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Gravity and magnetic model of the Målingen structure, a proposed marine impact crater.

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1. Introduction

Målingen is a 1km wide circular structure situated about 15km to SW of Lockne impact crater (central Sweden). The structure is developed in the Proterozoic basement and partially covered by a lake. The circular shape in the Precambrian crystalline basement and exposed sedimentary breccias resembling the resurge deposits at Lockne of the same age have led to suggestions for an impact origin in relation to Lockne. The basement in the Lockne/Målingen area is mainly constituted by granitoids in some places intercepted by dolerite sills. The basement is covered by 30m of mainly Cambrian dark shale and 50m of mainly Ordovician limestones.

The aim of this study is to develop both gravity and magnetic model to determine the dimensions and shape of the Målingen structure and evaluate its impact origin.

2. Methodology

A Geophysical survey was taken during 2010 and 2011 and has provided data for the geophysical modeling that it is being developed right now.

The gravity survey of the structure comprises 262 measurements with a spacing of about 25m. Gravity measurements intersect the western and northern parts of the rim and the apparent center of the structure. The gravity survey is connected to previous gravity grid over the Lockne crater [1]. Data correction was carried out following established protocol except for terrain correction, but the area is flat enough to make this assumption. The wet bulk densities of 84 samples from the MAL-1 core were measured as constrain for the gravity model. Furthermore, density values from the Lockne previous studies have been used in this model as an input to some lithologies such as post-impact sediments and resurge deposits [2].

The magnetic survey covers the whole structure and extends about one diameter outside the apparent rim where the terrain allows it. It includes 702 measurements in a grid with a line spacing of about 100-150m and about 50m separation between measurement points. The correction for diurnal variation was done with readings obtained from the Lyckselle and Abisko observatories. In order to estimate general susceptibility values for main lithologies around the Målingen structure, a total of 657 susceptibility measurements were taken with a field kappabridge KT-6 from five different areas. Additionally, the magnetic survey was complemented with 726 susceptibility measurements on the whole MAL-1 core.

Model Vision Pro software is being used in the development of both gravity and magnetic models. This software allows interactive modeling of $2^{1/2}$D and 3D geological cross sections.

3. Results and discussions:

The residual Bouguer anomaly map (Fig1) shows a gravity disturbance over the Målingen structure. Some high anomalies in the topographic rim have been observed. However, a general gravity low is obtained over the interior of the crater which is consistent with the gravity signatures of known, bowl-shaped, simple impact craters [3].

The magnetic anomaly map (Fig2) shows distinct anomalies distributed along the topographic rim. This supports the geological interpretation of a circular structure. The anomaly associated with the SE part of the apparent topographic rim of the structure coincides with the dolerite outcrop where the susceptibility was measured. Most likely, the other strong anomalies can be linked with masses of dolerite possibly relocated during the formation of the topographic rim.

The current gravity and magnetic modeling process is being developing with eight different units. The physical properties of each unit calculated from the data collected are shown in Table1. The ongoing model which we are working on is represented in Fig3.

4. Conclusions

The geophysical data displayed in the residual Bouguer anomaly map and the magnetic anomaly map support a likely impact origin of the Målingen structure. The geophysical support for the hypothesis is mainly the negative gravity signature over the interior of the structure, and the circular distribution of the magnetic anomalies along the topographic rim. The ongoing magnetic and gravity modeling give us more information about the dimensions of the Målingen structure and the distribution of some dolerite sills under the surface.

The quantitative results we obtain from the gravity and magnetic model will give us more information about the lithologies of Målingen. This will allow us to analyze in more detail the impact hypothesis for the Målingen structure suggested by geological interpretation and numerical simulations.

Table1: Physical properties of the units used in the model.

Unit	ρ(g/cc)	$\chi(\cdot 10^{-3}$ SI)
Post impact sediments	2.703	0.05381
Resurge deposits	2.699	0.06381
Shale	2.739	0.19198
Fractured zone	2.675	0.25378
Revsund grantie	2.666	0.12612
Mafic intrusion	2.91	32.68
Almost intact granite	2.633	0.037889
Dolerite blocks	3.020	7.5

Acknowledgements

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References

[1] Sturkell E. et al. (1998) Tectonophysics, 296, 421-435.

[2] Tornberg and Sturkell (2005) Meteoritics & Planet. Sci., 40, 639-651.

[3] Pilkington and Grieve (1992) Reviews of Geophysics, 30, 161-181.

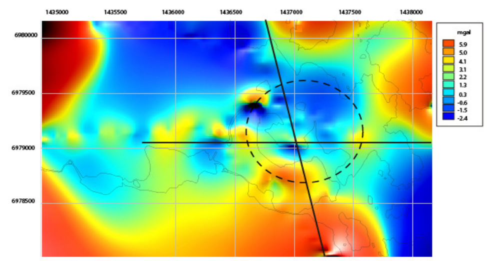

Figure 1: Residual Bouguer anomaly map.

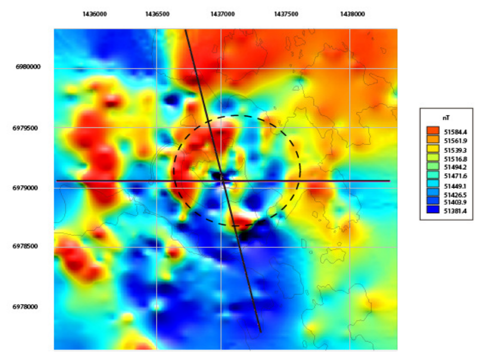

Figure 2: Magnetic anomaly map.

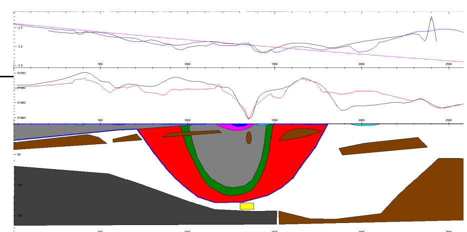

Figure 3: Gravity and magnetic modeling process.