Delta Deposit, Raglan Belt, Québec

VTEM

Geotech's VTEM data over the Delta Deposit in the Raglan Belt demonstrates the advantages of using a low base frequency and calculated B-Field in the search for massive nickel sulphides and other excellent conductors…

GEOTECH
AIRBORNE GEOPHYSICAL SURVEYS

Canada	geotech.ca	info@geotech.ca
International	geotechairborne.com	info@geotechairborne.com

Australia	+61 8.9249.8814	Canada	+1 905.841.5004
Barbados	+1 246.421.8129	Ghana	+233 21.286.170
Brazil	+55 21.2426.1354	South Africa	+27 11.312.2770

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A comparison of VTEM and AeroTEM data at the Delta Deposit, Raglan Belt, Québec

Geotech's VTEM data over the Delta Deposit in the Raglan Belt demonstrates the advantages of using a low base frequency and calculated B-Field in the search for massive nickel sulphides and other excellent conductors.

The Delta Deposit is located in the Raglan Belt in Northern Québec where Xstrata Nickel has operating mines and where Canadian Royalties is planning to put their Nunavik Nickel Project into production.

The Delta Deposit consists of three bodies named D8 south, D8 north and D9 Zones. The three sulphide zones total 817,000 tonnes at 3.05% Ni, 1.2% Cu, 222 ppb Au, 1007 ppb Pt and 1647 ppb Pd. An additional 205,200 tonnes of low grade – less than 1% Ni and low PGE – is also indicated as disclosed in assessment reports by Falconbridge (GM48413).

The D8 south zone is mostly disseminated with higher grade net-textured and semi-massive to massive sulphides rarely exceeding 10 feet horizontal distance. The D8 north and D9 zones consist of massive and semi-massive sulphides, some 600 metres (2000 feet) apart. The sulphides occur along a steeply dipping contact zone. Numerous faults, breccia and low grade sulphides are found throughout the contact zone. The D8 north zone dips steeply and plunges eastward at -40° to about 200 metres beneath the surface. The thickness decreases outward and down plunge into disseminated sulphides. The D9 zone is narrower than the D8 south zone and its plunge is near vertical.

Geotech overflew the Xstrata claims as part of a much larger survey in 2007 and retained the rights to the data. Previous exploration companies also overflew the same area in 2003 with the AeroTEM system and that data was released in assessment files (GM60799). This provided the opportunity to compare the systems over the same deposit. The VTEM flight lines were 50 metres apart as compared to AeroTEM's at 100 metre separation. Every other one of the VTEM lines were directly over the AeroTEM lines.

In quantitative analysis of time-domain EM systems and their conductivity aperture, it is the resolvable time constant that is of importance. The time constant is the length of time that it takes for induced currents to decay to 1/e of their initial value. The better the conductor in terms of size and conductance, the higher the time constant. Nickel sulphides and the associated sulphides of pyrrhotite are the most conductive sulphide minerals. Some of the nickel sulphides in Sudbury have time constants which are estimated to be in the 1000s of milliseconds and greater. Measuring long time constants requires lower base frequencies to allow time for the induced current to decay sufficiently to be measured. It also helps to have a low-noise system so that a smaller change in the decay can be measured. VTEM has arguably the industry's best signal-to-noise ratio, and it operates at the lowest available frequency of airborne systems at 30 Hz.

Figure 1 shows the image of a mid time (0.484 ms) VTEM B-Field channel. Figure 2 shows the AeroTEM II Zon15 (Z component, channel 15 on-time) data from the claims which hold the Delta Deposits.

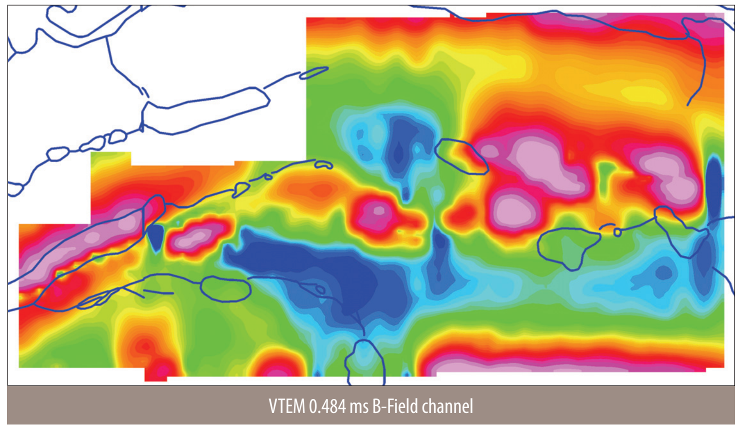

Figure 1 | *VTEM's 0.484 ms B-Field channel with every other line removed for comparison with the AeroTEM data below.*

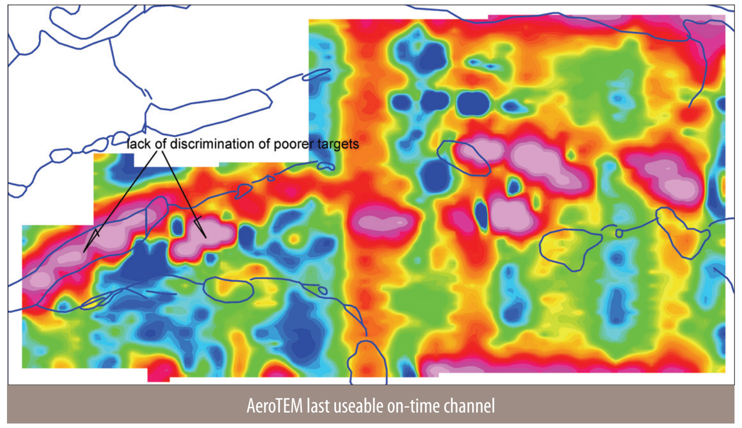

Figure 2 | *AeroTEM's Zon15 on-time channel.*

We immediately see that VTEM data is better leveled as evidenced by the lack of stripping in the grid caused by level shifts in the base-line values of the EM data.

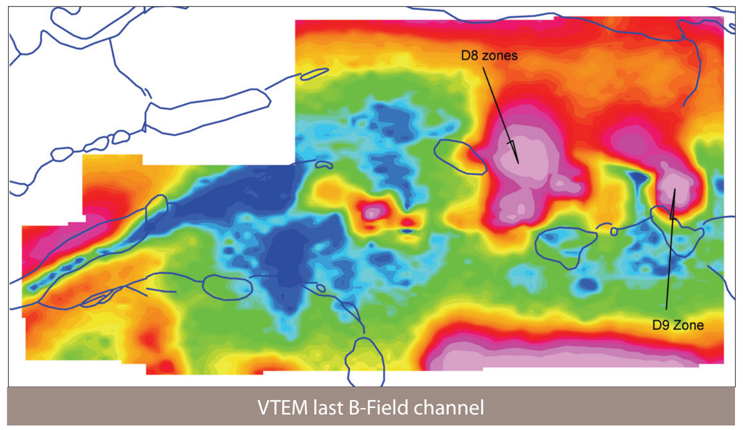

Figure 3 | *VTEM B-Field channel at 6.578 ms using all the survey lines.*

Figure 3 shows VTEM's last B-Field channel using every line. The Delta deposits are clearly seen in all three datasets. However, due to VTEM's higher conductivity aperture, it can discriminate between the high conductance responses of the nickel sulphides and the other conductors in the survey area. The AeroTEM data has similar looking responses over the long lake to the west and other similar looking targets in the survey area. This is due to AeroTEM's much smaller conductivity aperture which causes it to "see" the moderate conductors the same as good conductors. VTEM's early time 0.484 ms VTEM B-Field data sees these weaker responses as well, but they are not what the explorationist was targeting here. Thus the targeting of high conductance responses is vastly superior for the VTEM system.

Another example of VTEM's conductance discrimination is seen in a detailed examination of the D8 zone. Figure 4 shows 444 Hz MaxMin II data over the zone. The amplitudes, and the inphase to quadrature ratio, clearly show that the conductor is weaker near the lake and that the better target is about 6 lines to the east where the D8 zone is located.

Figure 4 | *444 Hz MaxMin survey over the D8 zone (data from assessment file: GM34807).*

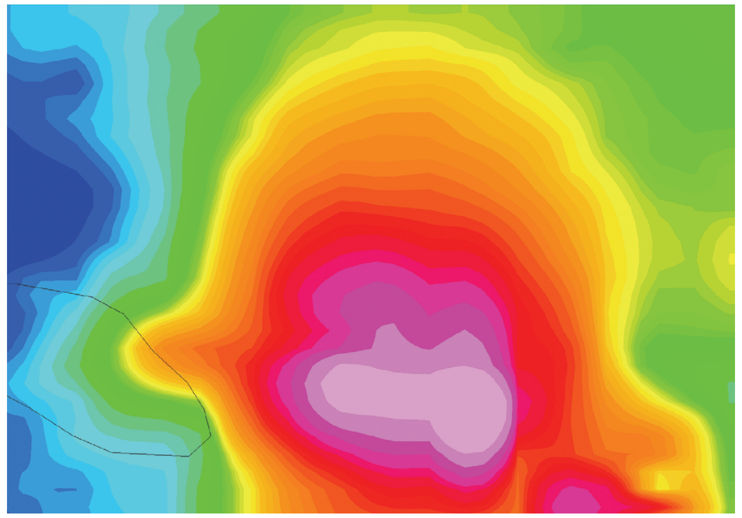

Figure 5 | *VTEM B-Field channel at 6.578 ms over the same area as Figure 4. Note the better late-time response some 200 metres east of the lake corresponding to the D8 Zone.*

The VTEM data of the same coverage and scale is shown in Figure 5. The VTEM data is able to show that the higher conductance related to the D8 Zone is some 200 metres to the east of the small lake, as opposed to being on the shore of the lake. This was not resolved by the AeroTEM II data.

In a more quantitative study, we can look at the decay curves and the time constants over the D8 Deposit. The flatter the curve, the longer the time constant.

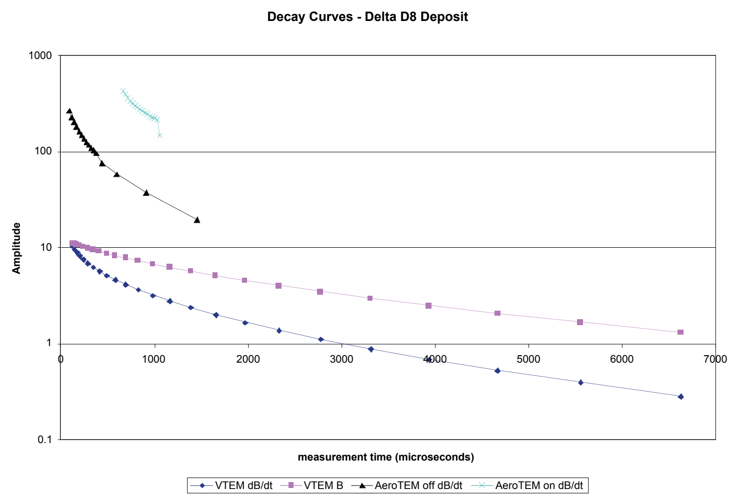

Figure 6 | *Plots of the amplitudes versus response times over the D8 deposit. AeroTEM off-times have been shifted to start at the end of the off-ramp as per normal convention.*

Examination of the plots shows how much longer VTEM measures the decay of the signal. It shows that, until AeroTEM runs out of time windows, its off-time behaves much the same as VTEM. Note particularly that the curve flattens as time increases, showing that the early time was only seeing weaker conductivity as opposed to the main sulphide body. The measured time constant of the AeroTEM off-time is 1.8 milliseconds compared to the 7.7 milliseconds for VTEM's off-time.

As is demonstrated in Figure 6, one can see that AeroTEM II's on-time's ability to detect excellent conductors does not match that of VTEM. Their triangular waveform and short pulse introduces difficulties in detecting excellent conductors as the response from the turn-on portion of the pulse cancels out a portion of the response from the turn-off portion of the pulse where their on-times are located. As the entire pulse is only 1.1 milliseconds long, this cancellation effect is seen even for moderately good conductors. The better the conductor, the greater the cancellation effect for the AeroTEM waveform. The time constant from the on-time is 1.9 milliseconds, as opposed to the B-Field time constant of 11.5 milliseconds.

As an aside, VTEM B-Field has been able to detect and resolve targets of up to 32 milliseconds in the Fox River Sill area.

Conclusion

VTEM's longer transmitted pulse, lower noise and higher power is better suited to airborne EM exploration. In particular, the higher conductivity aperture allows for better discrimination of the excellent conductive targets from the unwanted lake bottom/overburden or weakly mineralized areas. The VTEM data, both off-time and B-field, were able to resolve higher conductance targets than the on-time of AeroTEM II. ■