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Fishing for clues with SHRIMP

Geoscientists have pinpointed the timing of a vast outpouring of lava over northern Australia which could have triggered the world-wide mass extinction of life that happened around the same time. Dr Michael Wingate, a geochronologist with the Tectonics Special Research Centre at the University of Western Australia, and Linda Hanley, a PhD student with the Research School of Earth Sciences at the Australian National University, have obtained evidence that the eruptions occurred 513 million years ago.

"It's very important to identify the precise age of the eruptions, as this can lead to a greater understanding of the timing of major events which devastated the planet," Ms Hanley said.

"Until recently, the flows were thought to be between 560 and 509 million years old. By using the SHRIMP method, we have been able to pinpoint their age."

Dr Wingate described the method as "a bit like telling the time by counting the grains of sand in both the top and bottom of an hourglass."

"The SHRIMP, or Sensitive High Resolution Ion MicroProbe, can measure the relative amounts of uranium and lead in individual crystals of zircon which are microscopic," he said. "When zircons crystallise in cooling molten rock, they include uranium in their structure but exclude lead. This means that almost all of the lead present in a zircon today was formed by radioactive decay of the uranium. Because we know the rate at which uranium decays to lead, we can calculate how long it's been since a crystal formed."

"We've looked at zircons that formed upon eruption of the lavas – their age, and therefore the age of the eruptions, is 513 million years old."

"This means the flows took place in the Early Cambrian period," Ms Hanley said, "when northern Australia was near the equator and the climate was arid. The first land plants did not evolve until roughly 100 million years later, and strong south-easterly winds blew sand in, forming dunes over some of the lava flows."

"The lava flows are named the Antrim Plateau Volcanics and only one fossil type has been found alongside them – *stromatolites*. These are rigid domes created by colonies of cyanobacteria, which are the earliest and simplest form of life – in fact, you can still see living domes today at Shark Bay in Western Australia."

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“The Antrim Plateau Volcanics are an example of a *continental flood basalt* and the flows covered northern Australia with more than a million square kilometres of lava – extending from the Kimberley across to western Queensland, and from Daly River (near Darwin) south to the Tanami track. Each lava flow varies between 20 to 60 metres thick and the entire series of flows is up to one kilometre thick.”

“Eruptions of this type are very voluminous, far outstripping modern eruptions of basalt - a typical Hawaiian eruption is minute in comparison. Together, the flows of flood basalt represent a single geological event which typically spans one to two million years – a blink of the eyelid in geological terms. Examples exist around the globe and one of the most studied of these is the Deccan Traps in India. Even so, there is still considerable controversy about the origin of continental flood basalts which is the main focus of our research.”

Researchers speculate that these types of eruptions might have triggered mass extinctions. “The link is still conjectural, but is highly plausible,” Ms Hanley said. “The eruptions could have caused an enormous release of greenhouse gases, such as carbon dioxide and sulfur dioxide into the atmosphere, perhaps initiating a period of global warming.”

“The elevated temperatures might have led to the demise of many organisms that existed at the time and perhaps created a further effect – the break up of methane hydrate, which is locked in sediments beneath the oceans, into methane and water.”

“Methane, another potent greenhouse gas, would have been released into the oceans, and would have consumed oxygen from the water column, creating oxygen-starved oceans which were unable to support aerobic life.”

Was the eruption of the Antrim Plateau Volcanics responsible for the mass extinction in the Cambrian that influenced later evolutionary directions? “That’s a topic big enough for a separate thesis,” Ms Hanley said.

Findings by Ms Hanley and Dr Wingate appear in the current issue of the bimonthly *Australian Journal of Earth Sciences*, released this week.

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Media Contacts:

Ms Linda Hanley
Research School of Earth Sciences
Australian National University
Phone: (02) 6249 3956
Fax: (02) 6249 5989
Email: linda.hanley@anu.edu.au

Dr Michael Wingate
Tectonics Special Research Centre
Department of Geology and Geophysics
University of Western Australia
Phone: (08) 9380 2680
Fax: (08) 9380 1090
Email: mwingate@geol.uwa.edu.au

For further information:

Ms Sarah Belfield
Geological Society of Australia
Phone: (02) 9290 2194
Fax: (02) 9290 2198
Email: sarah@gsa.org.au

Geological Society of Australia Inc

Suite 706, 301 George Street SYDNEY NSW 2000
Phone (02) 9290 2194
sarah@gsa.org.au

