

Late Cretaceous oceanic anoxic events in the Western Interior Seaway foredeep, Alberta, Canada

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We report multiple chemostratigraphic and proxy records at a 0.5 m sample interval from a virtually continuous, slabbed whole core (~270 m long) which approximately spans from the Late Cretaceous Albian/Cenomanian boundary (100.5 Ma) to the Santonian/Campanian boundary (83.6 Ma) – age estimates via litho- and chemostratigraphic correlations. These data represent evolving paleoceanographic conditions of the higher, middle latitude (~ 53°N) Western Interior Seaway (WIS) preserved in marine successions of the Colorado Group in the Western Canadian Sedimentary Basin of Alberta, Canada. Four oceanic anoxic events (OAEs) are documented using stable C isotope chemostratigraphy and include the Middle Cenomanian Event (MCE), OAE2, the Late Turonian Events (LTEs), and OAE3. A negative carbon isotope excursion (CIE) preceding the traditionally positive CIE of OAE1d is also reported and corresponds to increased total organic carbon (TOC) and enhanced euxinia. The MCE and OAE2 are demarcated by a positive CIE, decreased TOC content (ave. 2.1 wt. %), and less euxinic (possibly suboxic to oxic) conditions. Increased TOC content (ave. 2.8 wt. %) is observed during long-lasting periods of enhanced euxinia and low $\delta^{13}\text{C}$ values. Punctuated periods of enhanced continental denudation occur before the onset of all OAEs discussed above. The onset and overall persistent euxinic conditions and open marine salinities at this location in the WIS corresponds to a regional transgressive surface (X-surface). We speculate that the X-surface represents the onset of the Greenhorn Cyclothem and demarcates the timing of warm, southern proto-Atlantic/Tethyan waters entering the northern WIS. Long-lasting increases in TOC and other elements, including CaO, also occur at the X-surface. Interestingly, the cessation of the MCE corresponds well with the onset of the Greenhorn Cyclothem (X-surface). Bioessential nutrients, Cu and Ni, are rarely enriched throughout the section except for Zn, which may be related to the denudation of mafic associated ferromagnesian minerals. Solid-state ^{13}C nuclear magnetic resonance on a small sample suite ($n = 2$) reveals an abundance of bridgehead aryl hydrocarbons and is suggestive of thermal alteration beyond the dry gas window ($\geq 150^\circ\text{C}$). Finally, we propose that this core be labeled the Pembina River Section for future reference and correlation.