# The world’s oldest water?

***This release is available in French.***

Washington — New evidence bolsters the notion that deep saline groundwaters in South Africa's Witwatersrand Basin may have remained isolated for many thousands, perhaps even millions, of years.

The study, recently accepted for publication in Chemical Geology, found the noble gas neon dissolved in water in three-kilometre deep crevices.

The unusual neon profile, along with the high salinities and some other unique chemical signatures, is very different from anything seen in molten fluid and gases rising from beneath the Earth's crust, according to University of Toronto professor Barbara Sherwood Lollar, who is the Canadian member of the international team that produced the results.

"The chemical signatures also don't match those of ocean water or waters higher up in the Witwatersrand Basin, where as in most regions of the crust ground waters show evidence of mixing with surface waters and are extensively colonized by microorganisms," she said. "We concluded that the deeper waters were the product of isolation and extensive chemical interaction between water and rock over incredibly long geological time scales."

The smoking gun was the ancient basement rock.

"We know that this specific neon isotope signature was produced and trapped within the rock at least two billion years ago. We can still find it there today," Dr. Sherwood Lollar said. "The study shows some of the neon found its way outside of the rock minerals, gradually dissolving into, and accumulating in, fluids in crevices. This could only happen in waters that have indeed been cut off from the surface for extremely long time periods."

The discovery adds yet another dimension to what has only recently been recognized as a truly unique environment.

One of these fracture systems contains the deepest known microbial ecosystems on Earth. These are organisms that eke out an existence independent from sunlight on chemical energy that originates from rock.

"These deep microbial communities radically expand our concept of the habitability of the Earth's subsurface and, indeed, our biosphere," said Dr. Sherwood Lollar.

"Given that they have a genetic similarity to organisms found at hydrothermal vents, we assume this is not a separate origin of life, but instead these organisms arrived from elsewhere to colonize these rocks in ancient times," she said.

"Clearly the long period of isolation affected their evolution. This is one area we hope to explore with continuing research with our microbiology colleagues."

The lead author of the paper is Johanna Lippmann-Pipke of the Helmholtz-Zentrum Dresden-Rossendorf in Leipzig, Germany. Researchers from that country, South Africa, the United States and Canada participated in the study.

Dr. Sherwood Lollar will be available to discuss the new findings at this year's meeting of the American Association for the Advancement of Science (AAAS) in Washington, DC. On Sunday, February 20, she will take part in a panel discussion on global water issues at the Think Canada Press Breakfast.

Thanks for your email. Happy to provide some additional info and

please feel free if there are additional follow-up questions you would like. I will also cc here the first author Dr. Johanna Lippmann and our collaborators from South Africa and Princeton too so you could contact them too if you wanted.

Regarding the age of the water.

These groundwaters are found in fractures in rocks and the residence time of the bulk waters vary from fracture to fracture ? ranging from tens of thousands of years old in fractures closer to the surface, to tens of millions of years old in the fracture in deeper rocks (approx 2-3 km depth).

These are not ages per se, but what is referred to as residence times for the bulk water, and are based on noble gas measurements. It?s a subtle distinction but the point is that any groundwater is a mixture of different components ? older and younger. Bulk groundwater residence time is the ?age? of the overall mixture.

The bulk water residence times are tens of thousands to tens of millions (as indicated above). What was especially exciting here is that we found that one component of the water (the dissolved neon) must be exceptionally old ? billions of years.

Moving on to the microbes ? one of the key objectives of the international team studying these systems is to understand the nature of deep subsurface microbial life. In particular understanding how deep and under what conditions one can find microbial life in the deep earth ? cut off from the photosphere - i.e. where we find microbial communities dominated not by photosynthetic energy, but drawing their energy for life from chemical reactions between the water and the rock. These are called chemosynthetic, rather than photosynthetic organisms which dominate the earth?s surface.

The ?age? of the groundwater is critical to this objective as it is what tells us that indeed these systems have been isolated from the earth?s surface for immense periods of time.

Similar thermophilic (heat-loving) chemosynthetic organisms have been found in the deep oceans ? but this research in the deep earth is exciting because it shows such organisms and life itself can in fact thrive much deeper and over potentially much large volumes of the earth?s subsurface crust than previously recognized.

I have often put it this way:

In the past half century we have moved from the misconception that life consists of a thin veneer on the surface of the planet driven by the sun's energy alone, to a recognition of deep biosphere oases at deep ocean vents and springs, to the possibility that the Earth's biosphere extends to kilometers depth over the planet's entire circumference.

With thanks and best wishes, Barbara

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IMPORTANT CHANGE OF ADDRESS INFO: The email address below is the only correct one for me. Please check your address books and listsservers and ensure that

any other email address is removed from your records.

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Quoting Unni Eikeseth <unni.eikeseth@nrk.no>:

> Dear Barbara
>
> I am a Norwegian Science & Technology journalist working for
> Norwegian Broadcasting Coorporation. I saw an article referring to
> your research in Science News from redOrbit:
> http://www.redorbit.com/news/science/1999579/the_worlds_oldest_water/index.html
>
> I have some questions concerning this research, that I hope you could answer.
> -The article in redOrbit just said that the groundwater in South
> Africa's Witwatersrand Basin may have remainted isolated for
> thousands, perhaps millions of year. How old is it?
> -how can you tell the age of groundwater?
> - why is it important to find water that has been isolated for a long time?
> - what can we learn from the microbes that live in these old waters?
> -is it anything special about the microbes that live in these water
> compared to other deepwater habitats?
>
> -last but not least important; do you have any pictures that you
> could give me permission to use? Pictures of the microbes or the
> area where the basin is situated?
>
> Best wishes,
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