



Insights into the onset of the late Paleozoic Ice Age from the paleotropical realm of North America and western Europe

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A number of near-field (glacial, proglacial, and glacialmarine) records of glacial activity in the late Paleozoic constrain the onset of the main phase of glaciation to the late Mississippian (Viséan-Serpukhovian). These events postdate some more isolated occurrences of glacially-influenced deposits in the late Devonian and early Carboniferous. The main onset is, nonetheless, not precisely constrained because of apparent differences in age among widely separated outcrop areas. This suggests that glacial onset was not globally synchronized and/or is inadequately constrained in absolute time. The near-field record holds the advantage that it is a direct reflection of glacial activity, but the disadvantage that such records are notoriously stratigraphically incomplete. On the other hand, far-field records from the paleo-tropical realm preserve the record of an indirect response to glaciation in the form of eustatic sea-level fluctuations, but are more likely to be a complete, time-averaged, global signal. Herein, we review the stratigraphic record of several late Mississippian successions in North America and northwest Europe, all of which show an upward transition from a noncyclic or cryptic stratigraphic stacking pattern to a strongly cyclic motif (“cyclothem”) through the late Mississippian. Among these successions are the Big Snowy Group of Montana, Manning Canyon and Doughnut Formations of Utah and Colorado, Windsor and Mabou Groups of Atlantic Canada, Clare Group of western Ireland, and Strathclyde and Clackmannan Groups of eastern Scotland. Cyclothem are m to tens of m thick intervals showing alternation between offshore marine and exposed, nonmarine deposits, and are interpreted as a record of sediment accumulation on low-gradient paleotropical shelves with low rates of sediment supply that were subjected to repeated, large-magnitude sea-level excursions. The transition to a strongly cyclothem motif is a consistently recognizable change in these successions, and seems to have taken place at about 330-332 Ma (straddling the Viséan-Serpukhovian boundary). This change significantly predates both major, global excursions in carbon and oxygen stable isotope values, and the Mississippian-Pennsylvanian unconformity, and is considered a more reliable indicator of the onset of widespread glaciation.