Published online 1 June 2011 | Nature | doi:10.1038/news.2011.342

News

Subterranean worms from hell

New species of nematode discovered more than a kilometre underground.

Nadia Drake

The discovery of multicellular creatures from the deepest mines sounds like something from the pages of J. R. R. Tolkien. But scientists have now found four species of nematode, or roundworm, lurking in South Africa's gold mines at depths where only single-celled bacteria were thought to reside. And at least one of them, *Halicephalobus mephisto*, has never been described before.

Halicephalobus mephisto lives deep underground where it feeds on colonies of bacteria.

Property of the University of Ghent, Belgium - Gaetan Borgonie

The 0.5-millimetre-long *H. mephisto*, named in reference to the light-hating demon of the underworld, feeds on films of bacteria that grow more than a kilometre down within the warm walls of the Beatrix gold mine, located some 240 kilometres southwest of Johannesburg.

"It's like 1 million times the size of the bacteria it eats — sort of like finding Moby Dick in Lake Ontario," says Tullis Onstott, a geomicrobiologist at Princeton University in New Jersey and a co-author of the study, which is published today in *Nature*[1].

Deep dwellers

Previously, nematodes had been found nearer the surface, with only bacterial populations living deeper down[2,3]. But the authors discovered *H. mephisto* existing happily at 1.3 km down — at which depth the temperature reaches around 37 °C, higher than most terrestrial nematodes can tolerate.

Different South African mines revealed other deep-dwelling roundworms. Two nematode species — one identified as *Plectus aquatilis* and one unknown species from the Monhysterid order — were found in the Driefontein mines at a depth of 0.9 km at 24 °C. The authors also recovered DNA from a second unknown monhysterid species in the Tau Tona mine, 3.6 kilometres down, where temperatures hover around 48 °C.

Finding the worms surprised even the study's authors. "When I proposed to look in the deep underground, this was a complete 'out of the box' idea," says nematologist Gaetan Borgonie, of the University of Ghent in Belgium. "It doesn't happen often that you can redraw the boundaries of a biosphere on a planet."

"That depth? Those temperatures? This is incredible," says Diana Wall, a soil ecologist at Colorado State University in Fort Collins, who studies antarctic nematodes.

'Big snot layers'

In their mine habitat, the worms munch on bacteria living in biofilms — "big, snot layers of gelatinous goo," explains Onstott. The biofilms form in the mine walls near boreholes, where the rock is fractured using jets of water. After culturing the worms in the lab, the team found that the nematodes preferred snacking on indigenous bacteria from the mine, suggesting that the communities are well established.

"That the worms are feeding and grazing on bacteria — and not on something that's a common bacterial species — means there is a fully functioning ecosystem at this depth," Wall says. Although she notes that the phenomenon is striking, she points out it is still unclear how prevalent these communities are.

To search for these subsurface communities of organisms, the researchers filtered and trapped biological material in the water pouring from boreholes — catching nematodes, bacteria and DNA. Genetic analyses confirmed the novelty of *H. mephisto*, which has a ribosomal RNA sequence and body shape that differ from its closest relatives.

To rule out contamination from the surface, the team tested thousands of litres of water used in the mining operations, and analysed nematodes in the soil near the boreholes. They found no worms in the water, and different species in the soils.

Elderly residents?

Microbiologist Karsten Pedersen at the University of Gothenburg, Sweden, says that the authors have done a good job arguing that the worms are residents of the deep Earth, but points out that it is still unclear how long they've lived there.

Onstott and his team would like to continue studying Earth's deep spots for the presence of multicellular life forms, viruses and complex communities. They'd also like to sequence the genomes of the recovered South African organisms. "That could tell us a lot about evolution," Onstott says. "Is *H. mephisto* endowed with any special capabilities? Is it more primitive? Has it acquired attributes that imply adaptation and evolution in the subsurface?"

"I doubt this nematode sprang from hell," says evolutionary biologist Byron Adams of Brigham Young University in Provo, Utah, referring to the new worm's name. "It more likely evolved at Earth's surface with the rest of the Nematoda. At some point they made their way down and with a few genetic refinements found themselves capable of doing just fine."

The presence of multicellular life in the harsh environment of the mine walls — oxygen-starved, hot and inhospitable — not only expands the sphere in which life might exist on Earth, but on other planets as well. "Now the deep subsurface of Mars looks very interesting," says Michael Meyer, lead scientist for NASA's Mars Exploration Program. "The Universe might have many more habitats than we thought."

References

1. Borgonie, G. *et al. Nature* **474,** 79-82 (2011). | **Article** |
2. Lin, L.-H. *et al. Science* **314,** 479-482 (2006). | **Article** | **ISI** | **ChemPort** |
3. Roussel, E. G. *et al. Science* **320,** 1046 (2008). | **Article** | **ISI** | **ChemPort** |

Comments

If you find something abusive or inappropriate or which does not otherwise comply with our ***Terms*** *or* ***Community Guidelines****, please select the relevant 'Report this comment' link.*

Comments on this thread are vetted after posting.

Thinking on the idea that a functioning ecosystem could exist downthere, brings the question of who is feeding from them in the chain, could be bigger. How do they get there? Most common carriers in a mine are minners, nematodes do live as parasites in human large intestine and some of them feed on intestine anaerobic flora, fever raise temperatures up to 34 C, they survive, from there to 37C, is just 3C.I dont know how old those mines are, but desease and poor hygine were common denominators hundreds years ago. From my point of view it was easier to adapt comming from an anaerobic habitat. It would be interesting to check some of those parasites human nematodes DNA to see how close they are. Thanks! **#23253**

Report this comment Posted by: **wilfredo santa** | 2011-06-01 05:54:00 PM

Sorry, I made a mistake, 37.50 C is body normal temperature, matches temperature of nematode site discovery. **#23263**

Report this comment Posted by: **wilfredo santa** | 2011-06-01 08:07:45 PM

Hey I bed your style I give take for your work please resource transmitting! **#23320**

Regards
learn to play craps
Provence rentals
home alarm systems
laser hair removal Scottsdale
Concord Cityplace

Report this comment Posted by: **jacks jacks** | 2011-06-02 06:35:33 AM

---

re: Wilfredo Santa **#23345**

Your hypothesis is possible but the timeframe that you give to the nematode to evolve from parasitic to free living is very very short and thus unlikely.

The paper states that the worm resides in fracture water that is between 3000 and 12000 years old, but the mines are much more recent. Furthermore, the authors went to great length to eliminate potential contaminant.

Report this comment Posted by: **Matthieu Vermeren** | 2011-06-02 09:45:51 AM

This is very interesting...S. **#23381**

Report this comment Posted by: **Sharon Aldridge** | 2011-06-02 08:27:40 PM

Add your own comment

This is a public forum. Please keep to our **Community Guidelines**. You can be controversial, but please don't get personal or offensive and do keep it brief. Remember our threads are for feedback and discussion - not for publishing papers, press releases or advertisements.

You need to be registered with Nature to leave a comment. Please log in or register as a new user. You will be re-directed back to this page.

Log in / register

Nature ISSN 0028-0836 EISSN 1476-4687