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Gravity worms in the prospecting of epigenetic gold deposits: Example from the Northern Fennoscandian Shield

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Mapping of mineralized geologic structures using geophysical potential field datasets has become an essential part of present-day exploration projects. Various geophysical processing and semiautomatic interpretation techniques have provided new tools into the field of conventional exploration process. Such is the multiscale edge detection or "worming-technique" introduced by Hornby et al., (1999). Worms are representations of the maxima of potential field horizontal gradients. They are calculated at different upward continuation levels providing an alternative view into potential field anomalies and geometry of the anomaly sources.
In this work we use the worming-technique on the regional gravity dataset collected by the Geological Survey of Finland during the last four decades in the northern Finland. The dataset consists of more than 19 000 ground gravity observations covering an area of about 15000 km2 with an average site separation of 0.5 - 1 km.
The study area covers the central part of the 2.4-2.0 Ga Central Lapland Greenstone belt (CLGB) which is one of the largest Proterozoic greenstone terrains in the world. The CLGB hosts numerous gold occurrences of varying type and size. The majority of the gold occurrences fall into the orogenic gold category but also Iron Oxide-Copper-Gold (IOCG) and paleoplacer types are known within the region (e.g. Eilu et al., 2007). Currently the largest known deposit in the area is the Suurikuusikko orogenic gold deposit with current resources exceeding 5 million ounces Au. The largest known gold resources in IOCG type deposit is in the Hannukainen deposit with ca. 200 000 ounces of gold.
All the known orogenic gold and IOCG deposits in the CLGB show intimate spatial correlation to shear zones of varying scale. Processed gravity worms display striking spatial correlation with the known orogenic gold and IOCG deposits. In some cases the gold hosting shear zones are outlined by gravity worms either completely (Sirkka shear zone) or partly (Kiistala shear zone) whereas the presence of some major shear zones is indicated by truncation of worms at the location of the shear zone (Hanhimaa and Muusa shear zone).
The important part of our work is the evaluation of the spatial correlation of gravity worms and known gold deposits using the weights-of-evidence calculation procedure. Our results show that presence of gravity worms are indicative of the structures controlling most epigenetic gold deposits in the CLGB area. Therefore, worming-technique proved to be an excellent tool in mapping of structures being prospective for epigenetic gold deposits in the study area and therefore likely in other areas of similar geology.

References:

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