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SPACE EXPLORATION SYMPOSIUM (A3)
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VENUS LONG-LIFE SURFACE PACKAGE (VL2SP)

Abstract

Measurements in the atmosphere and at the surface of Venus are required to understand fundamental processes of how terrestrial planets evolve and how they work today. While the European Venus community is unified in its support of the EnVision orbiter proposal as the next step in European Venus exploration, many scientific questions also require in situ Venus exploration. We suggest a long-duration lander at Venus, which would be capable of undertaking a seismometry mission, operating in the 460C surface conditions of Venus. Radar maps have shown Venus to be covered with volcanic and tectonic features, and mounting evidence, including observations from Venus Express, suggests that some of these volcanoes are active today. Assessing Venus' current seismicity, and measuring its interior structure, is essential if we are to establish the geological history of our twin planet, for example to establish whether it ever had a habitable phase with liquid water oceans. Although some constraints on seismic activity can be obtained from orbit, using radar or ionospheric observation, the most productive way to study planetary interiors is through seismometry. Seismometry requires a mission duration of months or (preferably) years. Previous landers have used passive cooling, relying on thermal insulation and the lander's thermal inertia to provide a brief window of time in which to conduct science operations – but this allows mission durations of hours, not months. Proposals relying on silicon electronics require an electronics enclosure cooled to < 200 C; the insulation, cooling and power system requirements escalate rapidly to require a > 1 ton, $>$ \$1bn class mission, such as those studied in the context of NASA flagship missions. However, there are alternatives to silicon electronics: in particular, there have been promising advances in silicon carbide (SiC) electronics capable of operating at temperatures of 500C. For the post-2030 timeframe, it will be possible to assemble at least simple circuits using SiC components, sufficient to run a seismometry lander. We are proposing a Venus Long-Lived Surface Package (VL2SP) consisting of power source (RTG), science payload (seismometer and meteorology sensors), and ambient temperature electronics including a telecommunications system weighing < 100 kg. We do not specify how this VL2SP gets to the surface of Venus, but we estimate that an orbiter providing data relay would be essential.