Discovery in northern lakes may be key to understanding early life on Earth

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A composite image of the Western hemisphere of the Earth. Credit: NASA

A team of researchers has discovered that many Canadian lakes can provide new insights into ancient oceans, and their findings could advance research about greenhouse gas emissions, harmful algal blooms, and early life forms.

Scientists from the University of Waterloo led the team of microbiologists, geochemists, and freshwater specialists in a surprising finding that lakes of the Boreal Shield may be similar to oceans of the Archean Eon, a period more than 2.5 billion years ago when microbial life thrived in a world without oxygen.

This finding is important because there are millions of Boreal Shield lakes in Canada that likely share key properties with the Archean oceans. Until now, scientists have relied on only four so-called analogue lakes—ones with similar primordial conditions—most of which are found in remote or ecologically sensitive locations.

"With so many lakes to study, this discovery changes how we approach this field of research," said co-author Jackson Tsuji, a doctoral student in the Department of Biology in the Faculty of Science. "It's exciting that these lakes, which are basically in our backyard, hold information that could have implications for global climate, past and present, and water management."

Published in *Scientific Reports*, the findings have the potential to transform how scientists carry out research about Earth's earliest life forms, which originated in oxygen-free oceans thought to be low in sulphur and high in iron. Many Boreal Shield lakes, also low in sulphur and high in iron, develop oxygen-free layers each summer. Although these layers mix in the spring and fall, they re-establish quickly.

"We used to think finding a suitable Archean ocean analogue meant that you had to find a lake that didn't mix. For example, current analogues

are hundreds of metres deep and completely stratified," said Josh Neufeld, a professor in the Department of Biology. "An important discovery here was how robust this oxygen-free community is, despite the mixing."

Researchers can use these lakes as living laboratories to study how microbes of the past might have functioned. The microbes detected in the sampled lakes are thought to metabolize iron compounds with the help of sunlight, which may help researchers understand how to predict and control harmful algal blooms because iron plays a key role in algal bloom formation.

In addition, the unique and previously unknown microbial communities, specifically methane-consuming microbes at the bottom of these lakes, have broad implications for greenhouse gas emissions.

The study compared aspects of the four current Archean-ocean analogues to two Boreal Shield lakes using water chemistry, microbial community profiles, and stable isotope patterns. The researchers' unique application of the latest biological and isotopic tools shows that similar biological processes to existing analogues are not only present, but active in the water, reoccurring every year.

"This groundbreaking discovery was possible because we had the flexibility to pursue some unexpected results with a multi-disciplinary team using state-of-the-art tools and techniques," said Sherry Schiff, a professor in the Department of Earth and Environmental Sciences.

Boreal Shield lakes are widespread across the Boreal Shield, the largest of the Canadian ecozones, which extends across more than 20 per cent of Canada's land mass. Similar lakes are found in Finland, Norway, Sweden, and Russia.

Provided by University of Waterloo