

# **GJI-S-12-0690 Electronic Supplement**

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## **1 GJI-S-12-0690 ELECTRONIC SUPPLEMENT**

### **1.1 Comparison between laboratory dielectric constant measurements on sandstones at various frequencies**

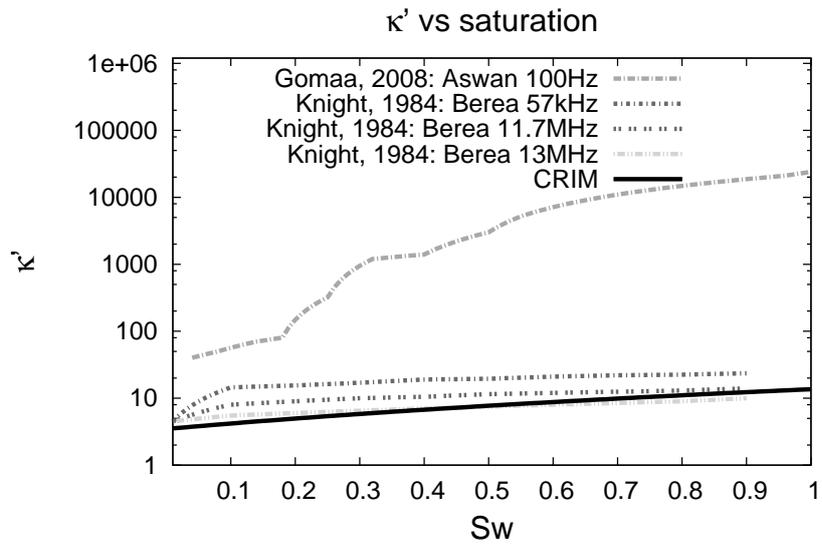
Figure 1 compiles the dielectric constant values measured on Berea sandstone samples of porosity  $\phi=19.7\%$  at different saturation levels by Knight (1984) at frequencies of 57 kHz, 11.7 MHz and 13 MHz. The values measured by Gomma (2008) at 100Hz for clean (clay-free) Aswan hematitic sandstone samples with 23 % porosity are also plotted. Finally, Figure 1 displays the dielectric constant as a function of saturation  $S_w$  as predicted by the CRIM formula for a clean sandstone with 23 % porosity.

### **1.2 Reciprocity test**

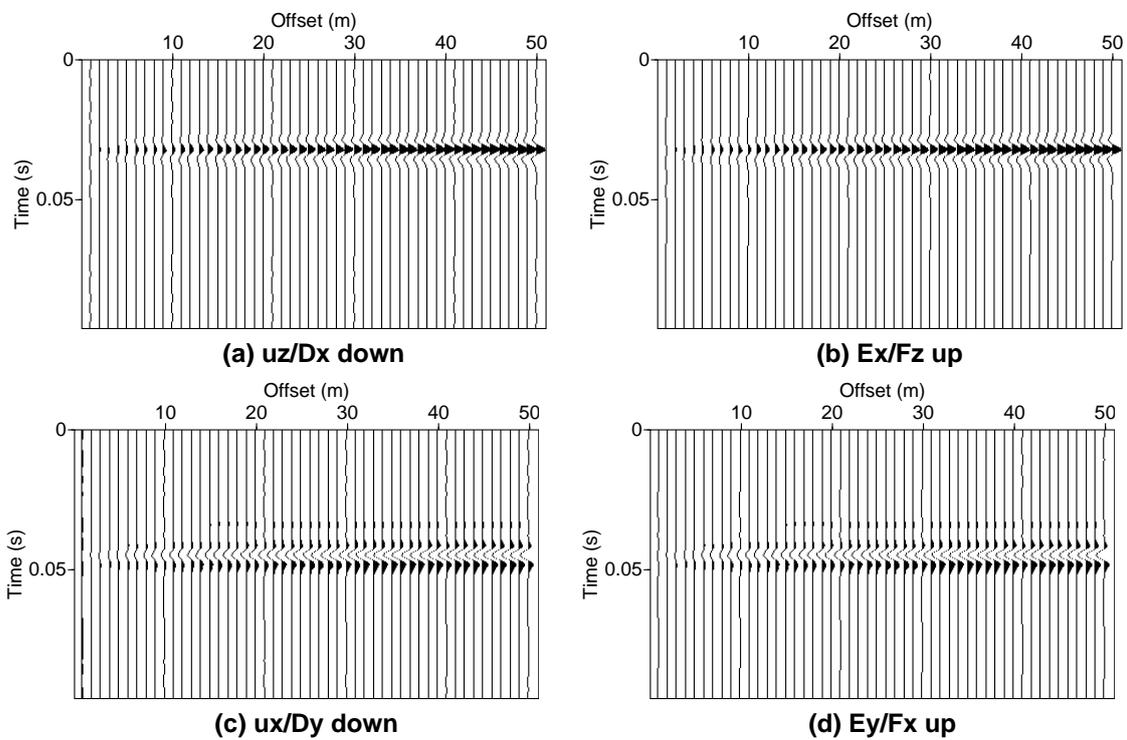
Checking for the reciprocity of the Green's tensor is a common way to search for errors in a numerical program. In this Section, we show that the program we have developed under partial saturation conditions verifies these reciprocity relations for coupled seismic / electromagnetic waves. We consider a simple tabular model, consisting of a partially saturated sandstone layer with  $S_w=0.4$ , 30 m thick, on top of a saturated sandstone halfspace. We model two source-receiver configurations:

- shallow source ( $z_s=1$  m) and receivers set at depth ( $z_r=59$  m), noted “down” in Figures 2 (a) and (c)), as most of the energy travels downwards.
- buried source ( $z_s=59$  m) with a string of shallow receivers ( $z_r=1$  m), noted “up” in Figures 2 (b) and (d)).

In both configurations, a 10 m offset along  $y$  was introduced between the source and receivers. In Figure 2, we have modeled only the interfacial conversions. The notation “uz/Dx” (Figure 2 (a)) refers to the vertical displacement created by a dipole oriented along  $x$ . This seismogram correlates well with the electrogram displaying the electric field along  $x$  obtained using a mechanical source along  $z$ . The maximum amplitude for the “uz/Dx” case ( $5.049 \times 10^{-6}$ ) is close to the maximum amplitude obtained for the “Ex/Fz” case ( $5.016 \times 10^{-6}$ ). In a similar way, the recordings displayed in Figures 2 (b) and (d) correlate well and show the same maximum amplitude ( $1.595 \times 10^{-6}$ ).



**Figure 1.** Dielectric constant versus water saturation  $S_w$  as measured by Knight (1984) on Berea ( $\phi=19.7\%$ ) sandstone samples and Gomaa (2008) for Aswan ( $\phi=23\%$ ) sandstone. The results obtained with the CRIM formula for a sandstone with a porosity  $\phi=23\%$  are also plotted for comparison.



**Figure 2.** Results of the reciprocity test described in Subsection 1.2.

## **REFERENCES**

- Gomaa, M. M. . N. R. C., 2008. Relation between electric properties and water saturation for hematitic sandstone with frequency, Published.
- Knight, R. J., 1984. The dielectric constant of sandstones, 5 Hz to 13 MHz.