

Ancient organisms discovered in Canadian gold mine

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Scientists have suspected that the three known domains of life -- eukaryotes, bacteria, and archaea -- branched off and went their separate ways around three billion years ago. But pinning down the time of that split has been an elusive task.

Now, a team of scientists present direct evidence that the three domains of life coexisted at least as long as 2.7 billion years ago.

The discovery came from chemical examination of shale samples, loaded with oily lipid remains of archaea found in a deep Canadian gold mine near Timmins, Ontario, about 400 miles north of Toronto.

Details are reported in the August 20-24 early edition of the *Proceedings of the National Academy of Sciences*.

Fabien Kenig, associate professor of earth and environmental sciences at the University of Illinois at Chicago, and his former doctoral student Gregory Ventura, spent nearly five years carefully analyzing the shale samples, originally to compare what they found with an earlier Australian study suggesting the presence of eukaryotes some 2.7 billion years ago.

Ventura, now a post-doctoral researcher at the Woods Hole Oceanographic Institution, said initial laboratory results stunned him. "I thought there was something very wrong, that the samples were contaminated," he said.

But Kenig was more confident they were on to something significant.

They didn't learn the true value of the material until it was analyzed using a sophisticated, multi-dimensional gas chromatography instrument at the U.S. Coast Guard Academy.

When they analyzed a sample, Kenig said, they were able to pull apart its complex mixture of molecular fossils, and found it was "essentially made of archaea-derived lipids."

The archaea lived in water and sediments when the region was covered by the sea. After burial, the archaea thrived where very hot water circulated in the rocks and where gold was deposited. Later, shale containing fossilized archaea got buried under thousands of feet of volcanic rock and sediments.

The researchers studied shale samples using a scanning electron microscope. They also analyzed rock formation, mineral deposits and molecular fossils. Findings led the researchers to conclude that archaea and the other two life domains coexisted.

"Now we are sure the three domains of life were well separated and evolving (independently) by 2.7 billion years ago," said Kenig.

The finding broadens the known geographic reach of archaea during this time period, adding proof that the ancient organisms existed both in sedimentary environments and in subsurface hydrothermal settings.

"Considering the extent and composition of today's deep biosphere, it is likely that such hydrothermal subsurface communities have existed for much of the Earth's history," Ventura and Kenig write.

Source: University of Illinois at Chicago

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