New study shows large landmasses existed 2.7 billion years ago

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A Cologne working group involving Prof. Carsten Münker and Dr. Elis Hoffmann and their student Sebastian Viehmann (working with Prof. Michael Bau from the Jacobs University Bremen) have managed for the first time to determine the isotope composition of the rare trace elements Hafnium and Neodymium in 2,700 million year-old seawater by using high purity chemical sediments from Temagami Banded Iron Formation (Canada) as an archive.

Earlier work has shown that these rocks from Canada only contain chemical elements that directly precipitated from ocean water. The Temagami Banded Iron Formation, which was formed 2,700 million years ago during the Neoarchean period, can be used as an archive because the isotopic composition of many chemical elements such as Hafnium and Neodymium directly mirrors the composition of Neoarchean seawater. These two very rare elements allow many valuable conclusions about weathering processes to be drawn.

During their investigations, the research team came to the surprising result that has been published in the renowned journal *Geology*: 2,700 million years ago, seawater contained an unusually high abundance of the radioactive isotope Hafnium 176 but a comparably low abundance of the radioactive isotope Neodymium 143, similar to what can be observed in present day seawater.

"In present day seawater, this can be explained by weathering and the erosion of the Earth's exposed surface," explains Prof. Münker. "If in

the Neoarchean period 97% of the Earth's surface had been, as estimated from computer models, covered by water, these geochemical signals would not have been found for Neoarchean seawater," adds Dr. Hoffmann.

According to the scientific team, the new findings show that 2,700 million years ago relatively large landmasses emerged from the oceans that were exposed to weathering and erosion by the sun, wind and rain. Dr. Hoffmann: "The isotope Hafnium 176 in contrast to its counterpart Neodymium 143 was transported by means of weathering into the oceans and became part of iron-rich sediments on the sea floor 2,700 million years ago."

The examinations were carried out in the joint clean laboratory of the Universities of Cologne and Bonn. Prof. Münker: "We are able to carry out these isotope measurements for very rare elements, the concentrations of which are in the ppb range, i.e. only a few parts per billion."

More information: Decoupled Hf-Nd isotopes in Neoarchean seawater reveal weathering of emerged continents, Sebastian Viehmann, J. Elis Hoffmann, Carsten Münker, Michael Bau, *Geology*, 2013.

Provided by University of Cologne