Seismoelectric Effects of Electrokinetic Origin

In postseismic media, compressional waves cause pore fluid to move to relieve the solid stress thereby moving the excess electrical charge in the outer mobile portion of the double electrical double layer (Figure 1). Charge differences are seen between plates of compressional and dilational character (Figure 2). This gives rise to a co-seismic electric field that is confined within the compressional area. When a compressional wave encounters a boundary plane, it generates a dipole charge through the water that distorts the resulting charge distribution (Figure 3), if generated by counouring electric field, which we call the interseismic electrokinetic effect. These effects propagate as electromagnetic signals and have been shown to arise at scales of meters and larger, and recover with an at-ear time essentially equal to the one-way seismoelectric wave propagation time (Figure 4).

Common Sources of Noise in Seismoelectric Measurements

Noise Source

Origin of the noise

Method to minimize impact

Powerline harmonics (60, 50 and/or 25 Hz and their harmonics)

Frequency components in geophysical records may be effectively suppressed by using 

Ambient sources

Seismic noise (earth currents), associated with atmospheric electricity

Amplifier gain and bandwidth effects caused by improper signal buffering or acquisition

Acquisition-related Artifacts

Impact related noise transients (especially from metal to metal contact)

Toggling noise

Impact noise is attenuated by using high-quality microphone cables

Noise from electrical blasting caps

Inadvertent demodulation of AM radio broadcasts

Source-generated noise

"Co-seismic" electrical signals that accompany the idealization of waves propagating in non-homogeneous media

Gain and bandwidth effects caused by improper signal buffering

Noise transients arriving in time zero can be caused by electrical blasting caps, the impact of steel hammers on a steel plate, and trigger cross-talk. In the example Jeff, the signal was associated with data on the trigger cable attached to the design sander used on the surface of the soil. Triggering the impact probe reduced the cable noise.