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Did you ever consider snow sampling could be used for mineral prospecting?

Maarit Middleton (photo), Associate Research Professor within the Information Solutions Unit of the Geological Survey of Finland (GTK) and her research colleagues in the EU funded Horizon 2020 project **NEXT - New Exploration Technologies**, are experts in what is known as surface geochemistry. We invited Maarit to explain the research group's passion for snow sampling, but let us start with the context.

What is mineral prospecting?

Mineral prospecting is the first geological phase in exploring for mineral deposits. The goal in exploration is to determine whether an area has any mineral resources. If so, geologists and exploration experts then set out to determine whether the deposit has a viable exploitation potential from an economic point of view.

The starting area of interest may range from hundreds to even thousands of square kilometres. Geologists rely on preliminary studies with airborne geophysical surveys, satellite imagery, as well as field observations of the outcropping rocks on the ground surface to pinpoint to areas where mineral potential is high. However, to reach a decisive conclusion actual drilling and excavations of the bedrock need to be conducted. Commonly, drill holes are spaced in a dense grid of one hundred to even just 10 meters, and tens of kilometres of core may be drilled as part of single prospecting project. At a drilling cost of 120 to 150 euro

per meter, plus analytical expenses and working time, this task is clearly expensive. It is also time consuming as it typically takes several years, even decades to make a profitable discovery. To illustrate the magnitude of the risk to investors, only one in a thousand prospecting projects end up in an actual mine development!

Objectives of the NEXT project

The overall objective of the Horizon 2020 NEXT project is to develop tools and techniques that would not only reduce the cost of mineral exploration but also minimize the environmental impact during the early stages of mineral exploration. The scientific domain of surface geochemistry is among several approaches that are being investigated as part of the ongoing research activities.

What is surface geochemistry and how does snow sampling come in?

The use of surface geochemistry relies on a multitude of transport mechanisms that enable the migration of ions from the mineralized deposits to reach the surface where the ions become fixed in the top layers of the soil and the vegetation. Obviously, this concerns just very small amounts of metals or other elements and hydrocarbons. The efficiency of this migration is controlled by several factors, and may include a combination of gaseous, microbial or electrochemical ion transportation mechanisms. Other factors include the hydrological regime as well as preferential pathways to the surface, such as geological faults as determined by the hydrogeological setting.

In surface geochemistry, the samples taken from the top layers of the soil and plants are analysed in the laboratory. The ions are released with very weak chemical extractions methods which then permits to determine the chemical element or hydrocarbon concentration of the samples.

When the surface is covered with snow, the flow of gasses continues, and the ions and hydrocarbon compounds accumulate to the base layer of snow. This is why very small amounts of metals or other elements and hydrocarbons can be analysed not only in samples of plant tissues and soil horizons, but also in snow samples.

The surface geochemistry approach thus permits to discover blind deposits even deep in the bedrock or beneath a thick cover of sediments as illustrated in the picture below.

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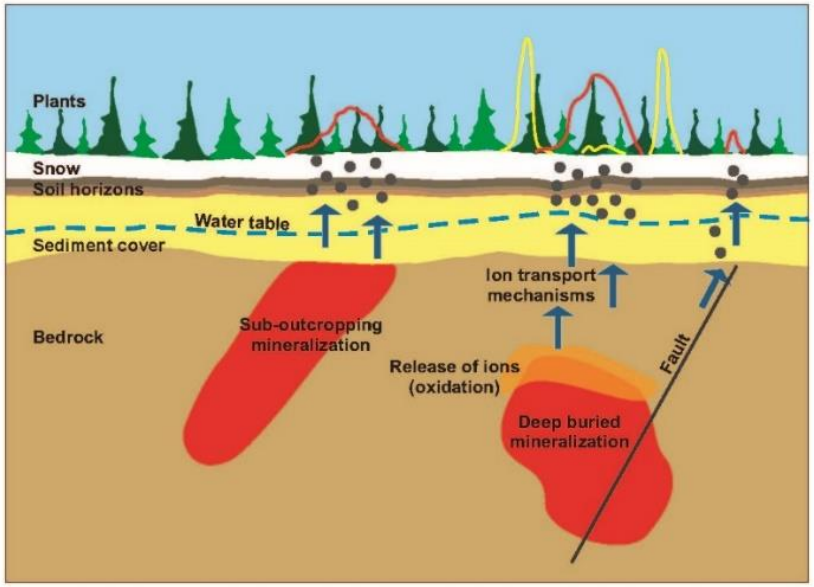

Figure 1. Ions released from mineralized deposits are transported to the surface and become fixed in the top layers of the soil and vegetation as well as in the base layer of snow.

Smart bedrock drill targeting with surface geochemistry

Surface geochemistry provides a very powerful approach to reveal the secrets of the underlying bedrock chemistry. In fact, there simply are no other methods available for detecting geochemical signals of mineralization under sediment and bedrock cover. This also explains why the approach has gained considerable importance in guiding exploration geologists to specific locations for bedrock drilling, avoiding the need for the conventional use of heavy-machinery assisted sampling.

Surface geochemistry is environmentally friendly and cost-saving

Organic and mineral soil horizons are sampled with a shovel only to a depth of 50 cm or less. Plants twigs are clipped with pruning shears and bark samples are obtained with paint scrapers.

The EU funding of the Horizon 2020 NEXT project brings the opportunity to test unconventional sampling material with extremely low environmental impact, such as snow and transpired fluids from plants or trees, for mineral exploration purposes.

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Figure 2. Soil (left) and plant (right) sampling. Photos: Maarit Middleton, GTK

Figure 3. Sampling of Norway spruce transpired fluids (left) and snow (right). Photos: Maarit Middleton, GTK

The sampling is done simply on foot and under the condition of snow cover on skies, snowshoes or snowmobiles, hence the insignificant environmental impact of the approach.

The cost savings for mineral exploration companies derive from land access permitting being simpler and, in general, permit processing times being shorter when compared to sampling conducted with heavy machinery. Sampling is fast and allows covering of larger areas or with higher number of samples in the time given. For northern European conditions, winter exploration activity enabled by snow sampling may speed up the exploration process.

More about NEXT: www.new-exploration.tech

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