2D Inversion of Pelabuhan Ratu Magnetotelluric Data, Indonesia

Febty Febriani¹, Peng H.¹, Chie Yoshino.¹, Katsumi Hattori.¹, Boko Nurdiyanto², Noor Effendi², Iwan Maulana², Suhardjono³, Prih Hardjono², Eddy Gaffar³
¹Chiba University, Japan
²Indonesian Geophysical, Meteorological, Climatological Agency (BMKG), Indonesia
³Indonesian Institute of Sciences (LIPI), Indonesia

SUMMARY

To identify the underground electrical structure close to Cimandiri fault, Pelabuhan Ratu, West Java, Indonesia, the subsurface structure near Cimandiri fault has been investigated by forty eight magnetotelluric (MT) sites. The MT exploration was carried out during two weeks, from July 27, 2009 to August 8, 2009. The data were distributed along about 13 km x 6.5 km profile. Two-dimensional modelling using the Ogawa and Uchida 2-D inversion has been applied in this research. The data analysis of 2D inversion is now going on and details will be given in our presentation.

Keywords: magnetotelluric, inversion, Cimandiri fault, Indonesia

INTRODUCTION

The tectonic settings of Indonesia are very complex due to a meeting point of several active tectonic plates. They are the Eurasia Plate, the Australian Plate, the Indian Plate, the Sunda Plate, the Caroline Plate, the Philippine Sea Plate, and the Pacific Plate (Figure 1).

![Figure 1. The tectonic settings of Indonesia (Robert McCaffrey, 2009)](image)

The existence of the Eurasian lithospheric plate forms the southeastern extremity of Indonesia. The subduction zone around the Eurasian plate is called the Sunda trench. The Indian-Australia plate moves toward the northeast at a rate of about 50-60 mm/year relative to the Eurasian plate. This results in oblique convergence at the Sunda trench. The oblique motion is partitioned into the thrust-faulting.

Such condition makes Indonesia become one of the most seismically and volcanically active regions in the world. Therefore, there are many high risk areas in natural hazard in Indonesia.

According to Irsyam et al (2010), the Java Island is one of seismically high risk areas in Indonesia. In addition, with a population of 128.5 million (as of 2005), the Java Island is the most densely-populated area in Indonesia (Statistics Indonesia, 2010a). It is 58.8% Indonesian population (Statistics Indonesia, 2010b).

Cimandiri fault is one of active faults in Java Island. Cimandiri fault lies close to Cimandiri River, West Java (Figure 2). Some moderate-large earthquakes often occur at areas near the fault. One of them is the 2009 Tasikmalaya, West Java, earthquake, which occurred on September 2, 2009.

![Figure 2. Figure of geological background of areas close to Cimandiri fault, West Java, Indonesia (modified after Effendi (1974) and Sukamto (1975))]
Since identifying the subsurface structure close to Cimandiri fault is of importance, we conducted sounding magnetotelluric (MT) observation in this area.

**DATA ACQUISITION**

The MT exploration was done by using MTU-net equipment from Phoenix Geophysics. during two weeks, from July 27, 2009 to August 8, 2009.

**ANALYSIS AND RESULT**

In this analysis, we used sites which having Ex coherency (Hx-Hy), Ey coherency (Hy-Hx), Hx coherency (Ex-Ey) and Hy coherency (Ex-Ey) more than 0.7. We assumed they are good data. Figure 4 presents relationship between apparent resistivity and frequency in loglog xy plot for sites 11 in line B. Figure 4 show that the apparent resistivity of XY and YX direction have the same characteristic.

For 1D analysis, we analyzed our data by using the Bostick inversion. This inversion scheme generates a continuous or near-continuous resistivity distribution versus depth (Bostick, 1977).

**Figure 3.** Map of MT field investigation

This research was carried out close to Cimandiri fault, Pelabuhan Ratu, West Java, Indonesia. The black rectangle in Figure 2 is our research area. Figure 3 shows more detail of all MT sites position. There are forty eight MT sites and distributed along about 13 km x 6.5 km profile. These sites were distributed on A line and B line (Figure 2 ). A line and B line are perpendicular and parallel to Cimandiri fault, respectively.

**Figure 4.** Figure of relationship between apparent resistivity and frequency in loglog plot for the 11 site.

In this study, we estimated the resistivity as the depth function by means of,

$$\rho(z) = \rho(\omega) \left( \frac{\pi}{2\varphi(\omega)} - 1 \right)$$

(1)

$$z = \left( \frac{\rho(\omega)}{\mu\omega} \right)^{1/2}$$

(2)

where $z$ is the nominal depth corresponding to the skin depth of a half-space of apparent resistivity $\rho_a$ and frequency $\omega$.

**Figure 5.** Result of 1D Bostick Inversion for the 11 site

Figure 5 shows one example of 1D Bostick inversion result for the 11 site. The profile of A line and B line are presented by Figure 6 and Figure 7.
Figure 6. Result of A line profile

Figure 6 shows there are high resistivity structure between 8 km length and 13 km length. The structure starts to appeared from 3 km depth until 6 km depth.

Figure 7. Result of B line profile

Figure 7 also shows high resistivity body in two location. The first one is between 0 km and 2 km length. The second one is between 4 km and 6.5 km length. The high resistivity body in B line appeared from 1.25 km depth.

The result of 1D Bostick Inversion is our preliminary result. To fulfill our goal in this research, we also will analyze our data by using 2D Ogawa and Uchida inversion (Ogawa & Uchida, 1996). The 2D Ogawa and Uchida inversion assumed that the static shift statistically has a Gaussian distribution and can be applied to our limited data set. We will present the detail result of 2D Ogawa and Uchida inversion in the symposium.

In the future, we also have plan to analyze our data by using 3D inversion method. Since we had the limited data now, analysis by using 3D inversion method will be done after getting the additional magnetotelluric data from our colleague.