VENUS' UNIQUE ROLE IN SOLAR SYSTEM HISTORY: THE FIVE BIG QUESTIONS. K. L. Jessup[1], M. S. Gilmore[2], D, Grinspoon[3], S. Limaye[4], J. Luhmann[5], [1]Southwest Research Institute (1050 Walnut St., Suite 300, Boulder CO 80302, jessup@boulder.swri.edu) [2]Wesleyan University (mgilmore@wesleyan.edu) Planetary Science Institute (grinspoon@psi.edu) [4]University of Wisconsin (1225 W. Dayton St, Madison, WI 53706, sslimaye@wisc.edu) [5] Space Sciences Lab University of California, Berkeley (jgluhman@ssl.berkeley.edu).

Introduction: Development of the next Planetary Decadal Survey will commence in February 2019. Now is the time to clearly articulate the outstanding mysteries regarding Venus' evolution as a planet, its unique and influential role in Solar System Research and the investigations needed to probe her decades' old secrets. This motivates our community to consider: a) what links may exist between Venus' list of unsolved riddles, and b) do the unanswered questions regarding Venus' atmospheric evolution, interior structure, surface evolution and habitability suggest that a single event or series of catalytic events are responsible for the state of Venus as we know it?

The Questions: Both the similarities and dissimilarities between the Earth and Venus raise challenging questions. Similarities include the solid body density and radius, the existence of mountains. ridges and plateaus -- possibly made of granite [1], and surface properties that suggest the surface is young and volcanically active [2-3]

The potential for granite compositions suggests an ocean period; yet, Venus' current dry state raises questions about the timeline of Venus' oceanic period and loss [4-5]. Venus' apparently random pattern of (arguably) unmodified craters, along with the un-Earth like lack of plate tectonics raises questions about the mechanisms and time scales that drive Venus' volcanic and tectonic activity.

Additional un-Earthlike Venus traits include: (1) the absence of a magnetic field (allowing continuous ionization and stripping of the upper atmosphere -- contributing to the dry condition of the atmosphere); (2) its retrograde rotation; (3) a slow solid body rotation rate, and the accompanying 4-5 Earth day, cloud super-rotation; (4) The 460°C surface temperature and and 90 bar surface pressure; and (5) an absence of advanced life forms. Indeed the only region of the planet that may host extant microbial life similar to that of the Earth is located 48-70 km above the planet surface in the dense H_2SO_4 clouds [6-7].

As VEXAG considers how to communicate "why Venus?" in a succinct way, it is important to consider how Venus' distinctly un-Earthlike characteristics may be linked. Over the decades theories suggested for Venus current spin state include surface-atmosphere interactions, the disruption of a once present Venus moon, or catastrophic impact [8-12]. Similarly, multiple hypothesis exists for the origin of Venus' lost ocean including comet impact [12]; yet, the true mechanism and timeline for Venus' water evolution is also an open question [5]. If catastrophic impact was a part of Venus' history could it have been the catalyst for the shift in Venus' climate and the proliferation of the greenhouse effect. Could it have been the mechanism to drive any microbial life that may have been developing and/or thriving during Venus' early temperate period to the cloud top regions [7,13]?

In the end, the web of questions raised by the similarities and dissimilarities between Earth and Venus can be categorized into 5 big Questions/Histories that need to be resolved/defined:

- What is Venus' water history: where did it come from, how did it evolve with time?
- How has the habitability of Venus evolved over time for microbial life?
- What are the characteristics of Venus' interior and how did it come to its current state?
- What is Venus' crust and weathering story***?***
- How have the spin states of the solid planet and the atmosphere evolved and interacted over time?

The Message: Lessons learned regarding Venus' atmospheric, interior and habitability evolution directly influence our understanding of the evolution of the Solar System. Likewise, these same lessons help us to refine what observables may be used as diagnostics in the investigation and interpretation of the evolution of extra solar planets. As the Venus Exploration community considers how to communicate "why Venus?" to the public and our policy makers, connections to these critical questions must be made in a way that is accessible and memorable.

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