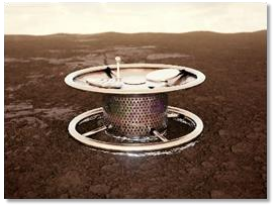
SAEVe: A long duration small sat class Venus lander, Tibor Kremic[1] (Tibor.Kremic@nasa.gov), Richard Ghail[2], Martha Gilmore[3], Walter Kiefer[4], Sanjay Limaye[5], Gary Hunter[1], Carol Tolbert[1], Michael Pauken[6], Colin Wilson[7] 1, NASA Glenn Research Center, Cleveland, OH 2, Imperial College of London, London, UK, 3, Wesleyan University, Middletown, CO 4, Lunar and Planetary Institute, Houston, TX 5, University of Wisconsin, Madison, WI 6, Jet Propulsion Laboratory, Pasadena, CA 7, University of Oxford, UK

NASA's science mission directorate has put increasing emphasis on innovative, smaller, and lower cost missions to achieve their science objectives. One example of this was the recent call by the Planetary Science Division for cube and small satellite concepts expected to cost $100M or less, not including launch and weighing less than 180kg. Over 100 proposals were submitted suggesting that indeed this is a size of mission worthy of being considered in future planning. Nineteen missions were selected for study, one being a long-lived Venus mission called SAEVe, for **S**eismic and **A**tmospheric **E**xploration of **Ve**nus.

The science objectives and relevance of SAEVe include: Is Venus seismically active? What can we learn about its crust (thickness and composition) and its interior (lithosphere, mantle, and core)? What can be learned about its evolutionary history or about the planet / atmosphere interactions? SAEVe begins to address these science questions with simple, but capable, instrumented probes that can survive on the surface of Venus and take temporal measurements over months—something never attempted before. The data returned will further our understanding of the solar system and Earth, and aid in meeting the NASA Science Plan goal to "**ascertain the content, origin, and evolution of the solar system…" and "the chemical and physical processes in our solar system…" [1]**

SAEVe is delivered to Venus as a ride-along on another mission to Venus. Its two small probes are placed into the Venus atmosphere via a single Stardust-like entry capsule, are ejected at different times, free fall, and decelerate in the thickening atmosphere to touchdown under 8 m/s$^2$ or less. The probes will begin taking measurements and transmitting important parameters at or near the surface and will focus on measurements like seismic activity, heat flux, wind speed and direction, basic chemical abundances, temperature, and pressure. At preset intervals, the probes acquire the science measurements and beam the data to the orbiting host spacecraft. SAEVe will serve as a highly capable precursor and pave the way for larger and more complex lander missions to explore Venus. The objectives of the study include:

- Refine science objectives, trade instrument options
- Flow driving science requirements down to probe systems / instruments
- Trade communication approaches—considering science, cost, and risk
- Identify key technology development needs and assess mission readiness
- Develop parametric costs for implementing the mission concept



| Science Objectives | Anticipated Instruments/ Measurement |
|---|---|
| Determine if Venus is seismically active | Seismometer and chemical composition |
| Determine the thickness and composition of the crust and lithosphere | Seismometer and heat flux |
| Determine current rate of energy loss from the interior | Heat flux |
| Estimate the momentum exchange between the planet and its atmosphere | Wind speed and direction, temperature, and pressure |
| Acquire acquire meteorological measurements to update global circulation models | Winds, temperature, pressure, and chemical composition |
| Estimate sources of atmospheric chemistry variability | Chemical composition, temper-ature, pressure, and winds |
| Potential: Examine rock and soil distribution and morphology | Potential: Camera package |

| Team | |
|---|---|
| Principal Investigator (PI) | Dr. Tibor Kremic, NASA Glenn Research Center (GRC) |
| Co-Investigator (Co-I) | Dr. Walter Kiefer, Lunar and Planetary Institute, Science Team |
| Co-I | Dr. Richard Ghail, Imperial College of London |
| Co-I | Dr. Gary Hunter, GRC |
| Co-I | Dr. Sanjay Limaye, U. Wisconsin |
| Co-I | Dr. Colin Wilson, U. Oxford |
| Co-I | Dr. Michael Pauken, JPL |
| Co-I | Dr. Martha Gilmore, Wesleyan U. |
| Mission Study Concept Team | GRC COMPASS team |

The SAEVe study will be completed and be presented around the LPSC conference in March of 2018.

**References:**

[1] National Aeronautics and Space Administration Science Plan (2014). https://cor.gsfc.nasa.gov/docs/2014_Science_Plan.pdf.