INTEGRATED GEOPHYSICAL INVESTIGATION OF ABANDONED LANDFILL, GRANDVIEW TRIANGLE, KANSAS CITY, MISSOURI

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Abstract

The University of Missouri-Rolla (UMR) acquired a suite of geophysical data (magnetic and electromagnetic) in the Grandview Triangle (GT) study area, Kansas City, Missouri for the Missouri Department of Transportation (MoDOT) as part of a broader geotechnical characterization of the site. The principle objective was to determine if a school bus is buried within the confines of the abandoned landfill (Site Landfill 47) that occupies part of the GT study area. A secondary objective was to determine if any large metallic objects (such as fuel tanks) remain buried within the abandoned fuel station sites (Site Tank 47 and Site Phillips 66) that also occupy part of the GT study area.

A preliminary interpretation of the acquired geophysical data suggests that a metallic body the size of a school bus is probably not buried in the abandoned landfill (Site Landfill 47) at GT study area. However, as a precaution we recommend the ground-truthing of the most prominent and areally-extensive geophysical anomaly observed on the acquired geophysical data set. The interpretation of the geophysical data also suggests that one or more buried tanks may be present at Site Tank 47 and Site Phillips 66. Again we recommend the acquisition of ground-truth information.

Introduction

In March 2001, a field crew from the University of Missouri-Rolla (UMR) acquired a suite of both magnetic and electromagnetic data in the Grandview Triangle (GT) study area for the Missouri Department of Transportation (MoDOT). The GT study area is situated immediately to the east of interstate I-71, in Kansas City, Missouri (Figure 1).

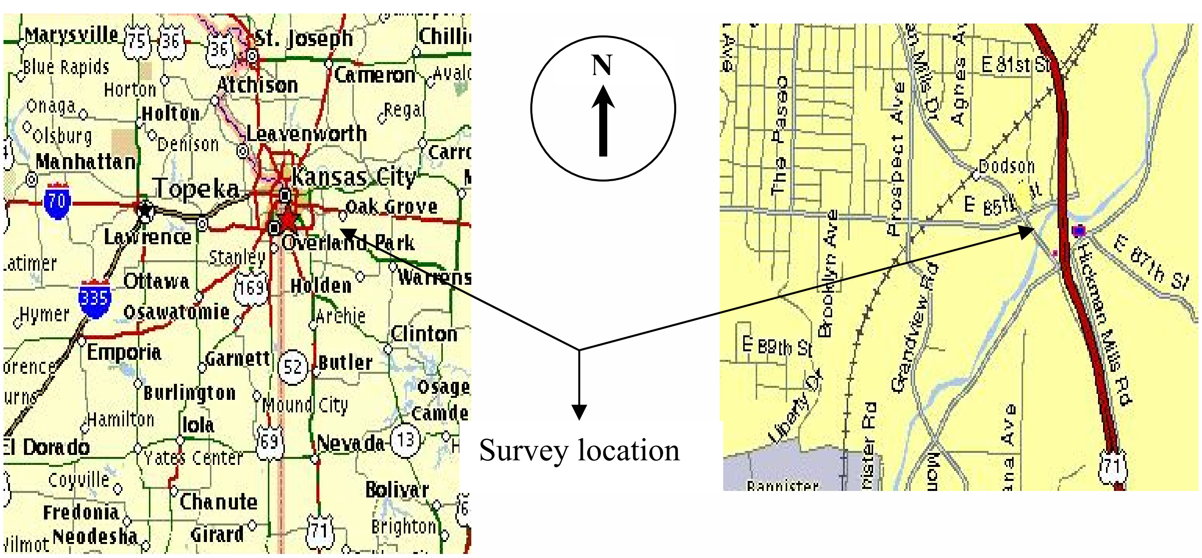


Figure 1: Grandview Triangle (GT) study area.

The GT study area is sub-divided into three 3 separate geophysical survey sites. Site Landfill 47 (Figures 2 and 3), located northwest of Hickman Mills Drive, is currently used as a school bus parking lot. Site Tank 47, an inactive/abandoned fuel pump station (Figure 4), is located immediately adjacent to the school bus parking lot office. Site Phillips 66 (Figure 4) is an active fuel pump station

Site Landfill 47 (Figures 2 and 3) is currently used as a school bus parking lot. Approximately, one half of this site is paved; the other half is gravel-topped. The paved section of Site Landfill 47 was essentially free of visual surface debris, however metallic debris, implanted spikes and fences, etc., were somewhat randomly distributed across the graveled section of the site. Some of these visually detected metallic objects generated identifiable electromagnetic and magnetic signals on both the magnetic and electromagnetic anomaly maps.

Site Tank 47 was paved and free of metallic debris. The Philips 66 site is also paved, however it was overlain in places by metallic debris (e.g., abandoned pump, scrap metal, etc.) that generated identifiable signal on the magnetic and electromagnetic anomaly maps.

Methodology

A grid consisting of seventy north-south survey lines was established on Site Landfill 47 (Figures 2 and 3. The line spacing was 7 feet. The station interval (separation between data collection points) along each line was also 7 feet. For acquisition purposes, the Site Landfill 47 grid was sub-divided into 3 sections (A, B and C; Figure 3). While geophysical data were being collected on a specific section, the school buses were parked in the other two sections in an effort to ensure the electromagnetic and magnetic signatures of the buses did not mask the signals generated by subsurface features of interest. Data at Site Tank 47 and Site Phillips 66 were acquired using a 5 ft by 5 ft survey grid (Figure 4).

A Trimble GPS G-856AX (Global Positioning System) was used to survey the GT study area. The Trimble GPS G-856AX was used with a Trimble GPS receiver. Four satellites were used to calculate reading positions.

A Geometrics G-856 proton precession magnetometer was used to record relative total magnetic intensity data at each station location in the GT study area. A GEM-300 was used to record multiple frequency (low, medium, high) electromagnetic induction data. The effective depth of exploration for a given earth medium is determined by the operating frequency of the primary electromagnetic signal. In effect, the lower EM frequencies penetrate deeper than higher frequencies. Therefor, measuring the earth response to multiple frequencies (low, 330Hz; medium, 3870Hz; high; 19950Hz) is equivalent to measuring the earth response from multiple depths (deep, intermediate, shallow).

Interpretations and Results

The presentation of data from Site Landfill 47 is in two forms. The total magnetic intensity data are plotted on a composite plan view map (Figure 5), whereas the GEM-300 electromagnetic data are plotted (as acquired) on three separate base maps (Figures 6, 7 and 8) corresponding to sections A, B and C, respectively. The Site Tank 47 magnetic and electromagnetic data are plotted as Figures 9 and 10, respectively. The Site Phillips 66 magnetic and electromagnetic data are plotted as Figure 9 and 10, respectively.

Several prominent anomalies are identified and labeled on the magnetic and electromagnetic data sets from Site Landfill 47 (Figures 5, 6, 7 and 8). Each of these labeled anomalies (or anomalous zones) is characterized by an anomalous magnetic signature and an anomalous electromagnetic (EM) signature.

The high frequency EM anomalies were generated by metal objects at or near the surface; the medium frequency anomalies were generated mostly by metal objects in the shallow subsurface (est. upper 2 feet); the low frequency anomalies were generated mostly by metal objects at estimated depths of between 2 ft and 10 ft. Anomalies 1 and 2 (Figures 5, 6, 7 and 8), are characterized by magnetic anomalies and medium to high frequency EM anomalies (Figures 6 and 7; Caption B). This suggests these geophysical anomalies were generated by one or more metal objects buried at depth within the landfill. EM anomaly 1 is linear and could be generated by a buried school bus – but the superposed effects of a multiple number of buried metal objects more likely cause it. EM anomaly 2 is also attributed to the presence of a large buried metal object within the landfill. Its dimensions suggest the source is significantly smaller than a school bus. The EM anomalies collectively labeled anomaly 3 are most prominent on the high and medium frequency plots, and are attributed to metal objects at or near the surface. Anomaly 4 is also most prominent on the medium and high frequency displays, suggesting a shallow source. The small areal extent of anomaly 4 also suggests it is not generated by a buried school bus. EM anomaly 6 (Figure 8) is attributed to the presence of a utility pole. EM anomalies 7 and 8 (Figure 8) are attributed to observed metal spikes and a metal trashcan, respectively.

Several prominent anomalies are identified and labeled on the magnetic and electromagnetic data sets from Site Tank 47 (Figures 9 and 10). EM anomaly 1 is attributed to a visible surface fuel tank. EM anomaly 2 (Figure 10) does not have a visible surface source and is most prominent on the low frequency display indicating it could be caused by a buried tank or other buried metal objects or debris.

Several prominent anomalies are also identified and labeled on the magnetic and electromagnetic data sets from Site Phillips 66 (Figures 11 and 12). EM and magnetic anomaly 2 is characterized by a low frequency EM signature and could be indicative of the presence of a buried fuel tank. Anomalies 1 and 4 are attributed to the presence of trash canisters. Anomaly 3 is attributed to a visible surface fuel tank.

Conclusions

Our interpretation of the Site Landfill 47 suggests that only one of the visually prominent EM/magnetic anomalies (anomaly 1; Figures 5, 6 and 7) could be generated by an abandoned buried school bus. Only this anomaly has an areal extent consistent with the dimensions of a school bus. Although this anomaly is most probably caused by the superposed effect of multiple buried objects, it should be ground-truthed through drilling or excavation.

Prominent anomaly 2 on the Site Tank 47 data set (Figures 9 and 10) does not have a visible surface source and could be caused by a buried tank or other buried metal objects or debris. We recommend ground-truthing.

Anomaly 2 on the Site Phillips 66 data set (Figures 11 and 12) is also characterized by a low frequency EM signature and could be indicative of the presence of buried a fuel tank. Again we recommend ground-truthing.

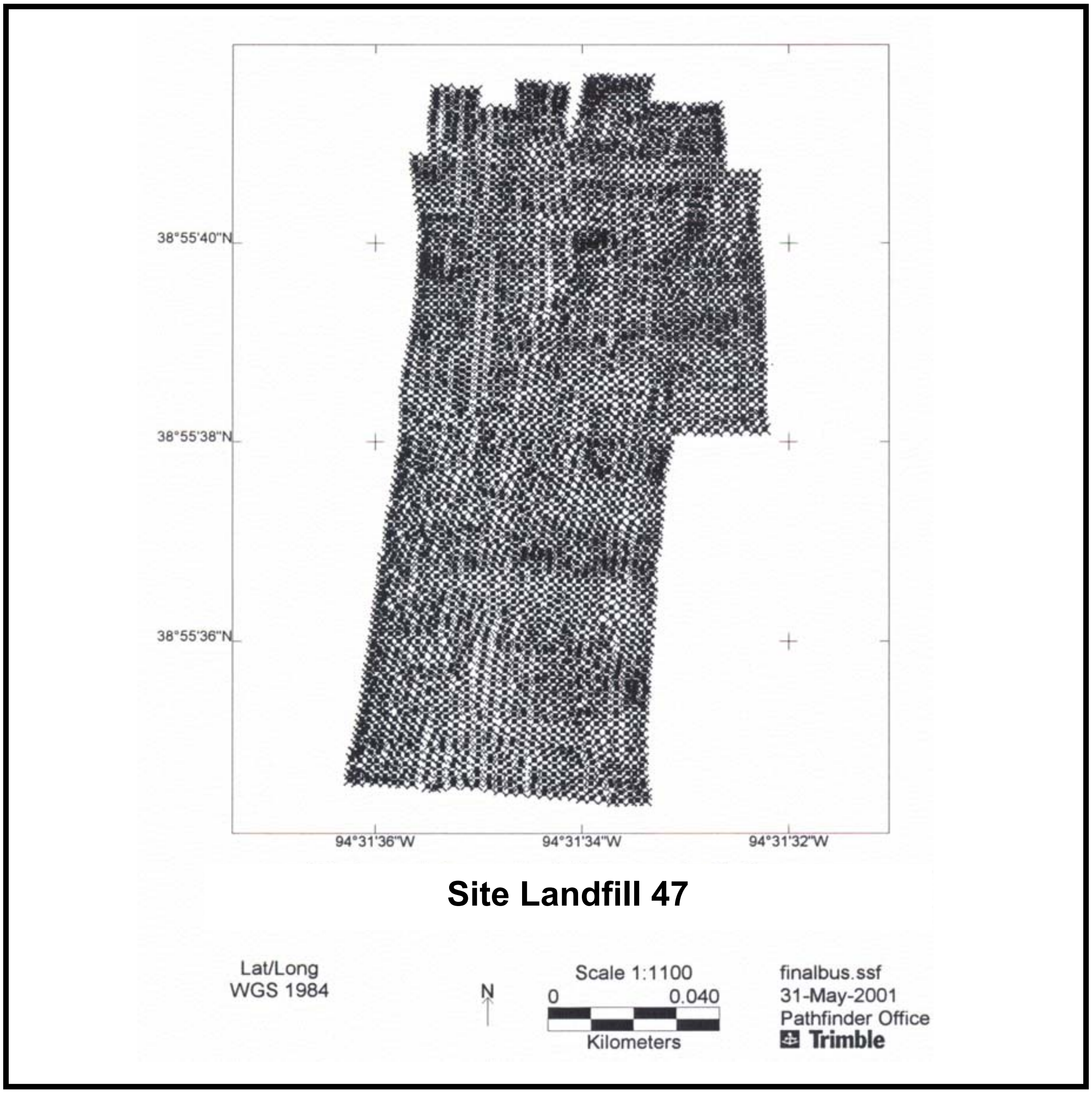


Figure 2: Grouping GPS data sets over Site Landfill 47.

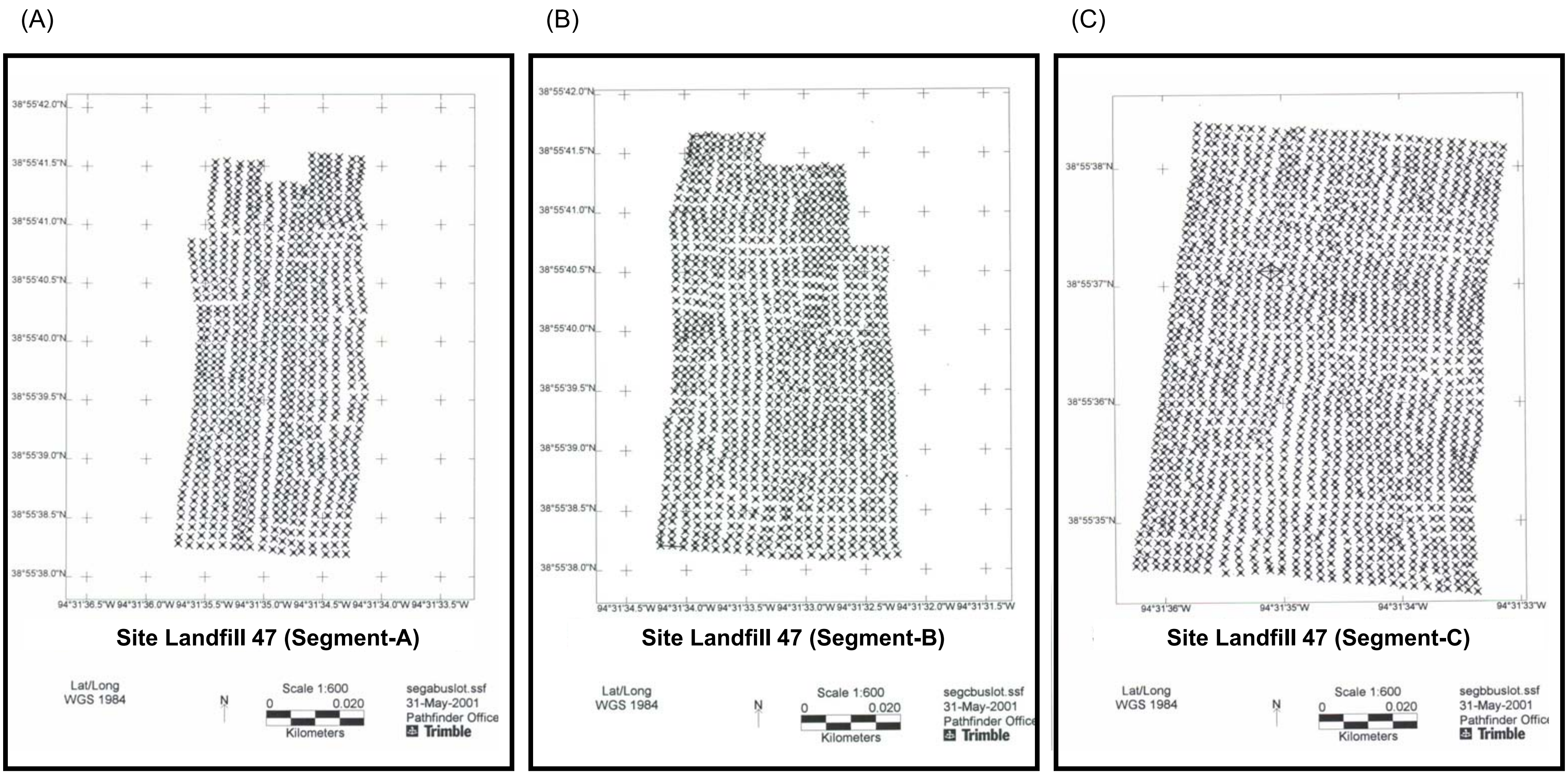
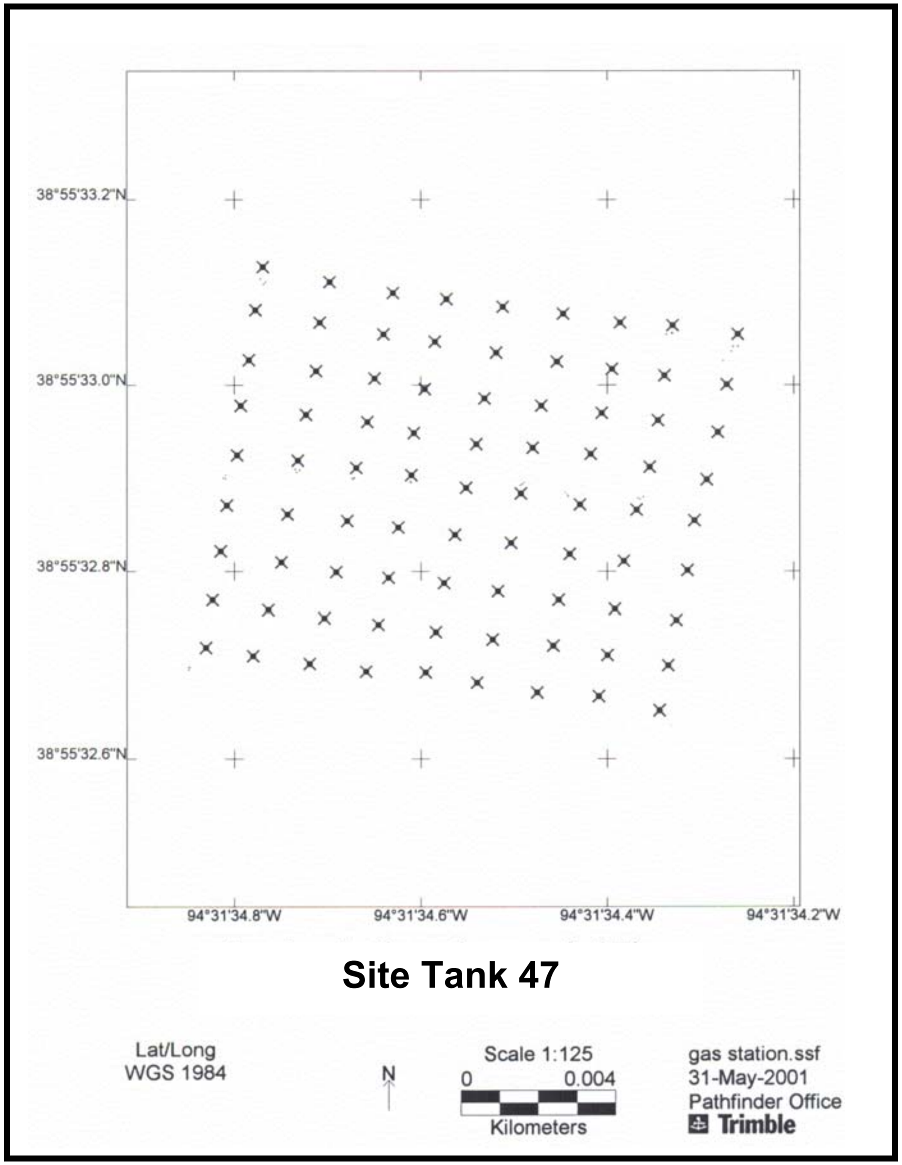


Figure 3: GPS data sets over Site Landfill 47, (A) Survey station location segment A, (B) Survey station location segment B, (C) Survey station location segment C.

(A)



(B)

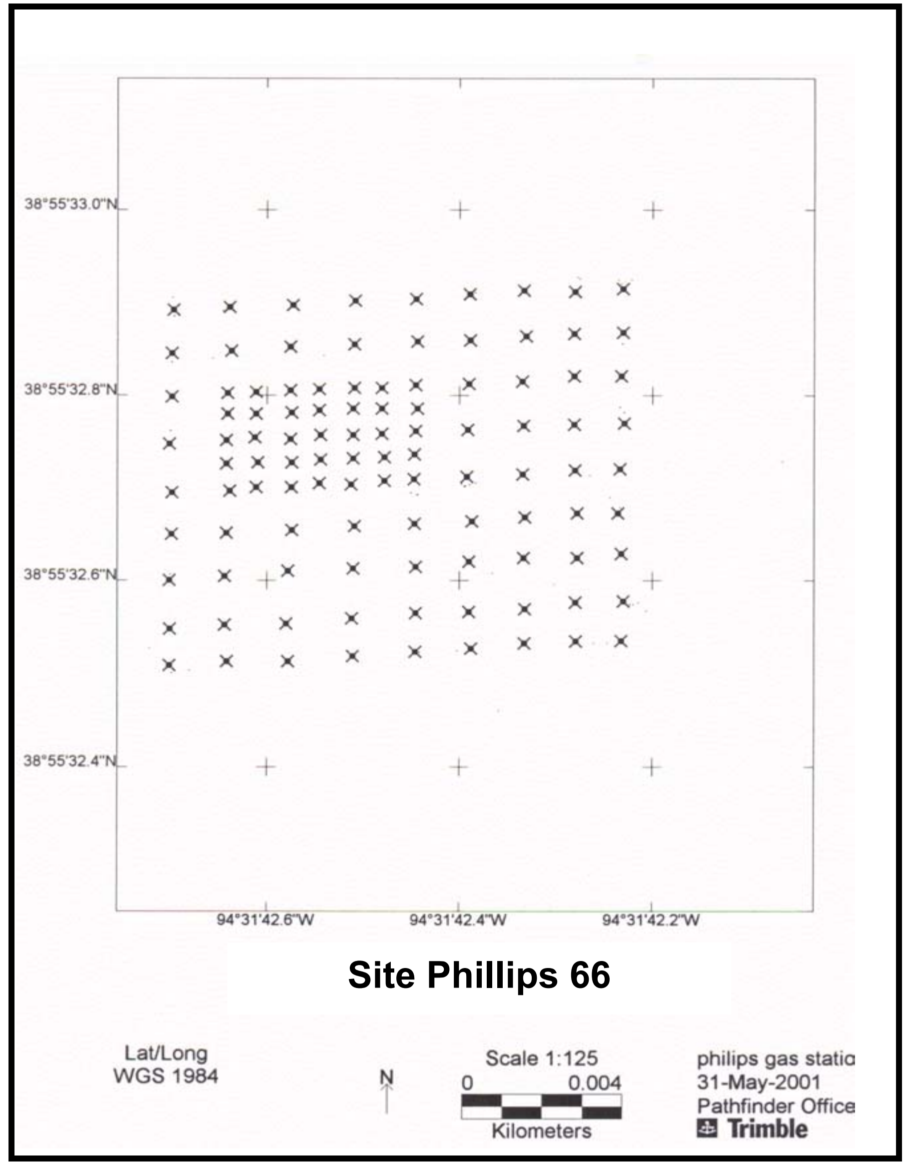


Figure 4: GPS data sets (A) over Site Tank 47 (B) Site Phillips 66.

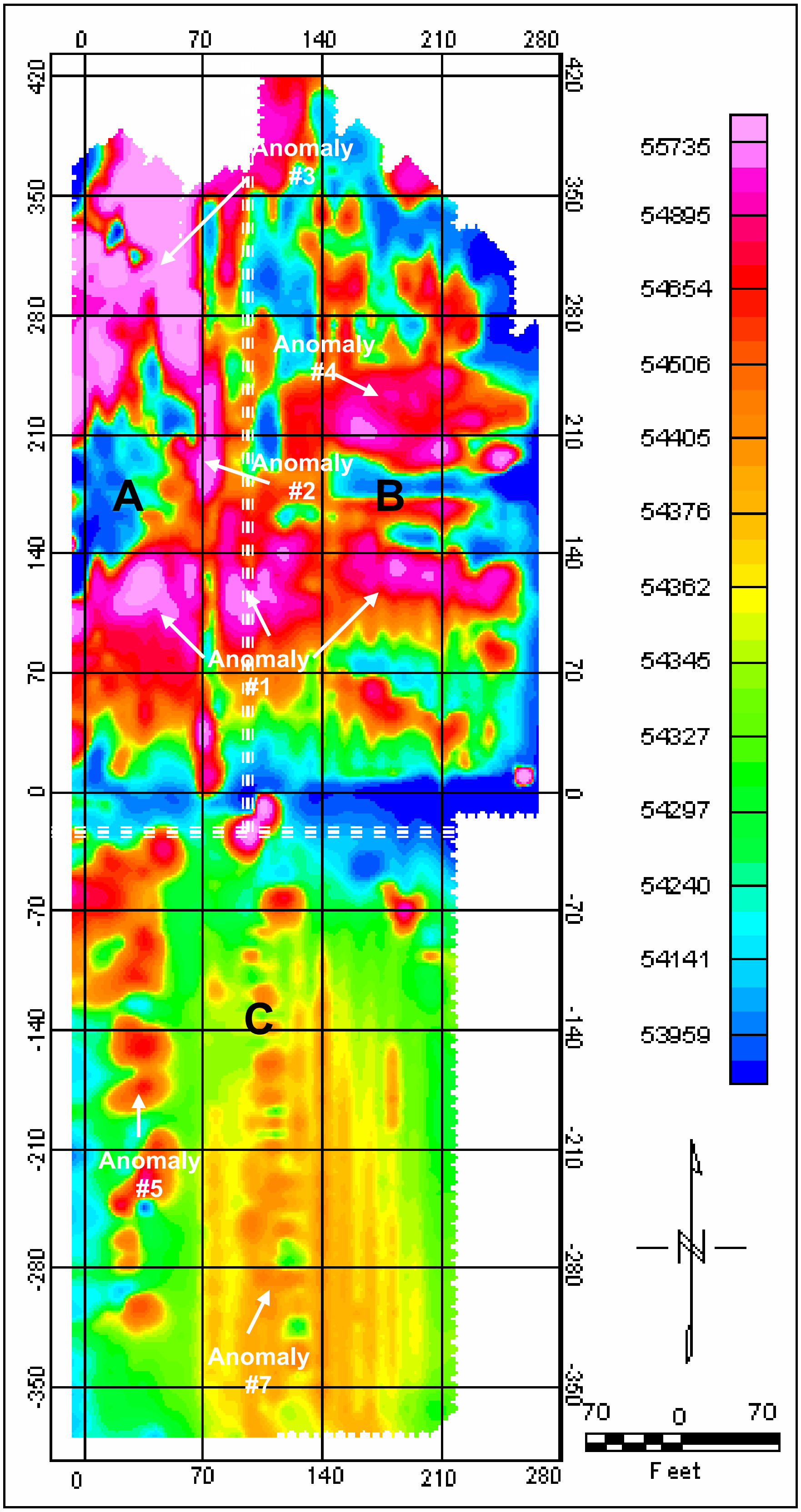


Figure 5: Magnetic data in Site landfill 47 (unit in gammas).

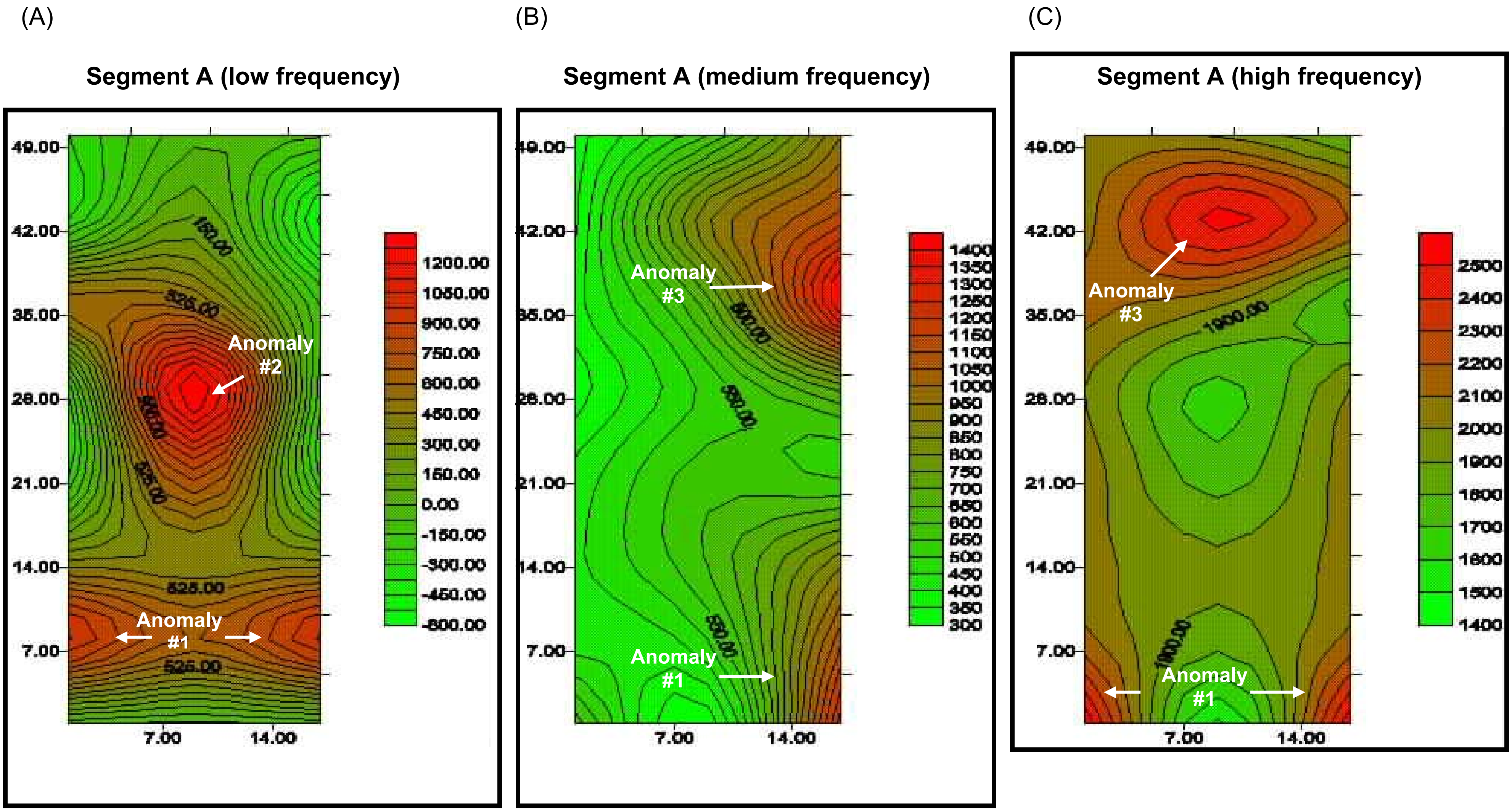


Figure 6. Electromagnetic data in Site Landfill 47 Segment A, (A) low frequency, (B) medium frequency, (C) high frequency (unit in gamma).

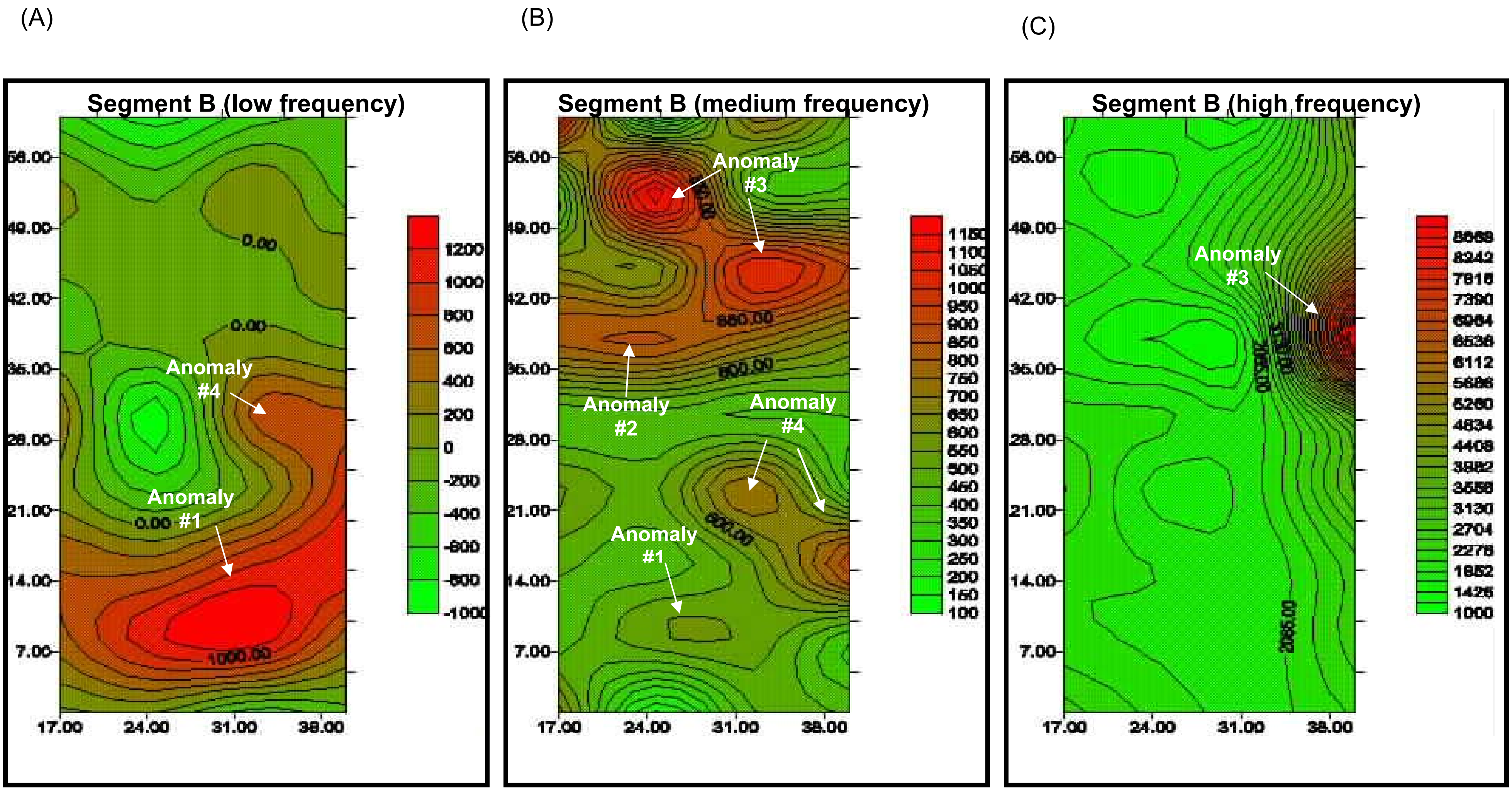


Figure 7: Electromagnetic data in Site Landfill 47 Segment B, (A) low frequency, (B) medium frequency, (C) high frequency (unit in gamma).

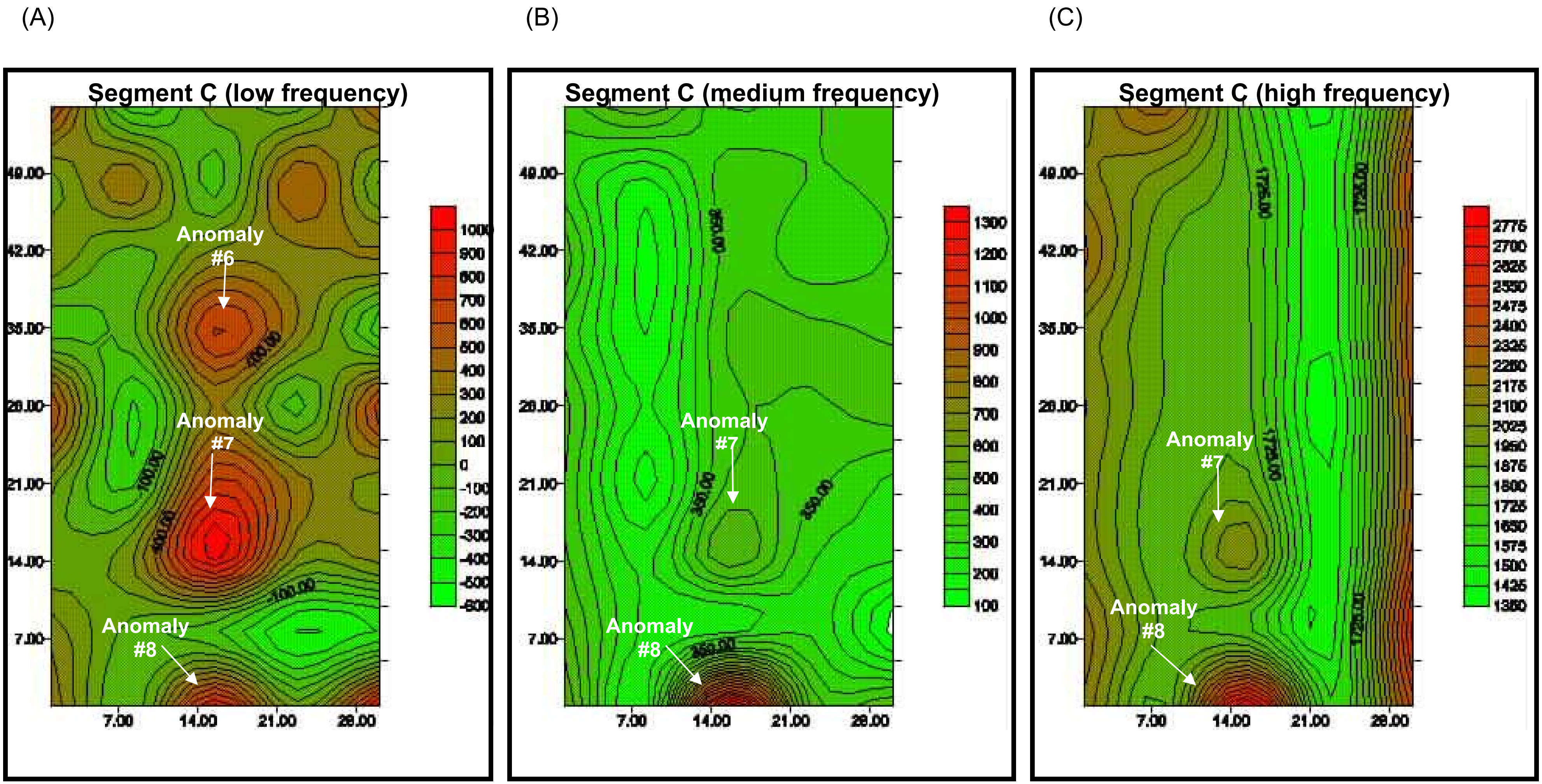


Figure 8: Electromagnetic data in Site Landfill 47 Segment C, (A) low frequency, (B) medium frequency, (C) high frequency (unit in gamma).

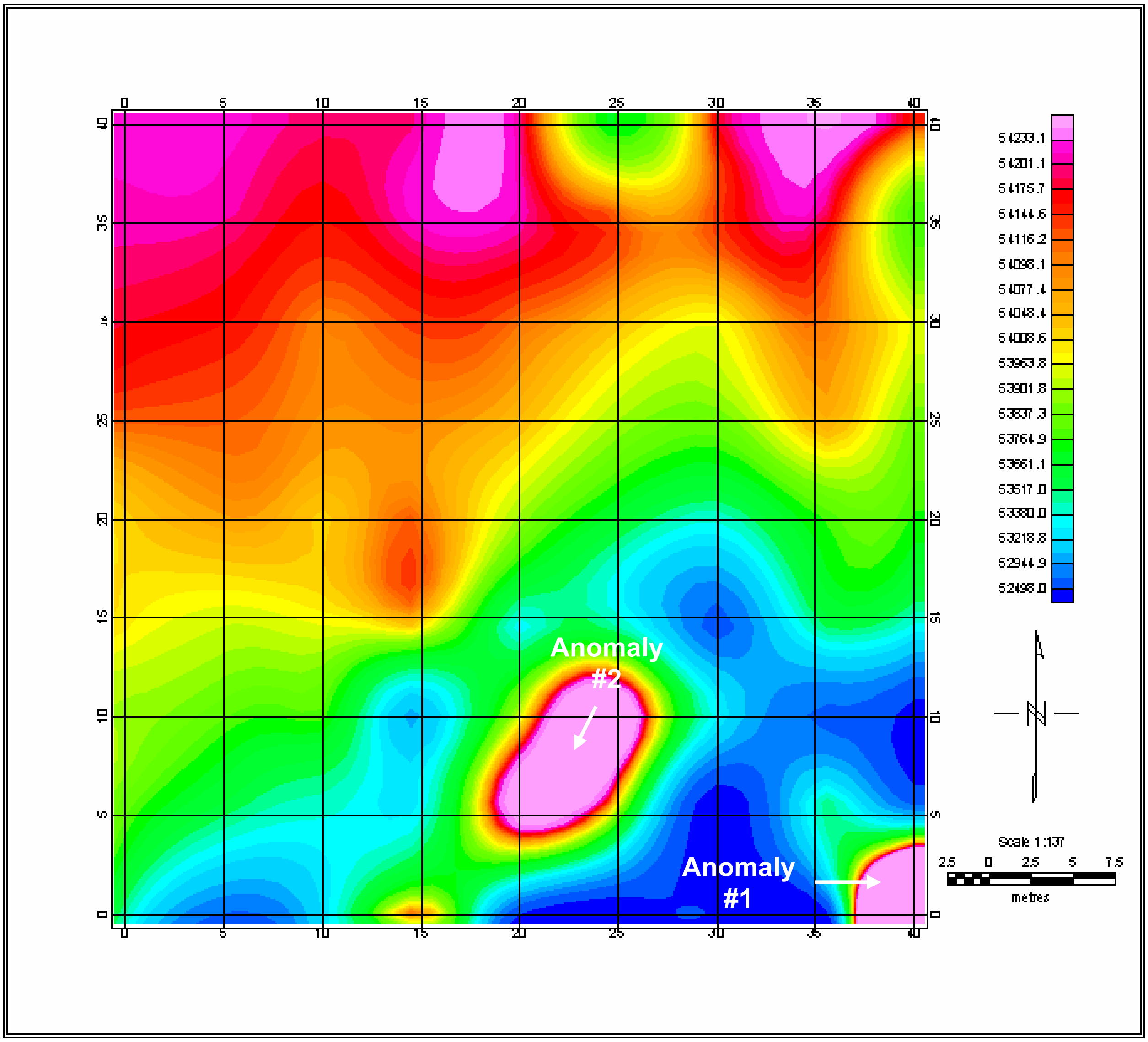


Figure 9: Magnetic data in Site Tank 47 (unit in gammas).

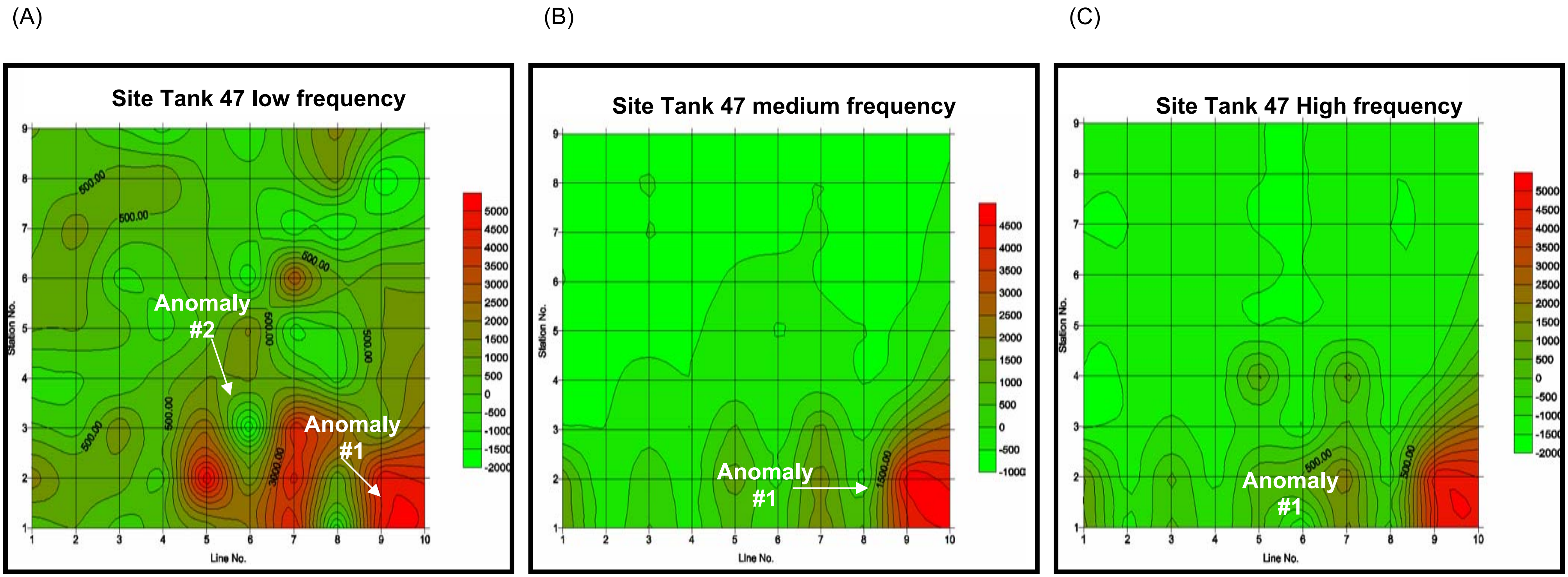


Figure 10: Electromagnetic data in Site Tank 47, (A) low frequency, (B) medium frequency, (C) high frequency (unit in gamma).

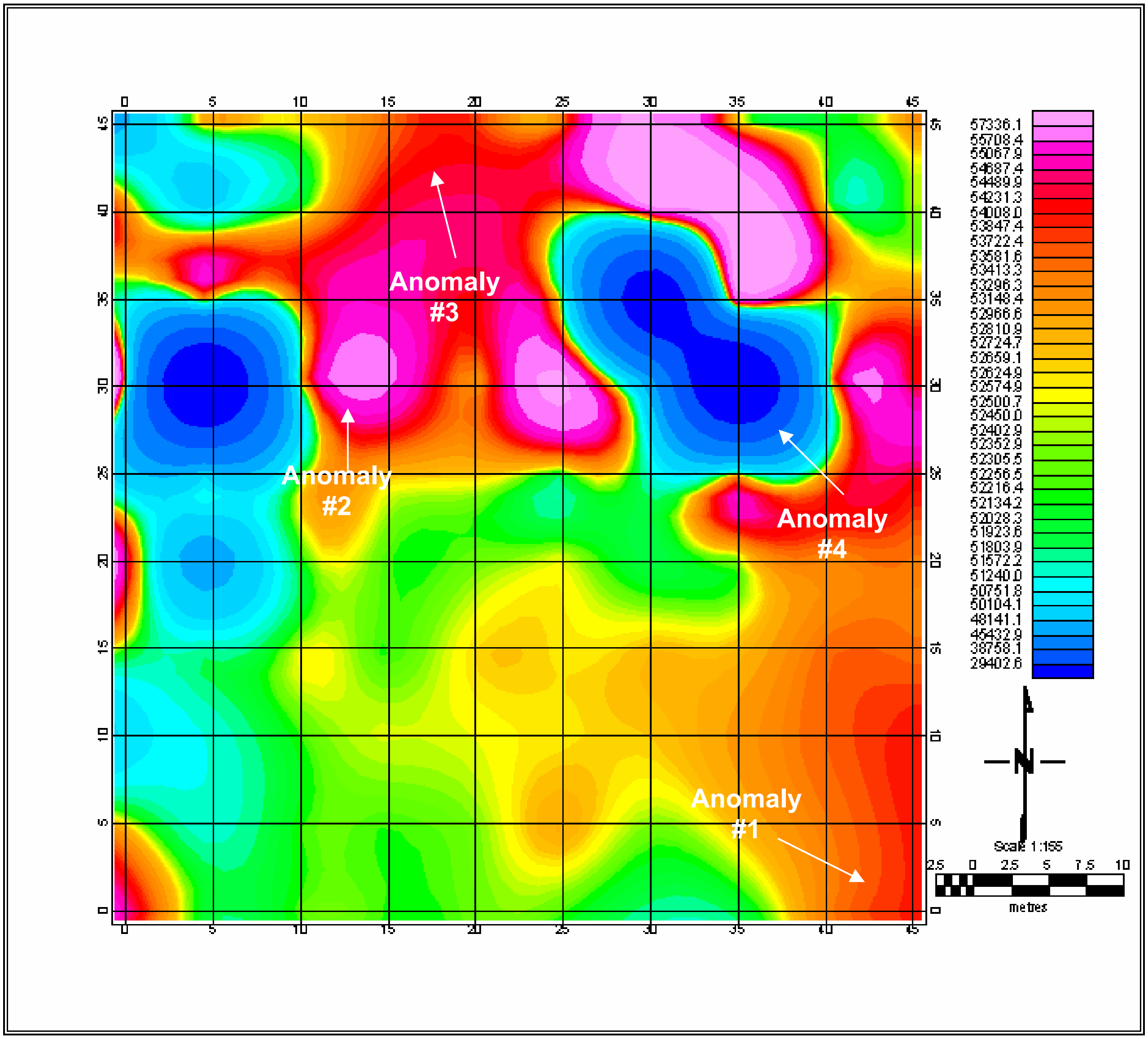


Figure 11: Magnetic data in Site Phillips 66 (unit in gammas).

(A) (B) (C)

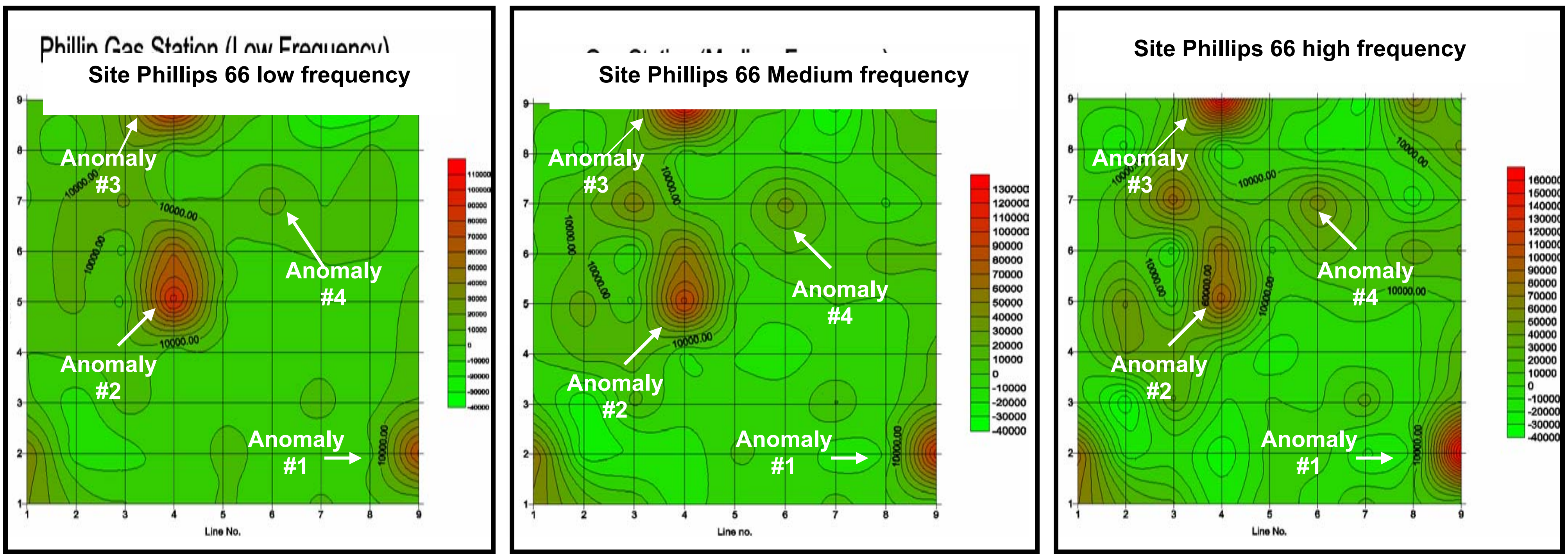


Figure 12: Electromagnetic data in Site Phillips 66, (A) low frequency, (B) medium frequency, (C) high frequency (unit in gamma).