Organic molecules transport strongest spectral signature of interplanetary dust particles

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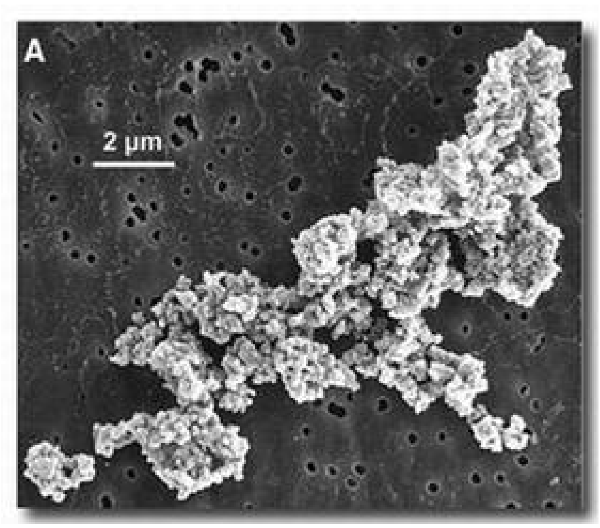

Carbon and silicate grains in interplanetary dust particles are helping scientists solve a 40-year-old astronomical mystery.
A collaborative team of researchers has discovered what turns the lights out from space.
Using sophisticated features on a transmission electron microscope, John P. Bradley, Ph.D., Director of the Institute for Geophysics and Planetary Physics at Lawrence Livermore National Laboratory, **has discovered that organic carbon and amorphous silicates in interstellar grains**

embedded within interplanetary dust particles (IDPs) are the carriers of the astronomical 2175 E extinction line.

Discovered by astronomers more than 40 years ago, the astronomical extinction line occurs at a wavelength of 2175 Angstroms, blocking light from stars from reaching the Earth due to the absorption of light by dust in the interstellar medium. One Angstrom (E) is one one-hundred millionth of a centimeter.

Bradley analyzed interstellar grains from the Laboratory for Space Sciences at Washington University in St. Louis to make the discovery.

Last year, Frank Stadermann, Ph.D., Washington University senior research scientist in physics, and Christine Floss, Ph.D., Washington University senior research scientist in earth and planetary sciences and physics, both in Arts & Sciences, reported that some grains within IDPs are presolar in origin. They used a unique instrument called the NanoSIMS – a type of secondary ion mass spectrometer – to measure the isotopic composition of the grains to determine these findings.

The NanoSIMS enables researchers to analyze particles at much higher spatial resolution than before, allowing them to find the small presolar grains within the dust particles. Until recently, ion microprobes could only analyze dozens of such sub-grains at one time and so were able to deduce only the average properties of a sample.

The findings were reported in the Jan. 14, 2005 issue of *Science*.

Collaborators on the discovery include researchers from the University of California at Davis, Lawrence Berkeley National Laboratory and NASA-Ames Research Center "Interstellar dust for some reason absorbs light at this frequency, and it has been difficult to pinpoint what the source of the absorption is," said Stadermann.

"The strange thing about this feature is that it was observed in different dust clouds and the peak width of the feature was variable, but the center of the peak was always exactly at 2175 E. People tried to reproduce this in the laboratory on graphite, for example, and they couldn't get exactly the right absorption peak. It was difficult to find the material responsible for this absorption. Now, for the first time, it can be said we have it."

Livermore's Bradley used a state-of-the-art transmission electron microscope equipped with a monochromator and a high-resolution electron energy-loss spectrometer, allowing him to analyze in the 2175 E range, to get exactly the same type of absorption feature in these dust particles.

"The interesting thing is that Bradley and his colleagues found the absorption feature in exactly those places in the IDPs that we have identified as presolar in origin," Stadermann said. "That is a good indication that what the astronomers have been seeing for the last 40 years is the same thing we now observe in these IDPs."

Floss said that Bradley's discovery is significant because organic carbon and amorphous silicates are abundant in interstellar dust clouds and abundant carriers are needed to account for the fact that the 2175 E feature is so commonly observed by astronomers. The Washington University contribution is important because the NanoSIMS measurements prove that these grains in the IDPs are actually presolar. This shows that this material has a direct connection to interstellar dust clouds and is not just something from the solar system that coincidentally shows the same extinction feature.

"We originally sent the IDPs to Bradley so that he could identify the presolar phases that we had found, "Floss said. "With this new technique he then made more measurements and made this discovery."

In 2000, with help from NASA and the National Science Foundation, Washington University bought the first commercially available NanoSIMS. Made by Cameca in Paris, the NanoSIMS ion microprobe can resolve particles as small as 100 nanometers in diameter. A million such particles side-by-side would make a centimeter. The presolar grains in IDPs range from 100 nanometers to 500 nanometers.

Source: Washington University in Saint Louis