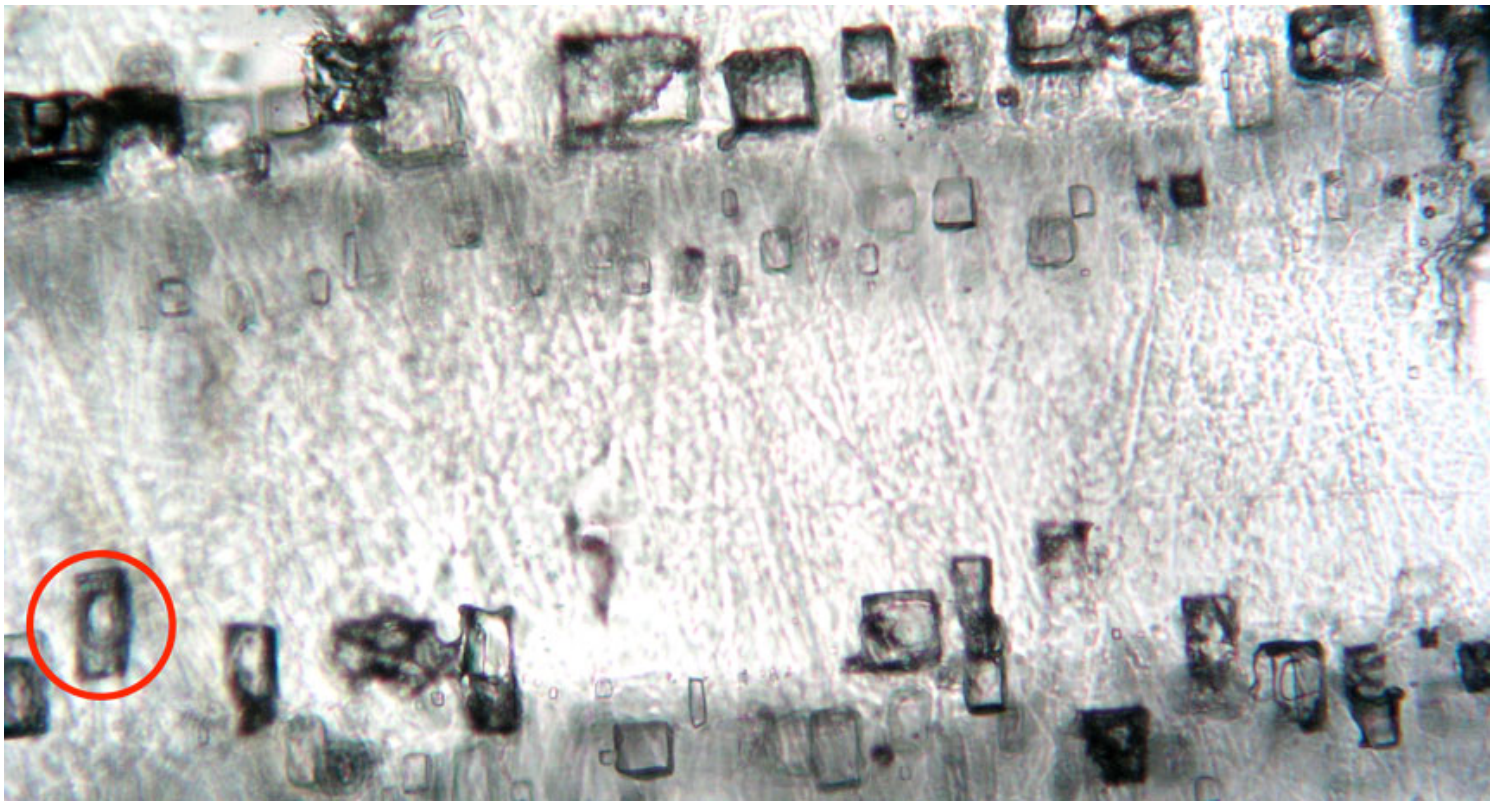
ScienceNews for Students

EARTH CHEMISTRY EVOLUTION

Oxygen-rich air emerged super early, new data show

If correct, it occurred before the evolution of animal life

BY THOMAS SUMNER AUG 21, 2016 — 7:00 AM EST



This sample of 815-million-year-old rock salt contains bubbles of ancient air (see the rectangular inclusions, one circled in red). That air indicates that oxygen was already plentiful by the time the first animals later appeared.
CHRIS LECUYER

Whiffs of ancient air are shaking up the history of oxygen — and of life on Earth.

Those tiny puffs of oxygen have been trapped for some 815 million years in rock salt. After carefully crushing the salt, researchers measured the chemical makeup of the air that had been trapped inside it. Oxygen made up 10.9 percent of the air back then, these data showed. This early boost in air's oxygen occurred around 150 million years before animals showed up in the fossil record. Scientists had thought that oxygen levels would not be that high for another 100 million to 200 million years.

"I think our results will take people by surprise," says Nigel Blamey. He's a geochemist at Brock

The researchers report their discovery in the August *Geology*.

Scientists had previously measured ancient oxygen in Earth's air. But they went about it in a different way. They had looked for the fingerprints of chemical reactions that need oxygen to occur. That work suggested oxygen levels rose sharply but only some 600 million years ago. The scientists reported that about two years ago,

First direct measurements

Those earlier tests did not measure oxygen directly. And that could have led to uncertainties in the numbers. Blamey's team instead went to the source — actual air from 815 million years ago.

Back then, in what is now southwest Australia, rock salt formed on the surfaces of evaporating ponds. As the salt grew, microscopic pockets formed. These trapped tiny bits of air. That air remains in the salt to this day.

For their new tests, the researchers crushed pieces of the salt in a vacuum chamber. Each piece, about the size of a match head, released five to 12 micro-puffs of air. Oxygen levels in that air were, on average, more than five times the concentration (2 percent) that earlier studies had predicted. To verify their technique, the researchers also measured oxygen trapped in younger rock salts. These included ones created in modern times. And the technique measured these oxygen levels correctly.

If the new findings are correct, they could add a twist to an ongoing debate. Some scientists had argued, last year, that the evolution of animals had been stalled by a long period when there was too little oxygen in the air.

But the new study has not fully convinced everyone. Outside air may have tainted the new results, says Noah Planavsky. He's a geochemist at Yale University in New Haven, Conn. Over hundreds of millions of years, gases may have passed through the salt. It this happened, they could have boosted oxygen levels in the air pockets.

Indeed, the oxygen levels just reported are so surprising that they would seem to make outside contamination likely, says Timothy Lyons. He is a geochemist at the University of California, Riverside. A level of 10.9 percent "is really high," he says. "There is nothing about the shifts you see in life or climate that demands an oxygen jump that high."

But Nicholas Butterfield has no trouble with the new data. He is a paleontologist at the University of Cambridge in England. Even with plenty of oxygen, he notes, animals still took a long time to evolve after the first emergence of complex life. "The delayed evolutionary appearance of animals," he has been arguing for a while now, "had nothing to do with [too little] oxygen."

Power Words

(for more about Power Words, click here (https://student.societyforscience.org/power-words-aid-stem-literacy))

evolution (v. to evolve) A process by which species undergo changes over time, usually through genetic variation and natural selection. These changes usually result in a new type of organism better suited for its environment than the earlier type. The newer type is not necessarily more "advanced," just better adapted to the conditions in which it developed. (outside biology) A term to describe the changes that naturally occur in some system over time in response to changing conditions.

fingerprint The unique pattern of raised lines and whorls that on each of an individual's fingers,

geochemistry A science that deals with the chemical composition of and chemical changes in the solid material of Earth or of another celestial body (such as the moon or Mars). Scientists who study geochemistry are known as **geochemists**.

inclusion (in geology) Something trapped inside a mineral.

oxygen A gas that makes up about 21 percent of the atmosphere. All animals and many microorganisms need oxygen to fuel their metabolism.

paleontology The branch of science concerned with ancient, fossilized animals and plants. The scientists who study them are known as **paleontologists**.

vacuum Space with little or no matter in it. Laboratories or manufacturing plants may use vacuum equipment to pump out air, creating an area known as a **vacuum chamber**.

Readability Score:

7.5

NGSS:

- MS-ESS1-4
- HS-ESS1-6
- HS-ESS2-4
- HS-ESS2-7

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Citation

N.J.F. Blamey et al. **Paradigm shift in determining Neoproterozoic atmospheric oxygen (http://geology.gsapubs.org/content/early/2016/07/08/G37937.1.abstract).** . *Geology*. Vol. 44, August 2016, p. 651. doi: 10.1130/G37937.1.

Further Reading

S. McDonaugh. "**Earth's early oxygen boost (https://www.sciencenewsforstudents.org/article/earths-early-oxygen-boost).**" *Science News for Students*. February 9, 2004.

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