A war without end—with Earth's carbon cycle held in the balance

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The greatest battle in Earth's history has been going on for hundreds of millions of years, isn't over yet, and until now no one knew it existed, scientists reported today in the journal *Nature*.

In one corner is SAR11, a bacterium that's the most abundant organism in the oceans, survives where most other cells would die and plays a major role in the planet's carbon cycle. It had been theorized that SAR11 was so small and widespread that it must be invulnerable to attack.

In the other corner, and so strange looking that scientists previously didn't even recognize what they were, are "Pelagiphages," viruses now known to infect SAR11 and routinely kill millions of these cells every second. And how this fight turns out is of more than casual interest, because SAR11 has a huge effect on the amount of carbon dioxide that enters the atmosphere, and the overall biology of the oceans.

"There's a war going on in our oceans, a huge war, and we never even saw it," said Stephen Giovannoni, a professor of microbiology at Oregon State University. "This is an important piece of the puzzle in how carbon is stored or released in the sea."

Researchers from OSU, the University of Arizona and other institutions today outlined the discovery of this ongoing conflict, and its implications for the biology and function of ocean processes. The findings disprove the theory that SAR11 cells are immune to viral predation, researchers said.

"In general, every living cell is vulnerable to viral infection," said Giovannoni, who first discovered SAR11 in 1990. "What has been so puzzling about SAR11 was its sheer abundance, there was simply so much of it that some scientists believed it must not get attacked by viruses."

What the new research shows, Giovannoni said, is that SAR11 is competitive, good at scavenging organic carbon, and effective at changing to avoid infection. Because of that, it thrives and persists in abundance even though it's constantly being killed by the new viruses that have been discovered.

The discovery of the Pelagiphage viral families was made by Yanlin Zhao, Michael Schwalbach and Ben Temperton, postdoctoral researchers working with Giovannoni. They used traditional research methods, growing cells and viruses from nature in a laboratory, instead of sequencing DNA from nature. The new viruses were so unique that computers could not recognize the virus DNA.

"The viruses themselves, of course, appear to be just as abundant as SAR11," Giovannoni said. "Our colleagues at the University of Arizona demonstrated this with new technologies they developed for measuring viral diversity."

SAR11 has several unique characteristics, including the smallest known genetic structure of any independent cell. Through sheer numbers, this microbe has a huge role in consuming organic carbon, which it uses to generate energy while producing carbon dioxide and water in the process. SAR11 recycles organic matter, providing the nutrients needed by algae to produce about half of the oxygen that enters Earth's atmosphere every day.

This carbon cycle ultimately affects all plant and animal life on Earth.

Provided by Oregon State University

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