Electrical parameter in the earth and Earth-origin electric noises

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Using a non-conductive bore-hole of 10 cm in diameter and 100 m in length constructed in the campus of Kyoto Sangyo University, we have been observing EM noises in the earth [1]. For this observation, we have developed a specific electric sensor (Co-axial linear dipole sensor) in our laboratory, and using it we could detect earth-origin electric pulse swarms [2] (see Session S039). In order to identify the source region of the earth-origin electric pulses and to clarify their propagating characteristics, it is necessary for us to know true electric and magnetic field values for the sake of clear analysis of propagation of the electromagnetic waves in the earth.

For this purpose, we needed to derive the impedance of the sensor in the earth crust. For the first step, we have developed an impedance measuring system. Since the admittance (the reciprocal to the impedance) of electric dipole antenna consists of both the antenna conductance and the antenna capacitance, the measured admittance also provides electrical parameters in the earth. First. we measured the admittance of the linear dipole above the ground (in the air). Next we conducted its measurements in the earth down to the depth of 95 m at every 2.5 m step by inserting the sensor system into the bore-hole. The obtained values of the antenna conductance and capacitance were normalized with those measured in the air. The normalized values provide the specific conductivity and the specific dielectric coefficient in the earth.

In addition to the measurements, we carried out the measurements of the intensity of wave electric field in the earth at the same depths with those of the admittance measurements. In these measurements, an important point we clarified was a relation between depth-dependences of the specific dielectric coefficient and of the intensity of the background electric noise. We found that the specific dielectric coefficient was monotonically increasing below the depth of 50 m and that the background electric field intensity was also increasing below the depth of 50 m. From the relation that the higher the specific dielectric coefficient is, the more intense the wave electric field is, we might be able to clarify the wave propagation and wave attenuation properties and also the generation mechanism of electric pulses in the earth crust with a high dielectric coefficient.

[1] M. Tsutsui, A New System for Measuring EM Field in the Earth, XXVIth URSI General Assembly, EP.1, Toronto, Canada, 1999.

[3] M. Tsutsui, Detection of earth-origin electric pulses, in press, GRL, 2002.