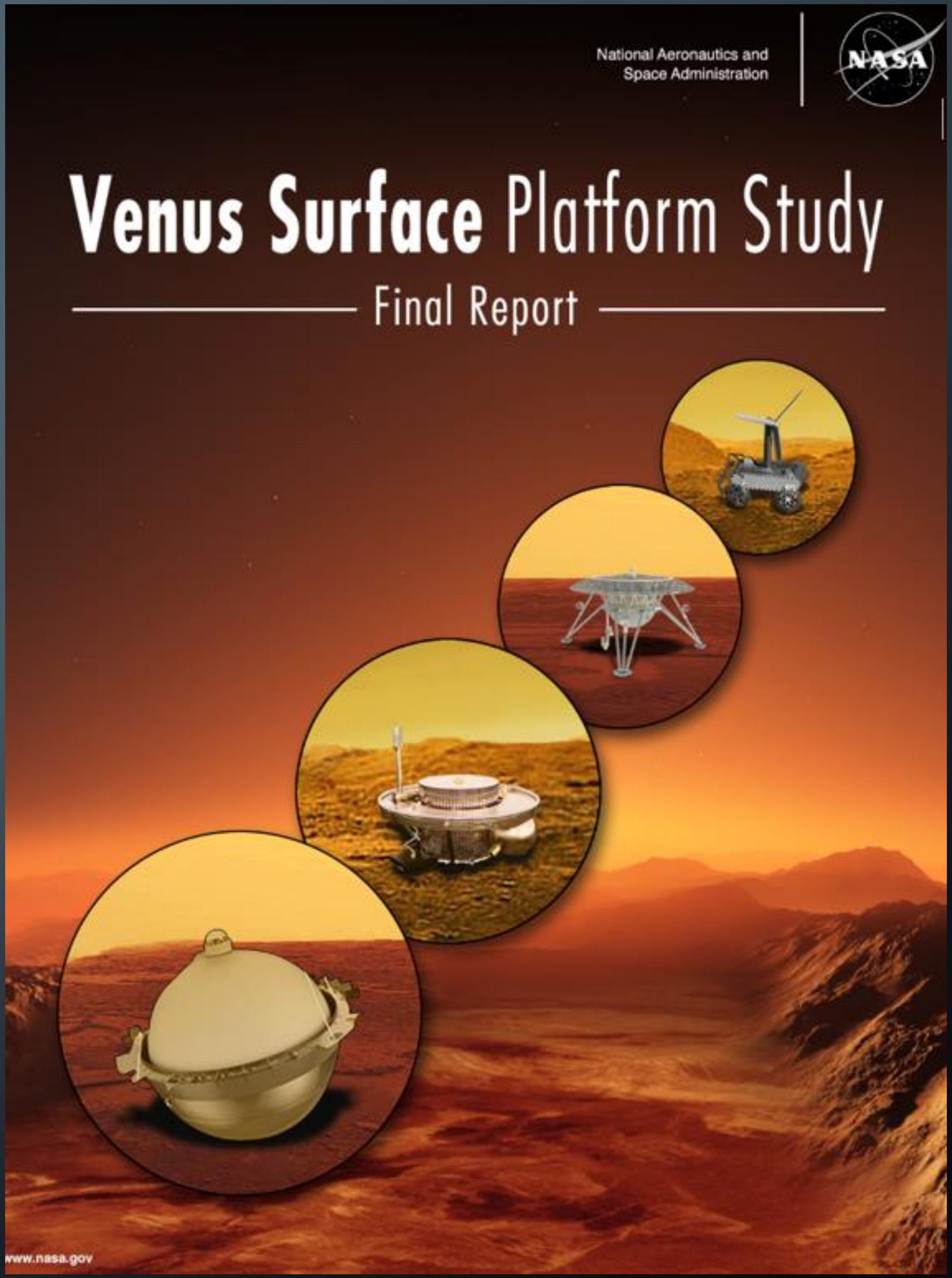
VENUS SURFACE PLATFORM STUDY UPDATE

VEXAG – NOVEMBER 2021



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THANK YOU TO STUDY ORGANIZERS/ LEADS AND PARTICIPANTS

Name (Alphabetical)	Affiliation	Role
Mike Amato	NASA Goddard Space Flight Center	Co-Chair
Jeff Balcerski	Ohio Aerospace Institute (OAI)	Organizing Committee
Noam Izenberg	Johns Hopkins Applied Physics Lab (APL)	Organizing Committee
Natasha Johnson	NASA Goddard Space Flight Center	Organizing Committee
Tibor Kremic	NASA Glenn Research Center (GRC)	Co-Chair
Thomas Thompson	Jet Propulsion Laboratory (JPL)	Organizing Committee
Carol Tolbert	NASA Glenn Research Center	Organizing Committee
Sub-Groups		
Interior: Geophysics, Geodynamics		
Walter Kiefer	Lunar and Planetary Institute (LPI)	Lead
Jeffrey Balcerski	Ohio Aerospace Institute (OAI)	Sub-Group Member
Robbie Herrick	University of Alaska Fairbanks	Sub-Group Member
Sue Smrekar	Jet Propulsion Laboratory (JPL)	Sub-Group Member
Surface Geology		
Martha Gilmore	Wesleyan University	Lead
Lynn Carter	University of Arizona	Sub-Group Member
Darby Dyar	Mt. Holyoke College	Sub-Group Member
Richard Ghail	Imperial College, UK	Sub-Group Member
Tracy Gregg	University at Buffalo College	Sub-Group Member
Misha Ivanov	Vernadsky Institute	Sub-Group Member
Surface Atmosphere Interactions: Composition, Chemistry And Geochemistry		
Natasha Johnson	NASA Goddard Space Flight Center	Lead
Joern Helbert	DLR Institute of Planetary Research	Sub-Group Member
Sebastian Lebonnois	Laboratoire de Météorologie Dynamique	Sub-Group Member
Sara Port	University of Arkansas	Sub-Group Member
Misha Zolotov	Arizona State University	Sub-Group Member
	Technology/Capabilities	
Jonathan Sauder	Jet Propulsion Laboratory	Lead
James Cutts	Jet Propulsion Laboratory	Sub-Group Member
Jeffrey Hall	Jet Propulsion Laboratory	Sub-Group Member
Gary Hunter	NASA Glenn Research Center	Sub-Group Member
Geoffrey Landis	NASA Glenn Research Center	Sub-Group Member
Fredrick Rehnmark	Honeybee Robotics	Sub-Group Member
Thomas Spilker	Orbital Assembly Corporation	Sub-Group Member

STUDY SUMMARY

- The Venus Surface Platform Study was implemented to understand the state of capability for Venus surface exploration and to explore what additional science can be achieved with increasing lander capability
- The study team (comprised of 4 subgroups) have produced the report and we also submitted a white paper to decadal process
  - Report went through lots of passes / inputs
- Report completed and being released. Will work to post on VEXAG website.
  - Expect to have limited number of hard copies, if that is of interest let me know.

KEY STUDY RESULTS

- The study team identified key capabilities that will drive in situ surface related science (lifetime, mobility, smarts, and multiple simultaneous measurements)
- Different degrees of these can enable unique and compelling new science. A couple examples of how platform capabilities can drive science:
- These capabilities are created and/or enhanced with specific technology investments
  - Some examples include: surface power, high-temperature systems (sensors and electronics, memory, power), mechanisms (actuators, drills, tools), and autonomy

POTENTIAL SCIENCE FROM LANDER PLATFORMS

Science returned by lander platforms is driven by key capabilities

Science field	Capability			
Interior	Time	Smarts	Mobility	MSM
Structure	H			H
Composition	H	S		H
Dynamics	H			H
Heat flux	S			S
Surface				
Composition		S		S
Dynamics (eruptions, flows, …)	H	S	H	
Diversity (spatial)	H	S	H	S
Morphology	H	H	S	H
Stratigraphy	H	H	H	H
Surface-atmosphere interactions				
Gas and surface composition	H	H		H
Winds	H			H
Reactions	H	H		S
Momentum exchange	H		S	H

Lander platform capability is enabled by key technologies

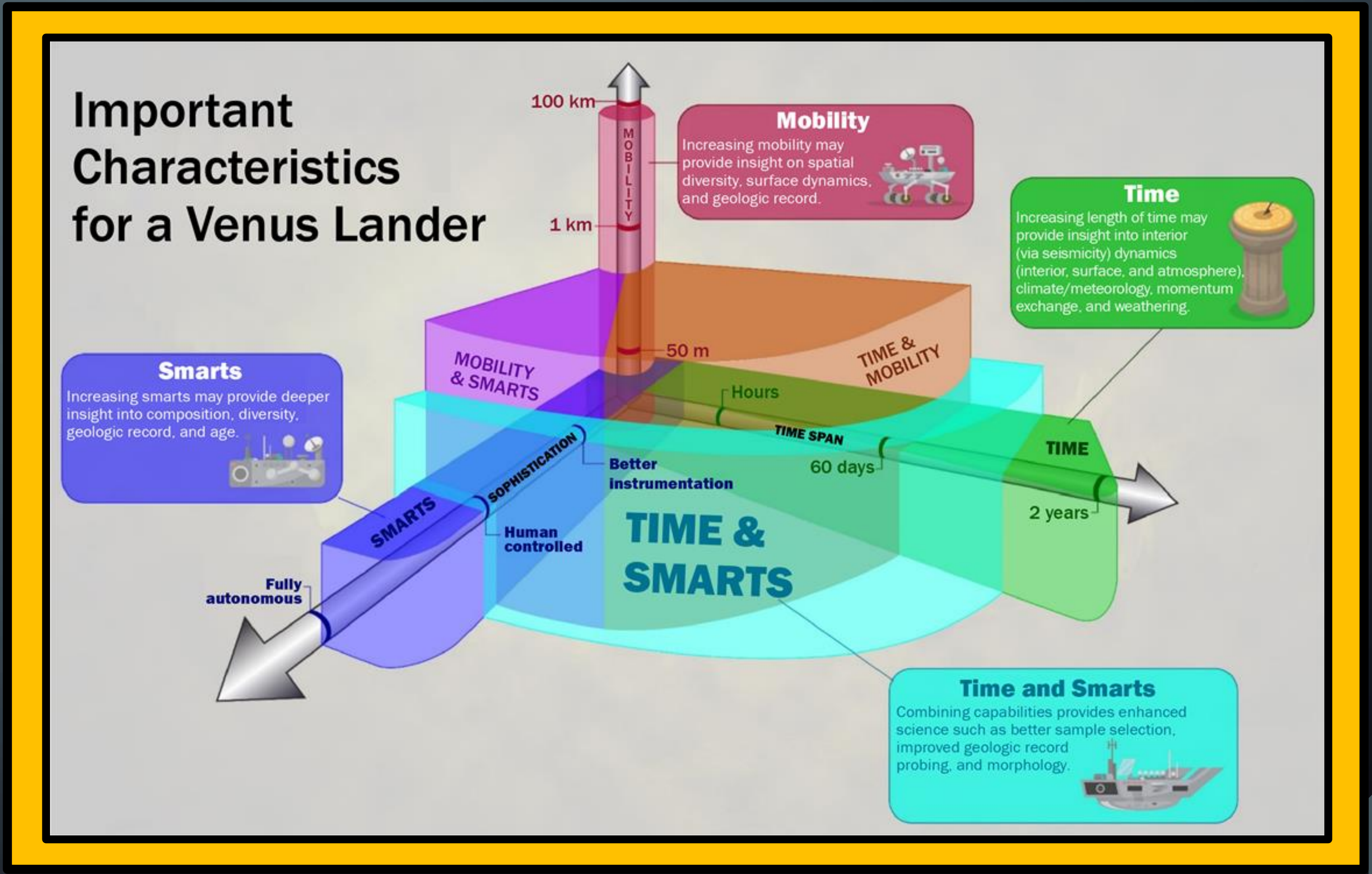
Critical underlying and supporting technology	Capability		
	Time	Smarts	Mobility
Power (low—10s of watts or less)	H	H	
Power (high—100s of watts)			H
Cooling (will also need power (high))	S	H	S
High-temperature electronics/memory/power processing	H	H	H
Mechanisms (drills, wheels, …)			H
Autonomous operations and navigation		H	H
State-of-art instruments		H	

Table Legend: "H" designates highly impactful, "S" somewhat impactful, and MSM = Multiple simultaneous measurements

POTENTIAL SCIENCE FROM LANDER PLATFORMS

Capabilities may be synergistic

Sustained technology investments will enable capabilities – particularly power, high temp electronics/memory / processing, and autonomous ops and Nav



KEY MESSAGES

- In-situ surface measurements are essential to addressing important science questions
  - Critical measurements including surface chemistry, mineralogy and morphology can uniquely be acquired with short-duration surface platforms.
  - Other critical measurements and data (like climate and meteorology, seismology, and geological processes) require longer duration surface missions.
  - Longer duration missions, mobility on the surface, increased surface platform sophistication, and simultaneous presence at multiple locations are needed to make those measurements.
  - Venus surface power systems and high-temperature electronics, memory and sensors & instruments are two technology investment areas that are expected to have significant impact in achieving desired surface platform capabilities.
    - This is followed by Autonomous operations/Nav and cooling systems development