DHEM
Queensland, 2009

Background:

In August of 2008 and July 2009, Outer-Rime Exploration Services (ORE) carried out downhole EM (DHEM) surveys with the Crone Pulse EM equipment. This equipment is essentially the same as that used in the 2010 ground survey except that 2 probes were used to read the response of the ground to the source from a transmitting loop. These two probes consist of the axial probe which measures the variation in the magnetic field with time orientated along the axis of the drillhole as the probe is lowered. The second probe measures two components of the time varying magnetic field perpendicular to the axis of the drillhole. As this probe naturally rotates about the axis of the borhole, the data is later rotated so that one component (Y) is such that its projection onto the horizontal is azimuthal to the borehole while the other component (X) is perpendicular to the borehole and horizontal (w.r.t. gravity). This probe carries deviation sensors in order to perform this de-rotation.

Both surveys suffer from design flaws which severely impact the data. The first and most significant factor is that the transmitting loops were positioned such that interference from fences is likely a significant factor in the data. Some aspects of these interference have been identified in our analyses and will be mentioned later in this report. The second most important factor is that the basefrequency (the fundamental harmonic) of the surveys was far too low (5Hz) expect possibly in the case of CT5001 (12.5Hz). From our discussions with ORE apparently this was because 5Hz was their common operation frequency as they normally survey in areas with strong conducting cover. However, here due to the high resistivity of the granites and only a very thin conductive cover, a high basefrequency is desired particularly as excitation of the lode zones is desired and these zones have a relatively weak conductance.

In 2008, 3 holes were surveyed at the eastern edge of Warrior East from one Tx loop and 1 hole in the centre of the Warrior structure. In 2009, 3 holes were surveyed in the central portion of the Warrior structure from 2 different loops. In this report, we will concentrate on the data from the central portion of the Warrior structure as we have more information from the resistivity structure in this area due to the higher concentration of survey points in the 2010 ground survey through the central area than to the east.

DHEM

Warrior Central DHEM:

Holes CT5003 and CT743 were surveyed from the western loop as indicated in black below. Hole CT5003 has the approximate dip of the lode structure while CT743 has a dip and azimuth approximately normal to the structure. The transmitting loop suffers from running close to a fence and a powerline along its west edge. It is also too close to a fence on the SW corner and also crosses a fence twice as well as running too close to a fence on the NE corner (this fence is not shown). The powerline has a problem in that it may inject a signal into the transmitter while the fences have a problem in that the pickup the signal of the transmitter and re-radiate this signal to interfere with signal from the transmitter and the ground.

Hole CT5001 collected in 2009 was drilled from Pad 3 and follows approximately the dip of the structures. A second loop more east of the first loop was used as shown in Fig. This data possibly suffers even more from interference as the loop follows 2 fences, a powerline and crosses several other fences.

CT4002 was surveyed in 2008 with a loop centered about Pad J with the hole orientated to intersect the southern portion of Sons of Freedom. However, this loop also suffers from being too closely placed next to 2 fences.

DHEM

2009 DHEM:

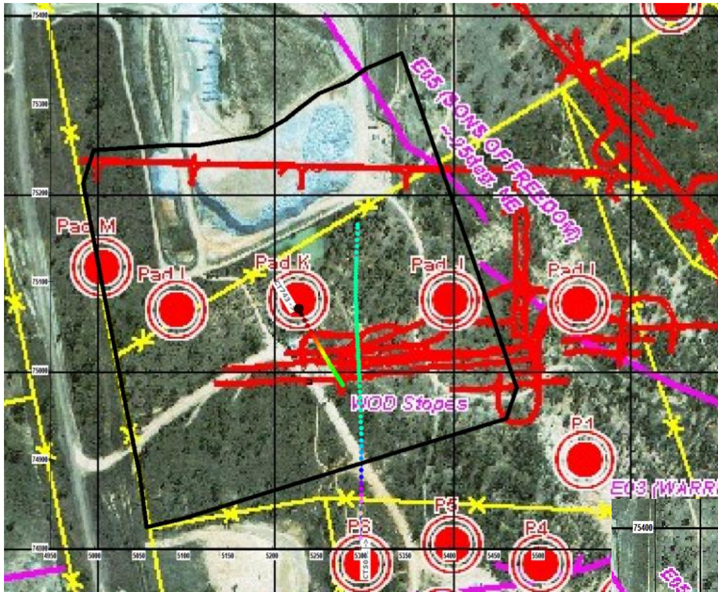
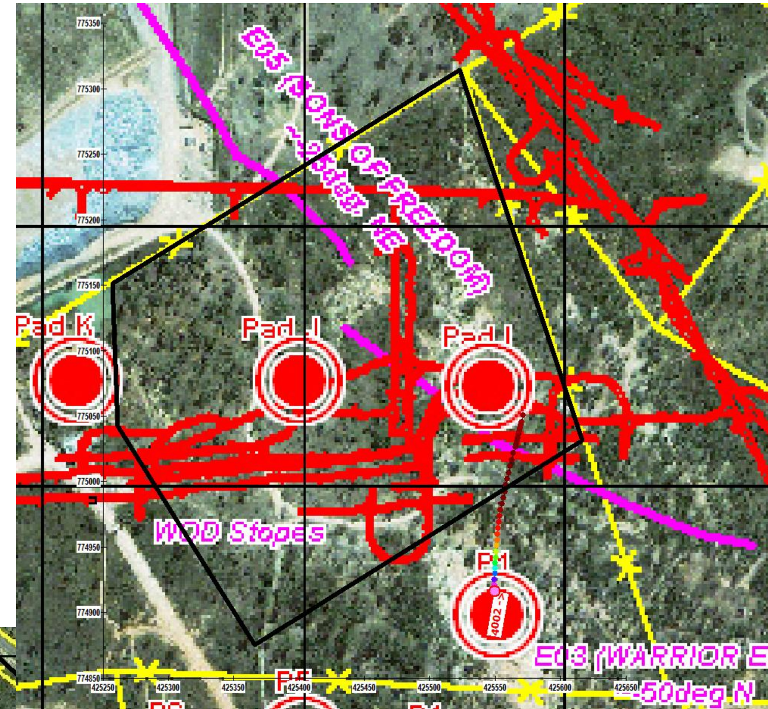


Fig DHEM1
CT 743 and CT 5003

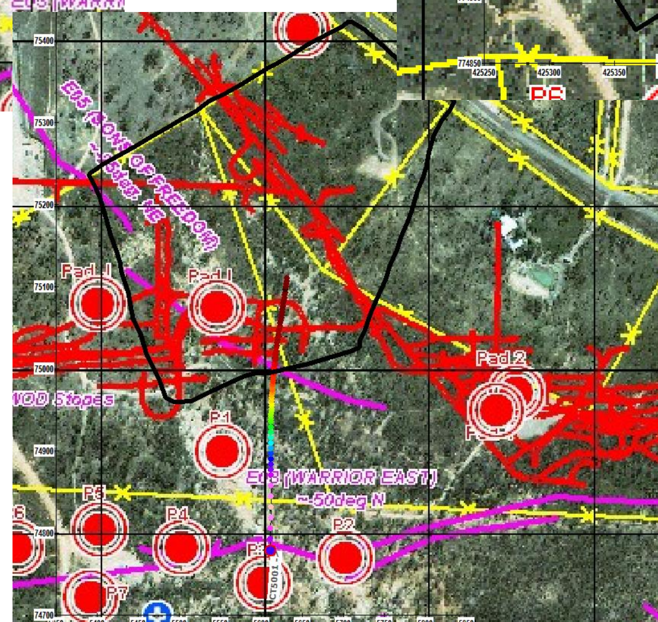
2008 DHEM:

Fig DHEM3
CT 4002



2009 DHEM:

Fig DHEM2
CT 5001



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Data Quality and Interference Issues:

The Crone Pulse EM system takes a series of measurements of the magnetic field at a sequence of timse at each location of the sensor(s). The first of these measurements is while the current in the TX is on and represents primarily the geometry of the loop and the location of sensor. This assists in verifying that the loop and sensor are correctly located in 3-space and also verifies the current strength as well as other finer issue. The remaining measurements are taken while the current is off and thus represents the response to currents which are induced by the current turn-off in the earth. For example, if the ground was entirely the granitic structures then the signal during this offtime would be essentially zero. Thus, this equipment is particularly adaptive to resolving weak or strong conductive structures in highly resistive ground as in the granitic environment is survey area. Any significant magnetic field response in the off-time is thus due to the low resistivity cover, the lode zone and or pyrite lens.

As an example, I first show a typical series of measurements taken during the recent ground survey (Fig DHEM4). This figure shows the measurements in a log scale versus the time after turn-off in millisec (msec). On can see clearly that the response falls off in amplitude with time until the last 3 channels which are erratic (noisy). In this case all but the last 3 time measurements (channels) can be utilized for interpretation. For comparison, I show a similar display of the data for a measurement from 2009 in hole CT743 at a depth of 67.5m along the hole. This data becomes erratic after only about 10 times measurements after the current turn-off which is at negative time. The amplitude of the response at this time is still above 100 nTesla/sec which is a very high noise level implying significant interference and noise. The data is somewhat noisier at shallower and deeper depths implying only 8-10 time measurements can be used at best. This result is typical for all the 2008 and 2009 DHEM data.

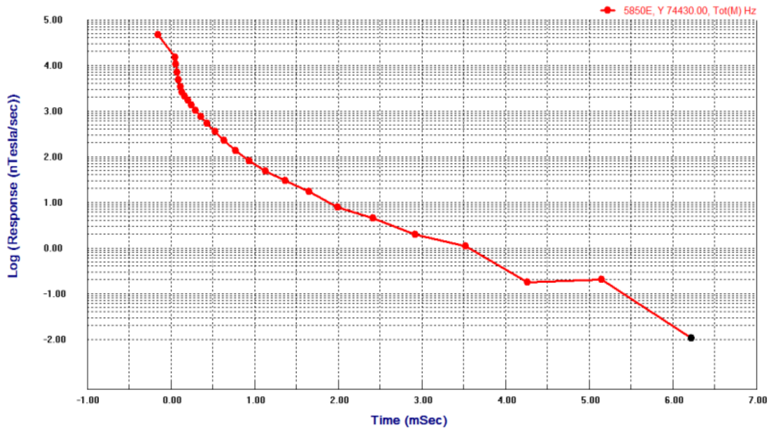

Fig DHEM4
Line 5850E, Station74430N

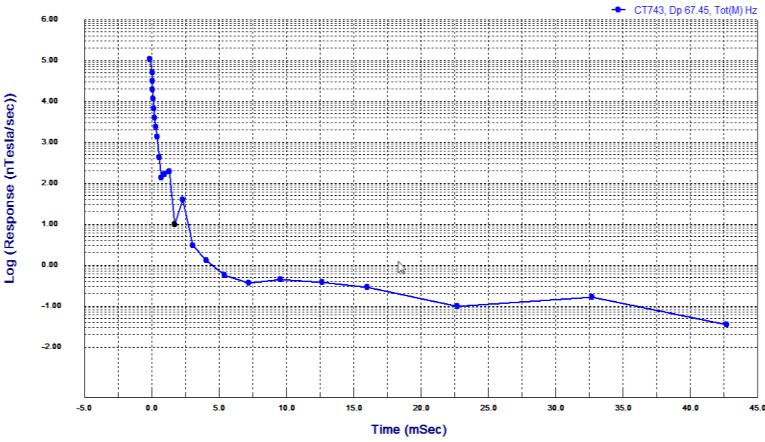

Fig DHEM5
CT743, Depth 67.5

DHEM

Data Quality and Interference Issues:

Figure DHEM6 shows the ontime measurement wrt to a simulation to the background model as determined by the ground TEM data (2010). The ontime data (Figure DHEM6) reflects that the primary field as determined by the TX and the geometry of the hole and the loop is correct. However, Figure DHEM7 shows that the modeled background (thin low-resistive cover over granite) is far too weak. In order to have such a large response then the cover would have to be much more conducting. However, even this provides the wrong shape of the response with depth. Models of the lode zone also have a different shape and are not strong enough thus implying either interference effects from the fences or the effect of another surficial strong conductor (e.g. the tailings) as possibilities. However, all of the DHEM data from both 2008 and 2009 show this aspect infering that most likely the effect is due to interference from fences. However, we will proceed with other aspects as one important aspect must be evaluated.

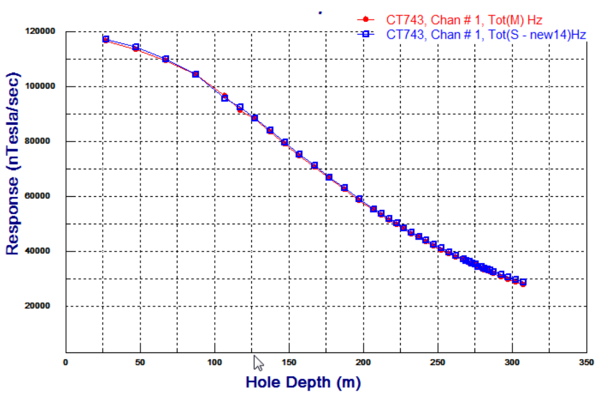

Fig DHEM6
CT743, Ontime

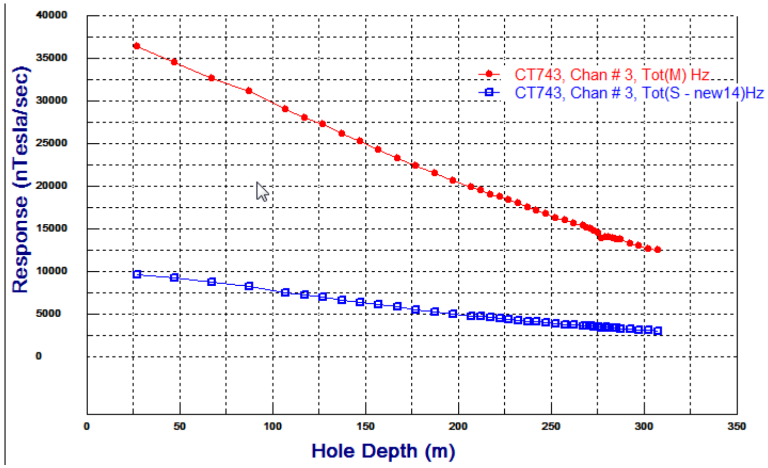

Fig DHEM7
CT743, 2^{nd} off time measurement

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Structural Modeling:
Initially, we will examine the data for CT5003 (2009) and examine it in relationship to the models determined from the surface TEM data. Figure DHEM8 Shows the response of the 3-measurmed components (Hz-axial in red, Hy-azimuthal in green and Hx-horizontal in orange) during the on-time channel compared to the modeled response for background resistivity as determined from the ground TEM. (e.g thin low-resistivity cover over very high resistivity granites). The axial component agrees very well between measured and modeled (simulated) whereas the other two components show a slight stronger simulated response over the measured data particularly at depths above 300m or so. It should be noted that Hz and Hy are of comparable strength with Hx of significant strength but about 1/3 as weak as the other two components. Hz simulated in blue, Hy simulated in brown with squares, Hx simulated in purple with circles.

Figure DHEM9 indicates the data as a function of depth for the first measurement after turn-off. Two very significant aspects of the data arise. First, we note that for the simulated data that the relative strengths of the 3 components remains somewhat the same as during the on-time (DHEM8). However, in the data, Hy becomes the largest response and Hx is now comparable to Hz. Secondly, Hz simulated still roughly matches the data particularly nearer the surface. These factors tell us that there is a significant structure affecting primarily Hx and Hy. Secondly, the long tail of Hy indicates that the structure is relatively deep and the strong variation in background simulated response to actual data in Hy indicates that it comes quite close to surface. Given the geometry of the hole and the placement of the loop, the strong effect on Hy is consistent with a northward dipping structure. Thus, to this extent we see that the DHEM data may be useful.

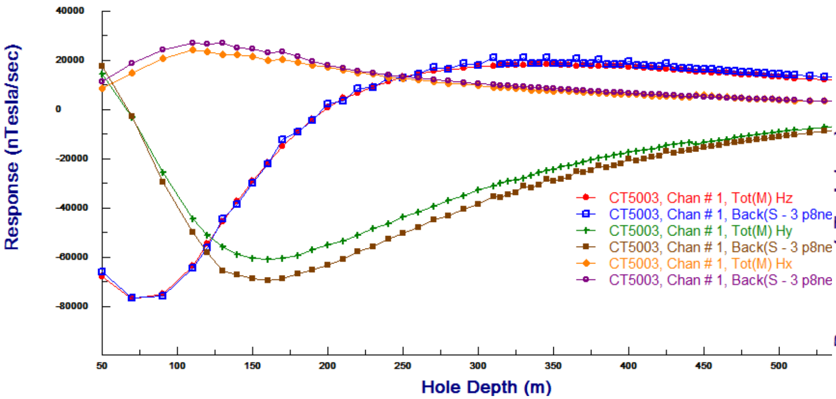

Fig DHEM8
CT5003 Ontime vs hole depth

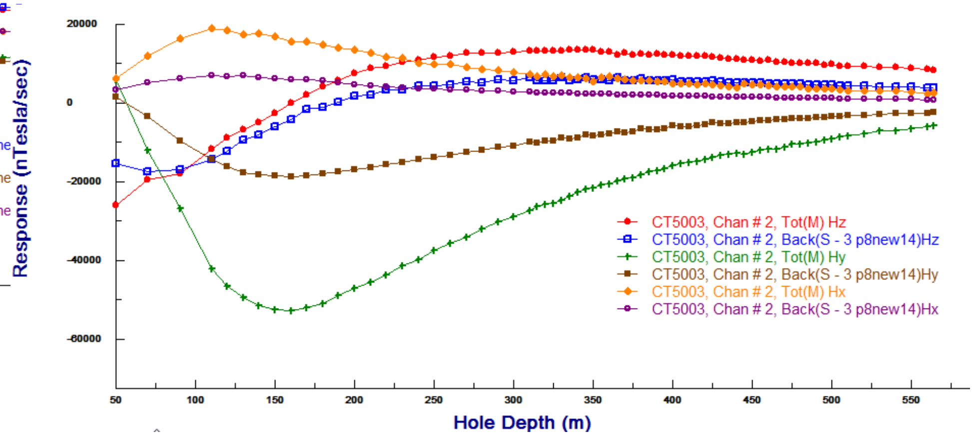

Fig DHEM9
CT5003, First off time measurement

DHEM

Structural Modeling:
Initially, as Hy is the major component we began with this component. While the 2 structure model from the ground data, ie. E03 and E04 represented the data reasonably well, the Hy component indicated that the alteration zone was either more conducting or thicker at shallow depths. Also, apparently alteration structures are deeper than was determined from the ground data.

Fig DHEM10 The transmitter loop is shown in yellow, Hole CT5003 in green. And the main E03 and E04 structures in blue. The thickening and more conductive top part of E03 is shown in red. Figure DHEM11, shows the actual Hy data in red and the modeled data in green . The particular shape of the data response about 150m depth requires a more conductive top section of the zones. The long tail of the data requires a deeper extent to the structures than from the ground model. Here E04 has a 400m depth extent and E03 a 500m depth extent. There are details of the data which are not yet fully represented in the mode. For example the details of the shape at a depth of 225m and the response at the end of the hole. The data however appears to imply that the structure flattens at depth. The model somewhat represents the Hx component but not well. This may be due to de-rotation effects when the data is rotated to standard orientations as it spins when being set down the hole. Hz (the axial component) does not fit at all. The response looks much like a simple 1D response which could be caused with it being strongly affected by the wire fences.

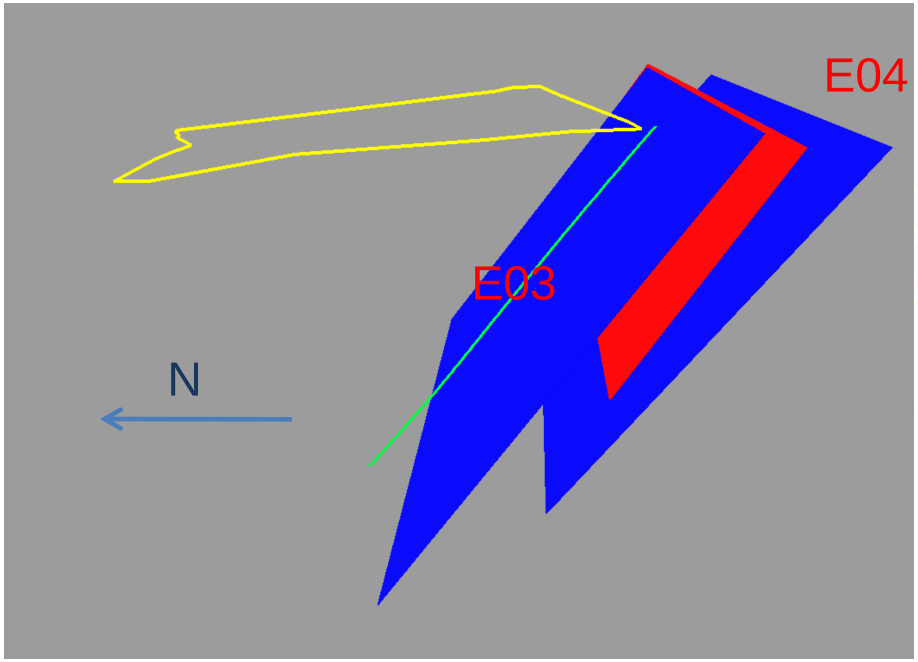

Fig DHEM10
E03 and E04

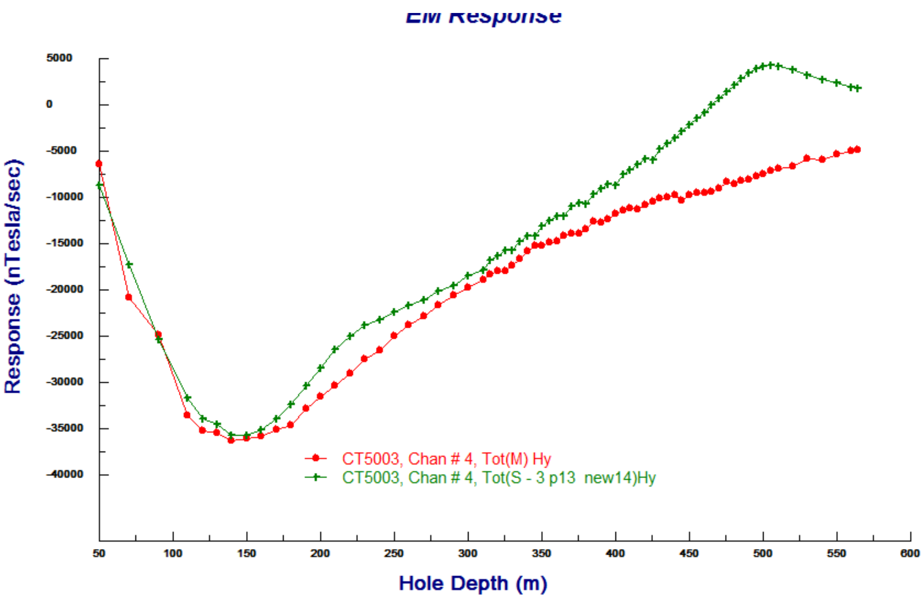

Fig DHEM11 –CT5003
Comparison of data to Model

DHEM

Structural Modeling:
We will next examine hole CT743 which was surveyed from the same loop as CT5003. Figure DHEM11 shows the response of the data in this hole against the previous model of E03 plus E04. While the on-time response closely approximates the simulated model, implying the geometry is not a significant problem, the off-time data bears no relationship to the modeled data as shown in DHEM11 where we show the first off time channel in the axial component (Hz -red) against the same component in the modeled data (green). Not only is the shape incorrect but also the broad amplitude and this is true for Hy which also has a significant data response as well as Hx which is somwhat smaller. The conclusion is that either the data is badly distorted by the effect of the fences or the data is responsive to a structure which is unknown at this stage.

Another very important issue is the response of the intersected alteration zone as indicated by the logging results of this hole. In this model, we represent the basic shape of the modeled alteration zones (E03 and E04) but not the effect of intersection. If in fact, the hole intersects E03, according to the modeling the data response at this depth (approx 277m downhole) would be much greater. We infer from this that the hole actually intersects another structure.

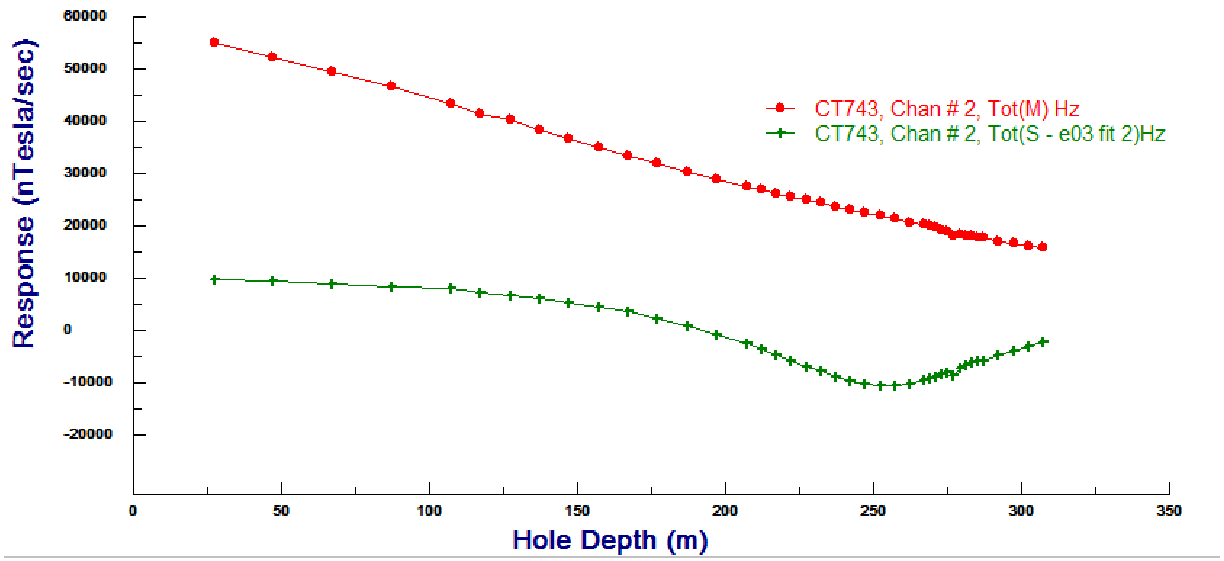

Fig DHEM11
CT743 Hz to E03,E04 model