

Heat-death by volcano - how Venus went rogue?

Michael Way^{1,2,3}, Richard Ernst^{4,5}, and Jeffrey Scargle⁶

- ¹NASA Goddard Institute for Space Studies, 2880 Broadway, New York, New York
- ²GSFC Sellers Exoplanet Environments Collaboration
- ³Theoretical Astrophysics, Department of Physics and Astronomy, Uppsala University, Uppsala, SE-75120, Sweden
- ⁴Department of Earth Sciences, Carleton University, Ottawa, Canada K1S 5B6
- ⁵Faculty of Geology and Geography, Tomsk State University, Tomsk, 634050, Russia
- ⁶Astrobiology and Space Science Division, NASA Ames Research Center, MS 245, Moffett Field, USA

The idea of a habitable Venus epoch has gained traction in recent years via 1-D and 3-D General Circulation Modeling (GCM) efforts [1,2,3]. Although recent work has supported an alternative permanent hot and dry scenario [4]. However, the habitable scenario presents us with a conundrum - how does a terrestrial planet transform from temperate to hot-house? For decades it was proposed that the gradual brightening of the sun was the probable cause [5]. Yet 4 billion years ago Venus was receiving nearly 1.4 times the insolation that Earth receives today, and many studies have put Earth at the inner boundary of the habitable zone today [6]. The newer 3-D GCM efforts have demonstrated that if Venus had an early habitable period, that the cloud-albedo feedback responsible for maintaining temperate surface conditions [7] could still be in operation today. From this perspective increasing insolation through time cannot be an answer to the transition from habitable to hot-house. We propose that the 'Great Climate Transition' (GCT) was triggered by simultaneous large igneous provinces (LIPs) akin to those like the Siberian Traps responsible for the End Permian [8]. We have taken the most up to date LIP database for Earth [9] and characterized their distribution through time as random or nearly random. Next we initiate a large suite of Monte Carlo simulations based on this record and generate the likelihood for simultaneous, or environmentally overlapping events in this hypothetical setup. We find the probability of such events to be quite high, a probable cause for Venus' GCT, and a possible harbinger of things to come for Earth.

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