PALEOENVIRONMENTAL INTERPRETATION AND IDENTIFICATION OF THE NORIAN – RHAETIAN BOUNDARY IN THE WHITEHORSE TROUGH (STIKINE TERRANE, NORTHERN CANADIAN CORDILLERA)

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Introduction

The Late Triassic was a time of rapid environmental and faunal change. Evidence for this is captured in the extensive and continuous limestone stratigraphy of the Sinwa and Aksala Formations in Northern BC and Southern Yukon respectively. Deposition occurred in the Whitehorse Trough, the forearc basin between pre-accretion Stikine Terrane and the North American Craton (Figure 1).

This study marks the first detailed stratigraphic investigation of these formations and has implications for interpreting Late Triassic paleoenvironmental shifts, and identifying the Norian-Rhaetian boundary in North America. It also contributes to ongoing research refining Late-Norian to Rhaetian conodont biostratigraphy.

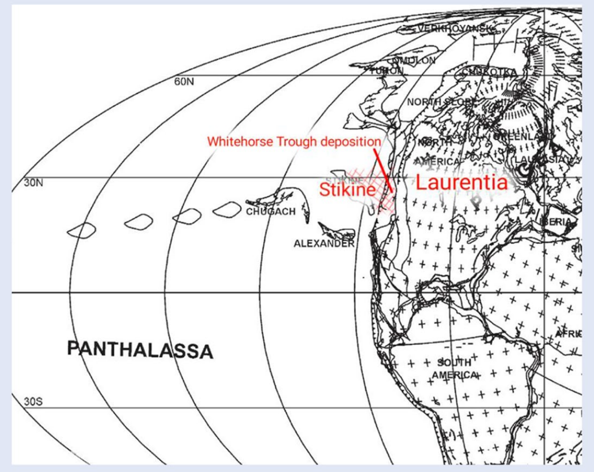

Figure 1: Continental arrangement during the Late Triassic. Modified from Golonka (2007).

Methods

Four sections were logged from outcrop (Figure 2), while taking samples for paleontological and geochemical analysis. The many complementary datasets include:

- Lithological facies progression
- $\delta^{13}C$ and $\delta^{18}O$ stable isotope geochemistry
- Conodont biostratigraphy
- Re-Os radiometric dating

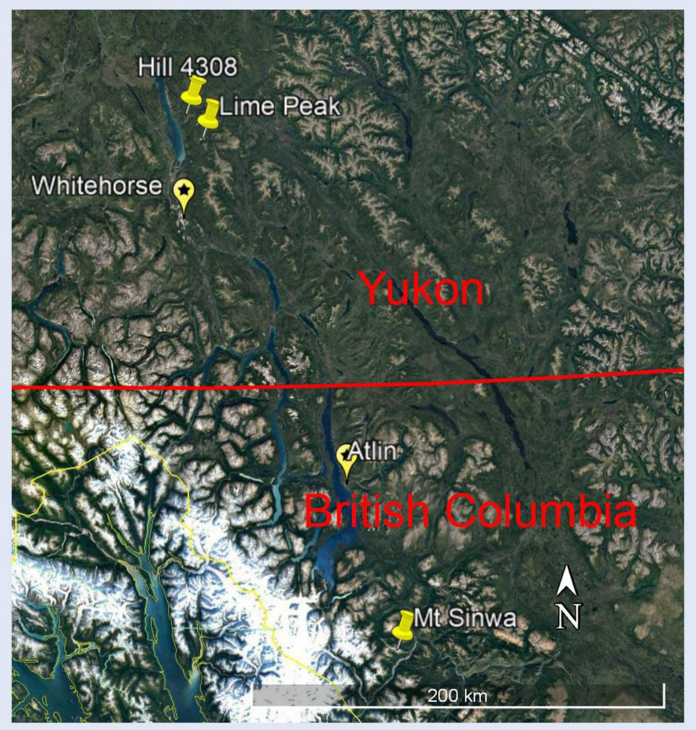

Figure 2: All section localities across the BC – Yukon border. Google Earth 2018. Image Landsat / Copernicus.

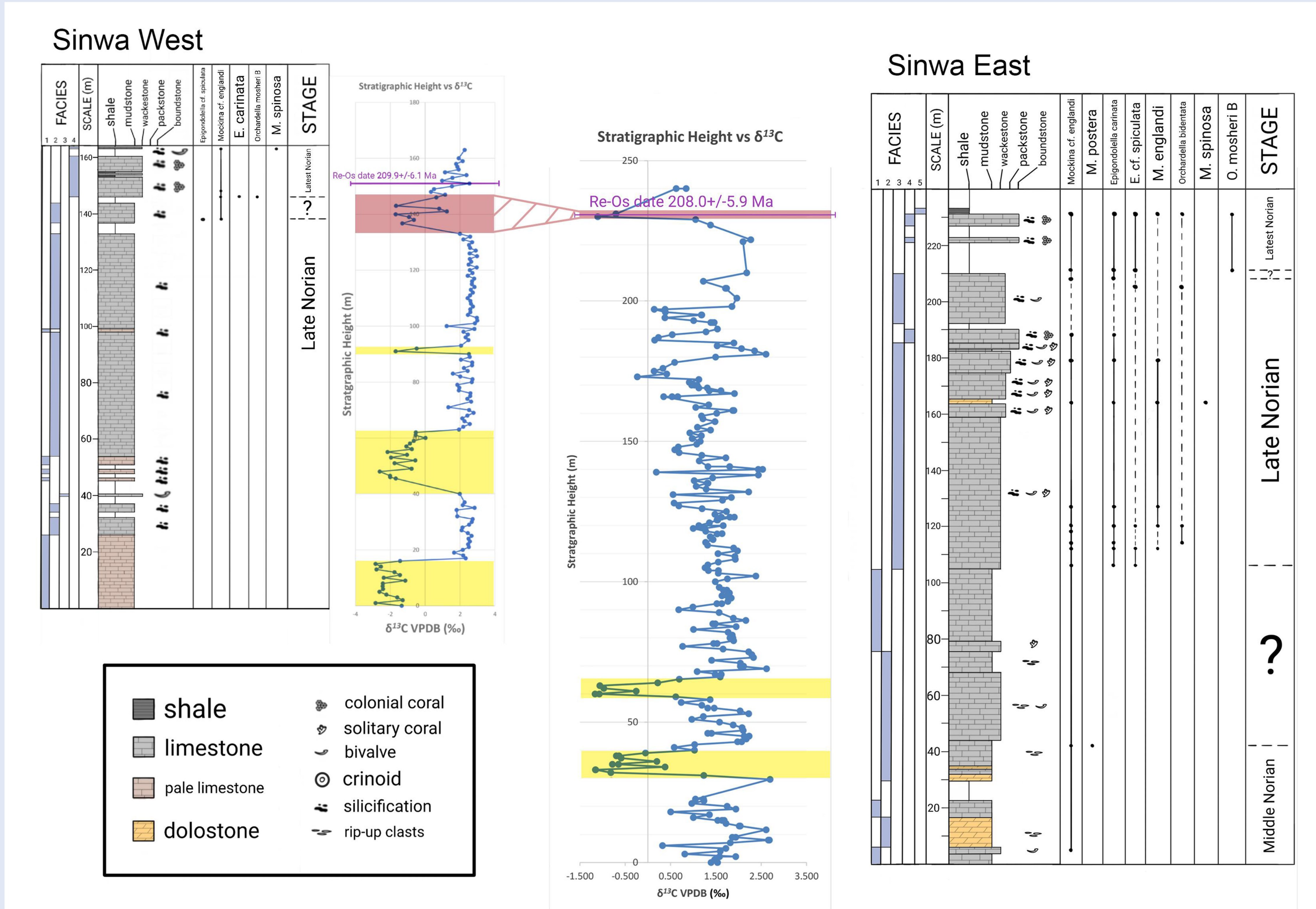

Figure 3: The lithological stratigraphy of the Sinwa Formation as exposed on Mt. Sinwa East and Mt. Sinwa West, aligned with their respective conodont biostratigraphy and $\delta^{13}C$ curves.

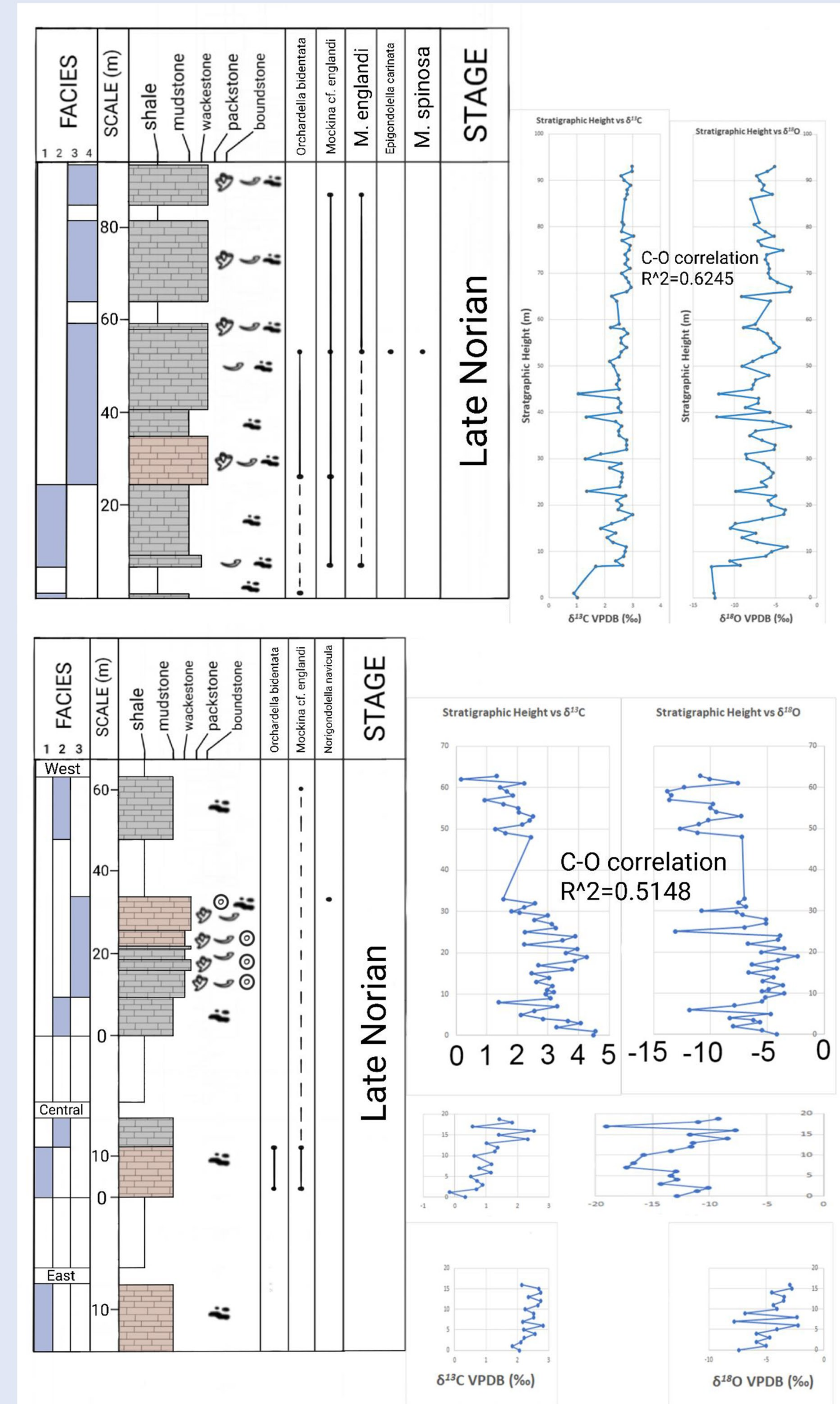

Figure 4: The lithological stratigraphy of the Aksala Formation as exposed on Lime Peak and Hill 4308, aligned with their respective conodont biostratigraphy and $\delta^{13}C$ curves.

Lithological Data and Facies Analysis

- Paleoenvironmental progression is the most clear in the Sinwa East section (Figure 5). A shallow marine, rip-up clast bearing facies shifts to become gradually more fossiliferous, culminating in a coral boundstone. There is then a sudden shift to a shale facies at the top of the section, possibly resulting from rapid base level rise due to local tectonics.
- Sinwa West is similarly topped with a shale facies sitting directly above a colonial coral facies. However facies progression is likely lost lower in the section due to higher degrees of recrystallization and silicification.
- Both Aksala Formation sections show an increase in bioclastic content up-section, but lack the reef and shale facies.

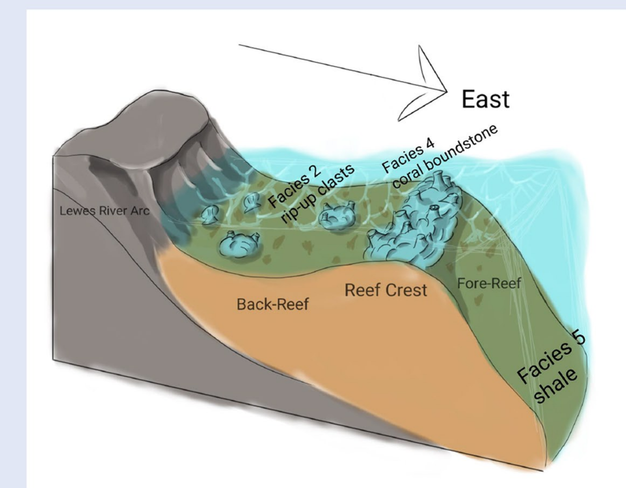

Figure 5: Depositional environments of Facies 1 through 5 in the Sinwa East section.

Paleontological and Geochemical Results

- Conodonts recovered from the section include *Epigondolella carinata*, *E.* cf. *spiculata*, *Mockina englandi*, *M.* cf. *englandi*, *M. postera*, *M. spinosa*, *Norigondolella navicula*, *Orchardella bidentata*, and *O. mosheri* morphotype B (Figure 6).
- The appearance of the Rhaetian species *M. mosheri* (Carter and Orchard, 2007) high in the stratigraphy of the Sinwa East and Sinwa West sections demonstrate close proximity to the Norian – Rhaetian boundary (Figure 3).
- Conodont recovery in the Aksala Formation sections confirm Late Triassic age, but do not place any stage boundaries (Figure 4).
- The Sinwa East section records 3 negative $\delta^{13}C$ isotope excursions which may indicate a fall in biotic productivity at each interval (Figure 3). The uppermost excursion occurs at the transition to shale facies. Zaffani et al. (2017) observed similar excursion patterns in $\delta^{13}C_{org}$ of a Western Tethys section of the same age and interpreted the stratigraphically highest excursion as coinciding with the Norian-Rhaetian boundary.
- The Sinwa West section records 4 negative $\delta^{13}C$ isotope excursions, with the uppermost excursion again occurring at the transition to shale facies (Figure 4).
- Strong correlation between the $\delta^{13}C$ and $\delta^{18}O$ curves in both Aksala Formation sections indicate the $\delta^{13}C$ record no longer represents a primary signal. There is no clear difference between the Aksala and Sinwa Formations that explains why this is the case.
- Re-Os dating near the top of both the Sinwa East and Sinwa West sections confirm the right age range for the Norian – Rhaetian boundary (Figure 4).

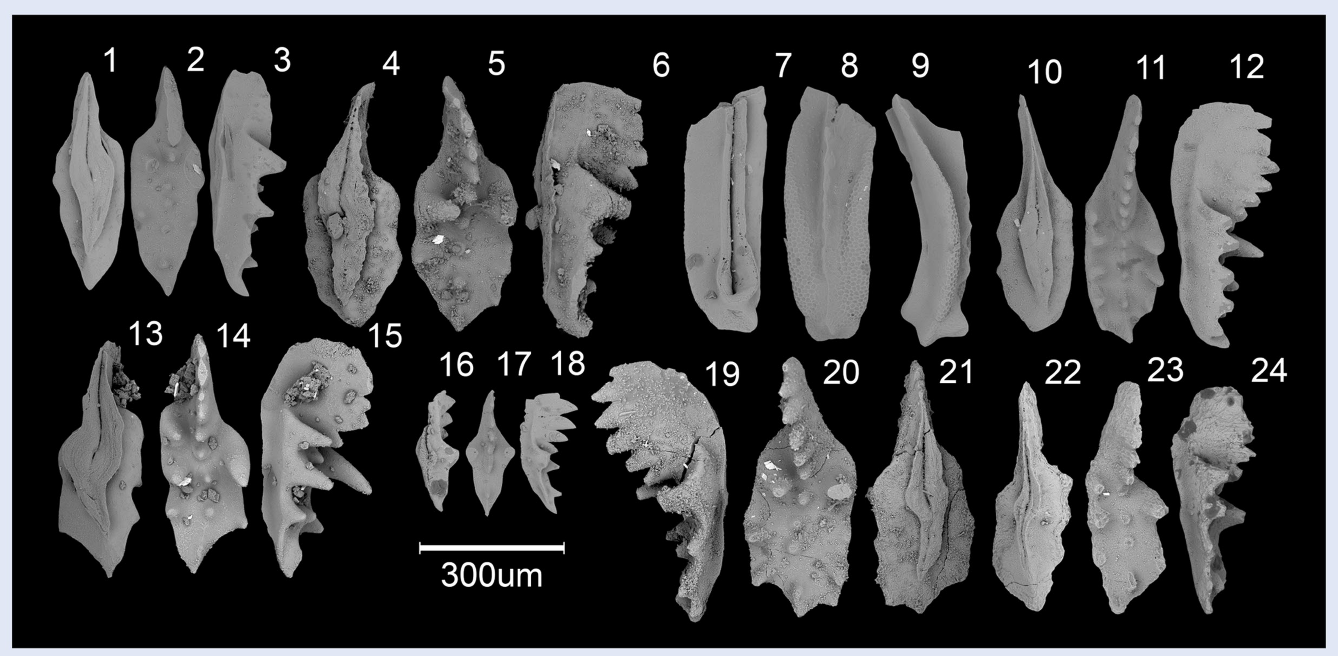

Figure 6: Conodont species recovered from the Sinwa and Aksala Formations. 1-3: *Orchardella mosheri* morphotype B (Kozur & Mostler, 1976); 4-6: *Mockina englandi* (Orchard, 1991); 7-9: *Norigondolella navicula* (Huckriede, 1958); 10-12: *M. spinosa (Orchard, 2018)*; 13-15: *Epigondolella carinata* (Orchard, 1991); 16-18: *O. bidentata* (Mosher, 1968); 19-21: *E.* cf. *spiculata* (Orchard, 1991); 22-24: *M. postera* (Kozur & Mostler, 1971).

Conclusions and Ongoing Research

- The Norian – Rhaetian boundary is identified in both Sinwa Formation sections, and is associated with rapid sea level rise transitioning to a shale facies.
- This boundary in the Sinwa Formation is supported by $\delta^{13}C$, Re-Os, and conodonts.
- Organic $\delta^{13}C$ and $\delta^{87}Sr$ isotope analysis are planned for the Sinwa sections and will further support primary paleoenvironmental signal from the carbonate $\delta^{13}C$.
- Analysis is ongoing for an additional 2 Late Triassic sections in Northern Vancouver Island. Being associated with the Wrangell Terrane instead of the Stikine Terrane, comparison with the Whitehorse Trough formations can differentiate global from regional paleoenvironmental shifts.

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