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Exploring for Orogenic Au Deposits Using Transpired Tree Fluids: A Proof-of-Concept Study in Northern Finland

SOLVEIG POSPIECH[1], MAARIT MIDDLETON[2] AND JANNE KINNUNEN[3]

[1]Helmholtz-Zentrum Dresden-Rossendorf, Institute for Resource Ecology, Bautzner Landstr. 400, DE-01328 Dresden, Germany
[2]Geological Survey of Finland GTK
[3]Mawson Oy

Orogenic Au deposits are an interesting source of gold, yet exploration in environmentally sensitive regions such as nature protection areas requires new and low-impact sampling media. Biogeochemistry as prospecting method has been used before, traditionally using leaves, needles, twigs, and bark for elemental analysis. However, these tissues require sample preparation (drying, sorting, ashing, digestion) and can be influenced by airborne particles and local mineral/soil dust. This study explores the use of transpired fluids — fluids exuded through tree canopies via stomata, cuticles, or branch lenticels — as a novel, low-impact sampling medium. These fluids represent analysis-ready solutions that eliminate the need for extensive sample preparation, and their collection does not destroy plant material.

The objective of this study was to determine the elemental composition of transpired fluids from Norway spruce (Picea abies) as a geochemical sampling medium to aid exploration for Au-Co mineralization. Norway spruce is a common conifer in the boreal and sub-alpine forests in the northern hemisphere. Its accessible foliage facilitates ground sampling. To test whether the chemical composition of fluids that originate in the root zone, are taken up by plant roots, travel through the xylem as solutes, and are finally released through the canopy reflects the underlying regolith or bedrock, a proof-of-concept study was carried out. The study used 17 samples collected from two drilled gold-cobalt (Au-Co) prospects at Rajapalot in the Peräpohja belt, northern Finland, as part of the EU-funded New Exploration Technologies (NEXT) project (2017-2020).

The main contributions of this study are: (a) adaptation of the previously presented sampling methodology by Heberlein et al. (2013) for tree transpired fluids to Norway spruce, (b) presentation of laboratory results produced by single quadrupole ICP-MS, and (c) application of compositional data analysis to the elemental data to avoid dilutional effects or bias. The results suggest that transpired fluids can detect geochemical anomalies related to Au-Co mineralization, offering a green and efficient exploration tool for orogenic Au deposits in forested terrains. This approach supports next-generation exploration models by providing new vectoring tools for (Co-)Au-bearing systems in environmentally sensitive regions.