

# NASA's DAVINCI mission to take the plunge through massive atmosphere of Venus

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Credit: NASA

In a paper recently published in *The Planetary Science Journal*, NASA scientists and engineers give new details about the agency's Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging (DAVINCI) mission, which will descend through the layered Venus atmosphere to the surface of the planet in mid-2031. DAVINCI is the first mission to study Venus using both spacecraft flybys and a descent probe.

DAVINCI, a flying analytical chemistry laboratory, will measure critical aspects of Venus's massive atmosphere-climate system for the first time, many of which have been measurement goals for Venus since the early 1980s. It will also provide the first descent imaging of the mountainous

highlands of Venus while mapping their rock composition and surface relief at scales not possible from orbit. The mission supports measurements of undiscovered gases present in small amounts and the deepest atmosphere, including the key ratio of hydrogen isotopes—components of water that help reveal the history of water, either as liquid water oceans or steam within the early atmosphere.

The mission's carrier, relay and imaging spacecraft (CRIS) has two onboard instruments that will study the planet's clouds and map its highland areas during flybys of Venus and will also drop a small descent probe with five instruments that will provide a medley of new measurements at very high precision during its descent to the hellish Venus surface.

"This ensemble of chemistry, environmental, and descent imaging data will paint a picture of the layered Venus atmosphere and how it interacts with the surface in the mountains of Alpha Regio, which is twice the size of Texas," said Jim Garvin, lead author of the paper in the Planetary Science Journal and DAVINCI principal investigator from NASA's Goddard Space Flight Center in Greenbelt, Maryland. "These measurements will allow us to evaluate historical aspects of the atmosphere as well as detect special rock types at the surface such as granites while also looking for tell-tale landscape features that could tell us about erosion or other formational processes."

DAVINCI will make use of three Venus gravity assists, which save fuel by using the planet's gravity to change the speed and/or direction of the CRIS flight system. The first two gravity assists will set CRIS up for a Venus flyby to perform remote sensing in the ultraviolet and the near infrared light, acquiring over 60 gigabits of new data about the atmosphere and surface. The third Venus gravity assist will set up the spacecraft to release the probe for entry, descent, science, and touchdown, plus follow-on transmission to Earth.

The first flyby of Venus will be six and half months after launch and it will take two years to get the probe into position for entry into the atmosphere over Alpha Regio under ideal lighting at "high noon," with the goal of measuring the landscapes of Venus at scales ranging from 328 feet (100 meters) down to finer than one meter. Such scales enable lander style geologic studies in the mountains of Venus without requiring landing.

Once the CRIS system is about two days away from Venus, the probe flight system will be released along with the titanium three foot (one meter) diameter probe safely encased inside. The probe will begin to interact with the Venus upper atmosphere at about 75 miles (120 kilometers) above the surface. The science probe will commence science observations after jettisoning its heat shield around 42 miles (67 kilometers) above the surface. With the heatshield jettisoned, the probe's inlets will ingest atmospheric gas samples for detailed chemistry measurements of the sort that have been made on Mars with the Curiosity rover. During its hour-long descent to the surface, the probe will also acquire hundreds of images as soon as it emerges under the clouds at around 100,000 feet (30,500 meters) above the local surface.

"The probe will touch-down in the Alpha Regio mountains but is not required to operate once it lands, as all of the required science data will be taken before reaching the surface," said Stephanie Getty, deputy principal investigator from Goddard. "If we survive the touchdown at about 25 miles per hour (12 meters/second), we could have up to 17-18 minutes of operations on the surface under ideal conditions."

DAVINCI is tentatively scheduled to launch June 2029 and enter the Venusian atmosphere in June 2031.

"No previous mission within the Venus atmosphere has measured the chemistry or environments at the detail that DAVINCI's probe can do,"

said Garvin. "Furthermore, no previous Venus mission has descended over the tesserae highlands of Venus, and none have conducted descent imaging of the Venus surface. DAVINCI will build on what Huygens probe did at Titan and improve on what previous in situ Venus missions have done, but with 21st century capabilities and sensors."

**More information:** James B. Garvin et al, Revealing the Mysteries of Venus: The DAVINCI Mission, *The Planetary Science Journal* (2022).  
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