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Linking sedimentological features of the Kapp Starostin Formation in Svalbard, Arctic Norway, to Permian glaciation and deoxygenation events using strontium isotope stratigraphy

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The Kapp Starostin Formation (KSF) of Svalbard is a Permian succession deposited on the northwestern shelf of Pangea. Although its age has been tentatively constrained by biostratigraphy, its absolute chronological framework remains poorly resolved. We analyze $^{87}Sr/^{86}Sr$ ratios of fossil brachiopod shells from the succession and apply strontium isotope stratigraphy (SIS) to refine its chronology.

The measured $^{87}Sr/^{86}Sr$ ratios of the well-preserved brachiopod shells range from 0.706868 to 0.707485. The up-section trend resembles the secular variation of Permian seawater $^{87}Sr/^{86}Sr$, which declined until the Capitanian and subsequently increased. This allows us to constrain the depositional age of the KSF to the Artinskian–Changhsingian. The refined age estimation also indicates that punctuated biostratigraphic records in the KSF might represent two global environmental events: the late Artinskian glaciation and Changhsingian anoxia.

A faunal transition from a “cool-water” brachiopod assemblage (represented by *Timaniella wilczeki* and *Arcullina polaris*) to a younger “cold-water” assemblage (dominated by *Spiriferella loveni*) has been documented in the KSF [1]. SIS ages of the youngest “cool-water” and the oldest “cold-water” fossils in the KSF are 285 and 283 Ma, respectively. This age range falls within one of the glacial intervals of the Late Paleozoic Ice Age, spanning from the Artinskian to the early Kungurian [2]. Therefore, the glacial climatic conditions may have contributed to the faunal turnover.

In the 385 m-thick type section of the KSF at Festningen, Bond et al. (2015) reported enrichments in redox-sensitive elements and the presence of fine framboidal pyrite at the ~345 m horizon, indicating euxinia. This horizon was attributed to the Capitanian extinction interval [3,4]. However, our chemostratigraphic constraints place it in the Changhsingian. We therefore interpret the euxinia as reflecting regional deepening superimposed on widespread anoxic Changhsingian seawater conditions, before the end-Permian mass extinction event [5].

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[3] Bond et al. (2015), Geological Society of America Bulletin, 127, 1411-1421.

[4] Bond et al. (2018), Geological Magazine, 155(5), 1023-1029.

[5] Newby et al. (2021), Nature Geoscience, 14, 678-683.