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Iodine-129 in ice and coral cores as candidate golden spikes for the Anthropocene

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The Anthropocene is a proposed geological epoch that will mark when humans have irreversibly affected the Earth. One of the primary requirements to formally establish this is a Global Boundary Stratotype Section and Point (GSSP) or "golden spike"–a record of a planetary signal marking the new epoch's beginning. Last July 2023, it was announced that the leading candidate for the Anthropocene's golden spike are the fallout peaks of 14C (T1/2 = 5,730 y) and 239+240Pu (T1/2 = 24,110 y and 6,560 y for 239Pu and 240Pu, respectively) from nuclear weapons testing in the 1960s recorded in a lake sediment core from Canada. However, in early 2024, the International Commission on Stratigraphy rejected the proposal to establish the Anthropocene as a new epoch. Among the reasons is that the proposed GSSP may not be definitive enough and that the chosen radionuclides' half-lives may not be sufficiently long for their signals to be observable in the far future and are, thus, not durable.

In this regard, here we show the 129I time series record in an ice core from the SE-Dome site, Greenland and from several coral cores from the Philippines. We find that 129I in ice core and corals record almost the entire history of the nuclear age in excellent detail at annual to sub-annual time resolution. More specifically, 129I in these records reflects signals from nuclear weapons testing, the Chernobyl and Fukushima Accidents, and various signals from nuclear fuel reprocessing. The quantitative relationships between 129I in the core records and these human nuclear activities have been established using numerical models. Similar signals are observed in other records from various environments worldwide, such as in sediments and tree rings. This global ubiquity and synchronicity are comparable to those of the 14C and 239+240Pu bomb signals, but the much longer half-life of 129I (T1/2 = 15.7 My) makes it a more durable golden spike. Furthermore, rather than existing as a single or a few bomb peaks, 129I clearly distinguishes before and after the proposed Anthropocene event because of the minuscule natural 129I levels before 1950 compared to the consistently elevated 129I levels after 1950 from human nuclear activities. For these reasons, the 129I in ice and coral cores can be considered an excellent candidate for the Anthropocene golden spike.

Student Submission

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