New research findings consistent with theory of impact event 12,900 years ago

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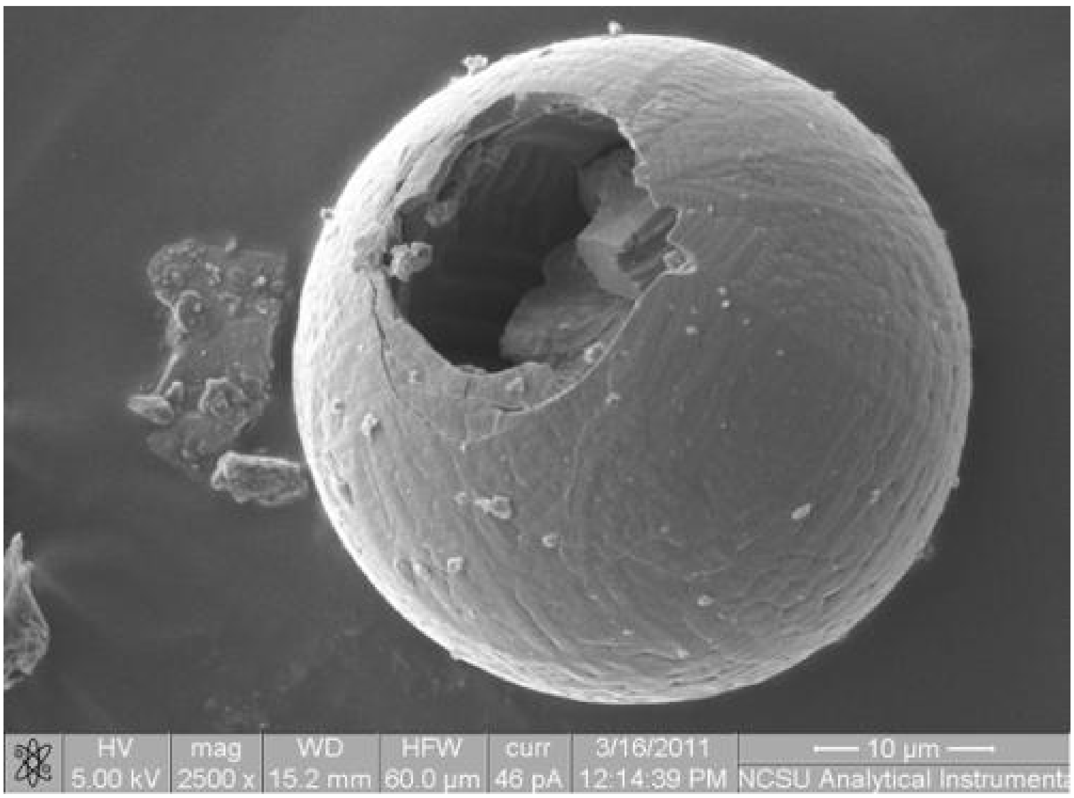

(Phys.org)—New research findings published in the *Proceedings of the National Academy of Sciences* (*PNAS*) are consistent with a controversial theory that an extraterrestrial body – such as a comet – impacted the Earth approximately 12,900 years ago, possibly contributing to the significant climatic and ecological changes that date to that time period.

The paper includes significant findings about the nature of so-called "microspherules" that were found at a number of prehistoric sites, based on materials research work done at NC State. But while the findings are interesting in themselves, the paper is only the latest in a heated scholarly debate focused on whether such an "impact event" took place.

The debate dates back to a 2007 paper, in which researchers reported finding evidence at multiple sites of a significant impact event. The evidence cited in that paper included a large increase in the abundance of magnetic microspherules at the study sites. The microspherules are metallic spheres in the range of 10 to 50 micrometers. For comparison, human hair is 50 to 100 micrometers in diameter.

Specifically, the 2007 team found hundreds to thousands of these microspherules in each kilogram of dirt they sampled at the Younger Dryas Boundary (YDB) layer from several sites. The YDB marks the period when the Earth's climate reverted to conditions similar to the ice age and populations of prehistoric animals, such as mammoths, appear to have dropped off precipitously. It also marks the period when the Clovis culture in North America seems to have experienced a significant population decline or some significant cultural modification. Samples were also taken from layers above and below the YDB. Microspherules were found in much greater numbers in the dirt samples taken from the YDB, as compared to the samples from the other layers. These microspherules have a variety of natural and artificial sources, including impact events, volcanoes and industrial pollution. Most types of microspherules are easily distinguished from one another.

However, in 2009, another team of researchers published a paper calling the 2007 findings into question. The researchers had examined two of the sites cited in the 2007 paper – the Blackwater Draw site in New Mexico and the Topper site in South Carolina, as well as 5 others – and reported that its researchers were unable to find increased numbers of the relevant microspherules in the YDB at all but one site – and even that site was questionable.

Now the new *PNAS* paper finds that the 2009 study relied on flawed protocols. Perhaps more importantly, the researchers behind the new study have re-examined the Blackwater Draw and Topper sites – as well as a third site in Maryland common to the 2009 study– and were able to find microspherules in amounts consistent with the 2007 hypothesis at each site.

However, it's important to not get carried away.

"Our study replicates only a small subset of the research reported in 2007 and within those narrow limits, our results are consistent with theirs. Much research remains to be done to prove or disprove the hypothesis," says Dr. Malcolm LeCompte of Elizabeth City State University, who is lead author of the new *PNAS* paper.

The Role of Materials Research

LeCompte brought some of these microspherules to the Analytical Instrumentation Facility (AIF) at NC State, which provides both analytical instrumentation and expert staff to help researchers analyze and characterize materials and material structures at the micro and nanoscale.

"They wanted to know what's in these spherules and where they came from," says Charles Mooney, the scanning electron microscope (SEM) lab manager at AIF.

"We analyzed the microspherules with an SEM, which allowed us to obtain high-resolution images of the microspherules. We also collected x-rays generated by electron beam-sample interactions to tell us what elements were in each sample," Mooney explains. "This told us that the microspherules were largely made up of iron, aluminum, silicon, and occasionally titanium, with one spherule containing significant amounts of rare earths, such as cerium."

Dr. Dale Batchelor, director of operations at AIF, also sliced open some of the microspherules using an analytical instrument composed of a both a focused ion beam (FIB) and an SEM to examine their interior structure and composition. Interestingly, some of the microspherules were partially hollow, but exhibited internal crystal structures when cross sectioned with the FIB. "To our knowledge this is the first instance of the FIB technique being used to cross section YBD microspherules – in effect exploratory surgery on the microscale," Batchelor says. "The FIB is the scalpel and the SEM is the eye."

Most of the microspherules were made up of elements in proportions similar to the composition of the Earth's crust and not, as some had proposed, meteorite material. In addition, the surface characteristics of the microspherules indicate that they were heated to a molten temperature and then cooled rapidly.

"This is consistent with the theory of an impact event, but falls short of proof positive," says LeCompte.

The paper, "Independent evaluation of conflicting microspherule results from different investigations of the Younger Dryas impact hypothesis," was published in *PNAS* Sept. 17. The paper was co-authored by Mooney and Dr. Dale Batchelor of NC State; Dr. Albert Goodyear of the University of South Carolina; Mark Demitroff of the University of Delaware; Dr. Edward Vogel of the University of Oregon; Dr. Barrett Rock of the University of New Hampshire; and Alfred Seidel of Seidel Research.

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