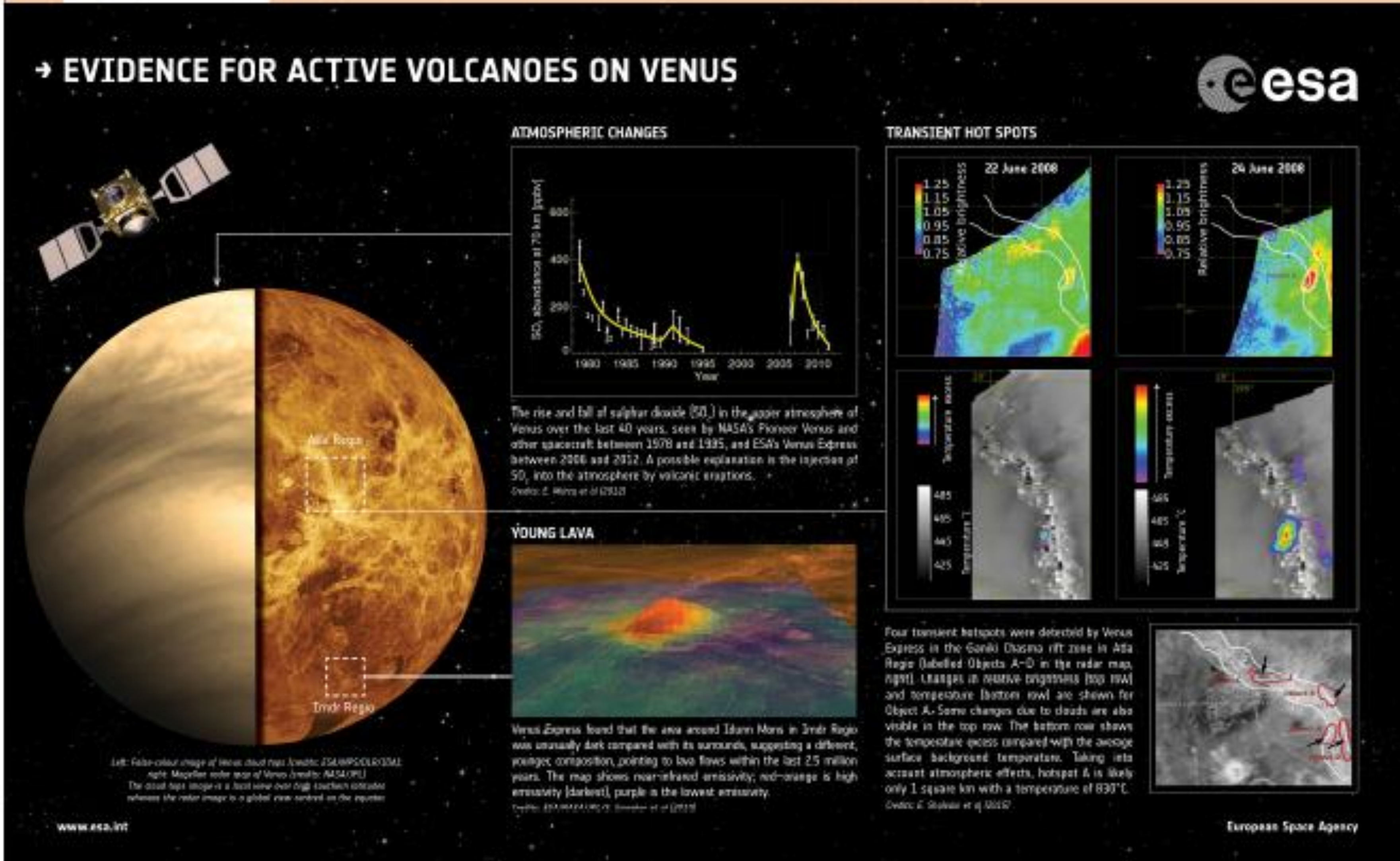
Evidence for methane in Martian meteorites

Nigel J.F. Blamey[1,2], John Parnell[2], Sean McMahon[2], Darren F. Mark[3], Tim Tomkinson[3,4], Martin Lee[4], Jared Shivak[5], Matthew R.M. Izawa[5], Neil R. Banerjee[5] & Roberta L. Flemming[5]



Nugget 3: Availability of methane and hydrogen is critical for microbial habitability of the Martian crust and evidence presented by Blamey et al. indicates that methane-bearing subsurface niches are likely present on Mars.

VENUS EXPRESS EVIDENCE FOR ACTIVE VENUSIAN VOLCANOES

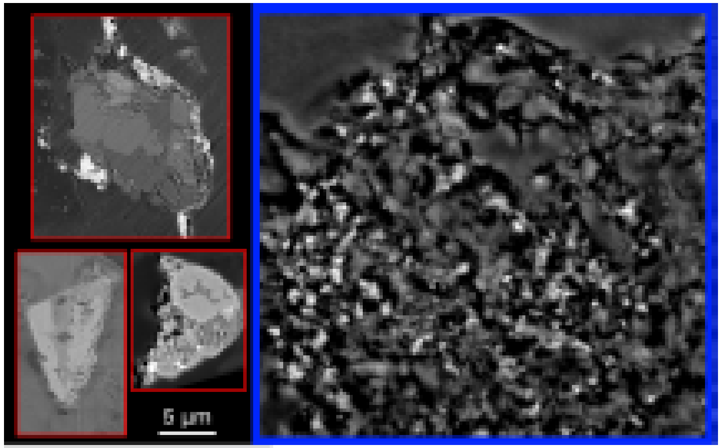


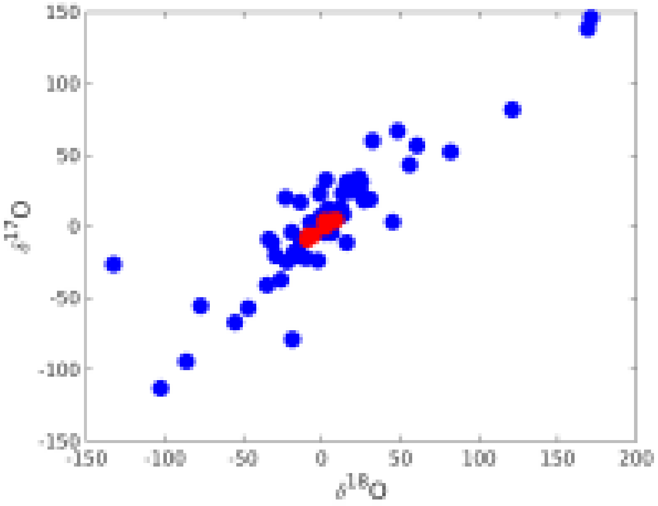
ESA Press Release – June 15, 2015

Diversity of Fine-Grained Material in Comet Wild 2

Large oxygen isotope variations in cometary fines point to a primitive or diverse source

Material from comet Wild 2 returned by NASA's Stardust mission contains igneous objects similar to what is found in meteorites. The fine-grained material from this comet, however, is more difficult to study. A recent paper in *Geochimica et Cosmochimica Acta* reports the oxygen isotope composition of a large number of small and large rock fragments from comet Wild 2. The larger fragments have compositions seen in igneous components from meteorites. The small fragments, on the other hand, show a very broad range of compositions. This implies that the fine-grained material is either the primitive, unprocessed building blocks of the Solar System, or a very diverse sampling of inner Solar System reservoirs.





R. C. Ogliore *et al.*, *Geochimica et Cosmochimica Acta* **166**, 74–91 (2015)

PSS Response to Request for Input to SMD Big Data Task Force:

The planetary science community is on track to manage and work with more than a petabyte (1,000 terabytes or 1,000,000 gigabytes) of science and engineering data (representing the holdings of the NASA Planetary Data System) in the next year. Along with this large volume of data come the challenges of processing, managing and analyzing data using tools and capabilities that may not have kept pace with the rapid growth of planetary data. There is a strong need within the planetary science community for improvements in the following areas:

- interdisciplinary standards for formatting, documenting and serving data to enable and foster increased collaborations across the Science Divisions

Response to Request for SMD Big Data Task Force Input (cont. 1):

*availability of high fidelity data products from missions, instruments and other data sources, for those investigators whose science investigations can be achieved using higher order data products as a starting point rather than the calibrated archived data,

•access to high-density storage and efficient transfer of data across widely varying bandwidths, to enable quick and easy data access and efficient archiving from all regions of the United States, the ability to quickly find, download and analyze data from many science disciplines regardless of their location (i.e., improved search and retrieval functions),

•access to on-demand analytical tools and services that enable users to identify and extract meaningful information from large volumes of data (e.g., automated, intelligent algorithms to search for features such as Mars recurring slope lineae in an image; detailed examinations of features of Saturn's icy moons in Cassini images),

Response to Request for SMD Big Data Task Force Input (cont. 2):

•visualization and data synthesis capabilities to support rapid and sophisticated science discovery, i.e., data fusion techniques to optimize the science return of disparate but related data sets (e.g., using both atmospheric density profiles and high resolution images to study dust devils on Mars; merging information from both remote sensing (e.g. IRTF, Hubble) and mission measurements to exploit Saturn auroral campaigns), and training of data providers and users in new data science methods and capabilities (e.g., modern search and retrieval tools, analysis programming languages, etc.).

Re. AAAC Report:

More discussion needed.