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Electromagnetic Field Caused by Transmission Cable in the Nojima Borehole Site

Takashi Fukumoto[1], Ichiro Tomizawa[2], Naoto Oshiman[3]

[1] Electronic Eng., Univ. of Electro-Comm., [2] Sugadaira Space Radio Obs., Univ. of Electro-Comm., [3] DPRI, Kyoto Univ.

To investigate extraordinary transmission path of seismognic EM emission, we have been conducting the EM-transmission experiment using underground electorodes in the Nojima borehole site.

The connection cable installed at the site is not designed to transmit high frequency signals down to the electrodes. It causes some disturbances, e.g., trasnmission loss, mismatching, and unbalance, during power transmission from the ground surface to electrodes. Such disturbances induce electromagnetic field close to the transmission cable. Because the induction field may interfere with electromagnetic fields emitted from the electrodes installed at 300 - 500m depth, we must reduce the induction one.

Accoding to the transmission efficiency to electrodes[1], some frequencies are identified for the transmission experiment. Then, we have measured the induction field around the borehole site when the transmission power is applied to some cable pairs at the ground site. The measurement is performed with electric field detection system with the narrow passband to improve signal-to-noise ratio and to reject strong broadcasting signals at those frequency bands.

Surface electric fields showed steep decrease along distance from the borehole, which can be interpreted as the induction field. We have compared the field strength variation with a equivalent electric dipole model located along the borehole because the possible induction source is related to the transmission cable. The equivalent electric dipole source is estimated to located around 10 to 20 m depth from the ground surface. It can be explained as the leakage from the transmission cable.

Additionally, dipole moments of the equivalent electric dipole are deduced by applying the measured field strength. The dipole moment shows small values at 80 kHz and more than 200 kHz. The former frequency is identical to the efficient frequncy of power transmission down to electrodes, however, the latter frequency band can not be explained by transmission efficiency. Even though, the latter frequency band can be interpreted as low interference frequency around the Nojima fault. Therefore, we have concluded that the next transmission experiment around the fault will be performed with 80 kHz and more than 200 kHz using higher transmission power.

Reference

[1]N. Ishii, I. Tomizawa, and N. Oshiman: Possibility of EM-transmission experiment using underground electrodes at the Nojima bore-hole site, The Japan EPS Joint Meeting 2000, Ag-004, 2000.