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## Mineral exploration in the glaciated terrain using upper soil horizon geochemistry and compositional statistical data analysis

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Vulnerable nature in northernmost Europe requires development of new, environmentally friendly sampling and analyses techniques for mineral exploration. Those areas are typically covered by transported glaciogenic sediments where the glacial till is most dominant. To offer an alternative for conventional basal till and bedrock sampling with heavy machines, the use of different surface geochemical sampling media and techniques which are quick and cost-effective have been actively applied during the last decade. Particularly, the development of selective and weak leach techniques for the upper soil (Ah and B) horizons' geochemistry has been intensive, but the reliability needs to be improved and testing is required in different glaciogenic environments.

In this research, carried out under the project New Exploration Technologies (NEXT), funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 776804, we used stratified random sampling strategy for choosing sampling locations and developed novel compositional statistical data analysis for the interpretation of geochemical data obtained by surface geochemical techniques. The test area is located in the Rajapalot area, Ylitornio, northern Finland, where an active project is carried out by Mawson Oy for Au-Co exploration. The thickness of till cover varies from some metres to 5 m and the glacial morphology is composed of the ribbed moraine ridges with peatlands in between. A sampling network for the Ah and B horizon samples was comprised of 89 routine samples and 10 field replicates acquired of mineral Podsol-type soils. The chemical analyses methods used were Ultratrace 1:1:1 Aqua Regia leach and 0.1 M sodium pyrophosphate leach for the Ah horizon samples, and Ionic leach and Super Trace Aqua Regia leach methods for the B horizon samples. The laboratory analyses were supported by the portable X-Ray Fluorescence (pXRF) analyses done directly in the field. The statistical analysis was based on log-ratio transformations of the geochemical compositions to avoid spurious results. In addition, the response ratios were calculated to measure the degree of enrichment in each element per sample.

The preliminary results of the soil geochemistry show a significant response to many elements (e.g. Au, Co, Cu, Mo, Sc, Te and W) with known mineralized bedrock targets observed in the drill

core data. Elemental distribution is also reflecting the lithological variations of the rock units in the bedrock. Based on the results, it is obvious that a) there is good or moderate correlation for several elements between the surface geochemical data and underlying bedrock, and b) soil analysis method using certain soil sampling procedure and selective extraction is an effective, environmentally friendly geochemical exploration technique in the glaciated terrains.