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Snow as environmentally low-impact sampling media for mineral exploration - a case study from Northern Finland

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Modern mineral exploration is required to be conducted in a sustainable, environmentally friendly and socially acceptable way. Especially for the geochemical exploration on ecologically sensitive areas this poses a challenge because any heavy machinery or invasive methods might cause long-lasting damage to nature. One way of reducing the impact of mineral exploration on the environment during the early stages of exploration is to use surface sampling media, such as upper soil horizons, water, plants and, on high latitudes, also snow. Of these options, snow has several advantages: Sampling and analysing snow is fast and low in costs, it has no impact on the environment, and in wintertime it is ubiquitous and available independent of the ecosystem.

In the “New Exploration Technologies (NEXT)” project*, snow samples were collected in March-April 2019 to evaluate the usage of snow as a sampling material for mineral exploration. The test site was the Rajapalot Au-Co prospect in northern Finland, located 60 km west from Rovaniemi and operated by Mawson Oy. A stratified random sampling strategy was applied to place the sampling stations on the test site. The sampling comprised 94 snow samples and 12 field replicates. The samples were analysed at the GTK Research laboratory using a Nu AttoM single collector inductively coupled plasma mass spectrometry (SC-ICPMS) which returned analytical results for 52 elements at the ppt level. After applying quality control to the data, the elements Ba, Ca, Cd, Cr, Cs, Ga, Li, Mg, Rb, Sr, Tl and V showed good quality and were used in the final data analysis.

Geochemical data of drill cores were used to train a model to predict bedrock geochemistry based on the 12 available element concentrations of snow analysis. Prior to statistical methods, all geochemical data was transformed to log-ratio scores in order to ensure that results are independent of the selection of elements and to avoid spurious correlations (compositional data approach). Results show that snow data provide reasonable predictions of bedrock geochemistry for elements such as Ca, Cr, Li and Mg, but also for elements not used in snow data, such as Mn and Na. This suggests that snow can serve as a lithogeochemical mapping tool for potential geological domains. For the ore related elements Au, Ag, Co, and U the model provided predictions with higher uncertainty. Yet, the pattern of the predicted values of ore related elements show that

snow can also be used to delineate prospective areas for continuing exploration with more sensitive methods.

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