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# The Early Cretaceous in the Richardson Mountains (Northwest Territories, Canada): palynological insights on the tectono-stratigraphic architecture of the Canadian Arctic mainland

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## Summary

The Sverdrup Basin is a sedimentary basin underlying the Canadian Arctic Archipelago; it currently provides the primary reference framework for the tectono-stratigraphic architecture of the Canadian Arctic. It contains a nearly continuous record of the Mesozoic rifting events that led to the formation of the Arctic Ocean and associated underlying Amerasia Basin including a widespread sub-Hauterivian (breakup) unconformity (Embry, 1991; Embry and Beauchamp, 2008; Hadlari et al., 2016). The Richardson Mountains, located in northwestern Canada, also contain a nearly continuous sedimentary record of Mesozoic events and are ideally positioned to investigate links between the tectono-stratigraphic evolution of the Sverdrup Basin and adjacent landmasses. Within the Richardson Mountains is a middle-upper Hauterivian unconformity, developed during a period of rifting and occurring erosionally at the base of the Mount Goodenough Formation (Dixon 1991; Dixon 1992; Dixon 1993). However, the precise age of the Mount Goodenough Formation, the unconformity, and its relation to polar tectonics remains uncertain.

The main aim of this project is to temporally correlate the intra-Mount Goodenough Formation Hauterivian-aged unconformity in the Richardson Mountains region with the sub-Hauterivian breakup unconformity in the Sverdrup Basin, to provide new insight into (1) the tectono-stratigraphic linkages with circum-Arctic areas and (2) the development of polar terrestrial ecosystems during a warm interval in Earth's history, both of which are important for resource assessment in the region. This will be accomplished using quantitative palynology (the analysis of organic-walled microfossils including pollen, spores and algal cysts) to statistically correlate pollen and spore assemblages from the Richardson Mountains to those published from the Sverdrup Basin to test time equivalence and reconstruct paleoenvironmental conditions. Ongoing work focuses on the palynological analyses of 87 rock samples from two stratigraphic sections, informally termed the Martin Creek Section ($n$ = 48) and the Mount Goodenough Section ($n$ = 39). Preliminary results reveal a poor to moderately well preserved but diverse palynological record.

## Method

Palynology is the analysis of organic-walled microfossils (palynomorphs) such as pollen, spores and algal cysts (Fægri and Iversen, 1989). These microfossils have distinct morphological features, which allow for high-level taxonomic identification and are particularly useful in the field of biostratigraphy. Pollen and spores are also produced in great numbers, spread more widely and evenly than macrofossils and are well preserved in the rock record allowing for the extraction of great quantities for study (Fægri and Iversen, 1989). Analyses of data will largely consist of quantitative palynological analysis including hierarchal cluster analysis, stratigraphically constrained cluster analysis and multidimensional scaling ordination, which together will be used for paleoecological reconstruction and aid in the delineation of palynoassemblages. Together these quantitative analyses will allow for the extraction of the dominant patterns of variability and be used to interpret drivers of vegetation change (e.g., humidity, disturbance, temperature). The data will be interpreted in the context of other well-documented, similarly aged strata from the Sverdrup Basin and other circum-Arctic areas.

## Observations/Results

Preliminary analyses reveal that the thermal alteration index of palynomorphs is generally low ( >2; Pearson 1984). Preservation ranges from moderate to good in the Martin Creek Section samples, to moderate to poor in the Mount Goodenough Section samples. The palynological assemblage is diverse with at least 40 pollen and spore genera and 8 dinoflagellate genera currently identified, indicating a Late Jurassic age for the Martin Creek Section and an Early Cretaceous age for the Mount Goodenough Section, and relatively moderate climatic variations over the studied intervals.

The palynological content and biostratigraphic significance of the Richardson Mountain strata will be further refined as a result of this work; allowing for in-depth reconstructions of Early Cretaceous paleoenvironments, which can then also be compared to other circum-Arctic areas to determine regional to global changes in paleoclimate and produce new insight into Earth System's processes such as climate change. The Cretaceous Period experienced warmer temperatures than modern climate. By delving into past analogues and terrestrial ecosystem response to warmer temperatures, it may be possible to better predict the impact of current and forecasted global warming. Mesozoic strata of the Sverdrup Basin are known to contain major petroleum fields (Chen et al., 2000). This project will facilitate resource exploration in the Richardson Mountains by relating the Mesozoic strata present in the area to those of the Sverdrup Basin and by providing new insight into the evolution and burial of potential source and reservoir rocks.

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