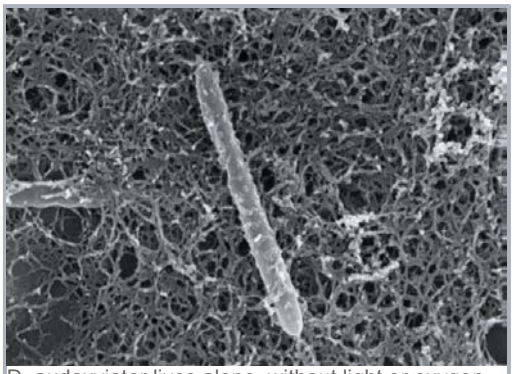
NewScientist Environment

Goldmine bug DNA may be key to alien life

19:00 09 October 2008
NewScientist.com news service
Catherine Brahic

See our online special report *The most extreme lifeforms in the universe*

A bug discovered deep in a goldmine and nicknamed "the bold traveller" has got astrobiologists buzzing with excitement. Its unique ability to live in complete isolation of any other living species suggests it could be the key to life on other planets.



D. audaxviator lives alone, without light or oxygen 2.8 kilometres down inside a South African goldmine (Image: Greg Wanger / Gordon Southam)

A community of the bacteria *Candidatus Desulforudis audaxviator* has been discovered 2.8 kilometres beneath the surface of the Earth in fluid-filled cracks of the Mponeng goldmine in South Africa. Its 60°C home is completely isolated from the rest of the world, and devoid of light and oxygen.

Dylan Chivian of the Lawrence Berkeley National Laboratory, California, studied the genes found in samples of the fluid to identify the organisms living within it, expecting to find a mix of species. Instead, he found that 99.9% of the DNA belonged to one bacterium, a new species. The remaining DNA was contamination from the mine and the laboratory.

"The fact that the community contains only one species stands one of the basic tenets of microbial ecology on its head," says Carl Pilcher, director of the NASA Astrobiology Institute, who was not involved in Chivian's DNA analysis but whose colleagues made the initial discovery that there were microbes living in this particular fissure two years ago.

Evolutionary biologist E. O. Wilson says the discovery is so important he will at once begin to mention it in his lectures on biodiversity.

Lonely bug

A community of a single species is almost unheard of in the microbial world. It means the ecosystem's only species must extract everything it needs from an otherwise dead environment.

"Virtually all other known ecosystems on Earth that don't use sunlight directly do use some product of photosynthesis," says Pilcher.

Deep-sea vent communities, for instance, are too far down to directly use sunlight but they do use oxygen dissolved in seawater, and that oxygen is produced by photosynthesising plankton at the surface.

Chivian's analysis shows that *D. audaxviator* gets its energy from the radioactive decay of uranium in the surrounding rocks. It has genes to extract carbon from dissolved carbon dioxide and other genes to fix nitrogen, which comes from the surrounding rocks. Both carbon and nitrogen are essential building blocks for life as we know it, and are used in the building blocks of proteins, amino acids. *D. audaxviator*

has genes to produce all the amino acids it needs.

D. audaxviator can also protect itself from environmental hazards by forming endospores – tough shells that protect its DNA and RNA from drying out, toxic chemicals and from starvation. It has a flagellum to help it navigate.

Ancient origins?

"One question that has arisen when considering the capacity of other planets to support life is whether organisms can exist independently, without access even to the Sun," says Chivian. "The answer is yes and here's the proof. It's philosophically exciting to know that everything necessary for life can be packed into a single genome."

Chris McKay, of NASA's Ames Research Center says that *D. audaxviator* is an amazing discovery, and represents the kind or organism that could survive below the surface of Mars or Saturn's sixth largest moon Enceladus.

Some of the bacterium's genes appear to be inherited from a related species. Others have been found in archaea, a group of organisms evolutionarily distinct from bacteria. Chivian says *D. audaxviator* may have evolved as it travelled down through the cracks in the rock, and acquired archaea genes through horizontal gene transfer from populations it crossed on its way down.

"It can't handle oxygen," he says. This suggests it has not been exposed to pure oxygen for a long time. The water in which *D. audaxviator* lives has not seen the light of day in over 3 million years, and this could be an indication of how old the species is.

In fact, the species got its name from its long journey towards the centre of the Earth. In Jules Verne's novel by that name, the fictional Professor Lindenbrock's journey is triggered by the following message in Latin: "*descende, Audax viator, et terrestre centrum attinges*" – meaning "descend, bold traveller, and attain the center of the Earth".

Journal reference: *Science* (DOI: 10.1126/science.1155495)

See our online special report *The most extreme lifeforms in the universe*

Astrobiology *– Learn more in our out-of-this-world special report*.

Related Articles

Was Mars too salty for life?
http://environment.newscientist.com/article/dn14016
29 May 2008

Extreme organisms
http://environment.newscientist.com/article/mg17323367.500
30 March 2002

Weblinks

Dylan Chivian
http://lib.bioinfo.pl/auid:1060

Carl Pilcher, NASA Astrobiology Institute
http://nai.nasa.gov/library/timeline_webpages/2001/Carl_Pilcher.htm

Chris McKay, NASA Ames
http://tellus.ssec.wisc.edu/outreach/getwise/lectures/solar/GET-WISE009-1/McKayBio.htm

Close this window