RESEARCH ARTICLE

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Estimation of Semarang Fault Zone Using Magnetic Method

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According to the geological structure of Semarang area, there are several faults. They are Kaligarang fault and Semarang fault. Semarang fault stretches from west to east in Semarang. It separates upper and lower Semarang morphologically. Because of its existence, there are so many damaged roads and problems in stability of soil. There haven't been many researches concern with the existence of faults. So, in this opportunity, the researcher was encouraged to conduct the research to map Semarang fault area using Magnetic Method. Fault mapping needed to be done to draw up the instructions of disaster mitigation, especially in the area around the faults. The basic principle of Magnetic Method is by measuring the Earth's magnetic field totally with Proton Precession Magnetometer (PPM) at certain areas on the Earth surface. The research was conducted in the location suspected as Semarang fault area geologically. It was approximately 15 km × 16 km, in UTM coordinate of easting 429000–445000 and northing 9227000. In this research, the faults were successfully measured. There are 110 measurement points distributed almost in every Semarang faults area which had been predicted geologically. Data of total magnetic field which had been measured was reduced to get the components of IGRF and daily variation components. Therefore, the measurement obtained the anomaly of total magnetic field. This anomaly data showed total magnetic field that is differentiated horizontally in east-west direction and north-south direction. Then it continued by carrying out the pseudo gravity transformation. The location of anomaly corresponded to the maximum point of horizontal gradient. However, in the data, pseudo gravity was between the maximum and minimum point. From these criteria, the area or location of Semarang faults was estimated in the southeast part to Kalipengkol between Kalikayen and Jabungan village. It continued to the north direction until JurangBlimbing and SendangKenongo village. From SendangKenongo, it turned to the west direction through Trangkil village, Ngesrep. It means that it continued from the west direction to the north through south Karangrejo village and still continued to the west until Ngelosari, Sadeng village.

Keywords: Semarang Faults, Magnetic Method, Disaster Mitigation.

1. INTRODUCTION

Geological structure in the form of fault especially in Semarang has been believed and has been put on geology map of Semarang.[1] Fault areas often cause many problems such as soil instability and damaged roads as found in Sekaran, Gombel, SigarBencah includes the damaged highway of Semarang-Ungaran in Gedawang. In the early 2014, the landslides occurred in those locations. Half of Sekaran-Sampangan road was lost because of landslide. The landslide in Gombel area resulted some ruined houses and one person was death. So, the people in Trangkil residence had to be relocated because the houses were heavily damaged because of landslide.[2] Many people called this fault as GombelFault., but because of its separation, it almost separated the upper and lower area of Semarang. Thus it was appropriate to be called as Semarang fault. Semarang fault stretches from west to east direction start from the north of Jatirejo, north of Sekaran, Gombel, curved and turned to the southeast through SigarBencah, Keramas and Gedawang.[1]

Because the condition of the area around Semarang fault is crowed by people, the existence of that fault needs to be researched and mapped to avoid the number of many victims. If the fault is dislocated or get movements again, it can stimulate the soil instability because of dislocation on those fault lines. Research conducted by Thanden et al.[1] showed that Semarang fault has been developed because of the small fault around it. However, the total fault lines haven't been known precisely. In this research, the existence of fault location in Semarang would be mapped using Magnetic method. By mapping the fault location, it can predict the area which is considered the disaster-prone area. So, it can provide information to the people who live around zone of Semarang fault or related institution (Bapeda Semarang city) especially in arrangement planning and area development as well as mitigation.

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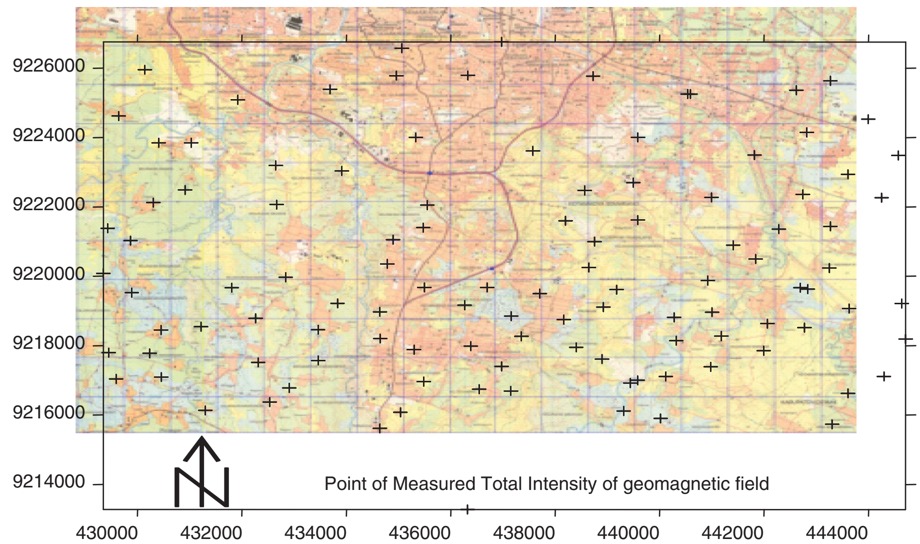

Fig. 1. The distribution of magnetic field measurement points (sign +).

2. GEOLOGY OF RESEARCH AREA

Based on the geological maps of Magelang and Semarang arranged by Thanden et al.,[1] stratigraphy order in Semarang and its surrounding can be grouped into several formations which is generally in the form of sedimentary rocks and volcanic rocks.

The group of sedimentary rocks which is found in Semarang area and its surroundings consists of several formations. They are Kerek Formation (Tmk) which consists of marl interfringerclay stones with tuffaceous sandstones, conglomerates, breccias and limestones. This formation is in the age of last miosen, exposed in banyumanik, East Ungaran, KaliKreo valley, KaliKripik, Kaligarang and around Jabungan. Kalibeng Formation (Tmpk) which is located unconditionally towards Kerek Formation with lithology consist of marl solid in the top part which contains carbon. Marl inserts of tuffaceous sandstones and limestones. This formation is in the age of Miosen-Pliosen exposed KaliKreo valley, KaliKripik and Kaligarang as well as in the area of Tembalang, Meteseh, Rowosari, Kali Pengkol valley and Kali Bade valley. Kaligetas Formation (Qpkg) consists of volcanic breccias such as lava, tuffaceous and mudrocks. Generally, weathering happens intensively to result the soil material with reddish brown colour, exposed in Tembalang, Banyumanik,

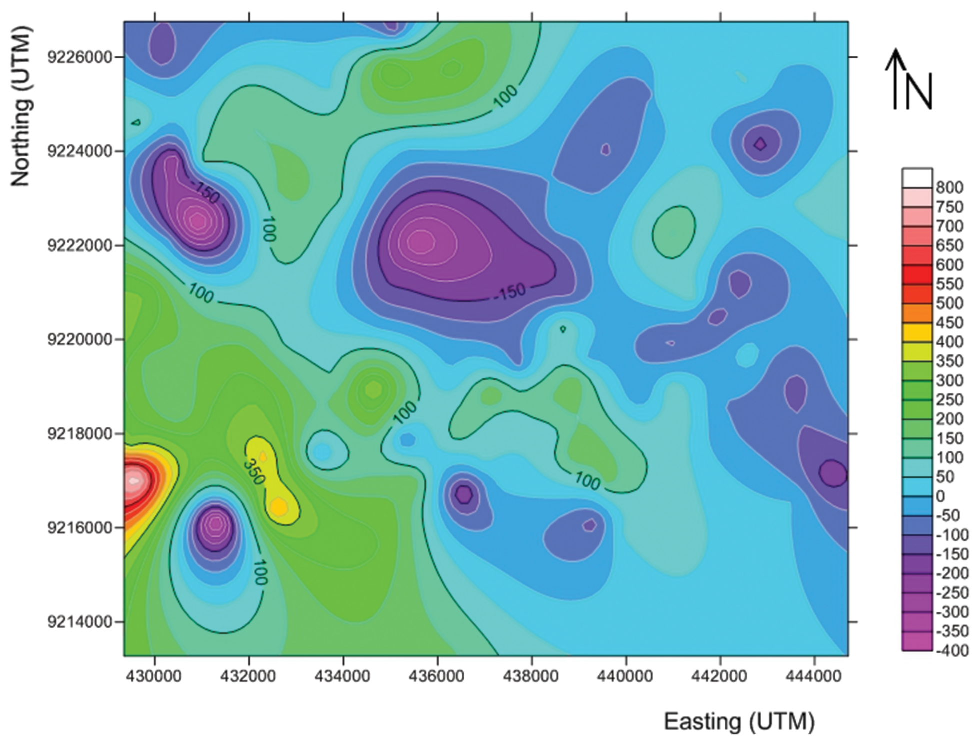

Fig. 2. Map of the total magnetic field anomalies.

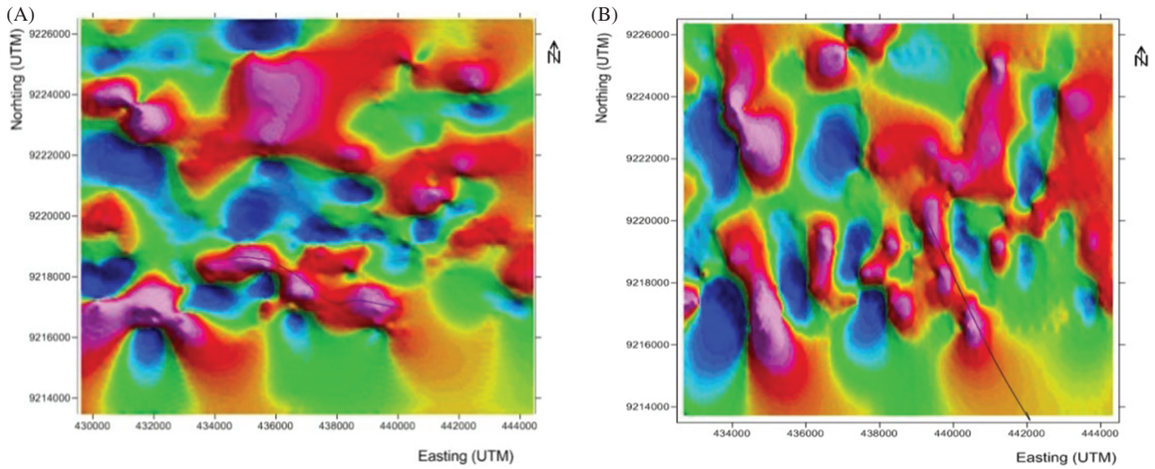

Fig. 3. Map of horizontal gradient towards north south direction (A) and the horizontal gradient map of the east west direction (B).

Grobogan, Wonorejo and Pringsari. Damar formation located unconditionally towards Kalibeng Formation consists of tuffaceous sandstones, conglomerates, volcanic breccias and tuffs. Sandstones consist of feldspar and mafic minerals, part of them are tuffaceous and calcareous in the local basis. Meanwhile, for breccias, the fragments are generally in the form of base volcanic rocks and outcrops found in Kedungmundu, Karanganyar and Ngadirejo. The age of this formation is last Pliosen to early Pliosen. Alluvium Sediment (Qa) consists of gravel and sand. Gravel and silt with 1–3 meter-thick are sediments in the river and revealed in KaliPengkol valley and its surroundings.

Rocks group as a result of volcanic activities consists of several units, one of them is Kaligesik Volcanic Rocks (Qpk). It is resulted because of volcanic activity in the form of augite olivine basalt flow which is revealed in northern slope of Mount Ungaran. The other unit is GajahMungkurVulcanic Rocks (Qhg). It consists of augite hornblende andesite that is generally in the form of lava flows and it is revealed in the top of Mount Ungaran and surround the Kemalon and Sangku Volcanic Rocks.

Andesite Igneous (Tma) is breakthrough acid igneous rocks of augit hornblende andesite type, revealed in Mangunsari, GunungTurun and PudakPayung. Igneous Basalt (Tmb) in the form of augite basalt is found in Mount Klesem as dikes. Prophyry plagioclase was found in Mount Sitapel and olivine-augite andesite basalt was found in Mount Mergi.

3. RESULTS AND DISCUSSION

This research was conducted in the areas where is suspected as Semarang faults, the area around the escarpment between lower part of Semarang and Upper part of Semarang. They extend from the area around Goa Kreo, Northern Sekaran, Gombel, Polines Residency, Sigarbencah, Keramas in Semarang city to Gedawang in Semarang district. The area of the research was about 15 km × 16 km.

Measurement of Earth's magnetic field was carried out in some points on a track which had been planned. The selection of Earth's magnetic field measurement points was carried out by considering the location of these points which are free of magnetic field interference such as network of power transmission PLN, Tower transmission of Mobile phone, radio transmitter and other magnetic fields like cars, motorbikes, watch, belts containing ferromagnetic materials and so on.[3–5]

The total of magnetic field was measured by using two units of PPM (Proton Procession Magnometer) type geometrics G-586 which is completed with censorship, sticks and dry battery. One of PPM units noted, measured, and recorded the magnetic field value in base station points automatically. Meanwhile, the other unit of PPM moved and measured the total magnetic field value in every measurement points.[5,6] The tools used in measurement were unit of GPS Garmin to measure the coordinates of measurement points (X, Y, Z), geological compass to determine the north direction as censor orientation of PPM, topography map and geology map to show the spread of rocks types and to estimate Semarang fault location.

4. RESULTS AND DISCUSSION

In this research, the researcher succeeded to measure the total of Earth's magnetic field. They were about 110 points almost distributed equally in research area with variation of distance between measurement points, shown in Figure 1. Meanwhile,

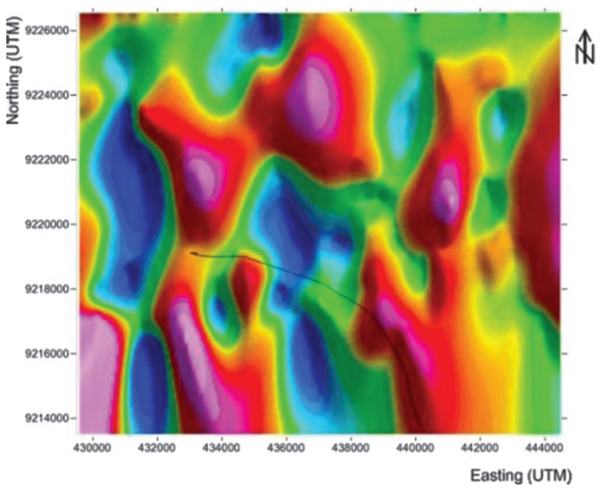

Fig. 4. Map of the value of pseudo gravity data.

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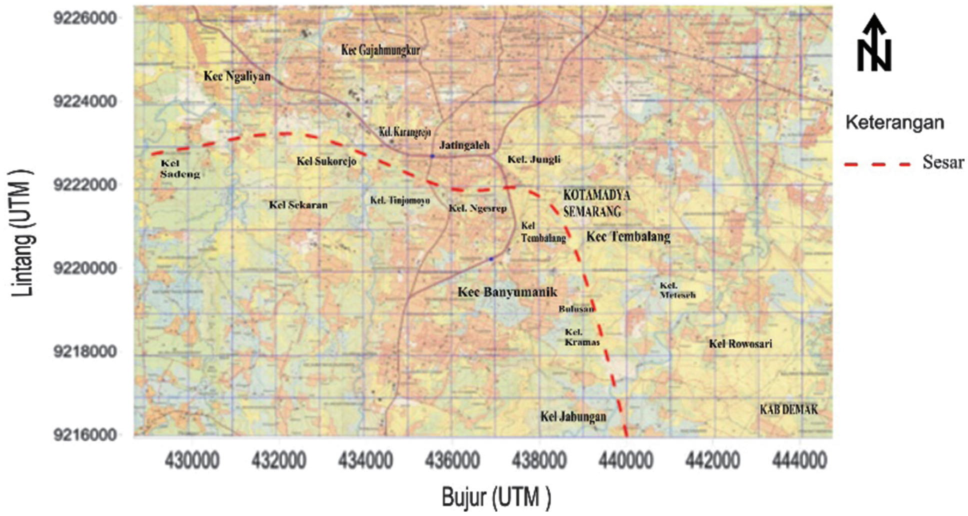

Fig. 5. Estimation of Semarang fault based on magnetic methods and geology survey.

anomaly contour map of total magnetic field can be seen in Figure 2.

To estimate the location of faults (anomaly), from the anomaly data of total magnetic field, value or point of horizontal gradient was calculated in east-west direction and north-south direction. Location of anomaly was in the maximum horizontal gradient.[6,7] Horizontal gradient map in a north-south direction can be seen in Figure 3(A), while the east-west direction can be seen in Figure 3(B).

As comparison in anomaly data of total magnetic field, the researcher also conducted the transformation of pseudo gravity and its result shown in Figure 4 in which the value or point of pseudo gravity in faults location was between minimum and maximum points.[6,7]

Based on the above criteria and the result of geology survey and according to the observation of revealed rocks in the area, in Figure 5 we can see the location of Semarang faults. Estimation of the Semarang fault location resulting from this research (Fig. 5) generally corresponds to the location of the fault as outlined in geology map.[1] Nevertheless map the location of fault results from this study in more detail.

5. CONCLUSION

After conducting the research using magnetic methods in Semarang area, we can conclude that Semarang faults with dip of 35 degrees to east and north. Semarang faults was found from Kali Pengkol between Kalikayen and Jabungan village to the north through Bukit Kencana Jaya, Bulusan, Keramas continued to the north to Jurangblimbing village and SendangKenongo. From Sendangkenongo, it turned to the west through Trangkil, Ngesrep village and to the north-west direction to south Karangrejo and then continued to the west direction until Ngelosari, Sadeng village.

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