Geophysical Research Abstracts, Vol. 8, 07959, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07959

3-D geological modelling using integration of geophysical data and verified geology in the Skellefte Ore District, northern Sweden

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A total ore tonnage exceeding 160 Mt makes the Skellefte ore district one of the largest early Proterozoic VHMS district in the world. The area is also the subject of increasing interest for gold and base-metal exploration. Although several studies have been conducted in the area, the contact relationships between the ore bearing rocks of the Skellefte Group and the surrounding rocks are poorly known at the depth. This is in parts due to flat nature of the post-glacial landscape that gives a very two dimensional aspect to geological interpretations. In such circumstances, more favourable situations are those where geophysical data, such as deep seismic, gravity and magnetic, are also available, allowing a better constraint on the interpretation of geological structures can be obtained. Five geological cross sections have been constructed in an upper crustal level, constrained by seismic reflection data previously acquired in the area, potential field modelling and geological observations. In order to validate the variability of the structures in different directions, 3D potential field modelling has been performed, based on petrophysical data available, and constrained by the geological observations, 2D seismic reflection data, and 2D potential field models. All of the 2D and 3D geological and geophysical models have been later visualized in a 3D context.

A structural basement has been introduced to the Skellefte volcanic rocks. This is uniquely constrained by seismic reflection data. The new structural profiles demonstrate that the Kristineberg ore is situated in the northern limb of a local synformal

structure. The interpretations help to identify new prospective areas, both down-plunge from known ores, and on the ore-bearing horizon on the southern limb of the syncline. Revsund granites are divided into two major groups based on their present day thickness and shapes. All the intrusions that are associated with gravity high are interpreted as thin sheet-like bodies with thickness little greater than topography. The intrusions that are associated with significant gravity low are interpreted to stoke/dome bodies, with a present day thickness of about 3-3.5 km. The new regional structural models for the Skellefte volcanics and overlying metasediments are of two thrust-sheets exposing the Skellefte volcanics in the cores of hanging-wall anticlinal structures. The new structural crustal models demonstrate the potential of using integration of geophysical and geological data to construct a pilot 3D geological model and to highlight the structures hosting the mineralization zones. A specific to this is the results of the seismic reflection data that in combination with other geological and geophysical data have greatly improved our understanding of the tectonostratigraphic framework and architecture of the poly-deformed c. 1.9 Ga the Skellefte VHMS belt.