ASEG-PESA 2015
Geophysics and Geology together for Discovery
24th International Geophysical Conference and Exhibition
15–18 February 2015 Perth, Western Australia

Using AMT in the new Zambian copperbelt (Enterprise and Kansanshi case study)

Adouley Guirou
First Quantum Minerals
Leve1, 24 Outram Street, Perth
Adouley.guirou@fqml.com

SUMMARY

During 2012 and 2013 FQML through its Zambian exploration team acquired about 300 line kilometres of Audio magneto telluric (AMT) survey for copper and nickel exploration in the north western Zambian copper belt. Kansanshi mine and the new $2bn Kalumbila (Enterprise Nickel deposit) development project are the survey locations (see Figure1). Hence this paper is a case study discussing major aspects of the projects including but not limited to major outcomes, difficulties encountered as well as solutions for futures data acquisition in similar geological settings. Stunning results were achieved whereby basement fault and many interesting geological features were identified (See Figure 2, Tm mode section along Line 19) over Enterprise and doming structures in Kansanshi (See figure 3).However limiting factors such as mine equipment noise, accessibility, swamps, tropical rain forest and wild life were some downside during the survey.

Key words: AMT, Zambia, Enterprise & Kansanshi

INTRODUCTION

Kansanshi and Enterprise (Kalumbila) projects are located in north western Zambia with Solwezi being the major town. Kansanshi mine is situated 10 km North of Solwezi and Enterprise Ni deposit 130 km west of Solwezi. In order to generate new targets around both mines (Kansanshi and Enterprise) a major AMT survey was initiated totalising well over 300 line km. AMT stands for Audio magneto telluric which is an Electromagnetic technics using Natural sources such as solar flares and lightning to measure earth resistivity distribution.

The ratio of electric (E) to magnetic (H) fields at a frequency ω is related to resistivity of the ground by

$$\frac{E}{H} = \sqrt{i\rho\omega\mu} = Z(impedance)$$

From which

$$\rho_a = \frac{1}{\omega\mu}\left|\frac{E}{H}\right|^2$$

.

ρ_a is the apparent resistivity

Zonge's GDP 32 multi-receiver was used to record the data with frequency range of 1 to 10000 Hz and various resistivity images were produced. Inverted frequencies ranged from 16 to 8000 Hz due to resolution of the data. TM and Te mode sections calculated using Zonge's SCIP2D program where Tm is given by this formula Tm= Ex/Hy and Te= Ey/Hx.

In Kansanshi, the survey intended to map smaller domes or pimples under Kansanshi main (bigger) dome where grade increases in association with weathering around quartz veins. While in Enterprise, delineating basement structure of an interpreted graben was the first objective. Surveys were run both in Enterprise and Kansanshi with 500m spaced line and 100m spread (50m dipoles). The level of details needed required such a sampling especially in Kansanshi where meter wide veins and few meters parasitic domes were targeted. Overall data acquired produced many small size targets and features which are under investigation. However the noise level around the active mine are limiting factors. Many static corrections were done to reduce their effect in the data.

Figure1: Kasanshi and Enterprise locations relative to Solwezi

RESULTS

2D and 3D inversions were run on the data and below are two (2) lines with some of the results achieved. Figure 2 is derived from line 19 in Enterprise survey showing major resistive basement delineate by a deep seated structure (dashed line) and possible half graben structures which bound a clear synform (conductive).

Figure 3 from the kansanshi's survey show the doming structure which is a critical aspect of mineralisation. Unfortunately, small parasitic domes are not well defined in this section.

Figures

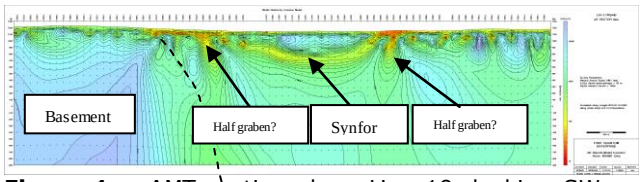

Figure 1 – AMT section along Line 19, looking SW, showing resistive basement on the left, the Enterprise half graben and synform, plus smaller folds on the right (NW). Selfe, G., FQM final internal report

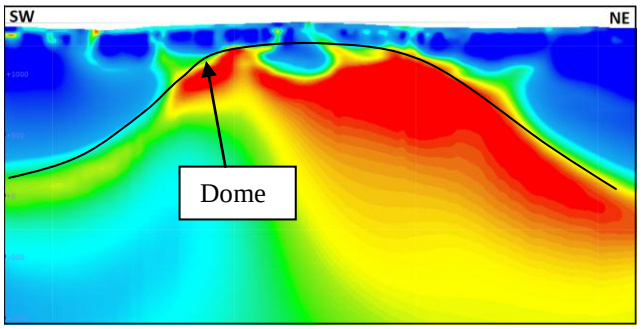

Figure 3 – AMT section along line 14500N, looking NW, showing conductive shale with doming structure. Red is conductor and blue- resistive.

CONCLUSIONS

The AMT surveys in Enterprise and Kansanshi overall were very satisfying in term subsurface mapping and 3 dimensional geological characterisation. It is now a major exploration tool in Zambia and similar geological setting such as Northern Botswana where exploration is ongoing. It suitable to run such surveys in quite environment as the current involved is weak, in the orders of µV.

ACKNOWLEDGMENTS

I acknowledge First Quantum Minerals Ltd for permission to present the data at the conference.

REFERENCES

Selfe, G., 2014, AMT 2012 and 2013 final internal report