A Comparison of Decay Shapes from B and dB/dt Measurements

Consider the simple case where a B-field TEM response is *the sum of* a power-law decay (such as that from a half-space) and an exponential decay (such as that from a confined conductor):

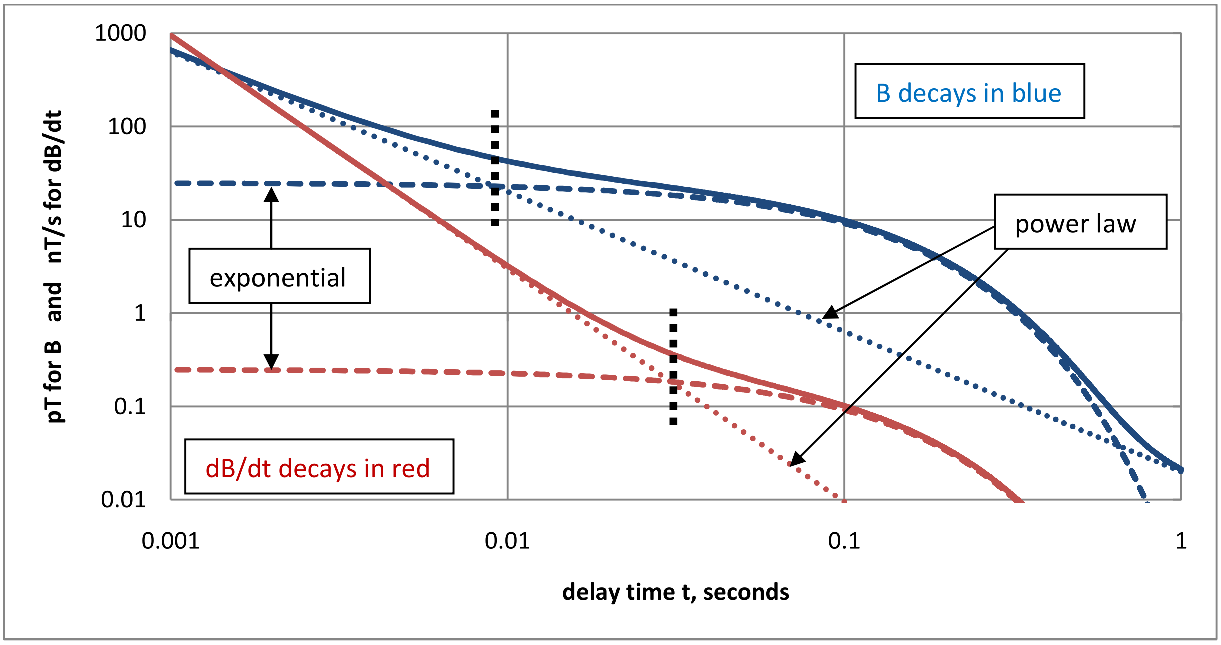
$$B\ (t) = P\ .\ t^{-3/2}\ +\ E\ .\ e^{-t\ /\ tau}\qquad (pT)$$

where P is the amplitude of the power-law decay, E is the amplitude of the exponential decay and tau is the decay constant of the exponential decay. A power law of -1.5 is used, simulating the B-field response of a conductive half-space. The time (t) and decay constant (tau) are in units of seconds. The exponential decay is used to simulate the response of a conductive target buried in a conductive half-space. Arbitrary units of pT have been used in the above.

Taking the time-derivative, the equivalent dB/dt response, in units of nT/s is:

$$dB/dt\ (t) = -0.001\ .\ (3/2\ .\ P\ .\ t^{-5/2} + (E\ /\ tau)\ .\ e^{-t\ /\ tau})\qquad (nT/s)$$

As a demonstration of the differences in decay shapes for B and dB/dt, responses are shown below on a log-log plot for P = 0.02 pT, E = 25 pT and tau = 0.1 seconds (100 msec, representative of the response expected from a good confined conductor). The reversal of polarity for the dB/dt responses is ignored. The power law decays (dotted) and exponential decays (dashed) are shown in addition to the combined responses (solid lines), blue for B (units of pT) and red for dB/dt (units of nT/s).



The thick vertical dashed lines show the time at which the exponential part of the decay starts to dominate over the power law for both B and dB/dt. That time is approximately a factor of 3 earlier for B (9 msec) than for dB/dt (29 msec) in this example. The response of conductive features is enhanced in a B measurement compared with a dB/dt measurement. These responses are observed earlier in the decay in a B measurement, with a corresponding higher probability of detection. This is clearly demonstrated in field data.

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