PEACE AREA PROJECT - COMPARISON OF RESISTIVITY GAMMA AND GEOLOGICAL LOGS WITH AIRBORNE EM INVERSIONS

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Contents

List of Figures

List of Tables

Introduction:

This paper is a follow up on a Geoscience BC report (Best and Levson, 2016) that selected wells for testing a stratigraphic model based on interpretation of airborne EM (AEM) inversions carried out by Aarhus Geophysics integrated with a gamma log study carried out by Petrel Robertson and Quaternary Geosciences Inc. (2015). This earlier report provides a discussion of the Peace Project, the data used to obtain the well locations and a summary of each well location. Eleven wells were selected for testing; however, funding only allowed for 8 wells to be drilled, with well 11 being abandoned after drilling. The 7 completed wells are listed in Table 1. Locations of most of these wells had to be moved because either the well locations were too difficult to reach or to respect land owner preferences. The table lists the UTM coordinates of the original location in Geoscience BC report 2016-18 (Best and Levson, 2016), the final location, and the distance separating these positions. The table also lists the closest line number for the original and final well locations. Two new wells were added (wells 10x and 13) so no original locations are recorded for them. They were selected by Simon Fraser University (well 13) and UBC (10x) for specific hydrogeologic projects. Figure 1 is a map showing the locations of all the wells, including those that were not drilled. Weatherford measured a suite of petrophysical logs on all the wells listed in Table 1 except well 3. This report uses the gamma and resistivity logs from this suite.

Well #	Original UTM easting	Original UTM northing	Original EM line number	Final UTM easting	Final UTM northing	Final EM line number	Approx. distance between original & final locations
3	533632	6335392	L 104802	532800	6337068	L 104503	1870 m
6a	546718	6262698	L 115801	546650	6262600	L 115801	120 m
7	570600	6261960	L 118302	570761	6262059	L 118302	190 m
10b	565670	6221360	L 123 202	564653	6220724	L 123202	1170 m
10 x	-	-	-	570720	6225047	L 123202	-
12	627284	6234107	L 301701	627050	6234063	L 301701	240 m
13	-	-	-	579293	6234812	L 122801	-

Table 1. Original and final locations for the 7 wells drilled and completed (wells 6a, 7, 10b, 10x, 12 and 13 also have geophysical logs).

The objective of this report is to compare the airborne EM inversions carried out by Aarhus Geophysics with the borehole geological logs and the resistivity and gamma logs. This is accomplished by 1) providing maps showing the original and final well locations overlain on the 15-20 m resistivity depth slice from the Aarhus AEM inversions, 2) identifying the final well locations on the closest flight lines (with the AEM inversion), and 3) comparing the AEM inversion with the geological log and the resistivity and gamma logs (with the same depth scale) for each well.

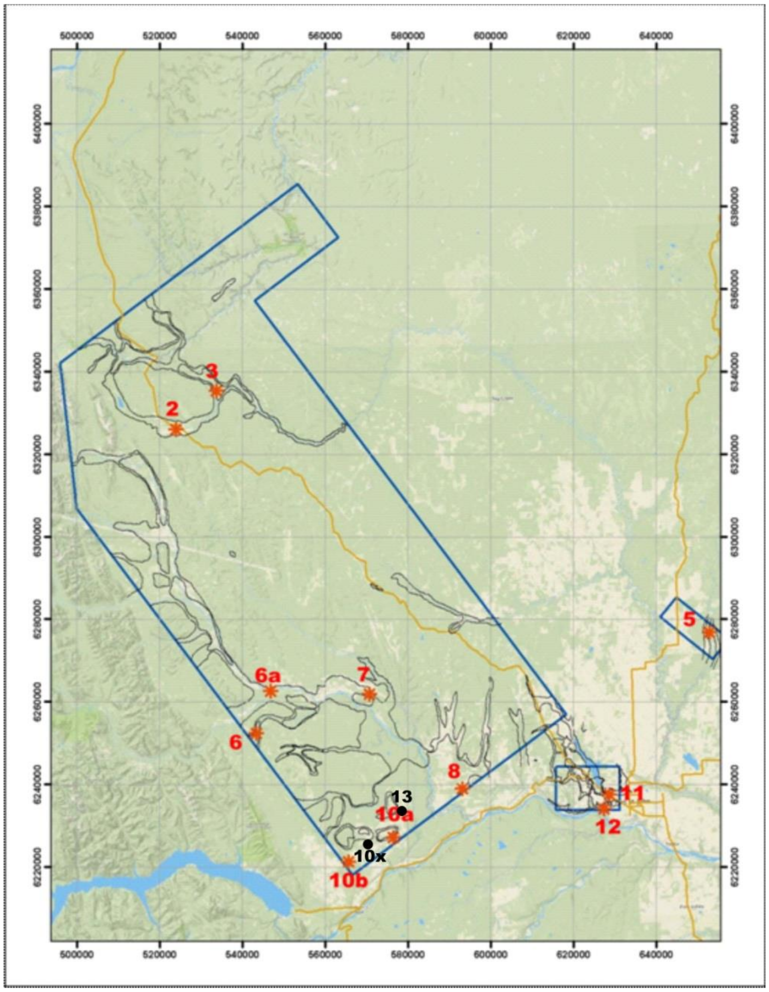

Figure 1. Location of all wells, including the two additional wells, selected for drilling, overlain on a map showing highways, major rivers and topography. The black dots are the locations of the two additional wells.

The following section on the geology and AEM inversion includes maps with the original and final locations of each of the 7 wells and cross sections of the AEM inversions with the approximate final locations of the wells shown. A short geological discussion is also included for each well location. A more complete discussion of the geology of each well is provided in Levson and Best (2017). The subsequent section in this report compares the AEM inversions, the geological log and the resistivity and gamma logs for each of the wells. A discussion of how these data sets compare to each other is included. The next section discusses well 3. Well 3 has a geological log but no resistivity and gamma logs so we are treating the discussion separately. Finally, the last section of the report provides conclusions based on the results from the earlier sections.

Geology and AEM inversions:

Throughout the remainder of this report we use colours for resistivity values with red reflecting high resistivity values and dark blue reflecting low resistivity values. Colours between red and dark blue tones are on a logarithmic scale.

Well 6a

Well 6a is located in the SW Peace north block as described in Geoscience BC report 2016-18. The original (old) and final (new) locations of well 6a overlain on the 15-20 m resistivity depth slice from the Aarhus inversions are shown in Figure 2. The original and final locations are only 120 m apart so the same flight line is appropriate for both these locations. Note for this depth slice both locations are within the same north-trending resistive (red) feature that was interpreted to detect the presence of shallow glaciofluvial gravel and sandstone units (Best and Levson, 2016). Figure 3 is the Aarhus AEM inversion for Line 115801 showing the final location of well 6a in the middle of a large resistive (red) feature near the surface that turns into a moderately conductive (light blue) feature at depth.

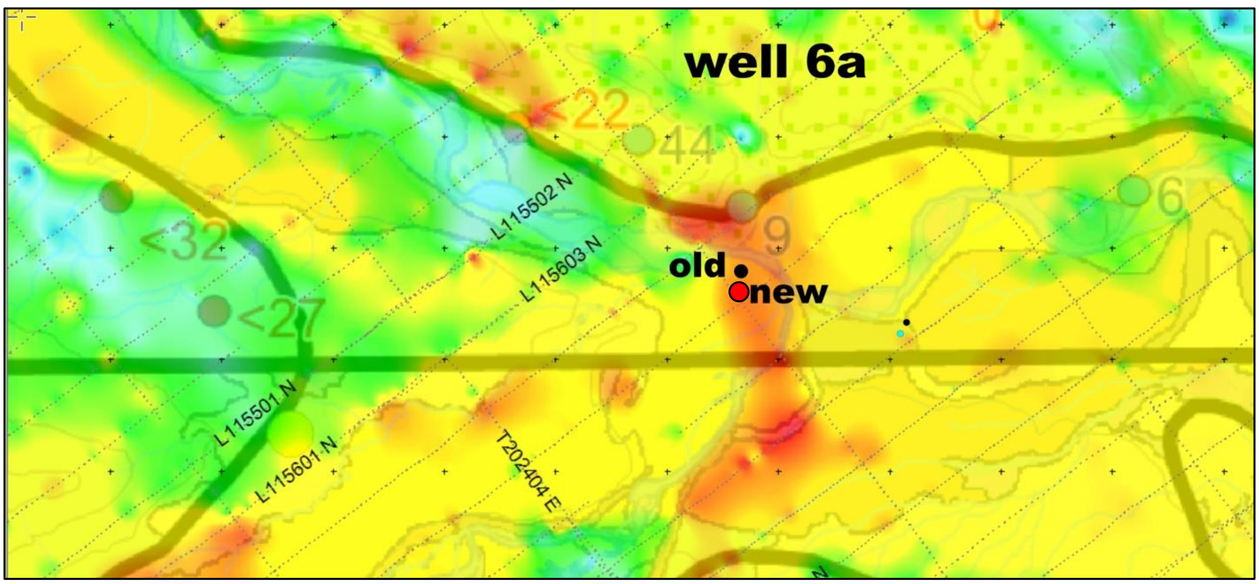

Figure 2. Planned (old, black) and actual (new, red) locations of well 6a plotted on the 15-20 m resistivity depth slice. Line 115801 is the flight line just to the SE of the wells.

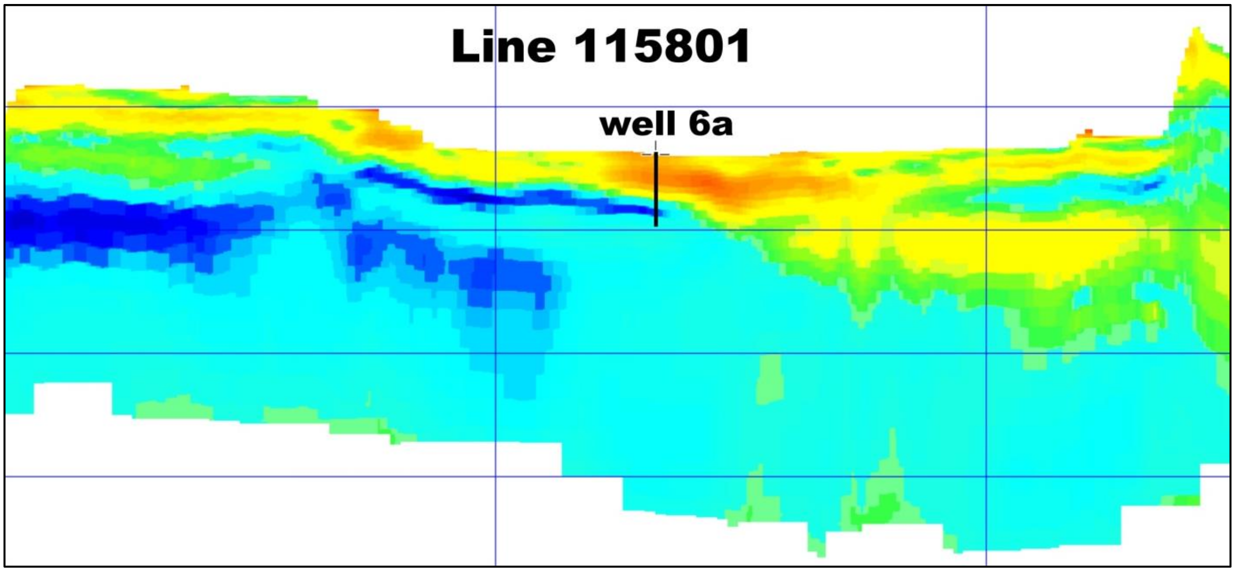

Figure 3. Plot of the Aarhus AEM inversion on Line 115801. The approximate final location of well 6a is identified.

Well 7

Well 7 is also in the SW Peace north block. Figure 4 shows the locations of the original and final locations of well 7 overlain on the 15-20 m deep Aarhus resistivity depth slice. The original and final locations are only separated by approximately 200 m so the same flight line can be used for the new location. Figure 5 is the resistivity section for Line 118302 with the approximate position of the final location for well 7.

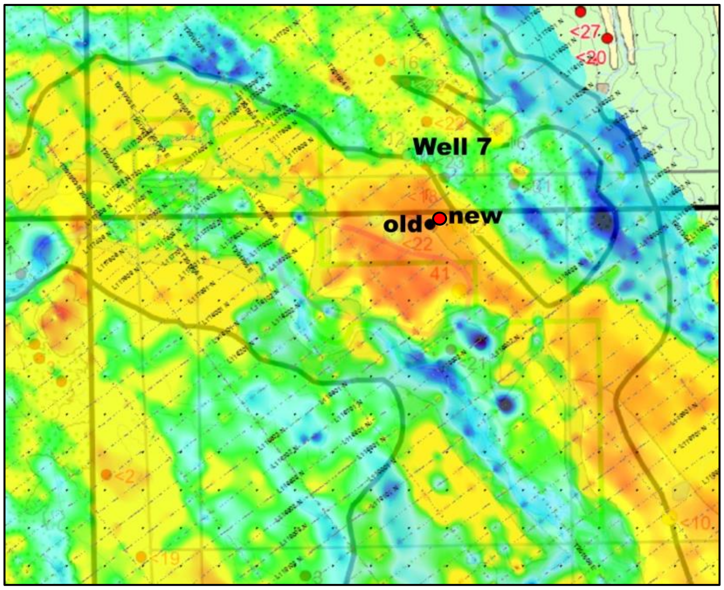

Figure 4. Location of well 7 plotted on the 15-20 m resistivity depth slice. Line 118302 is the flight line a few metres to the SE of the well locations.

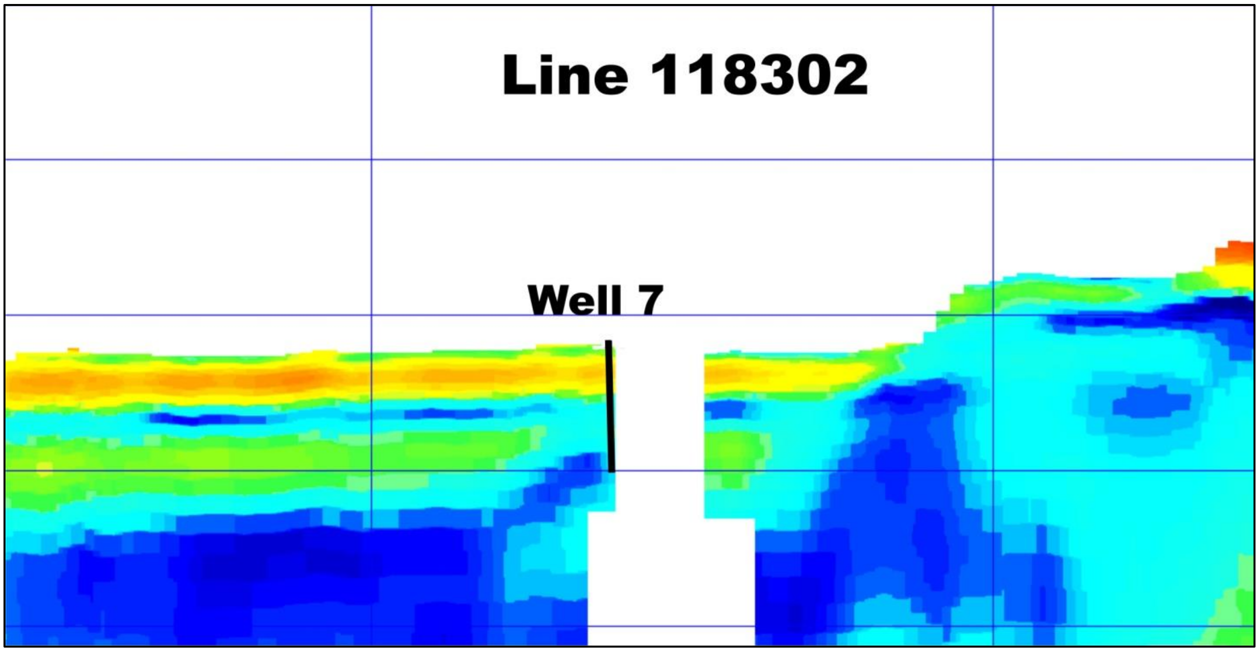

Figure 5. Plot of the Aarhus AEM inversion of well 7 on Line 118301. The approximate final location of well 7 is identified on the plot.

Well 7 is located east of the Halfway reserve within an extensive belt of glaciofluvial sediments that occur on a high bench distant from the modern river valley. The target area is along the northeastern margin of a possible paleochannel (identified by dark lines on Figure 4) located on a bench along the north side of the Halfway valley. The mapped paleochannel boundaries coincide in this area with a large resistive zone shown on the 15-20 m resistivity depth slice (Figure 4).

Well 10b

Well 10b is located in the SW Peace south block as described in Geoscience BC report 2016-18. The original (old) and final (new) locations of well 10b overlain on the 15-20 m resistivity depth slice are shown on Figure 6. Although the distance between the original and final locations is 1170 m, the wells are on the same flight line. The final location appears to be within a different resistive (red) feature than the original well. However, this is the result of erosion by Lynx Creek a valley that has incised into the resistive feature (Figures 6 and 7).

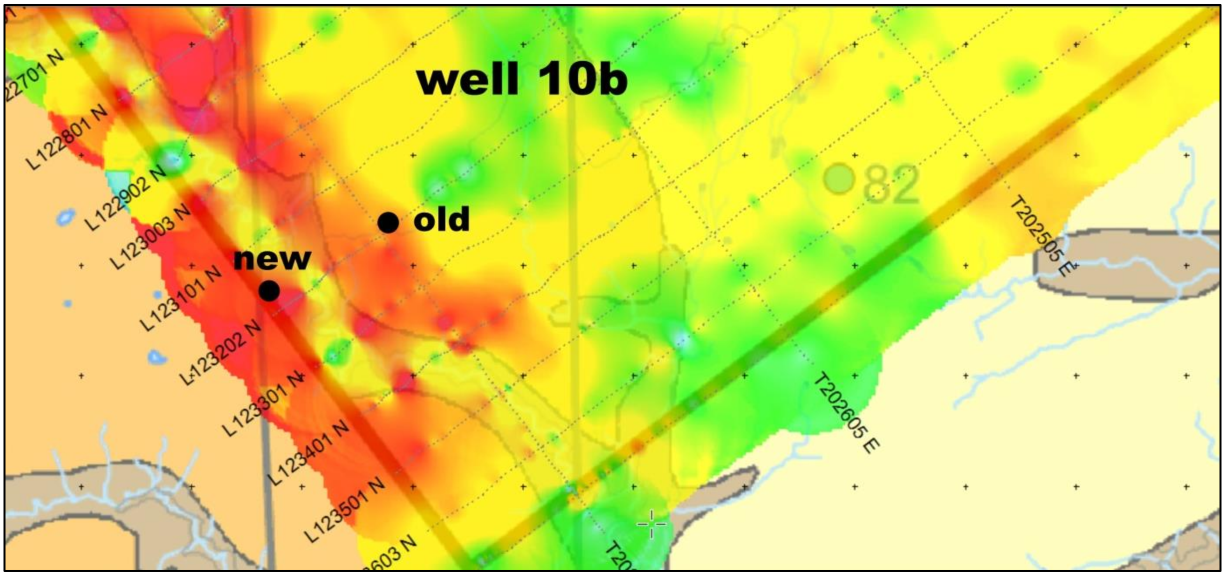

Figure 6. Location of well 10b plotted on the 15-20 m resistivity depth slice. The old and new locations are located close to same flight line in this case.

Figure 7 shows the Aarhus AEM inversion for Line 123202. The final location of well 10b is at the end of the line. This creates uncertainty in resistivity variation with depth. However, we are fairly confident the stratigraphy is relatively similar to that of the old location to the east, although some minor variations across the valley are evident on the resistivity section (Figure 7). The AEM inversion at the new well location shows a large resistive (red) feature near the surface grading into a moderately (yellow) resistive feature deeper in the section and finally going to a more conductive (green) feature at depth. A thin, moderately conductive (yellow to green) unit is present at the surface.

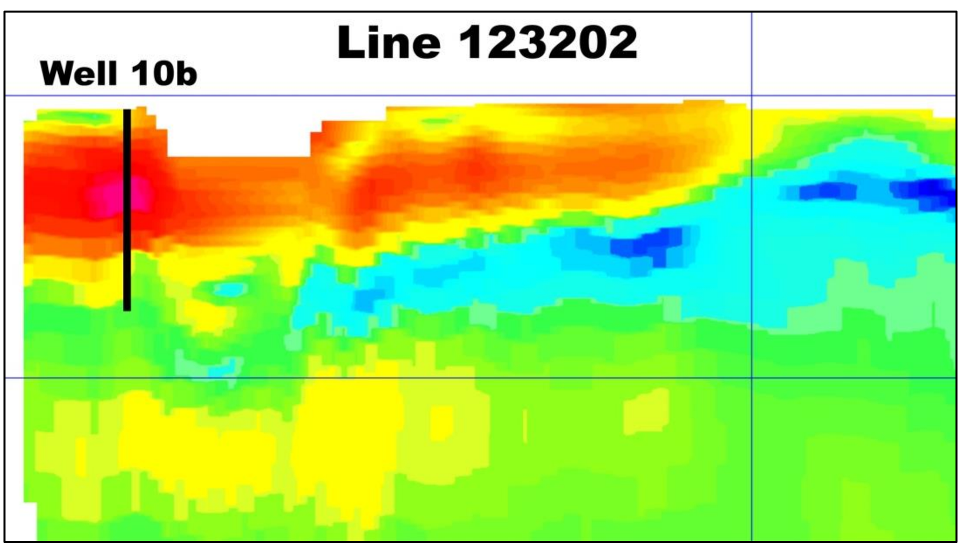

Figure 7. Plot of the Aarhus AEM inversion on Line 123202. The approximate final location of well 10b is shown at the westernmost end of the line.

Well 10x

Well 10x is located in the SW Peace south block (see Geoscience BC report 2016-18). This well was not included in the original selection of wells but was selected based on a set of requirements for a UBC project (Hudson's Hope Field Research Station - designed for a study of the effects of methane on aquifers). The location of well 10x, overlain on the 15-20 m resistivity depth slice, is shown on Figure 8. The well is in a broad zone that is defined by resistive material (orange) contained within the middle of a moderately resistive (yellow) feature. Resistivity values in the area are variable and the broad resistive zone is poorly defined but may connect to a narrow resistive zone to the northwest and possibly also to a large resistive area to the west (Figure 8). Figure 9 shows the Aarhus AEM inversion for Line 123202 with the approximate location of well 10x. The well is in a broad lens-shaped near surface resistive (yellow/orange) feature that turns into a conductive feature (dark blue) at depth. The well was selected in part because the resistive feature is relatively close to surface and UBC researchers were interested in a shallow target for a multi-well study.

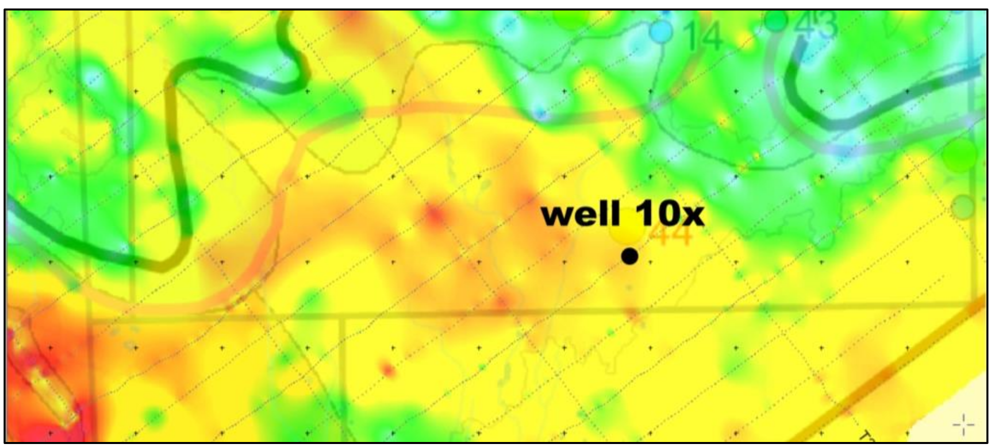

Figure 8. Location of well 10x plotted on the 10-15 m resistivity depth slice. Well 10x is located directly on line 123202.

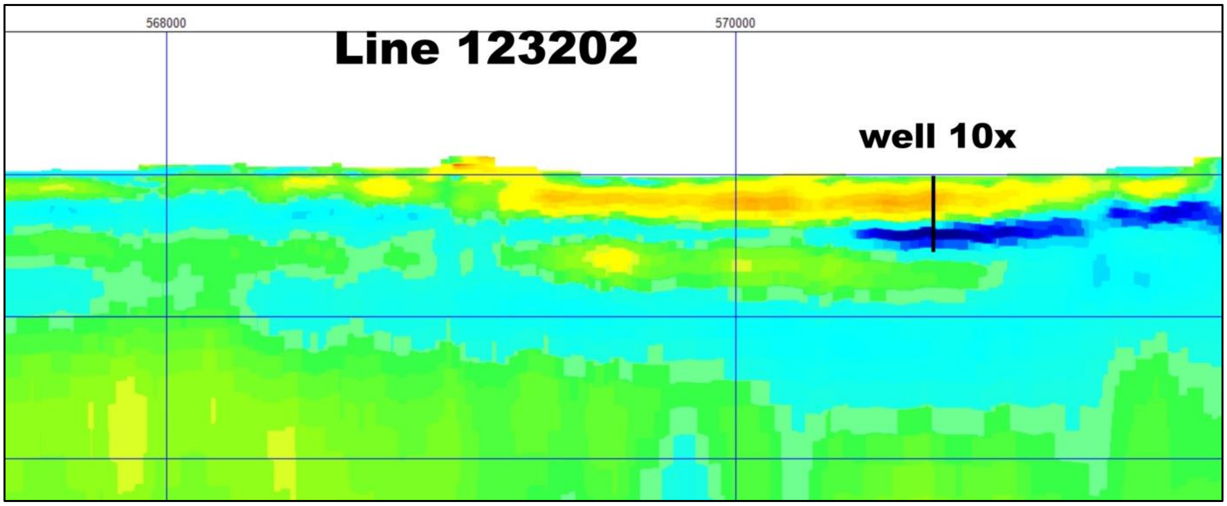

Figure 9. Plot of the Aarhus AEM inversion on Line 123202. The approximate final location of well 10x is shown.

Well 12

Well 12 is located in the south half of the Charlie Lake block (Geoscience BC report 2016-18). Figure 10 shows the old (original) and new (final) locations of well 12 plotted on the 15-20 m resistivity depth slice. The two locations are only 240 m apart so line 301701can be used for both locations. Figure 11 shows the final location of well 12 on the Aarhus inversion for line 301701. The site was selected because the resistivity section showed multiple resistivity units in an area interpreted to be near the northern margin of a paleovalley of the Peace River (Best and Levson, 2016). Surface sediments in the area are relatively thick glaciolacustrine silts and clays deposited in Glacial Lake Peace.

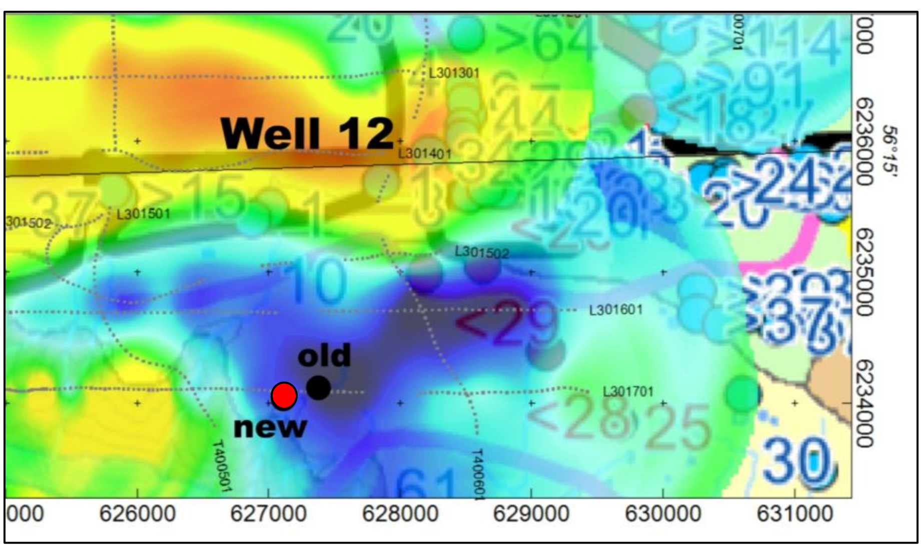

Figure 10. Location of well 12 plotted on the 15-20 m resistivity depth slice. The old location is directly on Line 301701.

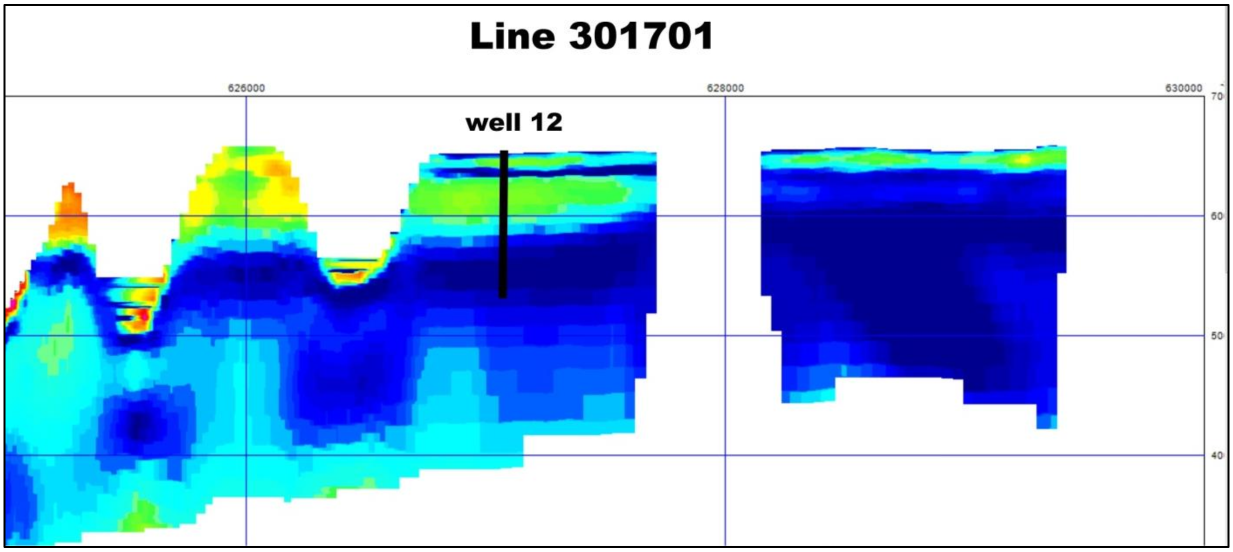

Figure 11. Plot of the Aarhus AEM inversion for Line 301701. The approximate final location of well 12 is shown.

Well 13

Well 13 is located in the SW Peace south block (Geoscience BC report 2016-18). This well was not included in the original selection of wells but was selected based on a set of requirements for a Simon Fraser University project. The location for well 13 overlain on the15 to 20 m resistivity depth slice is given in Figure 12. It is located near the edge of a large yellow (moderate resistivity) feature on the 15 to 20 m resistivity depth slice. Figure 13 shows the Aarhus AEM inversion for Line122801 with the approximate location of well 13. The well is in the middle of a near surface resistive (yellow/orange) feature that turns to moderately conductive material (light blue) at depth. A thin moderately conductive (green) unit occurs at surface (Figure 13).

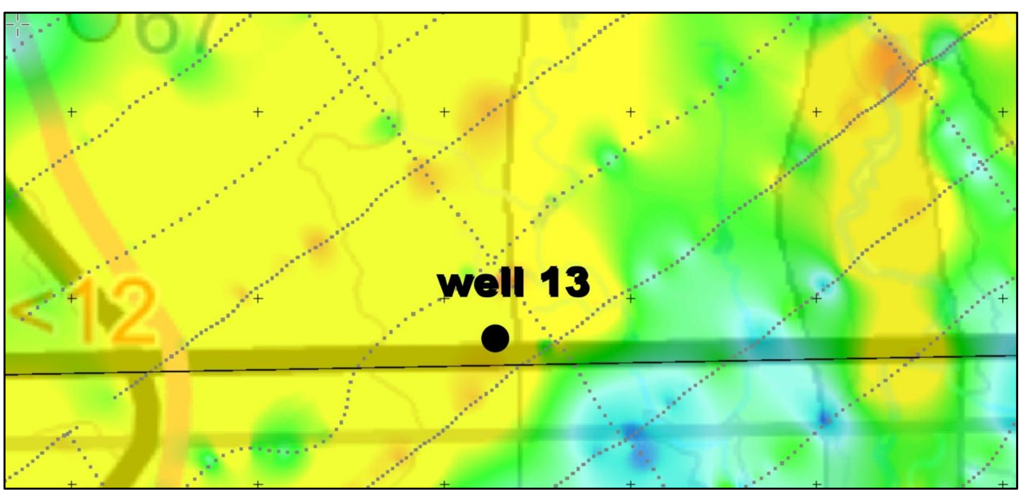

Figure 12. Location of well 13 plotted on the 15-20 m resistivity depth slice. Line 122801 is approximately 150 m SE of the well.

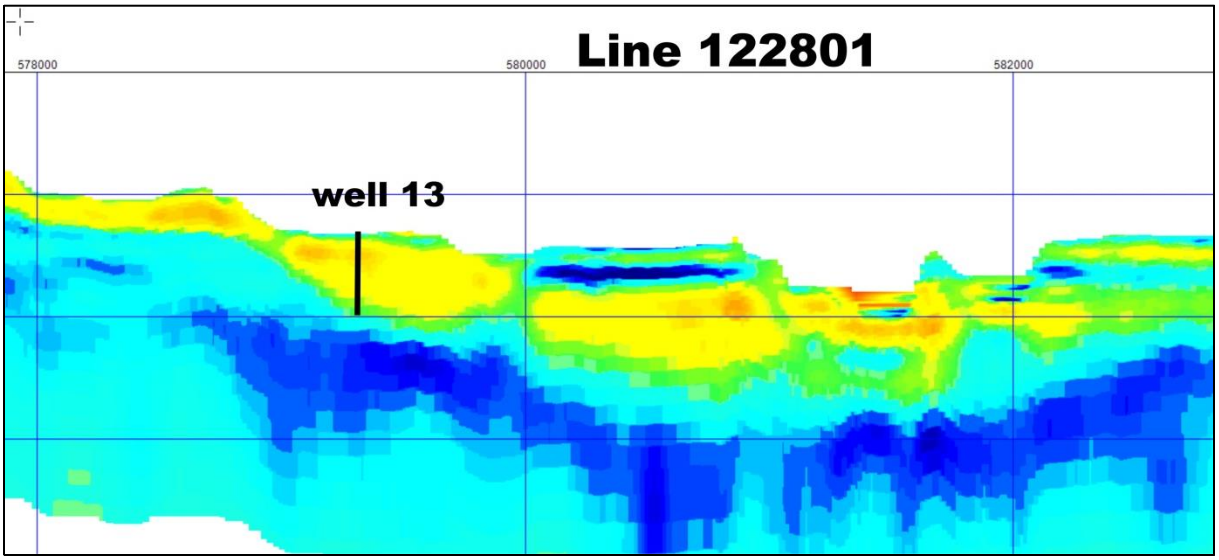

Figure 13. Plot of the Aarhus AEM inversion on Line 122801. The approximate final location of well 13 is shown.

Comparison of AEM inversions and resistivity logs

Well 6a

Figure 14 is a plot of the resistivity, gamma and geological logs on the right side versus the AEM inversion for well 6a on the left side. The total depth of the well is 14 m. This well was selected because it is part of a north-south complex of resistivity highs (Geoscience BC report 2016-18) which was thought to be related to potential shallow sandstone with a few m of resistive gravel overlying the sandstone. Sandstone bedrock was encountered at approximately 8 m which is close to the major break seen around 7 m in the resistivity log. However, the AEM inversion could not separate the overburden above 8 m depth from the sandstone below 8 m depth. This is not surprising looking at the geological log for this well. There is resistive gravel above the resistive sandstone so one would not expect to see a significant contrast across this contact. There is a thin bed of pebbly mud near the base of the overburden but it is not thick enough to be seen on the AEM inversion. However, the bed can be seen on the resistivity and gamma logs as the resistivity value decreases and the gamma value increases above the sandstone bedrock.

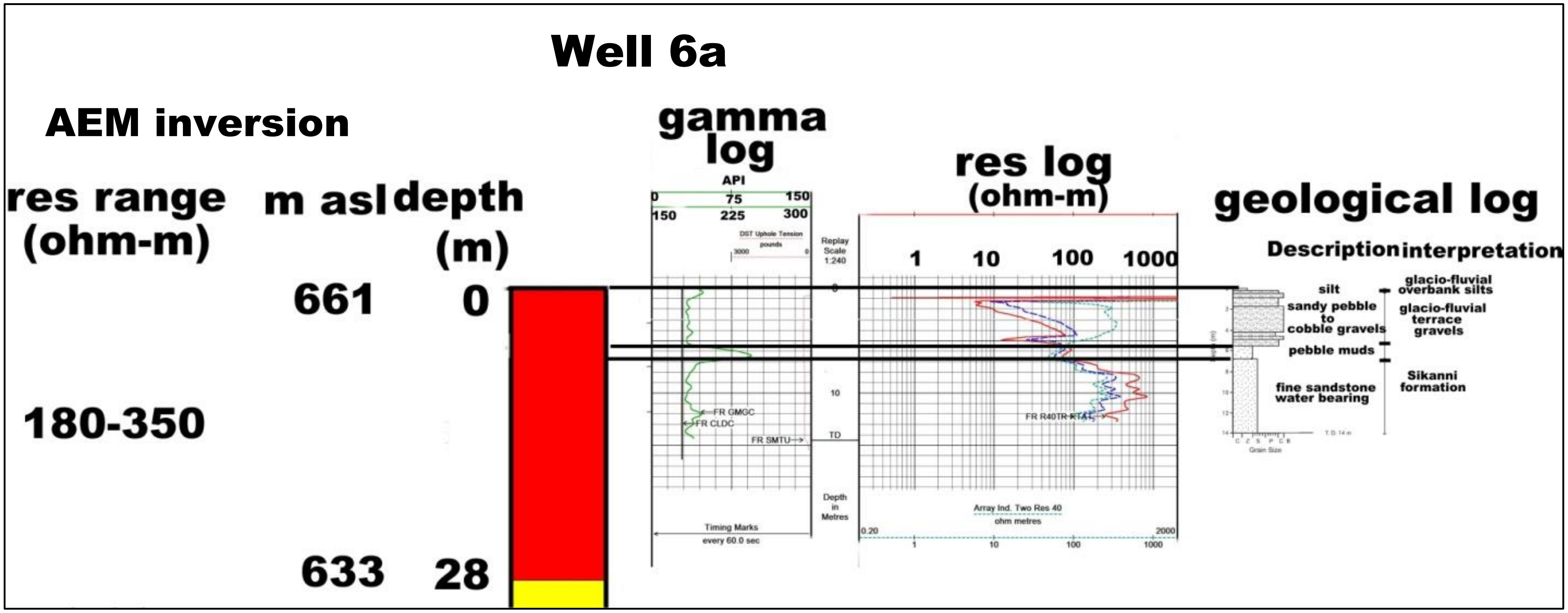

Figure 14. Plot of resistivity, gamma and geological logs on the right side versus resistivity interpretation from the AEM inversions on the left side for well 6a. The depth scale of the resistivity and gamma logs is within a few m of the AEM inversion).

Well 7

Figure 15 is a plot of the resistivity, gamma and geological logs on the right side versus the AEM inversion for well 7 on the left side. The total depth of the well is 54 m. The geological log indicates that the well is mostly fine and very fine sands with silt and clay layers dispersed throughout. A very fine sand and silt layer in the upper 5 m of the borehole correlates very well with a 5-m thick, moderately conductive (green) surface unit on the AEM inversion and with a 5-m thick conductive unit on the resistivity log. The top 5 m on the AEM inversion has a resistivity range between 32 and 50 ohm-m. The resistivity log is not as clear because of the effect of the metal protective well cover near the surface. (Metal well protectors were installed over all the wells and cemented to a depth of about 30 cm to protect the well and casing stick-up against damage and vandalism). However, indications are that it is most likely in this range. The break at 5 m is associated with silt and very fine sand above 5 m and fine sands below 5 m.

From 5-30 m, the geological log shows interbedded very fine sands, silts and clays. Sandy zones correlate with the most resistive parts of the resistivity log (and with low gamma counts) whereas zones with more silt and clay are more conductive and show correspondingly higher gamma readings, as expected. The AEM inversion changes resistivity at a 3-m thick clay layer that starts at 18 m. The resistivity decreases on the resistivity log and the gamma counts increase on the gamma log over this 3-m clay interval. However, it is too thin to be seen on the AEM inversion. Below about 30 m, there is more clay and silt present; this shows as a decrease in resistivity on both the AEM inversion and the resistivity log and as an increase on the gamma log. The resistivity break at 33 m on the AEM inversion is related to the change in geology at about 30 m depth.

The details seen on the geological log cannot be seen on the AEM inversions, particularly in the deeper section. Some of these details are observable on the gamma and resistivity logs (for example between 18 and 27 m (silt and clay and interbedded silt, clay and very fine sand) and between 27 and 32 m (very fine sand). Likewise, a silt and clay unit from about 39-43 m correlates well with a small but sharp increase in gamma counts and decrease on the resistivity log at 39 m. Between 43 and 49 m there is gravelly mud and below 49 m there is a silt clay diamict. The resistivity log shows a decrease with depth within these units and the gamma count increases but these details are not resolvable on the AEM inversion at this depth.

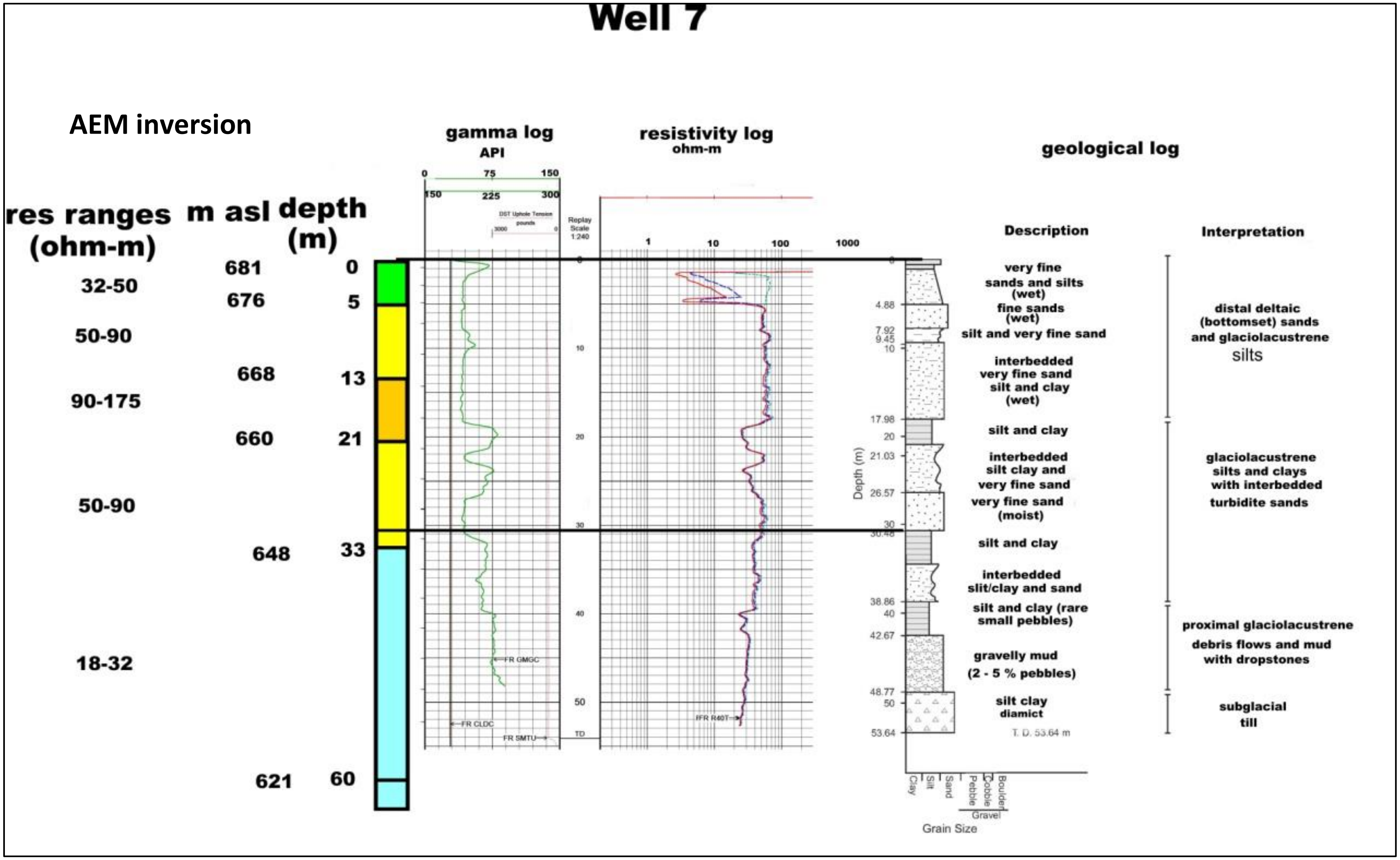

Figure 15. Plot of resistivity, gamma and geological logs on the right side versus resistivity interpretation from the AEM inversions on the left side for well 7. The depth scale of the resistivity and gamma logs is within a few m of the AEM inversion.

Well 10b

Well 10b (Figure 16) was selected because of a well developed glaciofluvial terrace present in the area (Geoscience BC report 2016-18). The Quaternary stratigraphy of the area is also of interest because of recent landslides in the region. Well 10b is at the western limit of Line 123202 (Figures 6 and 7). The total depth of the well is approximately 60 m. The AEM inversion has a resistivity range between 32 and 95 ohm-m from surface to a depth of 10 m that corresponds with a unit of bedded silts and clays and silts that coarsens down into silts with rare pebbles and finally into very fine to medium sands at about 10 m. This downward coarsening trend shows as dramatically increasing resistivity and decreasing gamma counts on the resistivity and gamma logs respectively. As seen at well 7 the uppermost part of the resistivity log is affected by the metal protective well cover near the surface.

From 10 to 44 m depth, the AEM inversion has resistivity values between 150-300 ohm-m (mostly within fine and medium sand units) which is consistent with the resistivity values on the resistivity log from a depth of about 10 to 45 m. From 43 to 53 m depth, the AEM inversion has resistivity values between 45 and 95 ohm-m (within very fine sand and silt units with some gravel) which is consistent with the resistivity log although the depths are a few m different in this interval. The bottom zone of the resistivity log has values dropping rapidly as it goes into a zone of silty clay diamict. This is consistent with the AEM inversion which has resistivity values between 45 and 95 ohm-m in this zone.

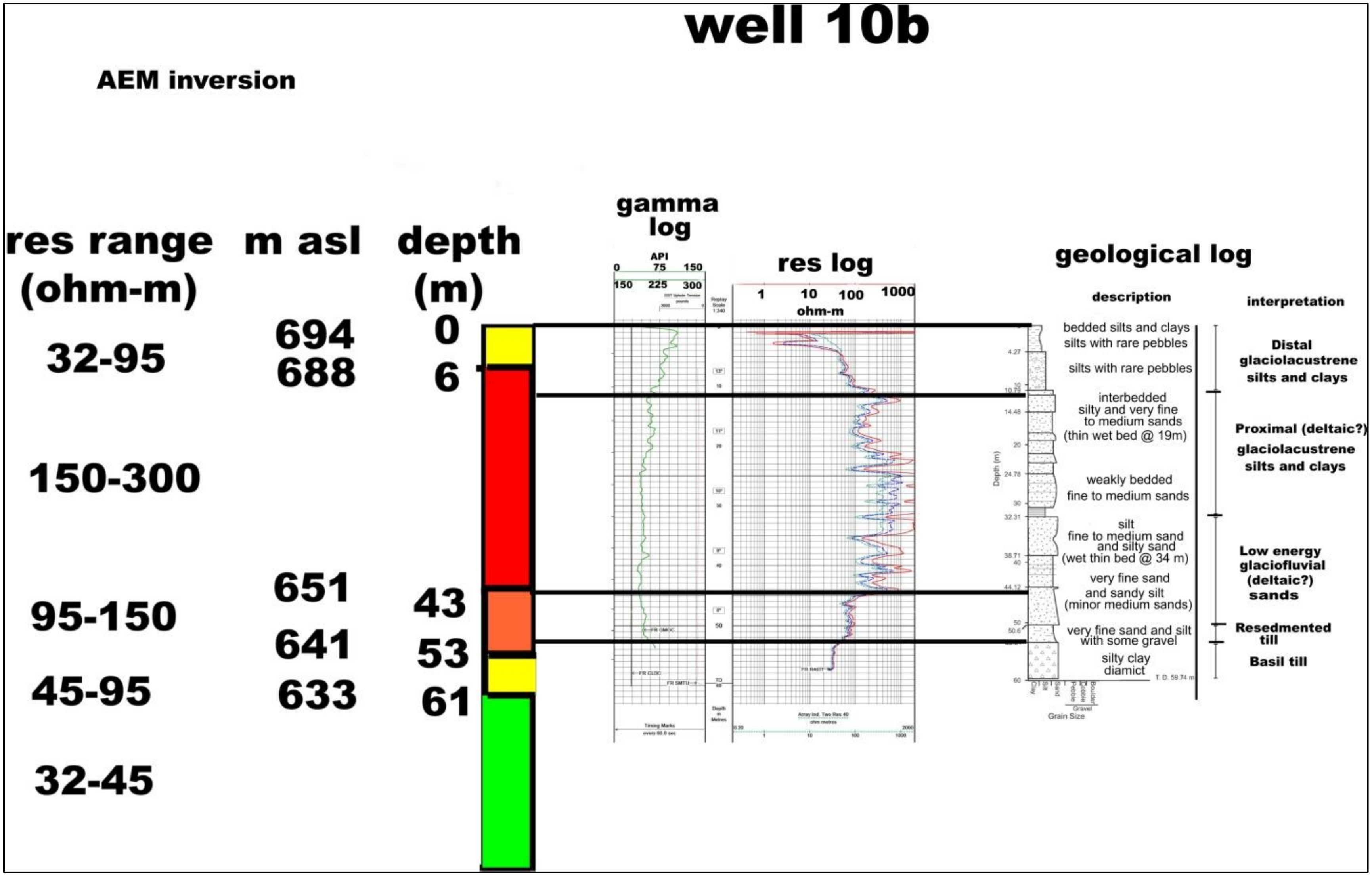

Figure 16. Plot of resistivity, gamma and geological logs on the right side versus resistivity interpretation from the AEM inversions on the left side for well 10b. The depth scales are approximate (within 1 - 2 m of each other).

Well 10x

Well 10x (Figure 17) was selected for a project managed by the University of British Columbia and was added after Geoscience BC report 2016 -18 was written. The total depth of well 10x is approximately 72 m. There is a resistivity break at a depth of 5 m on the AEM inversion and the resistivity log. The resistivity value of the AEM inversion is between 32 and 50 ohm-m. The upper part of the resistivity log is altered by the metal casing as mentioned earlier but the log shows a value of approximately 60 ohm-m at depths between 5 and 27 m. The AEM inversion has resistivity values between 50 and 90 ohm-m between depths of 5 and 13 m (within silty diamict and sandy silt diamict units) and a resistivity range between 90 and 130 ohm-m between 13 and 27 m depth (mostly within fine to very fine sands). The higher resistivity value seen on the AEM inversion does not show up on the resistivity log over this interval. At about 23-25 m depth a wet, pebbly fine sand bed occurs within the most resistive zone on the AEM inversion and correlates with a decrease in gamma counts and a small increase in resistivity on the resistivity log.

Between depths of about 25 and 60 m (within a sequence of mainly silty to silty clay diamicts) the resistivity log has a resistivity value of approximately 20 ohm-m. The AEM inversion has resistivity values between 18 and 32 ohm-m which is consistent with the resistivity log. Within this sequence, a sandy silt diamict bed at about 32-35 m depth correlates well with a small spike in resistivity and drop in gamma counts. The resistivity range for the AEM inversion between 60 and 65 m depth is between 32 and 50 ohm-m which is consistent with the resistivity log with an average resistivity value of approximately 50 ohm-m. From about 61 to 64 m depth there is a zone of poorly sorted gravels that correlates very well with a prominent increase in resistivity to about 100 ohm-m on the resistivity log and a corresponding decrease in gamma counts. Below 65 m, silts and clays dominate and resistivity values drop to about 20 ohm-m on the resistivity log.

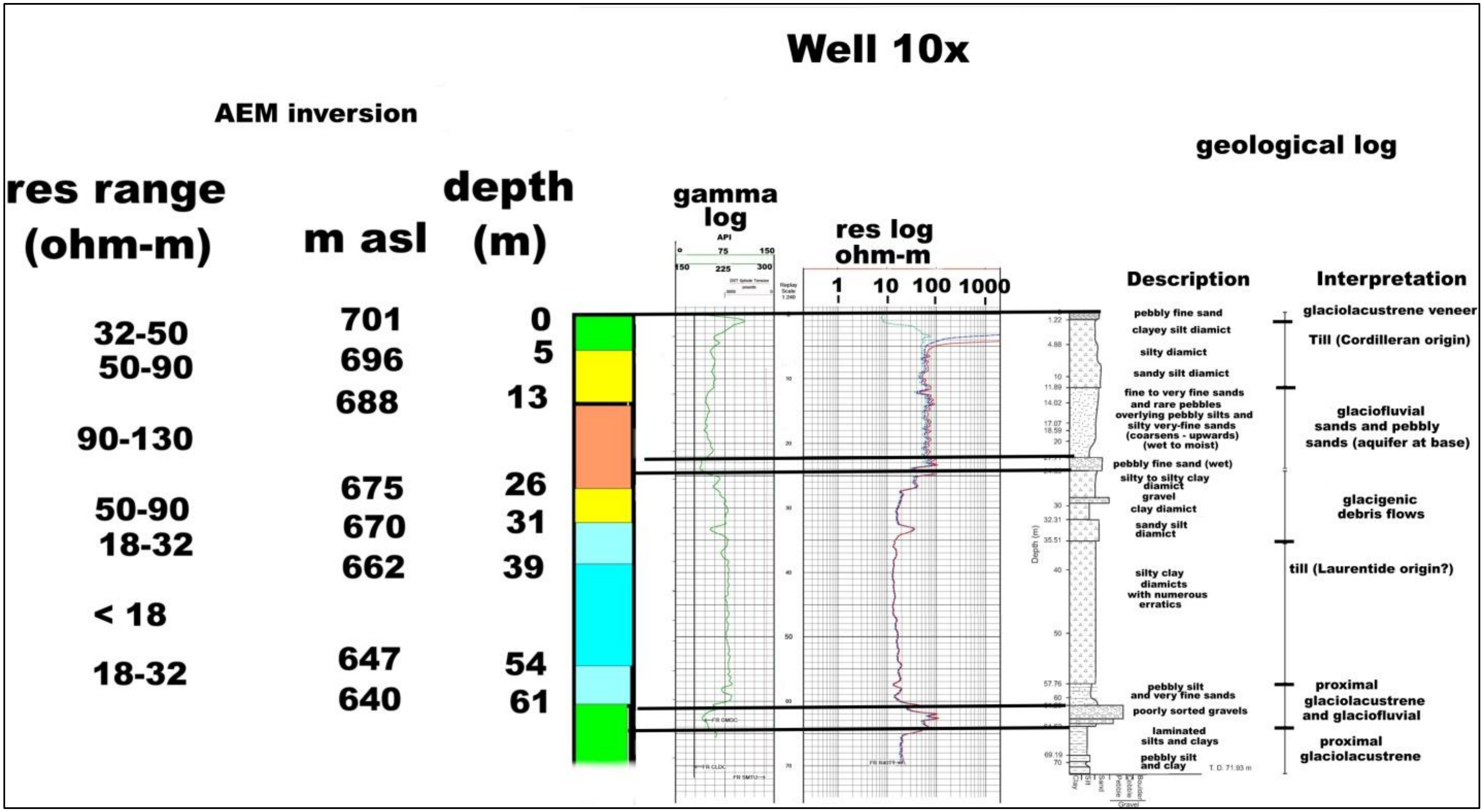

Figure 17. Plot of gamma, resistivity and geological logs on the right side versus resistivity interpretation from the AEM inversions on the left side for well 10x. The depth scales are approximate (within 1 - 2 m of each other).

Well 12

Well 12 (Figure 18) was selected because the location was thought to be within a large paleovalley associated with the Peace River. There are laminated clays and silts in the upper 8 m of the well. The resistivity log has an average resistivity value around 8 ohm-m after removing the effects from the metal protective well cover and is consistent with the geology and the AEM inversion which has a resistivity averaging about 32 ohm-m. For the depth range between 8 and 18 m the resistivity log has an average resistivity value of 20 ohm-m (within pebbly muds and silty clay diamicts) whereas the AEM inversion has a resistivity range between 32 and 50 ohm-m in the upper 5 to 12 m going into 18 ohm-m below 14 m. The resistivity range for the AEM inversion for depths between 18 and 31 m is < 18 to 50 ohm-m within a sequence of interbedded gravelly and sandy silt diamicts and silty fine sands. The resistivity log has an average resistivity value of 40 ohm-m over the upper 9 m of this interval which is consistent with the resistivity range of the AEM inversion. Over the lower 4 m of this interval the resistivity log has a resistivity value around 100 ohm-m where pebbly muds and gravels occur but this unit is too thin to be observed on the AEM inversion which has a resistivity range between 32 and 50 ohm-m. Below 31 m depth to the end of the hole at 54 m the geology log shows laminated clays and silt with fine sand beds and laminae throughout. The resistivity log through this interval shows an average resistivity value between 15 and 30 ohm-m, except for a 40 ohm-m value within a sand layer from 42.5 to 44.5 m depth. This is consistent with the AEM inversion which has a resistivity range between 32 and 50 ohm-m in this interval.

Well 13

Well 13 (Figure 19) is a well that was added after Geoscience BC report 2016-18 was written. The total depth of well 13 is approximately 51 m. The top 8 m of the resistivity log has metal casing problems, particularly for the shallower portion. The AEM inversion resistivity values are between 32 and 50 ohm-m within a unit of silts, clays and very fine sands that grade down into pebbly muds at a depth of about 10 m. Between depths of 10 to 20 m the resistivity log has values between 40 and 100 ohm-m within a diamict sequence with interbeds of pebbly silt and gravel. Within that same depth interval, the resistivity range of the AEM inversion is between 50 and 150 ohm-m. The zone from 13 to 30 m, depth on the AEM inversion has resistivity values between 95 and 150 ohm-m while the resistivity log has values between 40 and 60 ohm-m from depths between 13 to 20 m and 200 to 300 ohm-m between 20 to 30 m depth. Notably, a unit of pebble to cobble gravels at about 21 to 29 m depth, shows a pronounced increase in resistivity on the resistivity log and a less obvious decline in gamma counts. Under the gravels, at 30 m depth, a thin silt and clay bed correlates well with a spike in the gamma count and a sharp drop in resistivity. Below 30 m to the base of the hole at 51 m, the AEM inversion has a resistivity range between 50 and 95 ohm-m. On the resistivity log values vary between 100 to 200 ohm-m at depths between 30 and 40 m within a sequence of interbedded mud, gravelly mud and gravel, Resistivity values then slowly drop to 30 and 40 ohm-m within a gravelly diamict, pebbly mud and pebbly sand sequence that extends to the end of the hole at 51 m.

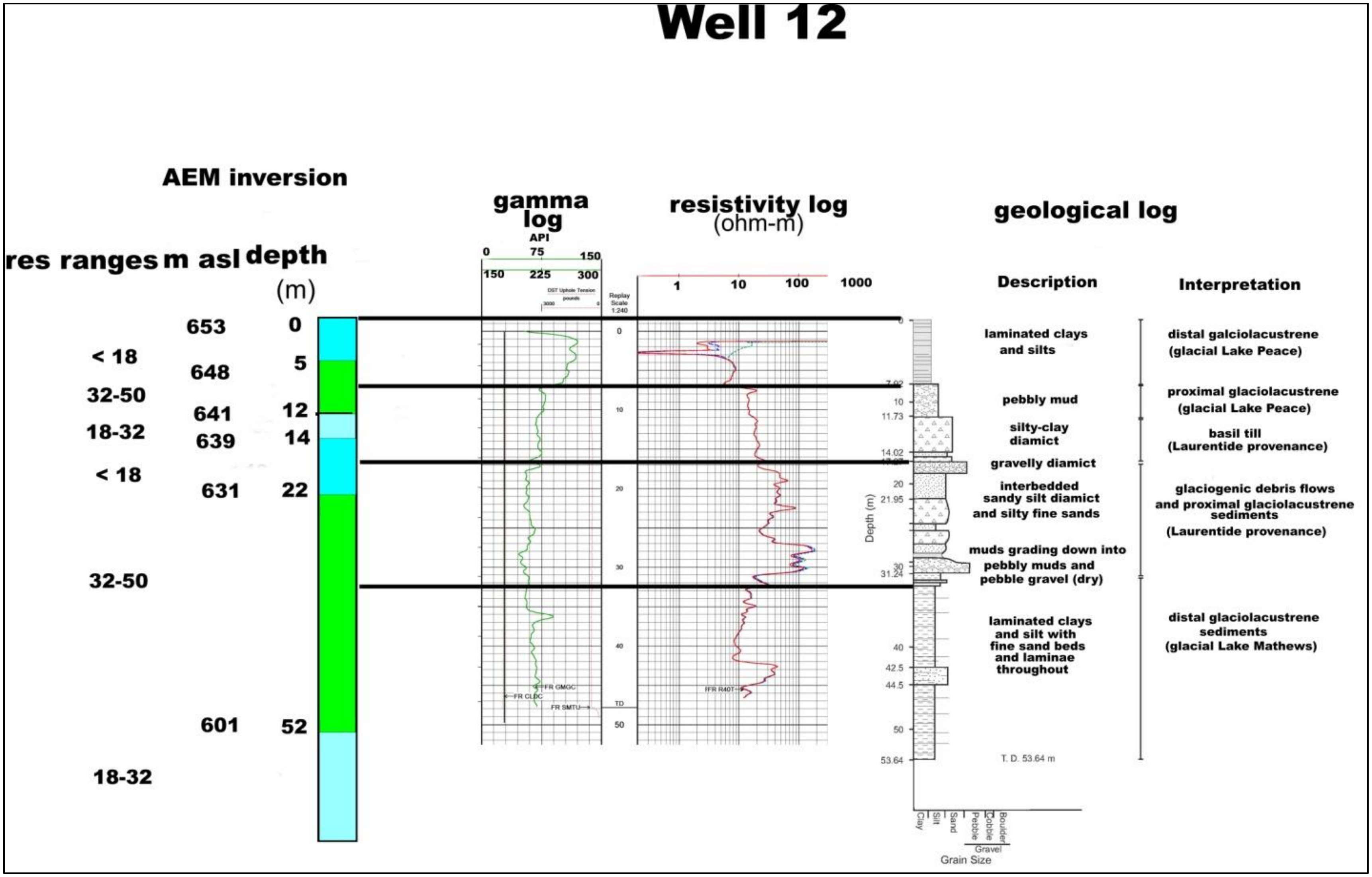

Figure 18. Plot of gamma, resistivity and geological logs on the right side versus resistivity interpretation from the AEM inversions on the left side for well 12. The depth scales are approximate (within 1 - 2 m of each other).

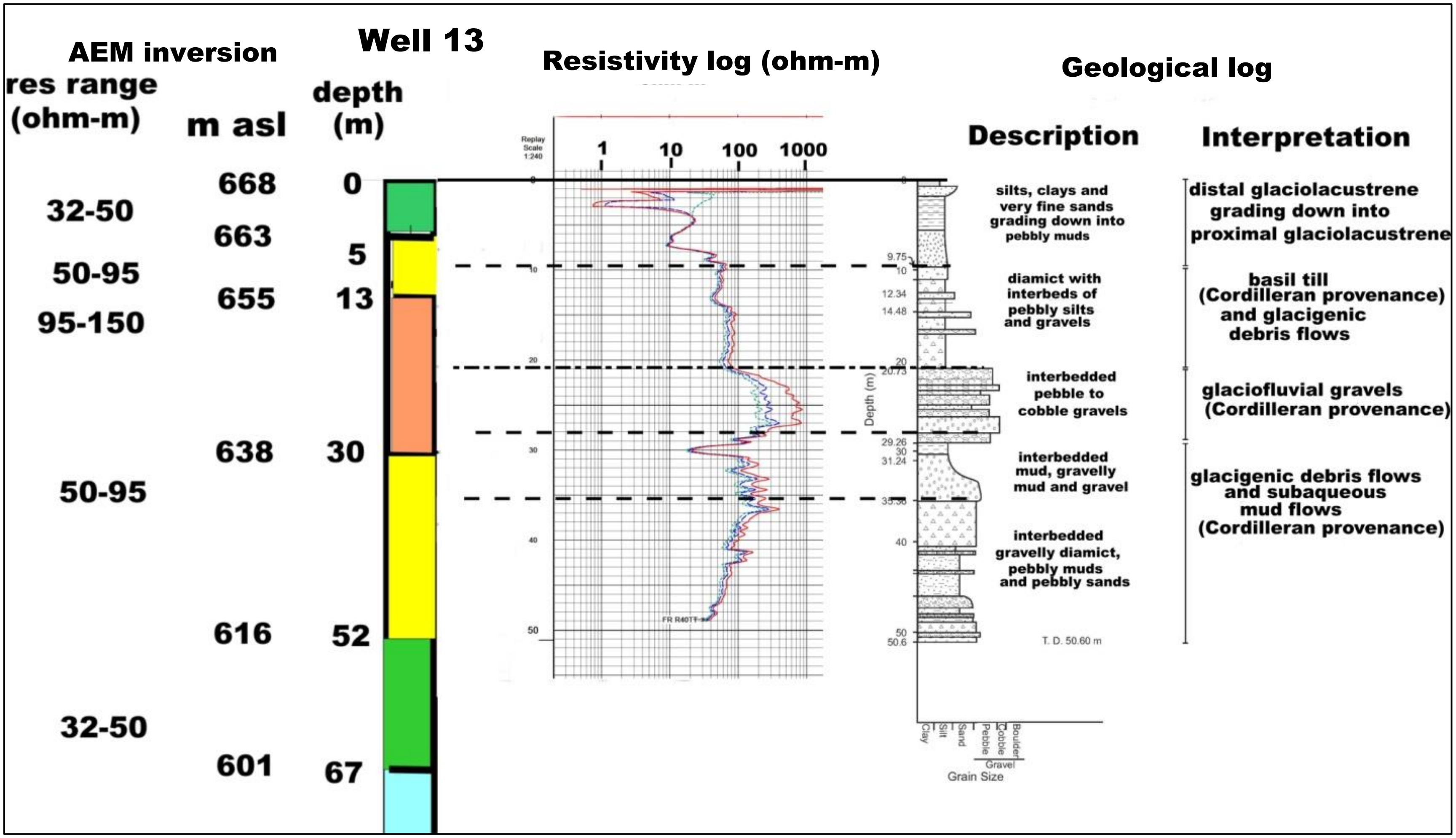

Figure 19. Plot of resistivity and geological logs on the right side versus resistivity interpretation from the AEM inversions on the left side for well 13. The depth scales are approximate (within 1 - 2 m of each other).

Well 3

Petrophysical logs were not obtained for well 3 because it was in the far northern section of the survey area and the distance between it and the other wells was considerable. We can therefore only compare the Aarhus AEM inversion with the geological log. The location of the original and actual locations for well 3 are given in Figure 20. Figure 21 provides the location of well 3 on Line 104503. The well location was selected to test the geological hypothesis that the Sikanni Chief River previously flowed southeastward through a saddle into the Beatton drainage, rather than to the northeast as it does today. Several gas wells have been drilled in this region and gamma logs from these wells suggest the presence of a potentially deep (>40 m) Quaternary paleochannel there.

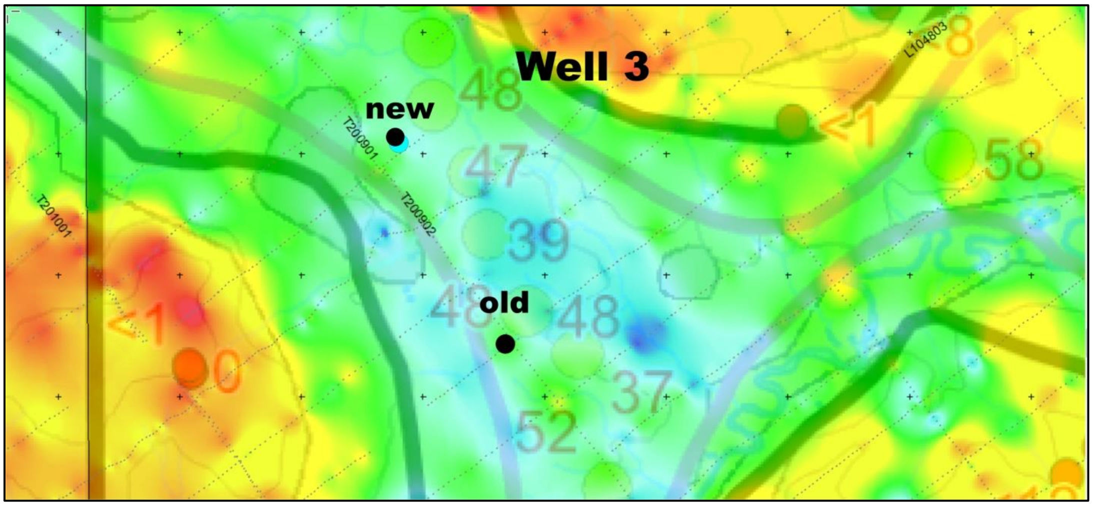

Figure 20. Planned (old) and actual (new)locations of well 3 plotted on the 15-20 m resistivity depth slice. The new location for well 3 lies directly on line 104503.

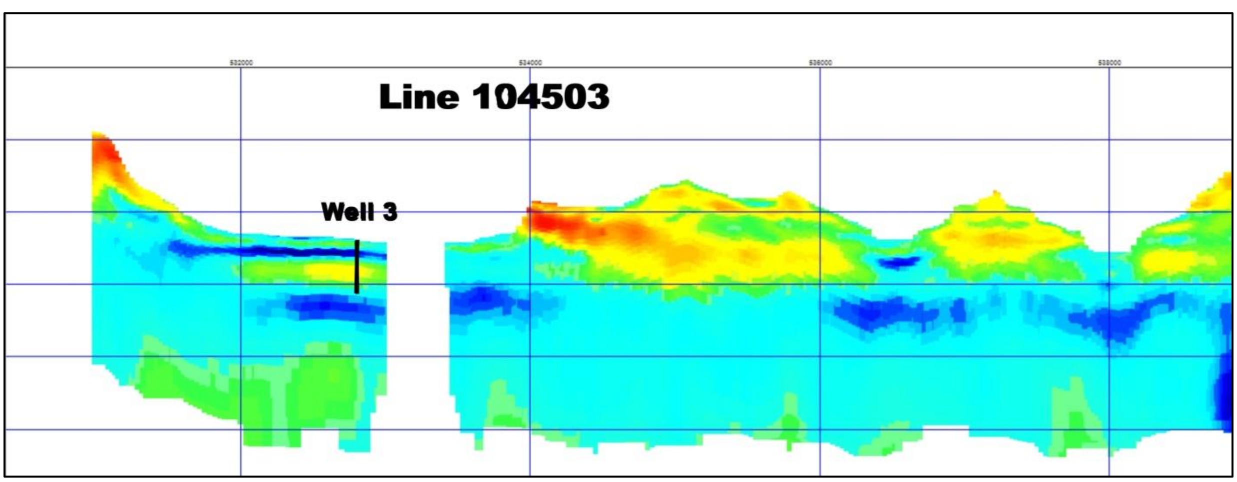

Figure 21. Plot of the Aarhus AEM inversion on Line 104503. The approximate location of well 3 is identified.

The new location for well 3 is north of the original location by approximately 1800 m. However, it appears to be within the same resistivity unit (light blue - 18-32 ohm-m and green - 37-50 ohm-m), at least on the 15 to 20 m resistivity depth slice.

Figure 22 is a plot of the Aarhus AEM inversion compared with the geological log. The upper 9 m of the well is a mixture of clay and silt laminae and corresponds with a resistivity value obtained from the AEM inversion between 37 and 50 ohm-m. Between 9 and 14 m depth the resistivity from the inversion is between18 and 32 ohm-m, between 14 and 25 m depth the resistivity is less than 18 ohm-m and from 25 to 29 the resistivity is between 18 and 32 ohm-m. The geological log over this same interval consists of silt and clay from 9 to 19 m depth and bedded clay from 17 to 19 m depth. From 19 to 23 m depth, it consists of laminated silt, clay and fine sand, and from 23 to 28 m it consists of bedded silt, clay and stony mud. The resistivity values are consistent with the mixed silt and clay within this depth range. From a depth of 28 m to the bottom of the well at 32.3 m, the geological log consists of massive sandy diamict which is consistent with resistivity values between 37 and 50 ohm-m. The AEM inversion has a resistive zone between 50 and 95 ohm-m starting just below the bottom of the well. Unfortunately, drilling was stopped due to technical issues so we are not sure the source of this resistivity value although water-bearing gravels were encountered below till in a nearby geotechnical well (P. Monahan, Personal Comm., 2017).

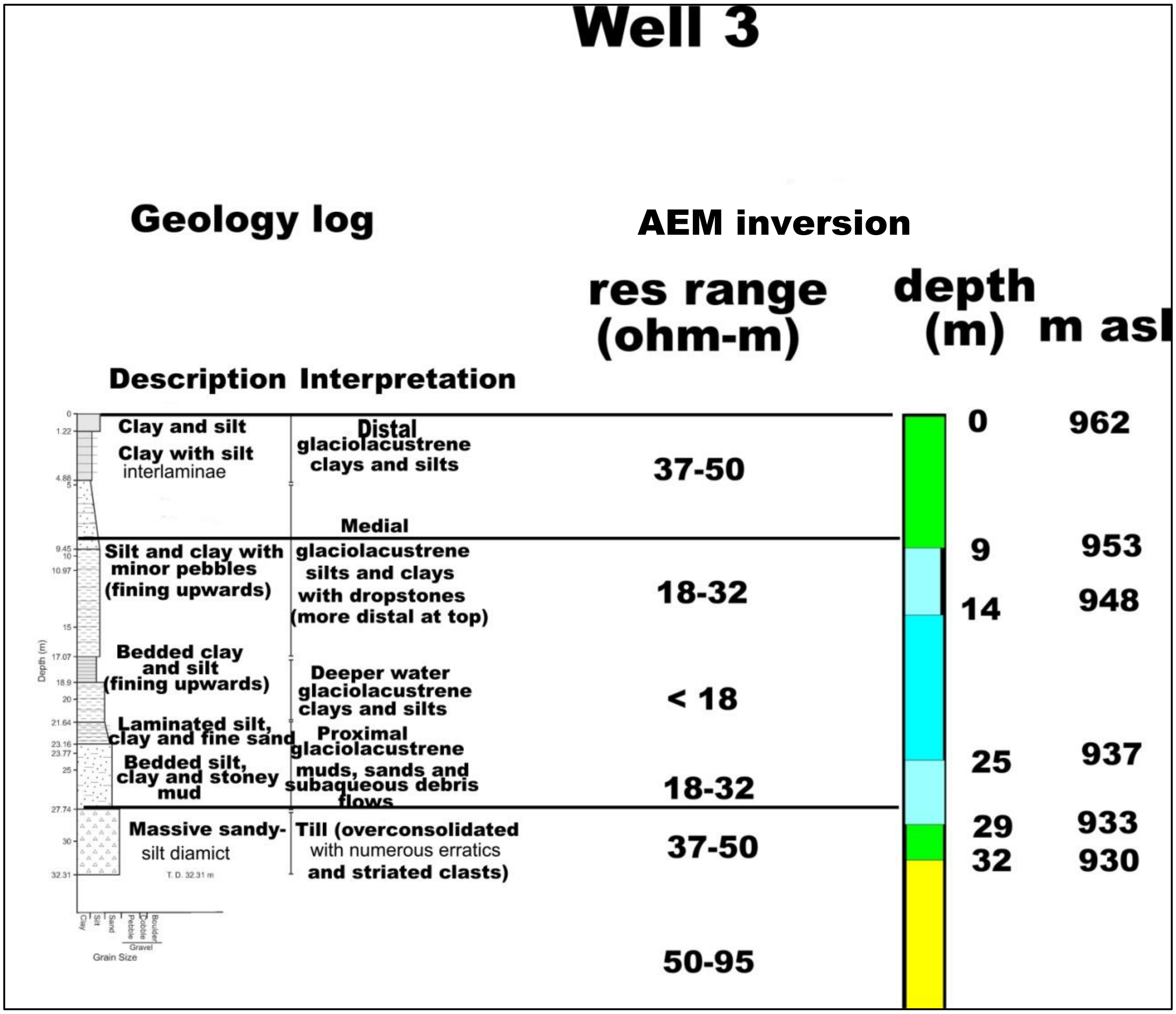

Figure 22. Plot of the geological log on the left side versus resistivity interpretation from the AEM inversions on the right side for well 3. The depth scales are approximate (within 1 - 2 m of each other).

Conclusions

Airborne EM systems average over a significantly larger volume of material than the resistivity log which only averages a few metres around the well bore. In addition, the resolution of AEM diminishes with depth due to averaging over larger volumes as the depth increases. Typical resolutions are a few m near the surface and around 10 m at depths of 60 to 70 m. Furthermore, the AEM system requires a resistivity contrast of approximately 2.5:1 in order to resolve contacts, assuming the formations have appropriate thicknesses to be seen. The inversion process has resolution limits as well. The inversion process used by Aarhus Geophysics assumes the earth is at most two dimensional. However, if three dimensional features are present then the inversion will produce incorrect results. The resistivity log has a constant resolution of a few 10's of cm, independent of the depth. One disadvantage of a resistivity log is that the metal protective well cover near the well surface decreases the resistivity (i.e. increases the conductivity) so the resistivity log can be incorrect in the very shallow sub-surface (upper few m).

Keeping the above limitations in mind, resistivity versus depth for the AEM inversions and the resistivity logs are in reasonable agreement. The geology logs are significantly more detailed than the AEM inversions as expected due to averaging. However, the resistivity values on the AEM inversions tend to match the overall geological properties quite well. At well 6a the bedrock contact isn't apparent on the AEM inversion because there was no resistivity contrast between the gravels in the overburden and the underlying sandstone bedrock. This is a situation that cannot be resolved by an airborne EM system. However, the resistivity log did show a subtle change in the resistivity value just above the sandstone due to the pebbly mud bed present there.

Comparing the predicted bedrock depth (Best and Levson, 2016) with the final geological logs for wells 7, 10b and 12 we observe the predicted depths are shallower than what was observed from the logs. Wells 7 and 10b didn't reach bedrock even though the total depths were deeper than the predicted depth. The depth to bedrock at well 7 was based on interpretation of a single gamma log 0.5 km distant from the site. No gas or water well logs were available for area 10b so the depth to bedrock there was estimated only from the AEM inversion data. Likewise, the predicted geology for well 12 was based on data points 1 to 2 km distant and estimated depths to bedrock were uncertain. In contrast our bedrock depth prediction for well 6a was deeper than the observed bedrock contact at 7 m, again because the interpreted gamma log was several kilometres from the drill site. This points out the complex geology in the AEM survey area. The depths obtained from the gamma study are quite variable, even when they are relatively close to each other which is another indication of the complex nature of the geological environment.

In summary, the AEM system provides a good regional evaluation of resistivity and correlates reasonably well with the resistivity logs. The resistivity logs generally provide a better correlation with the geologic logs because of higher resolution and, of course, because they are collected in the exact same location. In fact, resistivity logs are useful for correcting depth estimates on geologic logs because sonic core is recovered in 10 or 20 feet (3-6 m) long intervals.

References:

Best, M.E. and Levson, V.M., 2016: Peace Area Project - Well Selection for Testing Geological Model Based on Gamma and Airborne Electromagnetic (AEM) Studies; Final Report by Bemex Consulting International and Quaternary Geosciences Inc.; Geoscience BC Report 2016-18, 42 pages.

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