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Spatiotemporal link between mid-Proterozoic LIPs and black shales: Implications for defining the pre-Ediacaran geological timescale boundaries

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While the Phanerozoic and base of the Ediacaran in the international chronostratigraphic scale are each defined by a basal rock-based Global Stratotype Section and Point (GSSP) marked by "golden spikes" corresponding to environmental catastrophes induced by global events such as large igneous provinces (LIPs), the pre-Ediacaran geological timescale is formally subdivided by approximate absolute age due to a lack of rock-based GSSPs[1]. Although the 'Boring Billion' (1800–800 Ma) in the mid-Proterozoic is considered a stability era in Earth history[2], LIPs and large volumes of black shales are common during this period[3-5]. Recent research revealed synchronous deposition of voluminous black shales across different cratons in the Columbia and Rodinia supercontinents and established a spatiotemporal link between the mid-Proterozoic LIPs and black shales, especially those of ~1640 Ma, ~1380 Ma and ~1100 Ma ages[5-7]. Coeval LIPs and black shales can provide natural markers for the mid-Proterozoic geological timescale boundaries (Statherian/Calymmian, Calymmian/Ectasian)[6,7]. These boundaries are located at special horizons within black shales that can be defined as rock-based GSSPs. We recently discovered a unique 4-layer tuff marker horizon in black shales of the Xiamaling Formation in the North China Craton, which can be traced over a large area >400 km long by 100 km wide. High-precision dating shows that the sequence of volcanic eruptions occurred over a very short duration of 0.21+/-0.04 Myr at 1380.41+/-0.99 Ma. The 4-layer tuff marker horizon is likely related to the widely distributed ~1380 Ma LIPs and represents a potential golden spike for the Calymmian/Ectasian boundary at 1380.41+/-1.24 Ma. It provides the world's first "golden spike" for the pre-Ediacaran geological timescale.

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[1] Gradstein et al. (eds.) (2020) *Elsevier*, 1537 p. [2] Cawood and Hawkesworth, (2014) *Geology* **42**, 503–506. [3] Ernst (2014) *Cambridge University Press*, 653 p. [4] Ernst et al. (2021) *AGU and John Wiley & Sons, Inc.*, 3–26. [5] Zhang et al. (2021) *AGU and John Wiley & Sons, Inc.*, 449–486. [6] Zhang et al. (2018) *Geology* **46**, 963–966. [7] Zhang et al. (2024) *Geophy Res Lett* **51**, e2024GL109457.