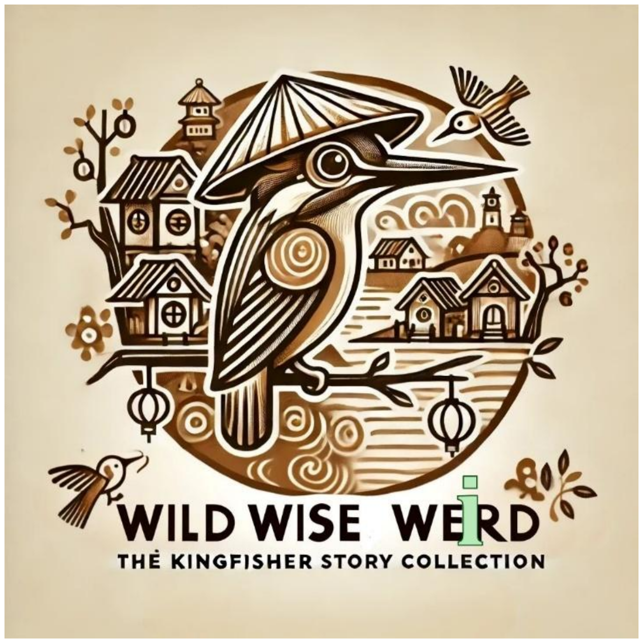
Toxic Sunlight: How Photic-Zone Euxinia Drove a Mass Extinction

Khướu Đá Hoa

14-04-2025



"On the third day, at dawn, the hungry and exhausted Kingfisher was horrified to see that the number of Taboo Fish in the pond had increased 20 times. With so many Taboo Fish, he probably wouldn't be able to catch a single fish to eat.

[…]

At this point, Kingfisher had no strength left to avoid. When the Taboo Fish clashed with him, Kingfisher's survival instinct prompted him to grasp the fish and rush up the tree branch. Then, Kingfisher's 3-day hunger caused him to lose control and swallow the Taboo Fish in no time. When regaining consciousness, Kingfisher realized he had just swallowed a Taboo Fish. He was scared, rushed home and lay still, waiting for the Death to visit."

In "Meditation Master"; *Wild Wise Weird* [1]

• • • • •

Around 359 million years ago, Earth witnessed a dramatic loss of marine biodiversity during the end-Devonian Hangenberg Crisis—a mass extinction event rivaling the most catastrophic in the planet's history [2,3]. While scientists have long suspected ocean anoxia (oxygen depletion) as a key factor, the precise environmental mechanism remained unresolved [4,5].

A recent study by Wang et al. [6] sheds new light on the crisis, revealing that photic-zone euxinia (PZE)—a condition where toxic hydrogen sulfide infiltrates the sunlit surface layers of the ocean—played a pivotal role in driving the extinction. Drawing on geochemical data from sedimentary sequences in South China and Western Canada, the researchers used mercury (Hg) isotope analysis, carbon isotope trends, and redox-sensitive indicators such as pyrite framboid size and cerium anomalies to reconstruct past ocean conditions.

The results revealed a consistent pattern of declining $\Delta^{199}Hg$ and rising $\delta^{202}Hg$ values across the extinction horizon. These isotopic shifts are characteristic of mercury transformations under sulfidic, light-penetrated waters, strongly suggesting the widespread onset of PZE. Complementary evidence from Ce/Ce* values and framboid morphology confirms the expansion of anoxic and sulfidic conditions in the upper ocean.

Importantly, the study found no significant mercury enrichments typically associated with large-scale volcanic activity, challenging previous hypotheses that linked volcanism to extinction [7]. Instead, the authors argue that enhanced continental weathering—possibly driven by tectonic uplift or the proliferation of early seed plants—led to increased nutrient delivery to the oceans. This surge in nutrients likely fueled primary productivity, depleted oxygen, and facilitated the rise of PZE.

This toxic shift in ocean chemistry proved fatal for many marine organisms, particularly those inhabiting shallow waters, such as stromatoporoids and corals. The decline of these species illustrates how environmental deterioration can precede and amplify mass extinction events.

The findings underscore the intricate coupling of terrestrial processes, ocean chemistry, and biological survival. They highlight how disruptions in Earth's surface systems—like intensified weathering—can cascade into marine ecological collapse. As modern oceans face similar threats from nutrient pollution and climate change, this deep-time perspective serves as a powerful reminder of the enduring connection between human activity and planetary health [8,9].

References

[1] Vuong QH. (2024). *Wild Wise Weird*. https://www.amazon.com/dp/B0BG2NNHY6/

[2] Myrow PM, et al. (2014). High-precision U–Pb age and duration of the latest Devonian (Famennian) Hangenberg event, and its implications. *Terra Nova*, 26(3), 222-229. https://doi.org/10.1111/ter.12090

[3] McGhee GRJ, et al. (2013). A new ecological-severity ranking of major Phanerozoic biodiversity crises. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 370, 260-270. https://doi.org/10.1016/j.palaeo.2012.12.019

[4] Kaiser SI, et al. (2016). The global Hangenberg Crisis (Devonian–Carboniferous transition): review of a first-order mass extinction. In RT Becker, P Königshof, CE Brett. (Eds). *Devonian Climate, Sea Level and Evolutionary Events* (pp. 387-437). Geological Society of London.

[5] Liu JS, et al. (2019). Intensified ocean deoxygenation during the end devonian mass extinction. *Geochemistry, Geophysics, Geosystems*, 20(12), 6187-6198. https://doi.org/10.1029/2019GC008614

[6] Wang X, et al. (2025). Photic-zone euxinia had a major role in the Devonian–Carboniferous boundary mass extinction. *Communications Earth & Environment*, 6, 283. https://www.nature.com/articles/s43247-025-02260-x

[7] Pisarzowska A, et al. (2020). Large environmental disturbances caused by magmatic activity during the Late Devonian Hangenberg Crisis. *Global and Planetary Change*, 190, 103155. https://doi.org/10.1016/j.gloplacha.2020.103155

[8] Ho MT, Nguyen DH. (2025). Of Kingfisher and Man. https://philarchive.org/rec/HOOKAW

[9] Nguyen MH. (2024). How can satirical fables offer us a vision for sustainability? *Visions for Sustainability*. https://ojs.unito.it/index.php/visions/article/view/11267