Advanced till sampling methods – application in geochemical and indicator mineral research

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In the **NovTecEx** project (Novel technologies for greenfield exploration; funded by the Tekes Green Mining Programme; 2012-2015) new mineral exploration methods were developed. Mineral exploration within thick glacial overburden, peat lands and different conservation programs was found to be very demanding, sensitive and expensive. Essential exploration techniques include concurrent use of geological, geochemical and geophysical surveys. These techniques allowed us to locate and thoroughly investigate geological processes responsible for mineral deposits and the indications of ore forming processes. The aim in this project was to find cost- and eco-effective best practices for mineral techniques and concepts. Research partners of the project were the Geological Survey of Finland and the University of Oulu.

Advanced ways to do mineral mapping and exploration were studied and developed in the eight tasks of the NovTecEx project:

Task 1: Developing sampling techniques for till geochemistry
Task 2: Indicator minerals, automated mineralogy
Task 3: On-site field assay techniques
Task 4: Spatial data mining and modeling
Task 5: Object based recognition of bedrock fractures
Task 6: AMT as a mineral exploration tool
Task 7: Development of the 2D interpretation of airborne TEM measurements
Task 8: Airborne gravity gradient surveys

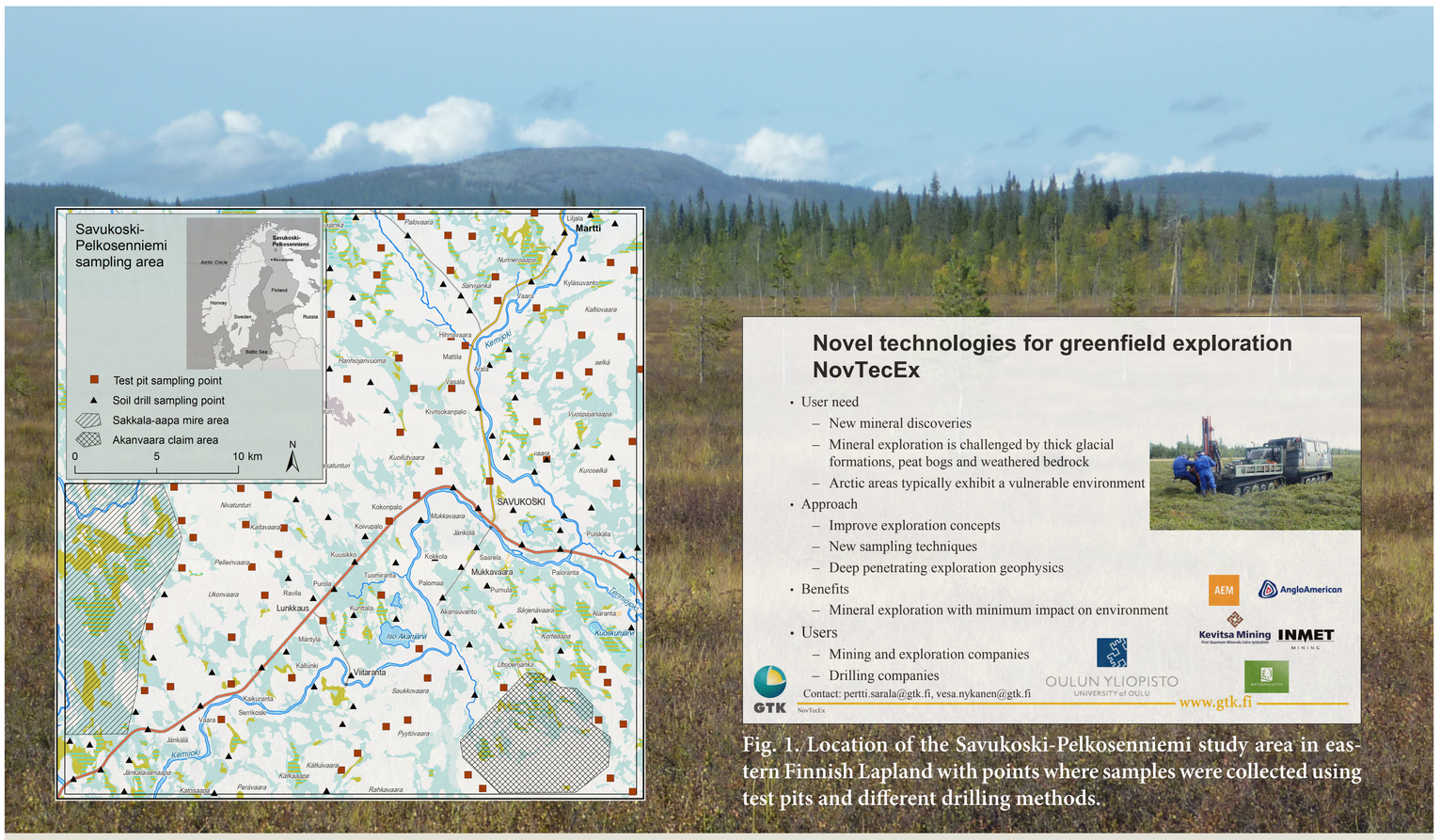

Fig. 1. Location of the Savukoski-Pelkosenniemi study area in eastern Finnish Lapland with points where samples were collected using test pits and different drilling methods.

Project goals

NovTecEx project generated and developed mineral exploration concepts utilizing methods and best available practices to assess mineral potential or directly locate especially deep seated mineral deposits within northern vulnerable terrains (Fig. 1). More effective processing, interpretation and modeling techniques of mineral exploration data enabled even larger amounts of data being processed fast. This goal serves especially the companies and organizations conducting grass root mineral exploration on regional scale. Techniques are also adoptable into target scale exploration.

Methodological development

The goal in the methodological development was to investigate new sampling techniques and analytical methods for till geochemistry and indicator minerals. Different drilling equipments were tested for the deep till geochemical and heavy mineralogical sampling. An aim was to get representative and stratigraphically controlled samples from till layers, and from weathered bedrock and/or fresh bedrock at the same location (Fig. 2). In addition to conventional geochemical assays, the samples should be collected also for heavy mineral (e.g. indicator mineral) studies. This means minimum sample size of 5 to 10 litres, i.e. 10 to 20 kg to get representative samples and enough high sampling accuracy.

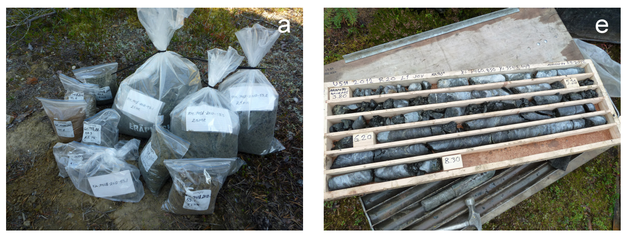

Fig. 2. Samples collected during test pit and drilling method testing in 2012. Photos by P. Sarala.

Additional information:
Sarala, P. 2015. Comparison of different techniques for basal till sampling in mineral exploration. In: Sarala, P. (ed.) Novel technologies for greenfield exploration. Geological Survey of Finland, Special Paper 57, 11–22. Also available: http://tupa.gtk.fi/julkaisu/specialpaper/sp_057.pdf

An ideal sampling layer for the regional till geochemical survey is usually the lowest till bed considering the glacial transport and deposition mechanisms (Fig. 3). By focusing sampling into this till layer in the whole sampling area, samples are the most comparable to each other. In this project several deep drilling equipments and test pits were tested for the till and pre-glacial weathered bedrock sampling. Tested methods included two different deep drilling methods (soil+diamond drilling), pneumatic and sonic drilling methods, and percussion drilling with a crushing bit (Fig. 4).

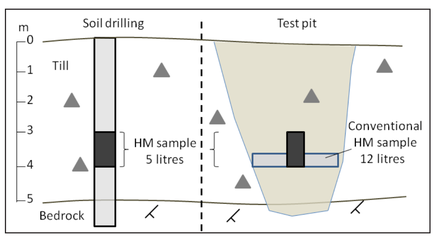

Fig. 3. Sampling strategy for the till samples using soil drilling and test pit excavations.

Fig. 4. Different drilling methods used in the Savukoski-Pelkosenniemi area in 2012 for basal till and bedrock sampling. a) A GM100 deep drilling unit (operated by GTK), b) a GM200 deep drilling unit (operated by Destia), c) a pneumatic drilling unit (operated by ADC) and d) a percussion drilling unit with crushing bit (operated by Moreeni Mäcklin).
Photos a, c, d by P. Sarala and b by H. Hirvasniemi.

Fig. 5. Photo of the full, 13 m long till, varved silt and weathered bedrock sample core (top on the up left and bottom on the down right) from eastern Rovaniemi as an example of methodological testing for the deep till sampling done in the NovTecEx project. The sample core was drilled using sonic drilling method. Length of the core box is one meter.
Photos by P. Sarala.

Results

The best and practical results in getting deep till samples were reached using conventional soil drilling rods without flushing water. That was supported by the followed sampling from the upper part of weathered/fresh bedrock using diamond drilling. Furthermore, good applicability was also found by the sonic drilling method that uses the high frequency resonant vibration technology. It provides a good penetration even into stony till and gives a possibility to collect continuous sediment and bedrock sample cores (Fig. 5) to support the stratigraphical work.

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