# The discovery of a regional scale strike-slip fault in northern Sweden through reevaluation of potential field data

Thorkild M. Rasmussen[a], Roshanak Vadoodi[a] and Tobias E. Bauer[c]

[a]Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology, Luleå, Sweden, thorkild.maack.rasmussen@ltu.se

The national airborne magnetic datasets acquired by the geological surveys in the Nordic countries constitute very important data sources for regional scale structural mapping. These data are of particular importance for structural interpretations due to low degree of bedrock exposures in many areas. Despite most of these data have been publicly available for decades, new data analyses reveal important information of hitherto unrecognized large-scale structures in the Fennoscandian Shield. This is exemplified by a recent discovery of the regional scale Norrbotten brittle strike-slip fault in northern Sweden with a length >250 km and apparent offset of 51.2 km. The fault extends northwards through Finland and possibly to the Caledonian Front in northern Norway. The discovery implies that geological maps need to be revised.

To validate and support the hypothesis of the fault, several other data types are included. They are:

- Multi-variate classification of magnetic gradient tensor data
- The Bouguer gravity field and derived gradient data
- Inspection of airborne gamma-ray and VLF data
- Geological field observations and structural measurements
- Early Holocene faulting and present-day seismicity along the fault
- A joint three-dimensional classification of crustal scale magnetic susceptibility, density, and electrical conductivity models
- Partly continuity of geological units across the fault after application of shift to mapped geological units.

Identification of faults and in particular estimation of fault displacements is in the ideal case based on a visual matching of well-defined markers. A simple restoration of the anomaly pattern on one side of the fault provides the estimate of displacement provided that a match between one or preferentially several anomalies is obtained. The anomalies are in this manner used as a simple barcode in the matching procedure. An initial interpretation based on pattern recognition was followed by visual inspection of short wavelength anomalies to quantify the displacement. An apparent horizontal displacement of 51.2 km is proposed for the discovered fault. In Sweden, the fault strikes N-S from Karesuando at the Swedish-Finnish border in the north to the Archaean-Proterozoic boundary marked by the Luleå-Jokkmokk Zone (c.f. Mellqvist *et al*., 1999).

The strikingly linear and straight character of the proposed fault implies a timing later than mapped ductile deformation events dated to 1.80–1.78 Ga (Bauer et al. 2022). We tentatively suggest the timing to coincide with the post-orogenic collapse at the latest stages of the Svecokarelian orogeny (approx. 1.76–1.70 Ga; Korja et al., 2006).

### References (format style Heading)

Bauer, T. E., Lynch, E. P., Sarlus, Z., Drejing-Carroll, D., Martinsson, O., Metzger, N., & Wanhainen, C., 2022: Structural Controls on Iron Oxide Copper-Gold Mineralization and Related Alteration in a Paleoproterozoic Supracrustal Belt: Insights from the Nautanen Deformation Zone and Surroundings, Northern Sweden. *Economic Geology 117, 327–359.*

Korja, A., Lahtinen, R., & Nironen, M., 2006: The Svecofennian orogen: a collage of microcontinents and island arcs. *Geological Society, London, Memoirs 32(1), 561–578*.

Mellqvist, C., Öhlander, B., Skiöld, T., & Wikström, A. (1999). The Archaean-Proterozoic Palaeoboundary in the Luleå area, northern Sweden: Field and isotope geochemical evidence for a sharp terrane boundary. *Precambrian Research, 96(3–4), 225–243*..