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The Cenomanian-Turonian boundary interval in the Western Canada Foreland Basin: Stratigraphy, geochemistry, geochronology and sea-level changes recorded in expanded and condensed clastic successions

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Summary

A 300 m thick section, dominated by shallow-marine mudstone, is exposed at Nini Hill in the proximal foredeep of the Western Canada Foreland Basin (WCFB) in NE British Columbia. The section spans the Cenomanian–Turonian boundary (CTB) and preserves a 185 m thick record of OAE2, characterised by a complex succession of organic Carbon-Isotope Events (CIE) amongst which globally-recognized peaks and troughs are identified. Osmium isotopes ($^{187}Os/^{188}Os$) show the characteristic shift to less radiogenic values 22 m below the onset of OAE2. The CIE record at Nini Hill is correlated with the English Chalk reference section at Eastbourne, and also with the well-dated record in the SH#1 core in Utah. The latter provides a gateway to other sections in the southern USA. However, only the ~450 m thick, deep-water CTB section in the Saku Formation, Japan, appears to match the detail of CIE preserved at Nini Hill.

High-resolution correlation via the CIE allows, for the first time, sea-level changes mapped in the poorly-fossiliferous Cenomanian–Turonian boundary interval of the WCFB to be correlated with coeval, and therefore probably eustatic, events in the Western Interior Seaway of the USA and the palaeo-Tethys and associated basins of Europe. The sub-plenus unconformity that underlies OAE2 in many shelf successions spanning the North Atlantic, is correlative with an array of high-frequency sequences that were preserved as separate events in the rapidly-subsiding foredeep of British Columbia. Eustatic sea-level fall and rise of 10–40 m has been inferred for this event at different locations, by different authors. Similar eustatic fall–rise events mapped in the BC foredeep correlate with the *S. gracile* and *N. juddii* transgressive events in the latest Cenomanian. A minor eustatic fall at the Cenomanian–Turonian boundary is followed by the basal Turonian *M. puebloensis* transgression, involving possibly >20 m of sea-level rise. Many more, lower-

amplitude relative sea-level cycles involving perhaps 5-10 m of change, form a persistent signal throughout the CTB interval.

Bio- and chemostratigraphic and well-log based correlation spanning 800 km was established between Nini Hill and Mount Robert in the proximal foredeep, and the more forebulge-proximal sections at Pratts Landing on the Peace River, and Ram River, Bighorn River and Highwood River in the southern Foothills. Physical allostratigraphic correlation showed that the expanded Nini Hill succession becomes progressively more attenuated as a result of condensation, by-pass, and erosion as the rocks thin towards the slowly-subsiding forebulge. The resulting subtle disconformities are virtually impossible to recognize in the distal offshore mudstones. Without a prior understanding of physical stratal geometry, the interpretation of carbon- and osmium-isotope profiles in such attenuated successions could lead to serious mis-interpretation. The new osmium isotope data from Canada complement published results from the southern USA and show that in a 3,200 km latitudinal transect, the influence of assumed Caribbean LIP-derived unradiogenic osmium diminished markedly northward.

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