Gravity observation of field camp geophysics in Karangsambung using Data Acquisition 2005-2019

E J Wahyudi¹, A Laesapnura¹ and D Sukmayadi¹
¹Institut Teknologi Bandung

Abstract. The study of field camp geophysics in Karangsambung has been done since 1996 until 2019 by geophysical engineering ITB. During the field activities, students was assigned with several data acquisition using various geophysical methods. One of the most common method to conducted alongside with surface geological mapping is gravity. Compilation of gravity data during the activities will be presented in this work. There are two categories of data compilation during 24 years: data compilation 1996-2004, and 2005-2019. The observation conducted using relative gravimeter with data distribution already cover geological surface map in the study area (Luk-Ulo Melange Complex, Karangsambung Formation, Totogan Formation, and Diabas Intrusion). The pattern of gravity observation shows correlated with topographic variation. Range gravity observation from this study is about 62 mGal.

1. Introduction

Field camp activities becomes an important for geoscience students, and it has been conducted worldwide in many universities. Several field camp course reports [1-3] describe many advantages for students because the souls of exploration with curiosity started to be waken-up. More experience for students in the field will help their improvement (technical skills and personal confidence) as exploration expert in the future. The activities in the field will set up the opportunity for students to show good friendship, team work, and communication skill.

Geophysical engineering of ITB have been conducted field camp course in Karangsambung since 1996. The implementation of geophysical methods for more than two decade in Karangsambung along side with surface geological mapping. In this work, we would like to show our summary of gravity data in the study area. The map compilation will shows coverage of all data and can be use to provide suggestion for next survey in field camp course. This study also part of the work of compilation data that started initially in 2015 and we already published for geomagnetic data only [4]. In this work, the summary of the activites was completed during the covid-19 pandemic period and the merge of gravity data from 24 years of annual field camp course also supported with gravity observation that can be link-up to the reference value of gravity from absolute gravimeter that previously observed in ITB campus.

2. Gravity Observation

Gravity data are collected using relative gravimeter (LaCoste & Romberg (LCR) and Scintrex CG-5). In this work, a compilation data will be categorize into two groups as follow: (a) data 1996-2004 and (b) data 2005-2019. The main data for this work is only group (b) because the data in group (a) insufficient and lack some of the essential information in mapping. We cannot find any reports from the data in 1996 to 1998, so the summary of field camp activities started in 1999 is shown in the table 1. From table 1 we can see the surveys conducted for each year, most of them in June. Only in 2015 the Scintrex CG-5 used in the data acquisition for undergraduate programe.
Table 1. Summary of Gravity Data Acquisition

| Date       | Month | Year | LCR G-504 | LCR G-1158 | SC CG5 | Loop | #obsv. | tide (μGal) |
|------------|-------|------|-----------|------------|--------|------|-------|-------------|
| 1st        | Jun   | 1999 | v         | v          |        | 1    | 47    | (-73 to +106) |
| 11th       | Jun   | 2000 | v         | v          | v      | 1    | 38    | (-58 to +110) |
| 6th        | Jun   | 2001 | v         | v          | v      | 1    | 47    | (-45 to +107) |
| 5th        | Jun   | 2002 | v         | v          | v      | 1    | 34    | (-60 to +150) |
| 5th        | Jun   | 2003 | v         | v          | v      | 1    | 35    | (-34 to +75)  |
| 5th        | Jun   | 2004 | v         | v          | v      | 1    | 34    | (-60 to +150) |
| 14th-16th  | Jun   | 2005 | v         | v          | v      | 3    | 79    | (-33 to +91)  |
| 18th-20th  | Jun   | 2006 | v         | v          | v      | 5    | 141   | (-47 to +105) |
| 19th-21st  | Jun   | 2007 | v         | v          | v      | 6    | 142   | (-49 to +92)  |
| 10th-12nd  | Jul    | 2008 | v         | v          | v      | 3    | 97    | (-28 to +88)  |
| 14th-17th  | Jun   | 2009 | v         | v          | v      | 4    | 157   | (-40 to +57)  |
| 21st-25th  | May   | 2010 | v         | v          | v      | 5    | 148   | (-51 to +124) |
| 30th-3rd   | May-Jun | 2011 | v         | v          | v      | 5    | 135   | (-68 to +111) |
| 20th-24th  | Jun   | 2012 | v         | v          | v      | 10   | 151   | (-101 to +141) |
| 4th-8th    | Jun   | 2013 | v         | v          | v      | 10   | 175   | (-11 to +125) |
| 13th-17th  | May   | 2014 | v         | v          | v      | 9    | 236   | (-78 to +148) |
| 7th-10th   | May   | 2015 | v         | v          | v      | 8    | 149   | (-64 to +150) |
| 25th-28th  | Apr   | 2016 | v         | v          | v      | 8    | 257   | (-56 to +113) |
| 15th-18th  | Jun   | 2017 | v         | v          | v      | 8    | 281   | (-49 to +87)  |
| 16th-20th  | Apr   | 2018 | v         | v          | v      | 8    | 176   | (-89 to +170) |
| 31th-3rd   | Jul-Aug | 2019 | v         | v          | v      | 8    | 258   | (-107 to +193) |

For this work, we have 106 of total loops of relative gravimeter surveys and 2817 of total gravity observations (figure 1). Some statistics of gravity data acquisition from 2005-2019 surveys shows that 2592 observations conducted with LCR G1058 (1478 observations), LCR G504 (1061 observations), and Scintrex CG5 (53 observations). The variation for tide correction for each year can be seen in figure 2. Brief evaluation of data quality from students observation using relative gravimeters can be seen in figure 3 and figure 4. In figure 3 we can see the drift correction for each loop assumed as linear (with zero at the start and (±) maximum stretch/shrink of the spring gravimeter sensor at the end of loop). In figure 4, the coefficient correlation value for each loop shows the relation of gravity data and elevation data. From figure 3 and figure 4, we have 54 loops in the range of maximum drift (-100 to 100 μGal) and 83 loops in the range of negative and strong coefficient correlation (-0.96 to -1.00) between gravity and elevation data.

Map of gravity data distribution in the study area shown as dot-plot in figure 5. Local gravity or relative gravity value with respect to the BASE station show in figure 5A and elevation data from handheld altimeters shown in figure 5B. Qualitatively, the maps in figure 5 shows negative correlation (with quantitative value of coefficient correlation already mention in figure 4).
Figure 1 Bar-plot of loop and observation number for each year.

Figure 2 Bar-plot of minimum and maximum value of tide correction for each year.

Figure 3 Dot-plot of drift correction (maximum stretch/shrink) for each loop.
3. Gravity Observation Map

We already have the data of absolute gravimeter in Bandung (ITB) that obtained from collaborated study with JICA in 2013 and 2014. The documentation of gravity observation using absolute gravimeter can be seen in figure 6. In September 2019, we conducted the gravity survey from Bandung-Karangsambung to get the value of gravity observation. The observation activity was planed to connect ITB stations (TG and GD) with BASE station in Karangsambung using relative gravimeter Scintrex CG-5. As illustrated in figure 7, we set up the transportation from Bandung-Banjar-Gombong-Karangsambung. In figure 7, we also can see the quality of gravimeter leveling using dot plot of digital data of tilt-X and tilt-Y Scintrex CG-5. Most of the data observation in the activity September 2019 was plotted inside the tolerance area (inside the red circle in figure 7). During mobilization in September 2019, we have 11 gravity observation in Bandung, Malangbong, Banjar, Ciamis, Cimanggu, Kebasen, Kebumen, and Karangsambung (table 2).
In Karangsambung (our study area), we use the value from ID station of LKS (table 2) as our BASE with gravity observation 978201385.048 μGal. The interpolation contour for gravity observation map shown in figure 8. The gravity observation map overlayed with outcrop locations in Karangsambung area (relatively similar as coverage in previous study [4]). Range gravity observation from the map is about 62 mGal (978144.303 to 978208.783 mGal).
Table 2 Gravity Observation from September 2019 activity

| ID STS | #Obsv. | StDev. (μGal) | G obs (μGal) | Location     |
|--------|--------|---------------|--------------|--------------|
| MBJR   | 12     | 87.950        | 978,201,481.760 | Banjar       |
| MCMS   | 24     | 103.436       | 978,144,228.506 | Ciamis       |
| MCMG   | 24     | 104.712       | 978,144,365.123 | Cimanggu    |
| BSCB   | 42     | 104.302       | 977,968,675.235 | ITB         |
| TM     | 18     | 123.078       | 977,968,481.796 | ITB         |
| BTSK   | 12     | 104.826       | 978,201,062.633 | Karsam      |
| LKS    | 24     | 102.564       | 978,201,385.048 | Karsam      |
| TBKS   | 12     | 104.895       | 978,201,188.185 | Karsam      |
| KBSN   | 12     | 89.643        | 978,179,605.977 | Kebasen     |
| KKEB   | 96     | 158.300       | 978,217,162.603 | Kebumen     |
| MLBG   | 24     | 105.355       | 978,020,603.567 | Malangbong  |

Figure 8 Gravity observation map from data 2005-2019.

4. Conclusion
The pattern of gravity observation shows negative correlation with topographic data variation. Low gravity observation can be seen in the picture correlate to high topographic area. Data distribution from field camp surveys already cover some geological surface map (Diabas Intrusion, Totogan Fm., Karangsambung Fm., and Luk-Ulo Melange Complex). Range gravity observation from this study is about 62 mGal.
5. References

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