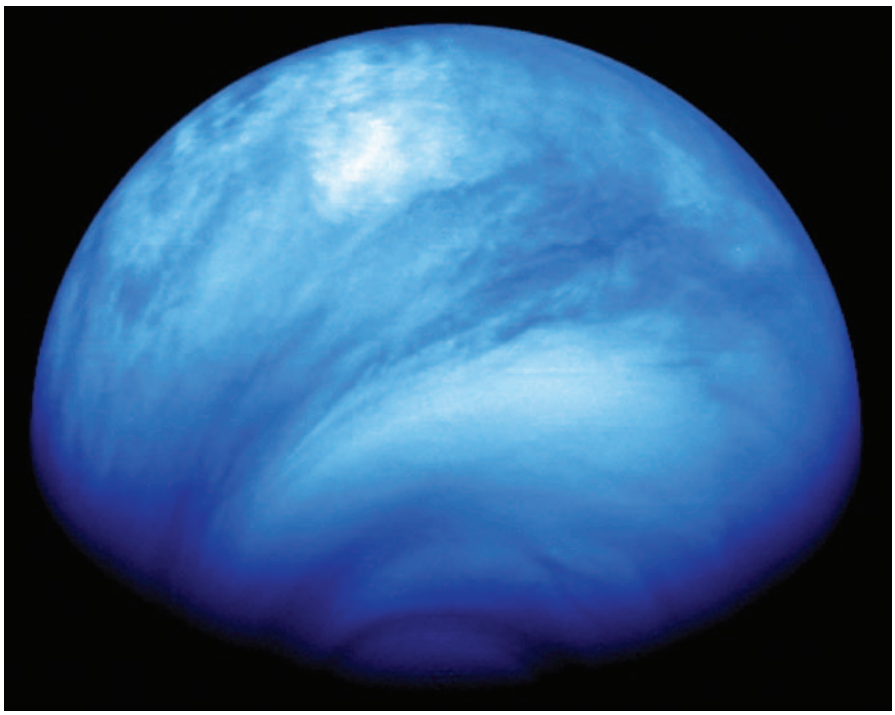
Sister Planet

Mission to Venus reveals watery past



EUROPEAN SPACE AGENCY

VENUS UNVEILED The Venus Express probe has delved beneath the thick clouds of our neighboring planet, whose southern hemisphere is shown here.

Dense clouds of sulfuric acid blanketing Venus have posed a problem for scientists seeking inside information about Earth's nearest planetary neighbor.

Now, the Venus Express probe, launched by the European Space Agency in 2005, has ventured beneath those clouds and found evidence that Venus once had more water than it does today. The probe also provided detailed new measurements of the weather on Venus, proof of lightning on the planet, and signs of a formerly unknown hot spot near its south pole.

In nine papers appearing in the Nov. 29 *Nature*, researchers say these findings could be useful for understanding Earth's atmosphere too.

"Venus resembles the Earth in many, many ways," says Andy Ingersoll of the California Institute of Technology in Pasadena. Not only do Venus and Earth orbit the sun at similar distances, but the two planets are similar in size, gravity, and composition. Though Venus' atmosphere contains much more carbon dioxide than Earth's, both have water vapor.

Water's role in Venus' past, in particular whether there used to be more of it, was one of the biggest questions about the planet, says Ingersoll.

"There's some water, but where's the ocean on Venus?" he asks. "Venus Express has addressed that."

If Venus once had more water, scientists figured, then vast amounts of hydrogen and oxygen must at some point have escaped Venus' gravity. But some hydrogen comes in a heavy form, deuterium. It is harder for the heavy form to escape gravity, so if lots of hydrogen from water left Venus, the ratio of deuterium to hydrogen left behind would rise.

A team of scientists led by Jean-Loup Bertaux of the Service d'Aéronomie du CNRS in Verrières-le-Buisson, France, showed that the deuterium-to-hydrogen ratio on Venus is, in fact, higher than that on Earth.

If the water vapor in Venus' atmosphere today were instead an ocean, it would be 3 centimeters deep. Using the deuterium-hydrogen ratio to estimate how much water has been lost, the scientists extrapolated that there once would have been enough water to cover Venus with at least 4.5 meters of water. (If all the water on Earth were spread out, it would be 2.8 kilometers deep.)

Furthermore, in a separate paper, Stanislav Barabash of the Swedish Institute of Space Physics in Kiruna showed that hydrogen and oxygen ions are still escaping from Venus today.

"The surprising discovery was the escape of oxygen atoms and hydrogen atoms keeps the same ratio as in a water molecule," says Barabash.

Understanding how and why water leaves Venus has important implications on Earth, Ingersoll says. When a climate heats up and oceans evaporate, the increased water vapor in the atmosphere acts as a greenhouse gas and can accelerate the warming of the oceans.

"If this runaway greenhouse effect could happen on Venus, could it happen on Earth too?" asks Ingersoll.

Insights into water on Venus weren't the only surprise findings from Venus Express. Scientists found a hot spot near the south pole that's 10°C warmer than the surrounding atmosphere. A hot spot of similar shape and size had previously been discovered near Venus' north pole.

The probe also improved scientists' understanding of weather patterns on Venus. Radio signals sent through the clouds recorded a difference in temperature between nighttime and daytime of 40°C, much larger than anticipated. Other instruments showed a lightning rate about half that on Earth.

Håkan Svedhem of the European Space Agency in Noordwijk, the Netherlands, says that the Venus Express findings offer a much-needed baseline for comparison with data from future missions.

"To follow all this and see how it evolves as a function of time will be interesting," he says. —S. WILLIAMS

Northwest Passage

Americas populated via Alaska, genetics show

A single population of prehistoric Siberians crossed the Bering Strait into Alaska and subsequently fanned out to populate North and South America, according to a new genetic analysis of present-day indigenous Americans.

The study also hints that early Americans reached Central and South America by migrating down the Pacific coast by land or sea and only later spread into the interior of South America.

"We have good evidence that a single migration [from Siberia] contributed a large fraction of the ancestry of the Americas," says population geneticist Noah Rosenberg of the University of Michigan

in Ann Arbor, who led the large international study team.

The finding draws on the largest database of Native American genetics ever compiled. The data include DNA from nearly 500 people belonging to 29 groups scattered across Canada, Mexico, Central America, and South America. The researchers also studied samples from 14 Tundra Nentsi individuals living in eastern Siberia.

"They should be commended for bringing together an enormous database, something no one has done before," says Tom Dillehay, an archaeologist at Vanderbilt University in Nashville.

The team examined 678 genetic markers in the human genome and found that one of the markers ties every Native American group to the Tundra Nentsi. The marker, moreover, is found nowhere else in the world. "It's extremely difficult to explain this kind of pattern unless all of the Native American populations ... have a large degree of shared ancestry," says Rosenberg.

In addition, the Canadian groups share more genes with the Siberians than do the groups in Central and South America, Rosenberg and his team report online in the November *PLoS Genetics*.

Tracing further migration through the Americas, the team then correlated genetic variations among different tribes with each group's location as measured along inland or coastal routes. The genetic data suggest that most migration to Central and South America followed the coast.

"That's the easy way south," says Vance Holliday, an archaeologist at the University of Arizona in Tucson. He cautions, however, that the groups that populated the South American interior would have had to surmount the formidable Andes Mountains.

Despite the migration findings, Holliday and Dillehay both say that southward migration along interior routes should still be considered. Dillehay notes that the current study excludes Native Americans from the United States and eastern Brazil. "It's a sampling bias," he says, that might have erroneously favored the Pacific coast migration model.

Rosenberg says that a second paper will soon address the genetics of tribes in the United States and whether there was more than one major Siberian migration.

While the study points to an eastern Siberian origin for most of the genes that spread across the Americas, it can't rule out small genetic contributions from other groups, says Kari Britt Schroeder of the University of California, Davis. In 2001, scientists unearthed 8,000- to 11,000-year-old skulls in Brazil that strikingly resemble today's Australian aborigines (*SN: 4/7/01, p. 212*). The find fueled speculation that several waves of immigrants from different parts of Asia reached the Americas.

"Even if Native Americans share a lot of ancestry from a single origin, there still could be contributions from other groups," says Schroeder. —B. VASTAG

So Sproutish

Anti-aging gene for plants gives drought protection

A gene for simulating youth in plants offers an unusual approach to protecting crops from drought, says an international research team.

The gene *IPT*, borrowed from a bacterium, codes for an enzyme that can delay the stress-triggered senescence of plant leaves.

Tobacco plants genetically engineered to express *IPT* at critical moments stayed green during a lab test when researchers stopped watering them for 15 days, says Eduardo Blumwald of the University of California, Davis.

IPT plants also did well on skimpy rations, achieving at least 85 percent of the usual yield when the researchers cut the water supply to 30 percent of normal. They report their findings in the Dec. 4 *Proceedings of the National Academy of Sciences*.

Blumwald says the tobacco work shows that the idea has promise, and he hopes to see it tested in food crops such as wheat and tomatoes.

"As an idea, it's brilliant," says Andy Pereira of Virginia Polytechnic Institute and State University in Blacksburg, a geneticist whose group has engineered water-thrifty rice. Over the years, geneticists have adopted the *IPT* gene to tweak non-drought traits in plants. But for drought resistance, the gene has "been sitting there till someone came along with some clever tricks," Pereira says.

For agriculture, "the single most important problem globally is drought," says Richard Richards, who breeds crops for Australia's Commonwealth Scientific and Industrial Research Organisation in Canberra. Even so, no transgenic crop touting drought tolerance has proved marketable yet, Richards says.

HANGING ON Regular tobacco plants (top) failed to recover after 15 days without water, but plants genetically engineered with an anti-senescence gene (bottom) perked up after watering resumed.

Dozens of genes, though, are under scrutiny for possible use, and plants carrying those genes are in various stages of testing. Monsanto, for example, reports progress on drought-tolerant corn and cotton.

Blumwald says he came up with his novel strategy while musing about how extreme water shortage triggers a phenomenon called leaf senescence, in which a plant withdraws useful nitrogen from failing leaf tissue and then drops the leaf. This typically happens in old age, but stress can cause a plant to age prematurely. Blumwald therefore reasoned that delaying senescence could extend a plant's ability to withstand drought.

Turning on the *IPT* gene added to a plant prompts a surge of enzymes that sustain synthesis of cytokinin, a growth regulator that normally tapers off as the plant's leaves age. The trick is to turn on the gene at the right moment. To tackle that challenge, Blumwald and his colleagues used a genetic mechanism that flips on a gene when plant tissue encounters stress or reaches advanced age. Plants in which this mechanism controlled the *IPT* gene were able to survive a lab-induced drought that killed neighboring tobacco plants lacking the add-ons.

Whether lab tests lead to commercially useful products is a big question, says plant breeder James Specht of the University of Nebraska–Lincoln. So far, many so-called drought-resistant varieties have failed because they can't match the yields of standard varieties in wet years. Farmers tell Specht that they can't afford to give up the chance of a boom year by planting a drought-resistant variety with lower yields. "Yield resistance—that's the derisive term," he says.

Richards applauds the new strategy, because drought is enormously variable. "It requires multiple solutions to minimize its effect," he says. —S. MILIUS

Calculated Risk

Shedding light on fracture hazards in elderly

When doctors evaluate an older person who has fallen and broken a bone, they immediately look for signs of osteoporosis, the brittle-bone disease. Conventional wisdom holds that low bone-mineral density, the hallmark of osteoporosis, is chiefly responsible for frac-

BLUMWALD