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Temporal variation of crustal resistivity in western Shikoku revealed by continuous MT observations

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Various kinds of slow earthquakes such as deep low frequency tremors (Obara, 2002, Science), deep very low frequency earthquake (Ito *et al*., 2007, Science), and slow/long-term slow slip event (Hirose *et al*., 1999, GRL; Obara *et al*., 2004, GRL) are observed in western Shikoku, Japan. In the lower crust of this area, existence of a characteristic low-resistivity structure was revealed by Magneto-telluric (MT) survey (Yamashita and Obara, 2009, AGU fall meeting). Since the low-resistivity structure would be derived from fluids dehydrated from the subducting Philippine Sea plate, continuous MT observations are being carried out to investigate relationship between the fluids and the activity of the slow earthquakes in this region. Since we succeeded to detect significant changes in the crustal resistivity by conducting careful data analyses, here we report the results. The continuous MT observations were carried out in two observational sites KBN and SGW in Ehime prefecture from September, 2008 to March, 2010. One MT observational system was moved from SGW to a new observational site IKT in April, 2010 and the observations are now continuing. To obtain highly reliable result by mitigating effects of noises, we followed the analytical method of Honkura *et al*. (2013, Nature Communications), in which we used only data whose coherency between electric and magnetic fields was larger than a threshold. Using the data, we calculated daily averages of apparent resistivity and phase. We further calculated moving average of them over 31 data points to reduce data scattering, which intrinsically arises in the MT method. Since the apparent resistivity shows annual variation due to atmospheric temperature variations, we removed it by using atmospheric temperature data obtained in Kuma observational site of Meteorological Agency. Number of analyzed frequencies of the MT data is nine between 0.00055-0.141 Hz. As a result of analysis, we successfully detected temporal variations which satisfy the following three conditions: (1) The apparent resistivity and the phase vary with antiphase at the same time. (2) The variations of (1) are similarly seen over several frequencies. (3) Similar variations are seen in two observational sites at the same time. From these results, we considered that the temporal variations of the apparent resistivity and the phase are originated from changes in the crustal resistivity. We then made a one-dimensional resistivity structure model based on the two-dimensional model revealed by Yamashita and Obara (2009), and compared an observational change with the simulated one by forward modeling. The result shows that the resistivity change in the depth between 20 and 25 km can approximately produce the observational changes in the apparent resistivity and the phase. We will further simulate how structural change can produce the observed variation based on the two-dimensional resistivity structure and also investigate the relationship between the observed resistivity variation and the activity of the slow earthquakes.

Keywords: Crustal resistivity, Magneto-telluric method, Slow earthquake, Subduction zone