

British Columbia Natural Gas Atlas Update 2017: Recorrelation Changes the Picture

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Introduction

After the publication of Evans and Whiticar (2017), the British Columbia Natural Gas Atlas (BCNGA; http://bc-NGA.ca/BC-NGA_Home.html) moved in a new direction in 2017. The project currently relies on gas composition and isotopic data submitted by industry to the BC Oil and Gas Commission (BCOGC). It was identified that these submissions had incomplete stratigraphy in the data and some could not be mapped. As a result, a correlation review was undertaken on the entire dataset intended for use in the northeastern British Columbia (NEBC; Figure 1) portion (more than 9000 entries of gas composition and approximately 200 entries of isotopic data) of the BC NGA under a separate contract funded by Geoscience BC. The recorrelation will have impacts on the future mapping because the identification of similar stratigraphic horizons is key to the geochemistry.

Background

Raw gas molecular composition data were previously downloaded from the BCOGC and filtered to a representative dataset for regional mapping. Filtering data was based on geographical distribution, well type, de-clustering well pads, making a representative point for horizontal wells and grouping strata (Evans and Whiticar, 2017). Some stratigraphic intervals retained almost all data points, whereas other intervals underwent strong filtering, particularly recent production intervals dominated by horizontal wells. Gas isotopic data are more recent and sparsely distributed across a few geological formations, but there was no correlation coding associated with these data and new codes were required for

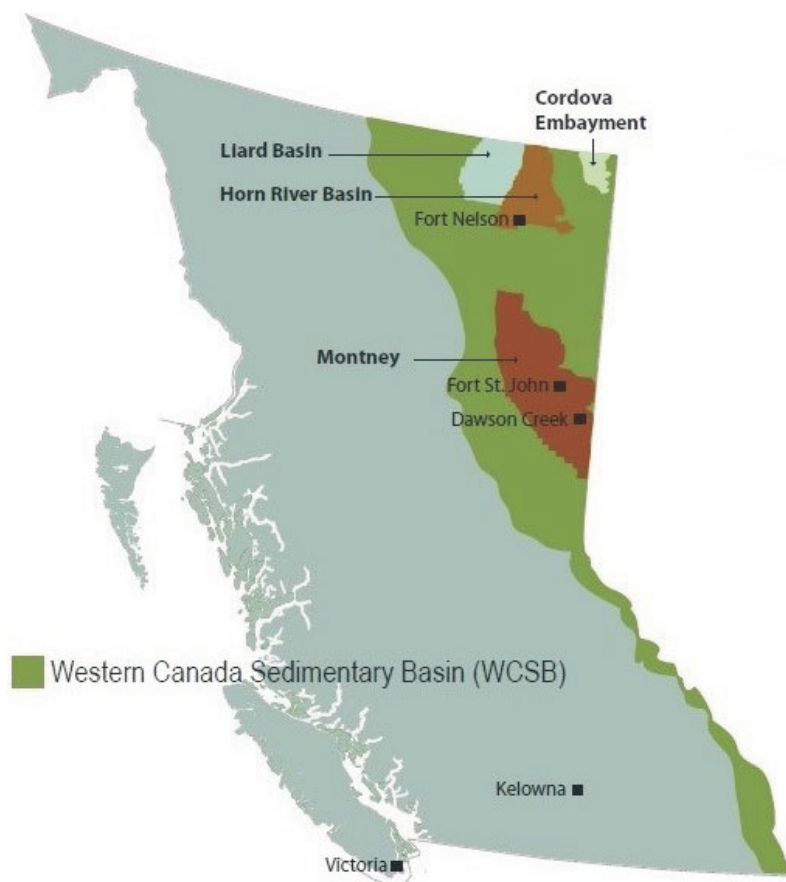


Figure 1. Location of the northeastern British Columbia portion of the Western Canada Sedimentary Basin (in green). The four sub-basins shown are current targets of natural gas exploration and development by industry (Evans and Whiticar, 2017)

correlation. Almost all isotopic data that can be reasonably traced to original lab reports have been used.

Methods

Wells and test intervals with molecular composition or isotopic data were compared against the geophysical logs publicly available from the BCOGC and new stratigraphic intervals were assigned where warranted. The original BCOGC formation codes have been retained for reference.

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Results

The recorrelation exercise is creating two types of results. Samples that originally had no formation code (generally on reports of shallow molecular composition tests and all reports of isotopic tests) were correlated and a small percentage of samples that were identified as incorrectly correlated were recorrelated. Continuing through the whole collection is resulting in new or changed formation (Fm) codes in addition to the original BCOGC formation codes.

The following are examples of the changes made, stratigraphically from the top. The BCOGC Fm codes are listed in parentheses after the formation name.

The Spirit River (2350) Fm in the BCOGC data currently has one sample location, but its members have significantly more: the Notikewin (2400) Member has more than 500 locations and the Falher (2500) Member and sub-members have more than 100 locations. The similar geochemistry of the Falher submembers have already been combined to member level for mapping purposes. The Notikewin and Falher can be readily identified from each other only to the south of a paleo-shoreline. To the north of that limit, the new correlation will assign all reservoir sands in the strata to the Spirit River Fm. Further mapping will be done to determine whether the Spirit River Fm should be mapped as one formation or split into the members.

The coarsening-upward marine shoreline sandstones and conglomerates of the Bluesky (2600) Fm have a large dataset (approximately 750 locations) and the fluvial and/or floodplain Gething (2700) Fm has a distinct set of more than 600 locations; however, where the formations are combined and previously thought to be undifferentiated, now are correlated as predominantly Bluesky Fm only. There are a significant number of Gething Fm tests where the fluvial and/or floodplain regime can be correlated with confidence. The Gething Fm does include the only coalbed methane tests in NEBC and needs to be mapped separately from the marine influenced strata.

The Chinkeh (2805) Fm, located only in the Liard Basin, is stratigraphically distinct from the Cadomin (2800) Fm, but they will be mapped together as an apparent contiguous dataset with a clear boundary between the areas. This may change if there is a large change in geochemistry between the formations.

The Dunlevy (2900) Fm is an obsolete stratigraphic term based on outcrop descriptions that were never reliably correlated to the subsurface. Detailed correlation and mapping has reassigned Dunlevy to the Buick Creek Sandstone (2890), which is laterally equivalent to the Nikanassin (2850) Fm, and in rarer cases the Dunlevy is now assigned to the younger Cadomin or Gething formations.

One of the largest datasets with more than 800 locations is the Baldonnel (4100) Fm, but sampling complexity occurs in three situations where

- a) the Baldonnel (4100) Fm is merged with the Charlie Lake (4500) Fm near the subcrop edge of the Charlie Lake Fm as the Baldonnel unconformably lies on top of the Charlie Lake. Tests here have been assigned to be Baldonnel only.
- b) near the northern subcrop edge of the Nordegg (3200) Member, some reservoirs have been assigned erroneously to the 'Nordegg-Baldonnel' or 'Nordegg'. These are actually basal Cretaceous deposits, formed by reworking of older Baldonnel and Nordegg strata into highly variable mixtures of radioactive shale, carbonate and sand that can easily be mistaken for the actual Nordegg or Baldonnel on geophysical logs. The combination Nordegg-Baldonnel is in an isolated area with very few samples. It was not recorrelated because it is not planned to be part of the overall mapping exercise—this may change in the future if analysis shows compatibility with any other formation.
- c) within the Rocky Mountain Foothills area, the Baldonnel gets structurally complicated with the Pardonet (4050) Fm. Tests here have been assigned to be Baldonnel only.

Other subcrop issues arise where the Lower Cretaceous Bluesky (2600) Fm and Gething (2700) Fm, by way of the sub-Cretaceous unconformity, erode down to the underlying formations of Charlie Lake (4500) Fm and Montney (5000) Fm. Where separate zones are distinct, the previously merged formation codes were subdivided to allow some separate mapping. In some locations, where further correlation work is required, the zones had to remain merged and will be the subject of a focused mapping exercise.

The Halfway (4800) Fm has the largest dataset with more than 1400 locations, but there is often an accompanying test in an interval called the lower Halfway (4805) Fm. It was determined that this interval was more like the Doig (4900) Fm and thus was recorrelated to Doig. Mapping will confirm that the geochemistry data are compatible.

The Montney (5000) Fm is the other large dataset with just less than 1400 locations after declustering horizontal well data. These data points are spread throughout a thickness that ranges up to 300 m. There is strong interest in production categories and reservoir characterization of the many different stratigraphic intervals within the Montney, but that formal subdivision and correlations have not yet been published. The correlations have been found to only be robust when based on geological ages at a very fine level that is often beyond the resolution of downhole geophysical logs. Further work will be required on this dataset.

The Kiskatinaw (7250) Fm is a well-defined clastic unit of Pennsylvanian age at the base of the Stoddart Group. Production is not always distinguished from the sour-gas-prone, overlying Permian Belloy (6200) Fm, but the testing in the Kiskatinaw is limited to approximately 50 locations and apparently the geochemistry maps very well with the underlying Debolt (7400) Fm. This will be confirmed in the future and may provide further information on the intervening Golata Formation shale. Any combination tests as Kiskatinaw plus Belloy were assigned to the Belloy Fm only.

The Rundle Group is not as well subdivided in NEBC as it is farther south. In NEBC, the hydrocarbon occurrences are concentrated near the top of the group in the Debolt (7400) Fm. All tests from the Rundle Group formations (Elkton [7450], Shunda [7500] and Pekisko [7600]) are now classified as being sourced from the Debolt Fm.

The Slave Point (8400) Fm, Keg River (8450) Fm, Sulphur Point (8500) Fm and Pine Point (8600) Fm have counts of sample locations as 390, 003, 001 and 043 respectively. These formations are stacked Devonian reefal carbonates bordering the Horn River Basin, Liard Basin and smaller embayments. Where good well control exists and the formations are fully developed, they can be subdivided with confidence. In many places, however, there are relatively few complete penetrations and diagenetic overprints can make it difficult to accurately distinguish stacked carbonate units. Currently, all are assigned to the Slave Point, but that will be confirmed in future work.

A stratigraphic chart showing these complexities is being generated for a later report.

Future Work

Ongoing mapping is illustrating clear trends in some horizons that match some already published material (Wood and Sanei, 2016). More work is required to ensure an accurate picture of the ‘gas fingerprint’ (Evans and Whiticar, 2017) is presented in the public data and manual confirmation of recorrelations is underway. Further stratigraphic work is required on the appropriateness of

- mapping grouped datasets (e.g., Kiskatinaw with Debolt);

- merging datasets that are too small or peripheral (e.g., the Nordegg-Baldonnel); and
- deciding if there is a need to split large datasets into finer correlations (e.g., the Montney).

Future publications will include a stratigraphic chart showing detailed correlation issues that will affect mapping and the interpretations for splitting versus grouping versus discarding some datasets.

Conclusions

The work on the BCNGA continues in the direction previously identified (Evans and Whiticar, 2017) with an expected completion of the NEBC portion in November 2018. Alignment of the project with stratigraphy will continue for the coming year.

Acknowledgments

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