UNIVERSITY of TASMANIA

NEWS FROM THE UNIVERSITY OF TASMANIA, AUSTRALIA

Media Release

Chiefs of Staff, News Directors

Tuesday, 13 February 2018

The Earth’s crust: an important driver of the evolution of life

The breakdown of certain types of rocks on the Earth’s surface had a dramatic effect on biological evolution throughout time, new research has found.

Led by the University of Tasmania’s Distinguished Professor of Geology Ross Large, scientists from the Centre of Excellence in Ore Deposits (CODES) and the Tasmanian Institute of Agriculture examined the make-up of the Earth’s crust going back three billion years.

The research team tracked how minerals, or trace elements, made their way from the rocks on the surface into the oceans where they played a crucial role in the evolution of life.

“There is a particular group of trace elements we call nutrient elements because they are essential for life and evolution in the oceans,” Professor Large said.

“As rocks on the continents break down due to weathering and erosion they release some of these bio-essential nutrients to the soil, rivers and eventually the oceans.”

But different types of rocks contain different levels of these nutrient elements, the team found, and so the type of rock that dominates the Earth’s crust determines nutrient levels in the oceans.

The research found that certain rock types, called mafic rocks – for example, basalt and dolerite - and Large Igneous Provinces have far more important nutrient elements than other rocks, called felsic rocks – for example, granite and rhyolite.

When mafic rocks are dominant compared to felsic rocks, nutrient elements including iron, phosphorus, nickel, cobalt, selenium, molybdenum, copper, zinc and manganese flow into the oceans.

“When the Earth was formed more than four billion years ago, basalt lavas were a major part of the planet’s crust, and the oceans were full of nutrients, particularly iron, nickel, cobalt and copper,” Professor Large said.

"However, toxic elements such as arsenic, mercury and antimony were also abundant in the oceans so complex life as we know it struggled to evolve."

Around 2.4 billion years ago, felsic rocks became more abundant, limiting nutrient supply. But toxic elements also declined in this period and simple-celled bacteria started to thrive in the oceans.

Between 2.2 and 1.8 billion years ago, large basalt lava eruptions occurred all over the Earth and rapidly eroded, supplying abundant nutrient elements and driving both evolutionary changes and increasing oxygen in the atmosphere.

Then, for a billion years, the continents were dominated by granites which were enriched in thorium and uranium but contained little of the nutrients essential for life.

CODES PhD student Indrani Mukherjee said this was a period of nutrient crisis that created evolutionary pressure.

"I propose it may have been this need to cope with the prevailing stressful conditions due to low nutrients, that saw existing single-celled life evolve into complex multi-celled life," she said.

"This period had critical implications for the following Cambrian explosion of life, 540 million years ago. I term this event the Slingshot for Life."

Over the last 500 million years the composition of the continents has varied in cycles, related to plate tectonic processes. Dramatic evolutionary steps have resulted from these cycles, not only forward steps, but also backward steps leading to mass extinctions, the latter caused by very low nutrient concentrations in the oceans.

Researchers used new technology, developed by CODES, which deploys laser analysis of Rare Earth Elements (REE) in shale samples collected from all over the world.

Professor Large said the findings by the team are very exciting, and demonstrate clearly how the composition of the Earth's surface varied significantly throughout time and had a critical role to play in determining rates and types of biological evolutionary change of life on Earth.

The research was recently published in *Earth and Planetary Science Letters*.

The project was funded by an Australian Research Council Discovery Grant.

For media interviews contact:

Professor Ross Large - 0418 352 501/ Ross.Large@utas.edu.au
Indrani Mukherjee (PhD student) - indrani.mukherjee@utas.edu.au

Media assets:
Media can access images, including a profile image of Professor Large, here:
https://cloudstor.aarnet.edu.au/sender/?s=download&token=c16ed491-9c6f-3542-5185-423ce5fa2fc5

Image captions:
(Southern UK jpg): Sampling 180 million-year-old black shales in Southern UK

(Canada jpg): Sampling 1800 million-year-old black shales in Central Canada

(Central Asia jpg): Sampling 600 million-year-old black shales in Kyrgyzstan, Central Asia

Information released by:
University of Tasmania, Communications and Media Office
Email: Media.Office@utas.edu.au