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3/09/2014

Non Linear Conduction In Sulphides. Possible Field Methods.

Studies conducted by White (1974 {see Tooronga.com for Thesis}), into the non linearity of conduction of current in naturally occurring sulphides noted, that although these effects were small, it should be possible to detect them in the field using suitable equipment. The study also showed that other materials such as clays and graphite did not show detectable non linearity, and hence it would be possible to discriminate these minerals.

The best method for studying the non linear effects was to use a dual frequency method with a DC bias. The frequency mixing produced intermodulation products. The study concentrated on the sum of the frequencies (in this case 56hz + 70hz = 126hZ).

	FREQUENCY Hz
ω_1	56
ω_2	70
$2\omega_1$	112
$\omega_1 + \omega_2$	126
$2\omega_2$	140
Mains	150
$2\omega_1 + \omega_2$	182
$2\omega_2 + \omega_1$	196

Frequencies used in present study and their products.

TABLE 6.

As noted in the study, the application of a DC bias increased the “mixing” some five or six fold. The intermodulation product was still some 60dB down on the primary signal.

To help signal processing it should be possible to “modulate” the DC bias using a square wave of say 8 seconds on and 8 seconds off. Subtracting the “off” readings from the “on” readings may help enhance the signal.

If the method proved viable, the DC modulation could revert to the typical IP frequency of 2 seconds on and 2 seconds off and the method could be run as part of a normal IP survey.

Before any major field equipment design is attempted the viability of the method needs to be checked in the laboratory in a similar way the initial tests were conducted only using modern

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electronics.

Stage 1

The receiver equipment needs to be designed and tested first. This should include a suitable pre-amplifier, then possibly a band width filter, all feeding a 24bit A to D. The A to D needs to be controlled by a laptop (probably USB) recording the full waveform.

The equipment should be designed in such a way as it can be used in any initial field trials.

For the Lab. work, the transmitters can be 2 sine wave generators and a DC power supply. Some passive circuitry may be needed to optimise the transmitted currents so as to simulate the field current densities.

The original work was carried out using a 1m^3 earthed aluminium box to shield from stray noise.

The signal processing software and front end electronics would all be developed in this stage 1.

Stage 2.

If similar results are achieved, then the system should be tested in the field.

This will require 2 power amplifiers, designed to be fed into a 50 to 100ohm load. The minimum output voltage would need to be in the order of 100v. The original sine wave generators could be used.

If tests were done on a very shallow source and 5 to10m electrodes used, sufficient current densities could be achieved.

An IP transmitter could then be used to supply the bias.

Stage 3.

If all these tests proved fruitful then the design of a full field system can be undertaken.

This would include redesigning the receiver to handle multi-channel inputs as well as processing software.

Stand alone high powered sign wave transmitters with a minimum of 5 KVA. output each.

Integration of the system into a conventional IP survey.

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Research work into the exact nature and cause of the non-linearity and any possible ways to enhance the phenomenon and any better ways to use and measure the non-linearity.

Development of interpretational parameters.

Development into advanced signal processing techniques to enhance the signal to noise, for example subtracting the biased and unbiased signals.

Possible airborne systems.