What Ancient Waters Found in Timmins, Ontario Could Reveal About the Possibility of Life on Mars

«««« By Lora Clausen
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Curriculum Connection: Grade 9 and 12: Earth and Space Science.

What can evidence found from within a Timmins mine tell us about the theoretical existence of life on Mars? Can and do microbes exist in subterranean waters? What does all this mean for space exploration and perhaps the potential to one day inhabit another planet?

During her visit with us at Dynamic Earth, home of the Big Nickel in Sudbury, Dr. Barbara Sherwood Lollar shared her most recent scientific discovery on ancient waters and the possible connection it could have to life on Mars. Dr. Lollar is a geochemist, Director of the Stable Isotope Research Lab and Professor in the Earth Sciences Department, at the University of Toronto.

About 20 years ago, Dr. Lollar and a team of colleagues including geologists, chemists and microbiologists from across the globe, were called in to investigate water that was discovered deep within mines in South Africa. The initial point of significance of this discovery was the source of water — found in crystalline rock fractures, vastly different from finding water from aquifers and pores within the earth.

Upon further investigation, the chemical composition of this water showed to contain a very high salinity, much more so than sea water, to the point of being viscous. This told scientists that this water was very old. The water also showed to have a similar chemical composition as water from hydrothermal vents found in oceans.

This exciting scientific journey has brought the team of scientists very close to home, when earlier this year, Dr. Lollar and her colleagues found ancient water in Timmins, Ontario. This rock bed — well known as the Canadian Shield — began to form in the Precambrian Era, billions of years ago and is the same rock formation also found in South Africa and other parts of the world. Exploration as deep as three kilometres below the Earth's crust in Kidd Mines in Timmins, unearthed water found in crystalline rock fractures, just as that in South Africa.

How exactly does one go about identifying the age of water?

The isotopic composition of oxygen and hydrogen, along with the salinity, tells researchers that the water is very old. Investigating radiogenic isotopes and measuring the amounts of noble gases (helium, argon, xenon, neon), which accumulate in the water over time, allows researchers to estimate just how old the water is. In South Africa, this

investigation resulted in dating the water to approximately 10 million years old. The water found in Kidd Mine in Timmins, is estimated to be anywhere from a whopping 1 to 2.6 billion years old — the oldest water found on Earth thus far!

Just as in the ancient waters discovered in South Africa, the chemical composition of the water in Timmins also tells scientists that it is similar to that of water one would find in hydrothermal vents, which are like hot water springs found at the bottom of the ocean floor. The energy from hydrothermal vents can support autotrophic life.

Autotrophs, such as phytoplankton, are organisms that create their own food. Most do so through the process of photosynthesis, where energy from the sun converts water and carbon dioxide into glucose. In harsher environments, where sunlight is not present, there exist some species of autotrophs that can create their own food through the process of chemosynthesis — using various chemical reactions such as combining methane and oxygen.

Discovering the approximate age and possibility of life existing within the subterranean water now leads researchers into investigating whether there actually are any living organisms existing in the ancient waters of the Canadian Shield.

As the water in the crystalline fractures is mostly still, and the fractures are separate from one another, Dr. Lollar refers to this as the "Galapagos of the deep" allowing researchers to study different biomes that are isolated from one another and compare the life forms within.

How does all of this research relate to the habitability of Mars? The Canadian Shield is similar in age to Mars, and even more fascinating, the chemistry and geology of the rock at this site is similar to parts of Mars' crust.

If researchers are able to prove that this water and life exists in the Earth's crust 2–3 km deep, it is conceivable to think that Martian rocks of similar age and geology could have energy-rich waters as well and that life could theoretically exist there.

How much more of this ancient water exists on Earth? Can scientists find microbial existence within the extreme depths of the Canadian Shield? Could Mars theoretically sustain life? These are the next great questions that researchers will tackle as they continue to delve their way through the ancient rocks on our own planet.