CAN LARGE SCALE VOLCANISM EXPLAIN THE HEAT-DEATH OF VENUS? M. J. Way[1,2,3] R. E. Ernst[4,5] and J. D. Scargle[6], [1]NASA Goddard Institute for Space Studies, 2880 Broadway, New York, New York (Michael.Way@nasa.gov), [2]Theoretical Astrophysics, Department of Physics and Astronomy, Uppsala University, Uppsala, SE-75120, Sweden, [3]GSFC Sellers Exoplanet Environments Collaboration,[4]Department of Earth Sciences, Carleton University, Ottawa, Canada K1S 5B6 (richard.ernst@ernstgeosciences.com), [5]Faculty of Geology and Geography, Tomsk State University, Tomsk, 634050, Russia, [6]Astrobiology and Space Science Division, NASA Ames Research Center, MS 245, Moffett Field, USA (Jeffrey.D.Scargle@nasa.gov)

Introduction: The road from a possibly earlier temperate period in Venus' history to its current hothouse state remains under debate [1-5]. Earlier work e.g. [1] assumed that a gradually brightening sun would drive this transition, but later work has shown that the cloud albedo feedback that keeps early Venus cool (at 4.2 Ga Venus receives ~1.4 the solar flux that Earth receives today) is so efficient that even modern Venus could in theory support temperate conditions [2,3,4].

Recent work [4] has speculated that large scale volcanism in the form of temporally overlapping Large Igneous Provinces (LIPs) could drive a transition from temperate to hothouse on Venus via dramatic increases in surface temperatures, shutting down subductive plate tectonics and volatile cycling. While a large impactor is an additional viable hypothesis it would be difficult to physically detect on Venus today given its young surface [6,7] although isotopic fingerprints remain a possibility yet to be explored. As well, LIPs, rather than impactors have been responsible for the majority of recorded mass extinction and large-scale climate events in Earth's history e.g. [8-10].

Methods and Conclusions: Given that Earth & Venus are similar in size and likely to be geochemically similar [11] we have examined the event history of LIPs through time on Earth (back to 2.8 Ga) as a proxy for Venus using the most up to date LIP database available [10]. Our statistical analyses of this Earth LIP database reveals a number of interesting conclusions:

1.) Using a simple cumulative distribution function of LIP events we find strong evidence for approximately random and uniformly distributed LIP occurrence through time.
2.) Any departure from this uniform probability over time would merely enhance the rate of overlapping events.
3.) We find that pairs and triplets of LIPs closer in time than 0.1 to 1 Myr are likely.
4.) The lengths of the shortest intervals between consecutive LIPs are on the same order as the durations of the environmental effect associated with major LIP eruption events such as those associated with the End Permian and End Triassic mass extinctions [9,12,13].

3-D climate modeling work with general circulation models (GCMs) has demonstrated the effects of individual LIPs on Earth's climate [14], but such models need to encompass multiple simultaneous large LIP events to better constrain their suitability for tipping a clement climate into a runaway greenhouse state like that of present day Venus. Current 3-D GCMs struggle to model runaway greenhouse events like that proposed herein, but progress is coming [15].

Acknowledgments: This work was supported by NASA's Nexus for Exoplanet System Science (NExSS). MJW acknowledges support from the GSFC Sellers Exoplanet Environments Collaboration (SEEC), which is funded by the NASA Planetary Science Division's Internal Scientist Funding Model. REE was supported by a Canadian NSERC Discovery Grant RGPIN-2020-06408 and is also partially supported by Russian Mega-Grant 14.Y26.31.0012.

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