

## MUDSTONE AGGREGATE ORIGINS AND DEPOSITIONAL INTERPRETATIONS OF THE SECOND WHITE SPECKS AND CARLILE FORMATIONS IN CENTRAL ALBERTA.

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### Introduction

In eastern and central Alberta, the Upper Cretaceous Second White Specks (2WS) and Carlile formations are established biogenic gas reservoirs but a thorough understanding of the complex stratal architecture remains challenging and ongoing. The formations were deposited in very different settings within the Interior Cretaceous Seaway although they are separated by a conformable boundary. Mudstone aggregates form the main detrital component of mudstone-dominated strata of both the 2WS and Carlile formations.

The 2WS formation is comprised of organic-rich mudstones with a large content of calcareous macro- and microfossils, and at several levels calcareous fine-grained sandstone beds. Total organic content (TOC) varies from 5-7% and is dominated by type II and III kerogen. The Carlile formation is comprised of intensely bioturbated non-calcareous mudstones with a variable content of silt- and sand-sized silica grains. The strata form 20-30m tall mudstone clinofolds in contrast to the tabular stratal architecture of the 2WS strata.

### Methods

This presentation will showcase our ongoing work towards characterizing the mudstone aggregates that make up the majority of the mudstone-dominated strata in the 2WS and Carlile formations. Some of the techniques applied in this approach include: XRD, XRF, scanning electron microscopy with element mapping, fluorescent microscopy, and facies descriptions from core samples. These approaches allow us to:

- 1) Identify the origin and composition of the mudstone aggregates.
- 2) Develop theories on the state of compaction and original water saturation of the mudstone aggregates.
- 3) Interpret depositional environments and how they changed throughout the strata.

### Results and Discussion

In both the 2WS and Carlile formations, mudstone aggregates are well preserved in the studied strata due to the relatively shallow maximum burial of approximately 1500-2000m. The aggregates occur as silt- to sand-sized particles with variable composition. In the 2WS formation, mudstone aggregates include intraformational mud clasts, coccolith-rich fecal pellets (the "white specks"), and bituminous carbonaceous flattened pellets of likely algal origin. The Carlile formation differs in that it consists of a

combination of silt and sand-sized inorganic mud aggregates together with flattened algal pellets similar to those present within the 2WS.

The shape of the aggregate varies between round/oval to completely flat. The rounded/oval shape indicates slight compaction and that the aggregates were semi-indurated at the time of deposition. Potential origins of the mudstone aggregates include extrabasinal grains, and/or intrabasinal rip-up clasts, or crustacean micro-coprolite fragments. The presence of coccolith fragments within the aggregates clearly demonstrates that the majority of the mudstone aggregates are intraformational in the 2WS; however, their variable composition from the surrounding matrix mud suggests transport at a significant distance from the site of origin. Furthermore, significant abrupt vertical changes in the grain size of the mudstone aggregates and their chemical composition shows that the area of origin changes between dominantly intra-formational rip-up clasts to micro-coprolites, relating to relative sea level changes. However, as individual sequence stratigraphic units often have relative uniform composition of mudstone aggregates, composition of the mudstone aggregates do not seem to be strongly related to water depth but rather changes in circulation within the Interior Seaway.

These ongoing studies into the characterization of the mudstone aggregates and their implications on depositional settings will provide greater insight as to how the 2WS and Carlile formations are understood as hydrocarbon resources.