

## **Explains the origins of complex life on land by the late stabilization of Earth's ozone layer**

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The origin of complex life and the evolution of terrestrial ecosystems are fundamental aspects of the natural history on Earth. Here, we present evidence for a protracted stabilization of the Earth's ozone layer. The destruction of atmospheric ozone today is inherently linked to the cycling of marine and atmospheric iodine. Supported by multiple independent lines of geological evidence and examined through an iodine mass balance model, we find that elevated marine iodide content prevailed through most of Earth's history. Since the rise of oxygen ~2.4 billion years ago, high marine iodide concentrations would have led to significant inorganic iodine emissions to the atmosphere, facilitating catalytic ozone destruction and resulting in atmospheric ozone instability with periodic or persistently lower ozone levels. At a global scale, unstable and low ozone levels likely persisted for about two billion years until the early Phanerozoic, roughly 0.5 billion years ago. The delayed stabilization of the Earth's ozone layer holds significant implications for the tempo and direction of the evolution of life, in particular life on land.