

Poisonous oceans delayed animal evolution

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Sedimentary rocks from Grand Canyon, USA, show evidence for widespread anoxic and sulfidic waters 750 million years ago. Since sulfide is poisonous to animals, it can explain why animals had not evolved on Earth at that time. Credit: PD photo (www.pdphoto.org)

Animals require oxygen, but oxygenated environments were rare on early Earth. New research from University of Southern Denmark shows that poisonous sulfide existed in the oceans 750 million years ago making large areas of the seafloor inhospitable to animal life. Such ocean conditions may have prohibited the emergence of animals on early Earth. The results are published in the scientific journal *Earth and Planetary Science Letters*.

"We have investigated the cycling of molybdenum (Mo) in [ancient oceans](#) by studying the elemental and [isotopic composition](#) of Mo in [sedimentary rocks](#) from Grand Canyon that formed in the oceans 750

million years ago", explains Tais W. Dahl, who did this research in collaboration with researchers from Arizona State University, Harvard University and the Nordic Center of Earth Evolution in Denmark (NordCEE).

Molybdenum tracks the presence of poisonous sulfide in ancient oceans

The study uses a new method to determine the extent of anoxia and presence of sulfide in the [world oceans](#). Geochemical analyses of the trace element, molybdenum, in 750 million year-old rocks from Grand Canyon suggest oceans contained enormous amounts of lethal sulfide.

Molybdenum is relatively rich in today's seawater, because it is soluble in water in the presence of O₂, and therefore it accumulates in modern oxygenated oceans. Conversely, molybdenum becomes insoluble in anoxic waters where sulfide is present, so it precipitates out of the oceans. The new results show that oceans contained less Mo in the past, because sulfide-rich waters extended over much greater areas than today.

Vast areas of animal-inhospitable seafloor

Today, oceans are nearly fully oxygenated and sulfide is only present in restricted areas of the ocean, such as the deepest parts of the Black Sea and the Baltic Sea. According to a hypothesis established by Donald Canfield (NordCEE) in 1998 sulfide was a much more common constituent in the oceans 1900-750 million years ago.

The new study is first to quantify the expansion of sulfide in the 'Canfield-ocean'. Model calculations for the oceanic molybdenum cycle suggest that 10-50% of the shallow oceans were covered with sulfidic waters. This is 400-800 times more than in today's oceans. The vast areas

of poisonous seafloor would have made oceans inhospitable for animals. Expansive anoxic and poisonous oceans are now held responsible for the late appearance of animal life forms on Earth.

More information: Dahl T. W., Canfield DE., Rosing MT., Frei RE., Gordon GW., Knoll A., Anbar AD., Molybdenum abundance and isotopic evidence for expanded sulfidic water masses in ~750 Ma oceans, Earth and Planetary Science Letters, available online, published on November 15, 2011.

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