

Early Silurian climate changes on Baltica and South China – a sedimentological, bio- and chemostratigraphic framework

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A series of glacial events during the early Silurian can be inferred from the sedimentological, bio- and chemostratigraphic records in Swedish and Estonian sedimentary successions, including the Siljan impact structure of Central Sweden, in successions of South China, including the Baizitian section in the Sichuan Province, from sections in Laurentia and high-latitude peri-Gondwana. Distinct $\delta^{18}\text{O}_{\text{apatite}}$ anomalies and subaerially exposed sequence boundaries with palaeokarst in these areas are interpreted as substantial climatic shifts and the development of ice-house conditions. In terms of $\delta^{18}\text{O}_{\text{apatite}}$, the re-evaluated and detailed record of the early Silurian in the Estonian Viki core serves as a standard section and provides a base for the evaluation of climate changes.

We present new Telychian to Sheinwoodian chemostratigraphic data, including several prominent excursions, such as the pronounced Manitowoc Carbon Isotope Excursion (Manitowoc CIE, 'Manitowoc Excursion'), spanning the upper *Pterospirifer eopennatus* Zone and the lower *Pterospirifer amorphognathoides amorphognathoides* Superzone in carbonates or a large part of the *Oktavites spiralis* Graptolite Zone in shaly successions. The Manitowoc CIE is well constrained by conodont biostratigraphy and an essential tie-point for a detailed correlation between the Baizitian succession in South China and the Telychian strata of Baltica and Laurentia. In the successions preserved in the Siljan impact crater, the corresponding early Silurian carbon isotope anomalies are measured on organic carbon of fine-grained siliciclastic strata (OCIEs in black shale and siltstone) and biostratigraphically constrained by graptolite biostratigraphy.

We focus on the early Silurian climate development, which includes the Telychian Valgu glaciation (more widely recognised than older glacials during the Aeronian), the Manitowoc Icehouse, including two short glacial events, the late Telychian Glaciation (LTG), and the Sheinwoodian glaciation, the latter reflected by the Sheinwoodian Oxygen Isotope Excursion (SOIE), which follows immediately after the $\delta^{13}\text{C}$ maximum of the widely known Early Sheinwoodian Carbon Isotope Excursion (ESCIE).

Keywords: Silurian, Baltica, South China, palaeoclimate, biostratigraphy, stable isotope chemostratigraphy.