LAMONTAGNE GEOPHYSICS LTD
GEOPHYSIQUE LTEE

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http://www.lamontagnegeophysics.com/

The UTEM5 system collects 3-component EM data from up to 3 transmitter loops - three coupling angles - simultaneously - translating to superior target definition and improved detection of all targets. In addition:

- UTEM5 precision is at least an order of magnitude better than the UTEM3 surface system. Our current estimate is that the UTEM5 surface coil precision will prove to be better by a factor of 10-40 times. Improved sensitivity equals better depth penetration. It also translates to significantly shorter stacking times or alternatively, better precision for the same stacking time. The improvement in precision is greater at lower frequencies (<4Hz).

- UTEM5 surface equipment has a greater advantage at low frequency - <4Hz. The UTEM5 technical advantage is greatest in the search for targets that are deeper and more highly-conductive using large transmitter loops - geometry of the applied field is simpler.. UTEM5, however, will be found to be extremely useful in numerous other applications.

- UTEM5 channels are spaced in a binary, geometric progression across each half-cycle of the received waveform - giving just over 3 channels per decade. Other features of the UTEM5 sampling channels include:
  - The implementation of Ch0, a narrow channel later in time than Ch1, making Ch0 normalization an option.
  - Three narrow timing channels improve the operator's ability to monitor Rx/Tx(s) synchronisation and allow for more precise phase correction/improved deconvolution.

- the UTEM5 rejection of non-survey frequencies including powerline noise is far superior to previous UTEM systems. One of the many features of the UTEM5 system that add up to the improved rejection is the option of tapered channel sampling.

The ability to simultaneously collect higher-precision, 3-component data from multiple transmitters (multiple coupling angles) at low frequency is really what the UTEM5 system is designed for - to be efficient and precise. To date UTEM5 surveys using multiple transmitters operating at base frequencies as low as 0.25Hz have confirmed that both the sensitivity of the system and the rejection of non-survey frequencies (powerline noise etc.) is far superior to previous UTEM systems.

In terms of BH operations, UTEM5 Rx coupled with our BHUTEM4 system allows for the collection of 3-component data from multiple transmitters simultaneously. The precision improvement may not be that noticeable near surface - in high field strengths. But at depth - low field strength - we estimate up to a factor of 5 improvement in precision. That improvement, and the multiple transmitter option, will add up to a considerable increase in the ability to resolve deep, highly-conductive targets - allowing for the detection of smaller targets and targets more distant from the hole.

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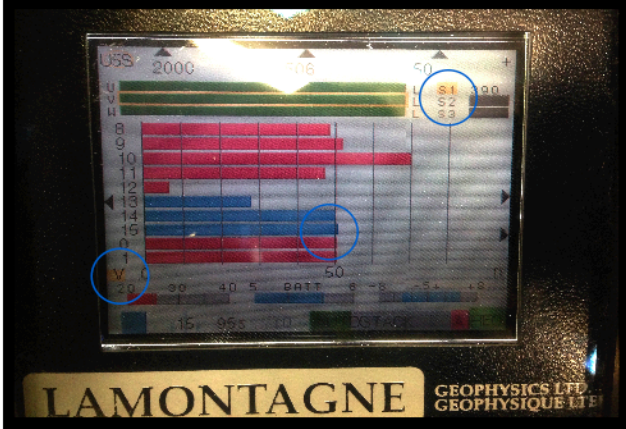

UTEM5

UTEM5 Surface equipment

The top two images show the UTEM5 Receiver/Coil pair: the UTEM5 Receiver and the UTEM5 3-component Receiver Sensor. The UTEM5 sensor is considerably more than a traditional surface coil - many of the features formerly incorporated into the receiver are now done in the coil. The link between the two is a dual-fibre optical fibre cable (red cable) typically 6m in length.

The middle image details the UTEM5 display. The display shows 12 channels plus Ch0 and the three timing Channels - a total of 16 channels that can be scrolled through. Details circled in blue indicate:

- S1 indicates Sampling1 (of up to 3 frequencies/Txs)
- V indicates component of UVW
- the different colour/similar amplitude for Ch0/Ch15 indicates synchronisation with the S1 transmitter.

The lower image shows the UTEM5 Receiver/Sensor pair: deployed in the field. Separation is a cable length. The receiver coil is aligned with the survey line and a set of three mutually-perpendicular accelerometers record the orientation.

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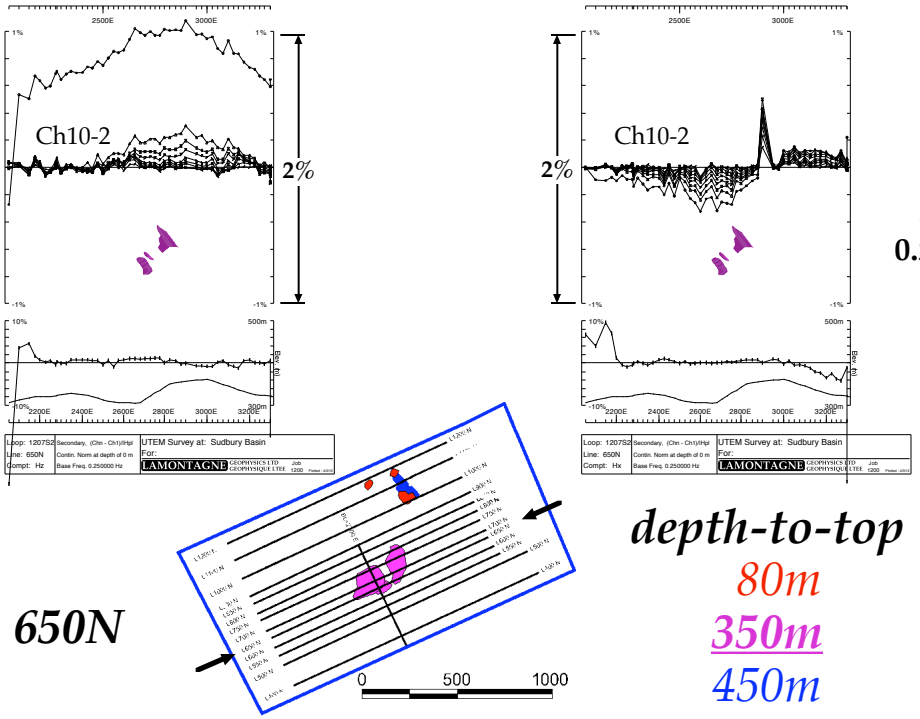
UTEM5 data



Hz
0.250Hz

Hx
0.250Hz

depth-to-top

80m
350m
450m

Line 650N

0.250Hz data showing the response of a mineralized zone @350m depth-to-top

UTEM5 Test Data

0.625Hz data showing the response of a small mineralized zone @80m depth-to-top

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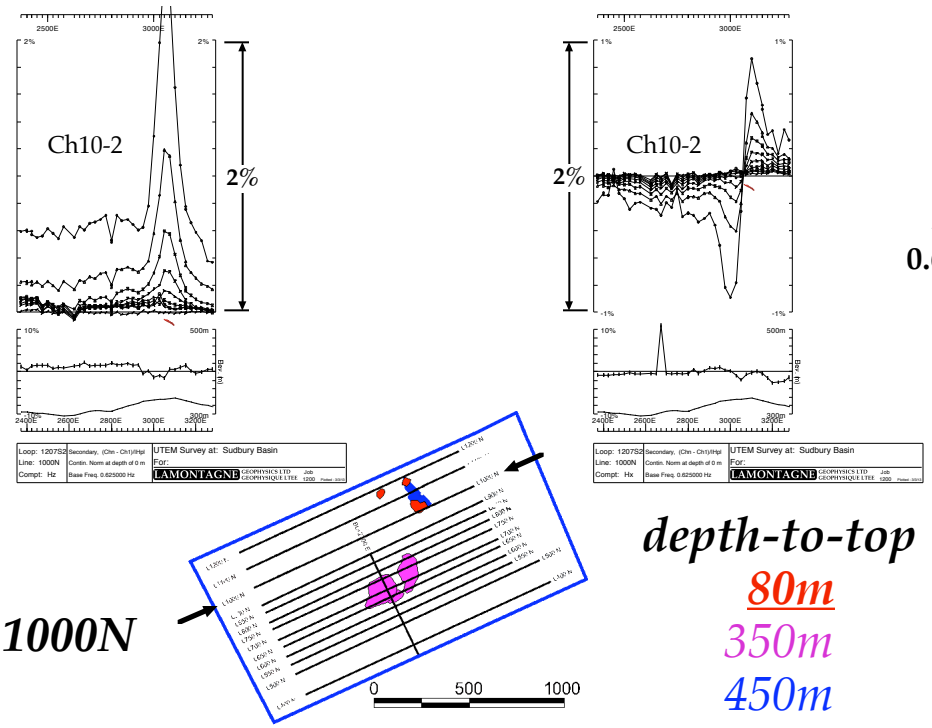
UTEM5 data



Hz
0.625Hz

Hx
0.625Hz

depth-to-top

80m
350m
450m

Line 1000N

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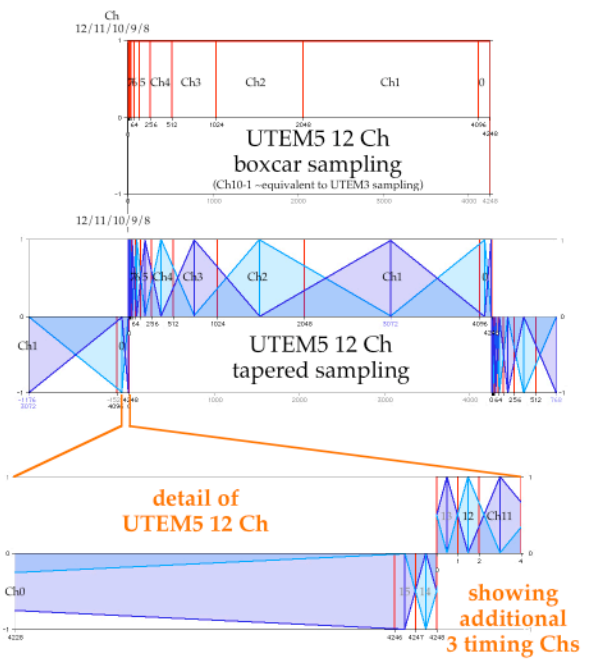

UTEM5 12Ch Sampling
boxcar/tapered options

outside	frequency	4.090910 Hz		in-loop	frequency	2.045455 Hz	
	period	0.24444 s			period	0.48888 s	
(5MHz clock)	half period	611110 0.2μs cycles		(5MHz clock)	half period	1222196 0.2μs cycles	
(narrowest Ch=1unit)	XNP	4248 /halfperiod		(narrowest Ch=1unit)	XNP	4248 /halfperiod	
	width of unit channel	2.87717e-5 s			width of unit channel	5.75422e-5 s	
	width of unit channel	28.7717 μs			width of unit channel	57.5422 μs	
(symbol) channel	peak of tapered ch Ch (μs)	tapered Ch begins - unit -	tapered Ch ends - unit -	(symbol) channel	peak of tapered ch Ch (μs)	tapered Ch begins - unit -	tapered Ch ends - unit -
timing Ch13	14.39	-0.5	1.5	timing Ch13	28.77	-0.5	1.5
12	43.16	0.5	3	12	86.31	0.5	3
11	86.32	1.5	6	11	172.63	1.5	6
10	172.63	3	12	10	345.25	3	12
9	345.26	6	24	9	690.51	6	24
8	690.52	12	48	8	1381.01	12	48
7	1381.04	24	96	7	2762.03	24	96
6	2762.08	48	192	6	5524.05	48	192
5	5524.17	96	384	5	11048.11	96	384
4	11048.33	192	768	4	22096.22	192	768
3	22096.67	384	1536	3	44192.43	384	1536
2	44193.34	768	3072	2	88384.86	768	3072
1	88386.67	1536	4171	1	176769.73	1536	4171
0	120006.77	3072	4246.5	0	240008.64	3072	4246.5
timing Ch15	122179.04	4171	4247.5	timing Ch15	244353.08	4171	4247.5
timing Ch14	122207.81	4246.5	4248+0.5	timing Ch14	244410.62	4246.5	4248+0.5
sub-stack time =		1.466666 s		sub-stack time =		1.466666 s	
number of substacks =		95 substacks		number of substacks =		95 substacks	
stacking time =		139.33 s		stacking time =		139.33 s	
cycles stacked =		570 cycles		cycles stacked =		285 cycles	
half-cycles stacked =		1140 half-cycles		half-cycles stacked =		570 half-cycles	

UTEM5 12Ch Sampling

UTEM5 12Ch sampling is detailed above. Both boxcar (equivalent to UTEM3) and tapered sampling are shown. The use of UTEM4/5 Transmitters and UTEM5 Receivers allows for the implementation of:
- Ch0 - a narrow Ch later than Ch1. Making Ch0 normalization - normalization at a later point in time - an option.
- 3 timing channels - Ch13/14/15 for 12Ch UTEM5 - these improve the operator's ability to monitor Rx/Tx(s) synchronisation and allow for more precise phase correction/improved deconvolution.

A target frequency is entered for each UTEM transmitter and the local powerline frequency are entered in the UTEM receiver. The actual frequencies used are selected by the receiver software to be as close to the entered target frequencies as possible while optimizing rejection of the other transmitters and powerline noise. In this instance the two frequencies are in the ratio **2:1**.

The minimum substack time is set by the receiver software to the shortest time that will include an integer number of cycles of each frequency used and 30(25)Hz (the first harmonic of the 60(50)Hz powerline frequency).

Where responses extend to the latest time-channel measured (Ch0) the survey frequency can be lowered. Reducing the number of channels from 12 to 10 allows for a wider anti-aliasing filter bandwidth. This can help improve S/N (signal-to-noise ratio) when dealing with high-frequency noise - eg. wind "whistling".

For more information, please visit us at PDAC booth 1103