Study heats up 'snowball Earth' debate

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Research by University Professor Richard Peltier of physics reveals that the Earth's surface 700 million years ago may have been warmer than previously thought.

Peltier developed a climate model that casts doubt on the popular "snowball Earth" hypothesis, a theory that posits the Earth was completely covered in ice and photosynthesis ceased during the late Neoproterozoic period.

The U of T physicist has found that the Neoproterozoic ocean's natural carbon cycle produced a "negative feedback reaction" that actually prevented the equator region from completely freezing over, allowing photosynthesis to occur.

Peltier's recent findings have found resonance among evolutionary biologists. The late Neoproterozoic period gave rise to arguably the most important period in Earth's biological history — the Cambrian period. It was during this time when the major groups of animal life exploded onto the fossil record. Rock samples containing evidence of early organic life — ancestors to photosynthetic life — have been dated to before and after glacial periods. The idea that these ancestors to photosynthetic life could have existed during a period when there was no photosynthesis has been a topic of much debate.

"As the temperature of the Neoproterozoic ocean cools and moves towards a snowball state, more organic carbon is converted into carbon dioxide. The oxygen is drawn down out of the atmosphere into the

ocean, re-mineralizing the organic matter and forcing respiration," Peltier explained. “When respiration occurs, it generates carbon dioxide, part of which remains dissolved in the ocean, but part of which is forced out of the ocean into the atmosphere which enhances the greenhouse effect and prevents the cooling.

“The mathematical model supports oscillatory glaciations and de-glaciations on a timescale that’s similar to the timescale that people have argued were appropriate for the Neoproterozoic,” he added.

Doctoral student Yonggang Liu and John Crowley, a former summer research student in Peltier’s lab, now pursuing doctoral studies at Harvard, co-authored the paper, published in Nature late last year.

The study builds on the findings published by Professor Dan Rothman from the Massachusetts Institute of Technology that suggest that the Neoproterozoic ocean was very rich in carbon life and findings published by Peltier on the cover of *Nature* in 2000 that, for the first time, demonstrated that while huge deep glaciations did exist, a large amount of water near the equator was left unfrozen. At the time, adherents to the “snowball Earth” theory coined the term “slushball Earth” to describe Peltier’s findings.

Source: University of Toronto