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Magnetic Modelling of Intrusive Dykes, Koster Fjord, SW Sweden

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SUMMARY

The Kattesund-Koster dyke swarm is an important relic within the Sveconorwegian province of the Baltic Shield. With an age of 1421 Ma, the doleritic dykes make up a key structural feature of the Kongsberg-Bamble-Østfold segment. The dyke structures also cut the crystalline basement rock on the half island of Saltö, east of the Koster Fjord, Sweden. One very prominent dyke feature, with a width of about 5 meters, is exposed on the most southern edge of Saltö. Scalar marine total magnetic field data was collected above this intrusive dyke. Results show that across dyke, the average magnetic anomalies lie between 80 and 130 nT. Along dyke the anomaly signature increases in magnitude south-eastward from an average of 30 to 85 nT. 2D Magnetic inversion techniques, using basic dipping dyke models, are applied to investigate several dyke parameters. These include the dip, extent, width and depth of the dyke. In an effort to create a broader geological model and better understand the geo-dynamics of the region, the data set is integrated with airborne total magnetic field data, as well as gravity data, provided by the Geological Survey of Sweden.

Introduction

Dykes are intrusive igneous sheet like rock bodies, often occurring in the form of dyke swarms. They can be seen as structural markers of geo-dynamic events. Therefore, investigating the geometry and occurrence of dykes can give insight into the structural evolution and geo-dynamics of the region.

The Kattesund-Koster dyke swarm, running along Bohus Län, Sweden into the Oslo fjord, Norway is such an important structural marker. With an age of 1421 Ma (Hageskov [1988]), the doleritic dykes make up a key structural feature of the Kongsberg-Bamble-Østfold (KBØ) segment, within the Svenconorwegian province of the Baltic Shield. Very nice exposure of the dykes can be found on the

Koster archipelago, SW Sweden. In previous work by Hageskov [1984, 1985, 1988] the dyke structures on the Koster Islands were structurally investigated, mapped, as well as analyzed for magnetic susceptibility and age. From the studies it was determined that the doleritic dykes were caused by the repeated injection of tholeiitic magma into simple dilational joints resulting from crustal extension. From our field campaign we are able to confirm that dyke swarm trends NNE-SSW, with a mean width of 2.2 meters. The dyke structures also cut the crystalline basement rock on the half island of Saltö, east of the Koster fjord. One very prominent dyke feature, with a width of about 5 meters and nearly 90° dip, is exposed on the most southern edge of Saltö (Fig. 1).

Figure 1 Dyke as seen on Saltö, Sweden.

The primary aim of this study, as part of a B.Sc. thesis, is to investigate and model these dyke structures using geophysical data. The created geological model will then give insight into the geo-dynamics of the region.

Methodology

During a field campaign in the Koster Fjord, Sweden in August 2013, scalar magnetic field data was utilized using an Overhauser magnetometer. The collected magnetic data (Fig. 2(B)) was processed to extract the total field anomaly. The total magnetic anomaly values were organized across and along the presumed strike of the dyke structure. Processing included subtracting the geomagnetic reference field (IGRF 2013) and interpolating the data to create initial 2D models. To further analyze the dyke structures, aeromagnetic total magnetic field (Fig. 3(A)) and gravity data, provided by the Swedish Geological Survey (SGU), are used. 2D Magnetic inversion techniques, using basic dipping dyke models, are applied to investigate several dyke parameters. These include the dip, extent, width and depth of the dyke. The data sets are then integrated in an effort to create a broader geological model, focusing on the dyke structures of the Koster Fjord area around Saltö.

Conclusions

Comparing the airborne total magnetic anomaly data to the magnetic data collected during the marine survey it can be observed that both show higher magnetic anomaly values at the presumed dyke location, south of Saltö. Results show that across dyke, the average magnetic anomalies lie between 80 and 130 nT. Along dyke the anomaly signature increases in magnitude south-eastward from an average of 30 to 85 nT. These preliminary results are in agreement with previously modelled values.

Total Magnetic Anomaly Map, Koster Fjord, Sweden

Airborne Total Magnetic Anomaly Map (SGU)

Total Magnetic Field Anomaly Map
South of Saltö

Total Magnetic Anomaly [nT]

Figure 2 (A): Airborne Total Magnetic Anomaly Map of the Koster Fjord, Sweden - The map depicts airborne magnetic anomaly data [nT] collected during a survey by the SGU in 1993 and 2003 at altitudes between 30 and 60 meters.

(B): Total Magnetic Field Anomaly Map, South of Saltö - The map depicts total magnetic field anomaly data collected during a marine survey in August 2013.

Acknowledgements

This project is an ongoing B.Sc. thesis work, and can therefore only present preliminary results. Magnetic modelling and data integration, as well as interpretation will be completed by mid May, 2014. All results and analysis will be presented.

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References

- Hageskov, B. [1984] Magnetic susceptibility used in mapping of amphibolite facies recrystallisation in basic dykes. *Tectonophysics*, **108**, 339–351.
- Hageskov, B. [1985] Constrictional deformation of the Koster dyke swarm in a ductile sinistral shear zone, Koster Islands, SW Sweden. *Bull. Geol. Soc. Denmark*, **34**, 151–197.
- Pedersen, S. and Hageskov, B. [1988] Rb-sr age determination of the Kattesund-Koster dyke swarm in the Ostfold-Marstrand belt of the Svenconnorwegian province, SW Sweden - SE Norway. *Bull. Geol. Soc. Denmark*, **37**, 51–61.