Magnetic Data Reduction of Basement Correction

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Introduction

The magnetometer survey is a passive geophysical technique that measures the contrasts of magnetic properties between the feature of interest and its surrounding environment. This technique has wide applications in mineral and archeological investigations. Rocks and minerals with high ferrous content provide anomalous signatures than the background enabling to screen them.

The magnetometer surveys are always disturbed by temporal variations: Diurnal variation, Magnetic storms and Micro-pulsation, which depend upon the time and space. Magnetic surveys are not done during magnetic storms. The diurnal variation cannot be avoided and the noise will disturb the data quality. To eliminate the diurnal variation from data a base station is used in magnetic surveys.

In order to overcome the temporal variations, a base magnetometer is needed to correct these time dependent variations. . While the base records the temporal variation of the area the rowing magnetometer records both the temporal variation and the local anomaly. For a large-area survey, or an airborne survey, the magnetic field may be monitored at several locations, continuously, to identify the spatial variations of the time-varying field.

If the rover is too far away from the base station, the time-varying fields measured at the rover will differ from those measured at the base station, resulting in increased error. The effective range of a single base station is generally considered to be less than 100 km for air-borne survey and for a ground survey it is about 200 m. This distance may vary according to the survey area and the expected accuracy.

Owing to the large area covered by an aeromagnetic survey, a single magnetic base station would not have provided adequate coverage. Instead, several base station magnetometers are in operation during the survey (Hrouda *et al*, 2009).

The base correction is conducted with the assumption that the environmental effects over the survey area are constant. The base magnetometer is synchronized with the rowing component and the environmental effect is removed according to the respective time stamps. However, if the survey area is large, the base station needs to be shifted as the assumption is no longer valid. As the crustal magnetic component of locations where the base station(s) establish during a survey is not a constant, a correction is needed to be applied for base stations. The present work attempts formulating a model for the basement correction.

Methodology

A mathematical model that completely describes the magnetic surveys, with two sub surveys was created. This method can be extended for many sub surveys, considering two sub surveys at a time. The variables were: IGRF value, local anomaly, environmental noise, local anomaly at the base station, and the location.

The mathematical model finally describes a relationship of the magnetic intensity gradient between the two magnetic basements and shift of the magnetic values at the boundary of the two sub surveys. The two sub surveys were considered as 'X' and 'Y'.

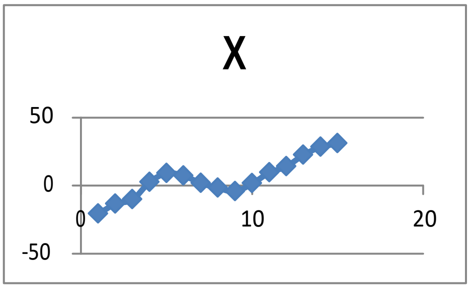

Figure 1. Magnetic intensity at the boundary. (The X sub survey)

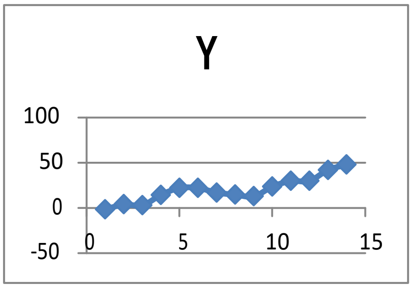

Figure 2. Magnetic intensity at the boundary. (The Y sub survey)

The model was confirmed by a test trial. This was done in a grid of 5m intervals, in an area of 20m x 40m. The area was divided into two as two sub surveys for data acquisition. Another survey was done for the entire area to compare the results. The boundary line of the two sub surveys were surveyed separately. GSM-19TW model overhauser effect Proton Precession Magnetometer was used for the data acquisition.

The diurnal correction was done by the "Gem link 5.3" software. The shift was calculated using Microsoft excel 2010 software. Two data sets were prepared using the suggested method and the conventional method. The data were graphed using the "Geosoft Oasis Montaj" software.

Results and Discussion

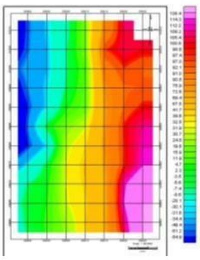

Figure 3. Anomaly map of the corrected data.

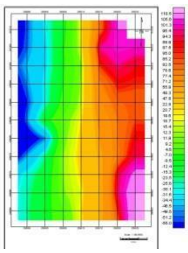

Figure 4. Magnetic anomaly map created using the conventional method.

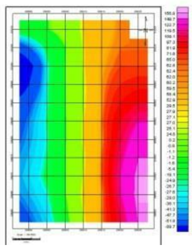

Figure 5. Anomaly map of ground. (Measured using one survey)

Both Figure 4 and Figure 5 are derived from two surveys. Hence the deviation of the pattern is much critical at the boundary of two surveys. The anomaly in pink color (at the bottom right) in Figure 4 shows some difference in Figure 5.

The pink color region starts from the bottom of the map (239020 E, 236965 N) and gradually decreases northward. According to Figure 3 and Figure 5 this decrement continues further north while it discontinues at the middle in Figure 4 (236985 N).

The color scale is not the same in each figure which becomes the major disadvantage in analyzing. The same color does not represent same value in the each figure. Hence much attention must be paid before coming to a conclusion.

Conclusions

If the magnetic intensity difference between the two base stations is too high, this correction will give the correction for the data by taking them onto a common platform. But if the magnetic intensity difference between the two base stations is negligible, this type of correction may not be necessary.

References

Hrouda, F.; Krejci, O.; Potfaj, M. & Stranik, Z.: Magnetic fabric and weak deformation in sandstones of accretionary prisms of the Flysch and Klippen Belts of the Western Carpathians: Mostly offscraping indicated, TECTONOPHYSICS, 2009, 479, 254-270.