Title: Recovering Complex Conductivity from Frequency and Time Domain Geophysical Surveys.

Author: Seogi Kang, David Marchant, and Douglas W. Oldenburg

Geophysical Inversion Faculty, University of British Columbia, Canada

The electrical conductivity of earth materials can be frequency dependent. The bulk conductivity decreases with decreasing frequency because of the buildup of electric charges that occur under the application of an electric field. Effectively, the rock is electrically polarized. Finding the polarization response (often referred to as IP, Induced Polarization) can lead to economic benefits, as in the case of discovering sulphide minerals, but there is applicability in environmental problems, groundwater flow, and site characterization. We have the ability to model Maxwell's equations in 3D for complex conductivity in either the time or frequency domain. The challenge therefore is to invert the EM (electromagnetic) data to recover a four-dimensional conductivity (σ (ω, x, y, z) using limited EM data generally acquired on, or above, the surface of the earth. At late times (or low frequencies) the static Maxwell's equation are valid and, if a background conductivity is known, then chargeability can be extracted. Unfortunately the static assumption is often violated and EM induction processes contaminate the sought signal. For example, signals in the time domain have three parts: a static on-time, an early-time inductive portion, and a late-time IP signal. Information about conductivity using the appropriate Maxwell's equations is available from each of these segments. The potential contamination of the IP from EM induction (often referred to as EM coupling) and the potential contamination of the EM signal from the IP data (IP coupling) can cause deleterious effects and must be addressed. The goal of this talk is to address such issues and outline a practical procedure for extracting IP information from existing time and frequency domain surveys.