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Besa River Formation, Western Liard Basin, British Columbia; Geochemistry and Regional Correlations

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Abstract

The British Columbia Ministry of Energy and Geological Survey of Canada are collaborating through the Geo-Mapping for Energy and Minerals (Energy) Program to provide the following geoscience information on the geology and natural resources of northeast British Columbia.

In northwestern Liard Basin, the Besa River Formation represents the basin ward equivalent of the Horn River to Debolt formations. In the Caribou Range, over 285 m of fine grained carbonaceous siliciclastic sediments of the Besa River Formation were measured (the upper 15 m and lower 25 m of the section are not exposed) which sit above carbonates of the Dunedin Formation (Nahanni and Keg River equivalents) and below sandstones of the Mattson Formation. The Besa River Formation has been subdivided into 6 informal lithostratigraphic units composed primarily of dark grey to black, carbonaceous siltstone to shale. The exception is a middle unit comprising distinctive pale grey weathering siliceous siltstone which is tentatively correlated with the Fort Simpson Formation. A hand held gamma ray spectrometer was used to produce a gamma ray log across the section which delineated two radioactive zones that are correlated with the Muskwa and Exshaw markers in the subsurface. Correlation indicates profound westward thinning of the Fort Simpson Formation, in conjunction with the shale out of the various carbonate units. Rock-Eval geochemistry delineates several zones of high organic carbon, with levels as high as 6 % in Exshaw equivalent strata. Abundances of major oxides and trace elements show distinct variability across the section. The concentration of major oxides generally correlates with lithologic subdivisions, whereas some of the trace elements abundances display a relationship to organic carbon content, suggesting these levels are tied to redox conditions at the time of deposition.

Methodology and Results

A nearly complete section of Besa River Formation was measured and described through use of a 1.5m staff along a west facing valley, some 22 km southwest of Beavercrow Mountain (base of section; UTM 367107E, 6643192N, top; 367496E, 6642948N; Zone 10, NAD 83; Figure 7).

Representative chip samples were acquired across 2 m intervals along the entire section. Samples were split, with one group being analyzed for whole rock, trace and rare earth element abundances by ICP-ES and ICP-MS via a lithium metaborate-tetraborate fusion at Acme Analytical Laboratories (Vancouver), and a second group, at 4 m spacing, for Rock-Eval analysis at Geological Survey of Canada (GSC) laboratories (Calgary). A smaller sub-set of these samples will also be analyzed by x-ray diffraction (XRD) at GSC laboratories for semi-quantitative determination of mineral abundances. Separate samples were collected for thermal maturity determination at GSC laboratories in Calgary through reflected light microscopy. Data not presented or discussed in this paper will be presented elsewhere or published in later publications. In addition, a hand held gamma ray spectrometer (RS-230 by Radiation Solutions Inc.) was used to measured natural gamma radiation every 1m over a 2 minute time interval allowing the calculation of K (%), U (ppm), Th (ppm) and total gamma ray count. The resulting diagram shows the variation in total natural radiation along the section and is approximately equivalent to conventional gamma ray readings collected from boreholes in the subsurface. Results of this exercise were used to assist in the correlation of the outcrop section with equivalent rocks in the subsurface.

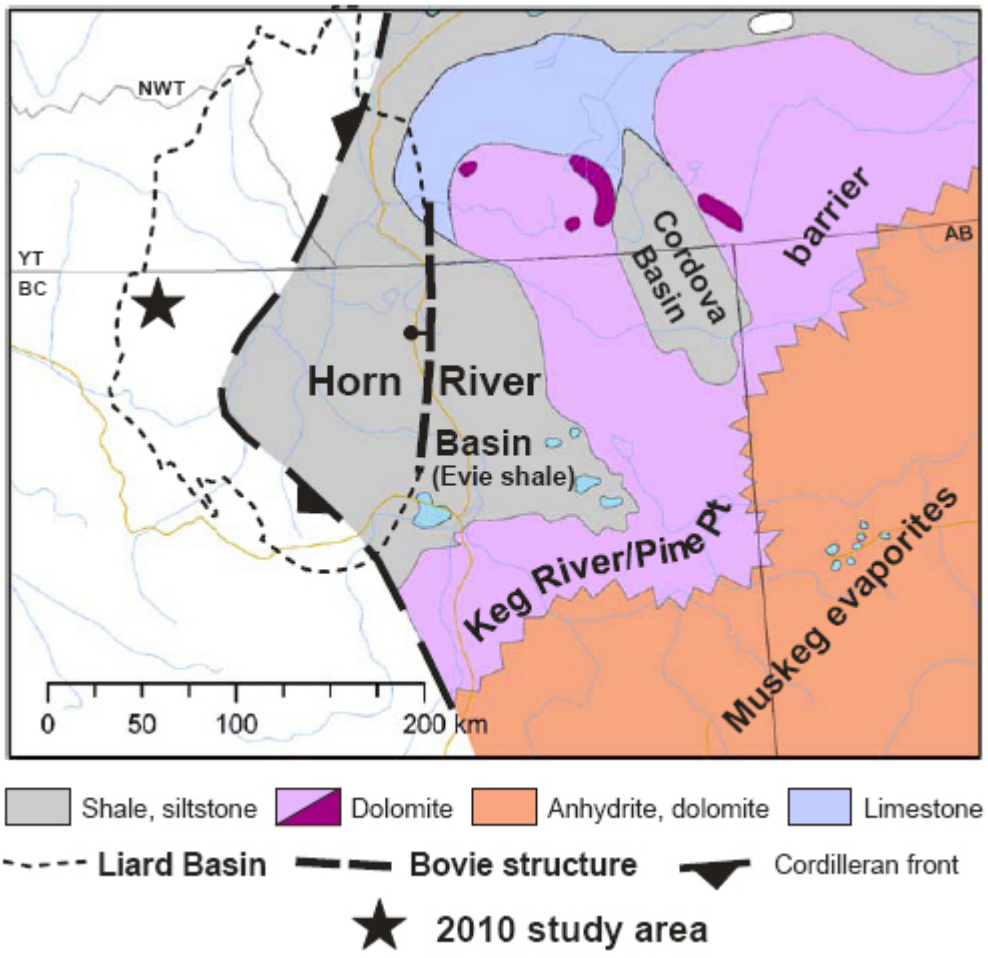

Figure 1: Schematic representation of the Horn River Basin (and Codorva Basin) during upper Keg River times (Givetian). Superimposed on this is the outline of the Liard Basin. This reef/carbonate/shale basin configuration persisted until the end of Slave Point times (end of Givetian).

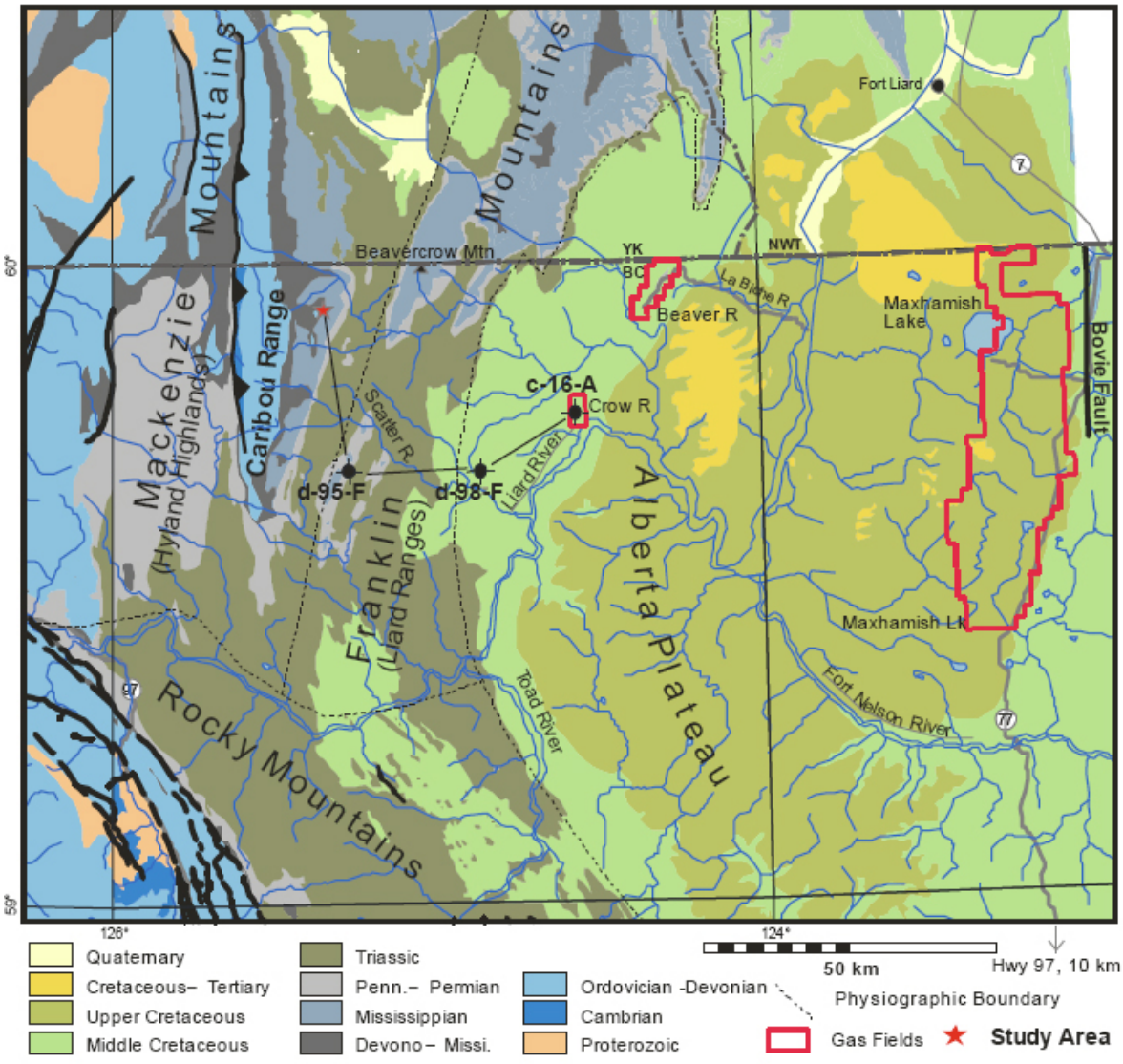

Figure 2: Geology of the western portion of the Liard Basin.

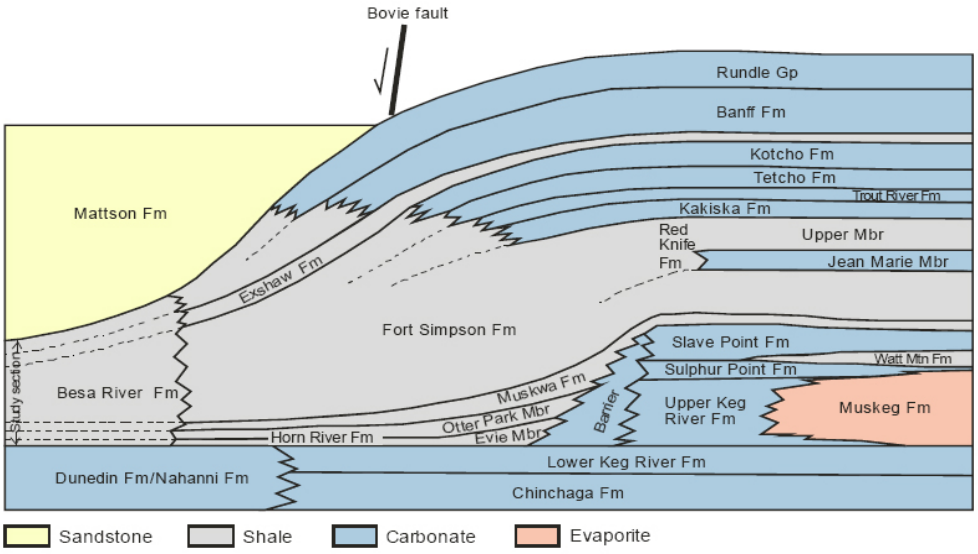

Figure 3: Schematic diagram showing relative thickness variations between mid to Upper Paleozoic shelf and off-shelf sequences depicted in Figure 1.

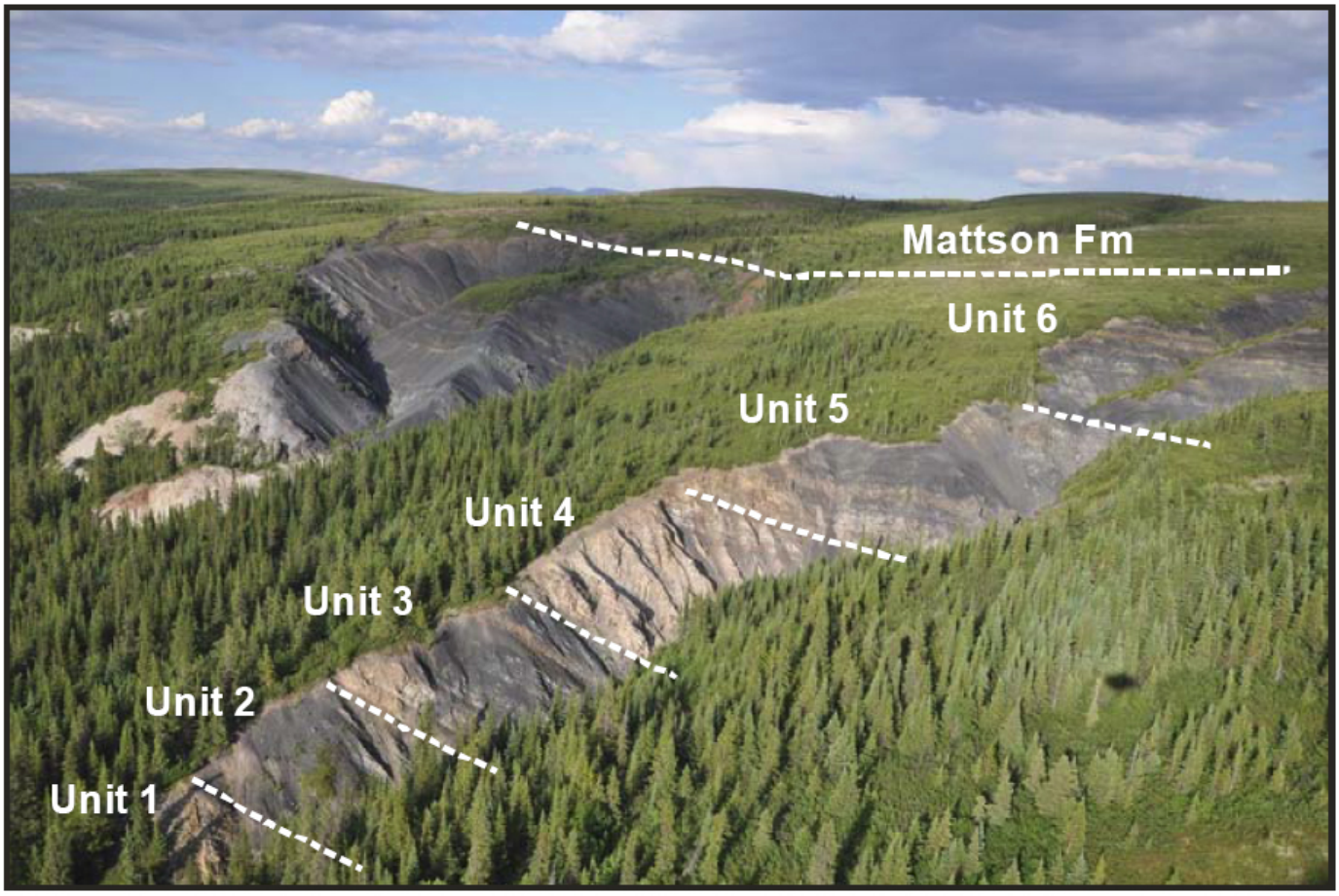

Figure 4: Aerial photograph of the measured section of Besa River Formation showing the character of exposed lithologies. The light coloured material is produced by the more siliceous siltstones of unit 4. Upper Besa River siltstones (unit 6) appear somewhat more recessive that the under siltstones of unit 5.

Figure 5 (next page): (a) Rusty weathering siltstone of unit 1 at the 5m level; (b) Beige to grey weathering, dark grey siltstones of unit 2 between 37 to 41 m; (c) Contact between units 2 and 3, showing the slightly more resistive nature of the siltstones in unit 3; (d) General shot of grey to dark grey weathering siltstones of unit 3 at the 80m level; (e) Light grey and rusty weathering siltstone of unit 4, 116m level; (f) Dark grey and resistive siltstones with shaly partings within unit 5 at the 150m level; (g) transition from more resistive ribs of siltstone in unit 5 into more recessive siltstones of unit 6; (h) Crumbly dark grey siltstones of unit 6, 238-250m level.

a)

b)

c)

d)

e)

f)

g)

h)

Figure 6: Lithologic section of Besa River Formation measured along the eastern part of the Caribou Range.

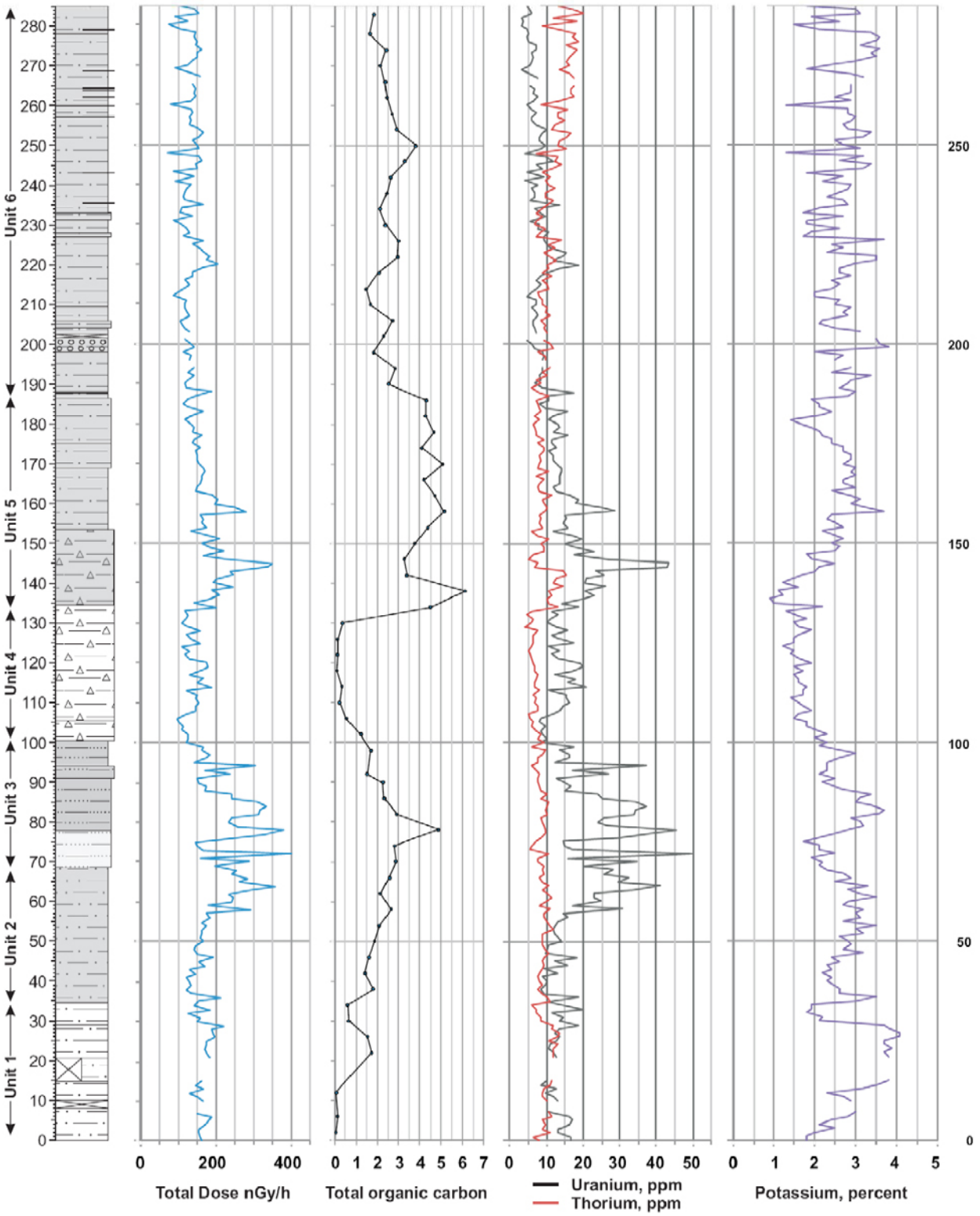

Figure 7: Comparison of main lithologic units of the measured Besa River Formation section with measured levels of total gamma ray counts, uranium, thorium, potassium and total organic carbon.

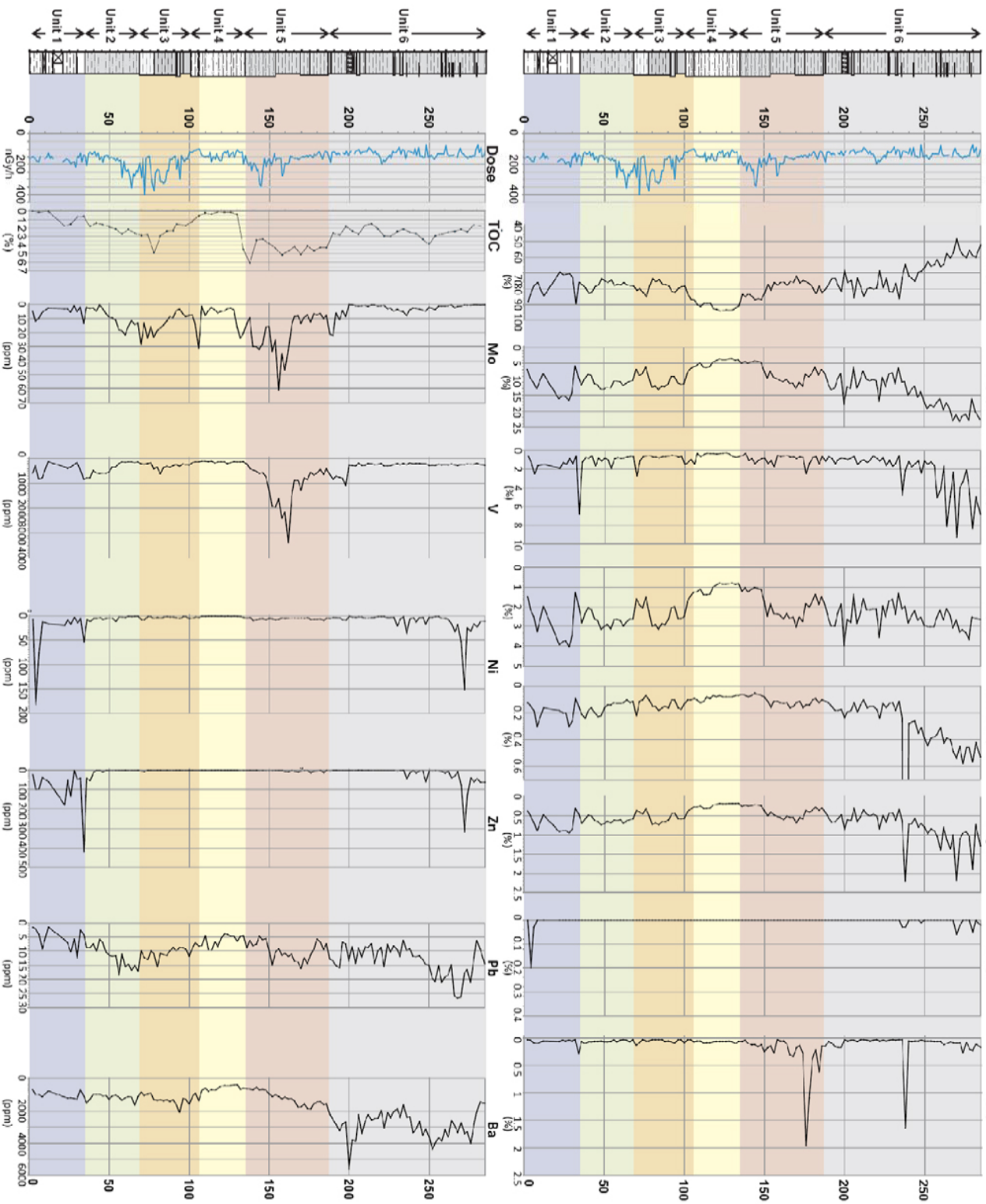

Figure 8: Abundances of select major oxides and trace elements within rocks of the Besa River Formation within the study area. The lithologic log, with units are shown on the right. The colour banding is provided as a guide to the unit boundaries.

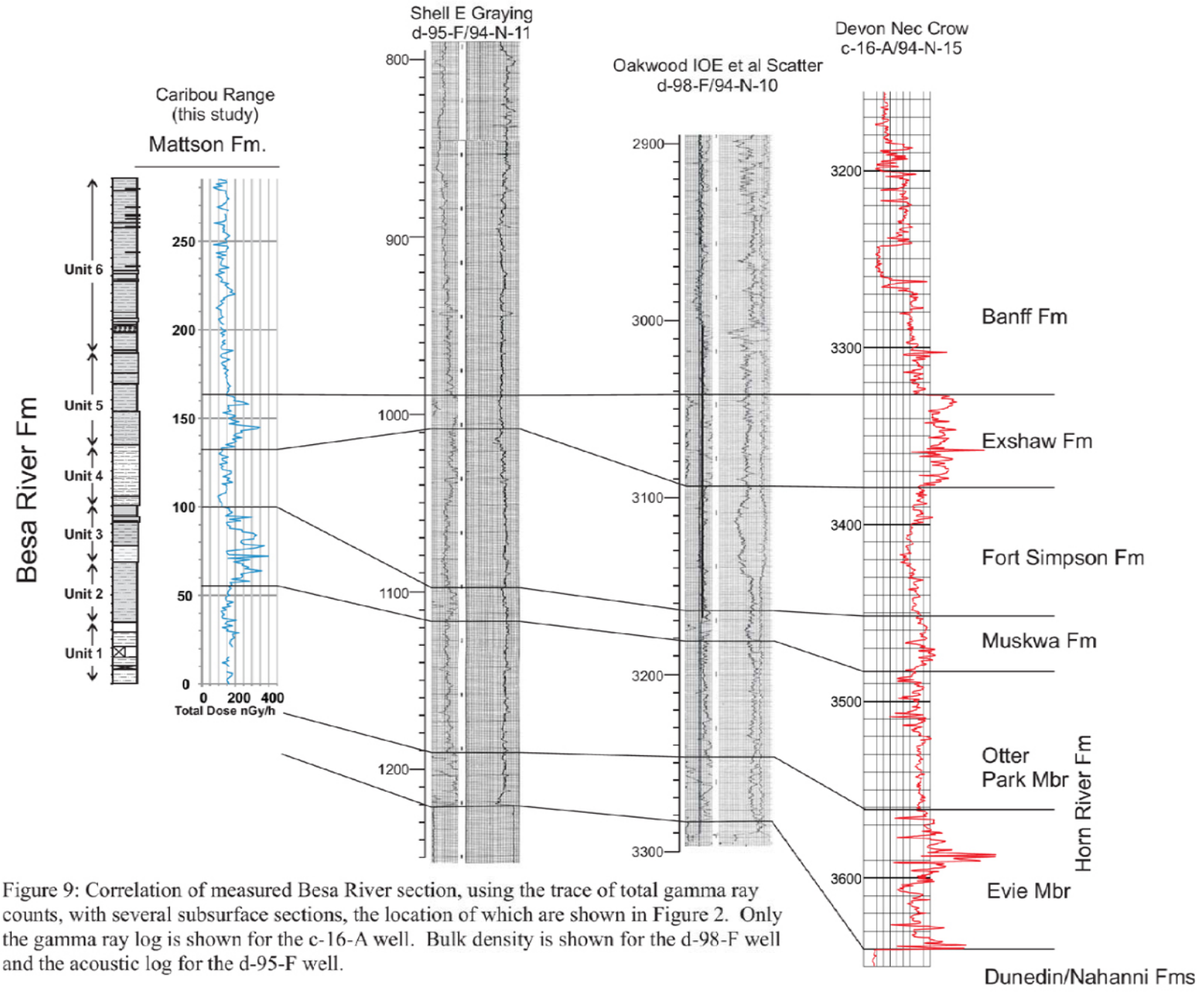

Figure 9: Correlation of measured Besa River section, using the trace of total gamma ray counts, with several subsurface sections, the location of which are shown in Figure 2. Only the gamma ray log is shown for the c-16-A well. Bulk density is shown for the d-98-F well and the acoustic log for the d-95-F well.

References

Ferri, F., Hickin, A., and Huntley, D. (2011): Besa River Formation, western Liard Basin, British Columbia; geochemistry and regional correlations, BC Ministry of Energy, Geoscience Reports 2011.