Study Suggests Giant Space Clouds Iced Earth

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Eons ago, giant clouds in space may have led to global extinctions, according to two recent technical papers supported by NASA's Astrobiology Institute.
One paper outlines a rare scenario in which Earth iced over during snowball glaciations, after the solar system passed through dense space clouds. In a more likely scenario, less dense giant molecular clouds may have enabled charged particles to enter Earth's atmosphere, leading to destruction of much of the planet's protective ozone layer. This resulted in global extinctions, according to the second paper. Both recently appeared in the Geophysical Research Letters.

"Computer models show dramatic climate change can be caused by interstellar dust accumulating in Earth's atmosphere during the solar system's immersion into a dense space cloud," said Alex Pavlov, principal author of the two papers. He is a scientist at the University of Colorado, Boulder. The resulting dust layer hovering over the Earth would absorb and scatter solar radiation, yet allow heat to escape from the planet into space, causing runaway ice buildup and snowball glaciations.

"There are indications from 600 to 800 million years ago; at least two of four glaciations were snowball glaciations. The big mystery revolves around how they are triggered," Pavlov said. He concluded the snowball glaciations covered the entire Earth.

Pavlov said this hypothesis has to be tested by geologists. They would

look at Earth's rocks to find layers that relate to the snowball glaciations to assess whether uranium 235 is present in higher amounts. It cannot be produced naturally on Earth or in the solar system, but it is constantly produced in space clouds by exploding stars called supernovae.

Sudden, small changes in the uranium 235/238-ratio in rock layers would be proof interstellar material is present that originated from supernovae. Collisions of the solar system with dense space clouds are rare, but according to Pavlov's research, more frequent solar system collisions, with moderately dense space clouds, can be devastating. He outlined a complex series of events that would result in loss of much of Earth's protective ozone layer, if the solar system collided with a moderately dense space cloud.

The research outlined a scenario that begins as Earth passes through a moderately dense space cloud that cannot compress the outer edge of the sun's heliosphere into a region within the Earth's orbit. The heliosphere is the expanse that begins at the sun's surface and usually reaches far past the orbits of the planets. Because it remains beyond Earth's orbit, the heliosphere continues to deflect dust particles away from the planet.

However, because of the large flow of hydrogen from space clouds into the sun's heliosphere, the sun greatly increases its production of electrically charged cosmic rays from the hydrogen particles. This also increases the flow of cosmic rays towards Earth. Normally, Earth's magnetic field and ozone layer protect life from cosmic rays and the sun's dangerous ultraviolet radiation.

Moderately dense space clouds are huge, and the solar system could take as long as 500,000 years to cross one of them. Once in such a cloud, the Earth would be expected to undergo at least one magnetic reversal. During a reversal, electrically charged cosmic rays can enter Earth's atmosphere instead of being deflected by the planet's magnetic field.

Cosmic rays can fly into the atmosphere and break up nitrogen molecules to form nitrogen oxides. Nitrogen oxide catalysts would set off the destruction of as much as 40 percent of the protective ozone in the planet's upper atmosphere across the globe and destruction of about 80 percent of the ozone over the polar regions according to Pavlov.