

When was Maximum Transgression on Laurentia during Late Ordovician?

New Evidence from Slave Craton and Hudson Bay Basin

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Summary

The discovery of Richmondian (Late Ordovician) conodonts from Slave Craton on Archean Canadian Shield, in addition to late Edenian (Late Ordovician) conodonts in Hudson Bay Basin, has proved that Late Ordovician transgression on Laurentia was not a one-time event, but went through three phases (Chatfieldian, late Edenian and Richmondian) to reach its maximum in Richmondian time, rather than in Chatfieldian time as previously interpreted.

Introduction

Laurentia, also known as the North America Craton, laid around the paleo-equator in Late Ordovician time. The timing and extent of maximum transgression on Laurentia during Late Ordovician are a long-lived hot topic in North America geology; however, numerous previous studies on this topic have focused on the southeastern margin of Laurentia, and recent studies are in agreement with Haq and Schutter (2008) that the highest sea level during Late Ordovician (or Paleozoic) occurred in Chatfieldian time (Fig. 1).

Building a model of Late Ordovician sea-level history and paleogeography for Laurentia is difficult, because the Ordovician rock record in large parts of northern and central Laurentia is either missing (e.g., over parts of the Precambrian Shield), or poorly understood. This report provides reliable fossil evidence from 1) the xenoliths of Paleozoic sedimentary rocks contained in Middle Jurassic kimberlites, piercing the central Slave Craton where the Paleozoic cover is now-missing; 2) the outcrops on Southampton Island and well material from Hudson Bay Lowlands and offshore area. The new data from central and northwestern Laurentia are critical in estimating timing and extent of Late Ordovician transgression across Laurentia.

Conodont faunas and their paleo-environment

A Richmondian (Late Ordovician) microfossil conodont fauna, represented by *Plegagnathus dartoni* (Stone and Furnish), occurs in limestone xenoliths contained in the Jerico kimberlite pipe in the central Slave Craton where there is no preserved Paleozoic cover nowadays. Elsewhere, a late Edenian (Late Ordovician) conodont fauna occurring in the lowest part of Upper Ordovician sequence, represented by *Belodina confluens* Sweet, has a widespread occurrence in limestone that rests unconformably on rocks forming the Precambrian basement of Hudson Bay Basin. Together, these fauna and the lithofacies indicate deposition in shallow- and open-marine environments.

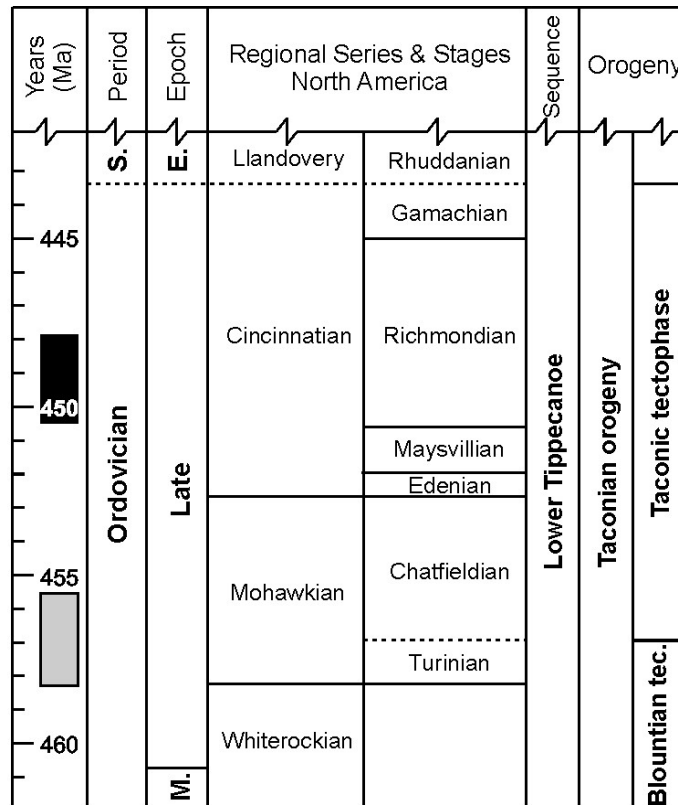


Fig. 1. Late Ordovician time scale. The grey and black boxes on the left represent the duration of highest sea level during Late Ordovician analysed by Haq and Schutter (2008) and this study, respectively.

New insight into Late Ordovician sea-level history and paleogeography across Laurentia

Haq and Schutter (2008) have suggested that Chatfieldian was a time when the sea-level reached its highest point during Late Ordovician (Fig. 1), which was also the highest during the entire Paleozoic. In contrast to this interpretation, conodont faunas from both Slave Craton and Hudson Bay Basin provide reliable evidence that:

- 1) The inundation on the now-submerged Hudson Bay (central Laurentia) and now-exposed Slave Craton (northwestern Laurentia) by shallow seas began in the late Edenian and Richmondian time, respectively.
- 2) Transgression during the second phase of the Taconian orogeny, the Taconic tectophase, was not a single event, but at least three phases were involved in, including:
 - i. Chatfieldian initiation of transgression in southeastern Laurentia. Deepening happened on the southeastern margin of Laurentia during the Chatfieldian time, as proved by an unconformity below Chatfieldian strata (e.g., Etensohn, 2008).
 - ii. Late Edenian flooding in central Laurentia. During the late Edenian time epeiric sea extended to central Laurentia; as a result, an unconformity and a late Edenian conodont fauna occurring directly above the Precambrian basement in the Hudson Bay Platform (Zhang and Barnes, 2007).
 - iii. Richmondian inundation in northwestern Laurentia and highest sea level. During Richmondian time, epeiric sea further extended to northwestern Laurentia

and sea level reached its highest point, as demonstrated by Richmondian conodonts from the kimberlite xenoliths in Slave Craton.

3) Late Ordovician transgression across Laurentia during the Taconic tectophase started in the early Chatfieldian time; it was not complete until Richmondian time, and lasted about eight million years. Evidence presented herein suggests that sea level reached its highest point and the epeiric sea extended its maximum coverage on Laurentia in Richmondian time, rather than in Chatfieldian time as interpreted by Haq and Schutter (2008) and many more.

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