WU scientists analyze solar wind samples from Genesis Mission

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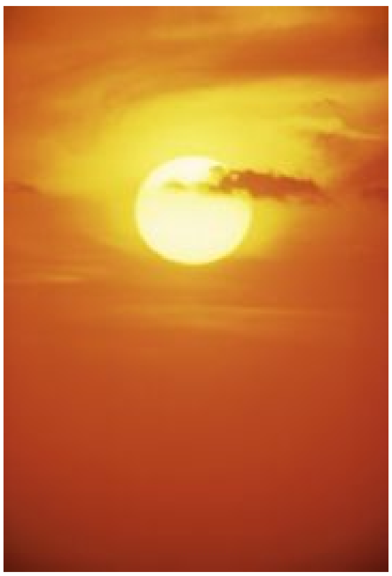

As reservoirs of valuable information go, nothing beats the sun. This sphere of heat and energy holds 99.9 percent of the solar system, saved in all original proportions after planets and meteorites formed. Analyzing the mix of hydrogen, oxygen and noble gases found in the sun can answer one of the biggest questions of the universe: How did our solar system evolve?

Scientists at Washington University in St. Louis and a large team of colleagues marked the beginnings of that odyssey by examining samples of solar wind for neon and argon, two abundant noble gases. The work was published in the Oct. 19, 2007, issue of *Science*.

These samples came from NASA's Genesis mission, which launched in 2001, and orbited the sun for more than two years, collecting samples of solar wind. In 2004, the soft landing planned for the craft went wrong and Genesis smashed into the Utah mud, splintering into more than 10,000 pieces. Fortunately, these fragments were large enough to yield highly precise data for neon and argon.

Alex Meshik, Ph.D., lead author and research professor of physics in Arts & Sciences at Washington University, credits mission planners for preparing for every outcome long before launch. At the time, decisions to craft solar wind collection arrays in different thickness in case they were broken on landing likely saved all data.

"The arrays are made of super-pure metals and diamonds deposited on sapphire," Meshik says. "There was no way to mark them otherwise. Now we can take a piece and know which array it came from."

Genesis collected samples by deploying different arrays during three types, or flow regimes, of solar wind: low-speed, high-speed and the spectacular coronal mass ejections. Because solar wind streams at different velocities in different regimes, on-board instruments move the arrays to collect separate data for the different regimes.

The abundances and isotopic composition of the noble gas from the regimes could in turn be used to understand how well the solar wind truly represents solar composition.

Data presented in the *Science* paper made one thing clear: The isotopic composition of neon and argon in all three regimes were the same. So measuring solar wind means that you are sampling the solar corona, the place at which ions stream out of the sun.

"This is good for future measurements of nitrogen and oxygen and other elements because if it's true for noble gases, it's true for other elements as well," says Meshik.

This work gives scientists who design models of how the solar system formed the actual ground truth, explains Charles Hohenberg, Ph.D., WUSTL professor of physics. Differences in isotopic composition between the planets and the sun tell us about their evolutions. Also, the team's ability to measure neon and argon with high precision helps other Genesis scientists calibrate their data.

Although Washington University scientists won't be measuring oxygen — a critical element for planetary studies — their Genesis findings will help scientists make their measurements more accurate.

"There are so many elements that other scientists would like to measure that are very, very difficult to measure because of their low abundance and high potential for contamination," says Hohenberg.

Refining the equipment

Even though WUSTL scientists were able to extract valuable data from Genesis' broken pieces, the work required the design of new equipment and refinement of existing measuring devices. Both Meshik and Hohenberg stressed the team aspect that made and continues to make this project possible.

Five of eight authors on the current Science paper come from Washington University. In addition to Meshik and Hohenberg, fourth-year graduate student Jennifer Mabry, whose Ph.D. research is based on this work; senior research scientist Olga Pravdivtseva, Ph.D.; and Yves

Marrocchi, who is now at Nancy-Université in France, worked on all aspects of the project. Also among the co-authors is a former student of Hohenberg's, Chad Olinger, Ph.D., who is at Los Alamos.

Next, WUSTL scientists will measure heavy noble gases from the solar wind samples — they've already redesigned two new mass spectrometers specially made for this effort. Unlike argon and neon, which are abundant enough for multiple measurements, the rarity of heavy nobles like xenon allow for perhaps only one or two attempts.

The Genesis mission was the first since the Apollo era to bring extraterrestrial material back to Earth, so the team wants the best measurement of the sun's xenon and krypton possible. Therefore, these measurements have been delayed while measurement techniques are optimized.

"If you look at meteorites, the argon that you measure is very close to what you see in the sun. That's not the case for xenon and krypton and that's not the case for the atmosphere. Understanding how those things all fit together is important. Nobody really knows yet," says Hohenberg.

Source: Washington University in St. Louis