Geoscience Canada

Adjuncts to Boulder Tracing in Mineral Exploration

Harry H. Warren

Volume 9, numéro 1, march 1982

URI : https://id.erudit.org/iderudit/geocan9_1aqg05

Aller au sommaire du numéro

Éditeur(s)

The Geological Association of Canada

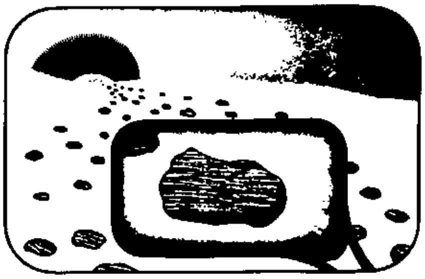
ISSN

0315-0941 (imprimé)
1911-4850 (numérique)

Découvrir la revue

Citer cet article

Warren, H. H. (1982). Adjuncts to Boulder Tracing in Mineral Exploration. *Geoscience Canada*, *9*(1), 48–50.



Adjuncts to Boulder Tracing in Mineral Exploration

Harry V. Warren
Department of Geological Sciences
University of British Columbia
Vancouver, B.C. V6T 2B4

Introduction

Professor Dreimanis and Dr. Shilts have drawn attention to the practicability of using boulder tracing as a mine finding tool. Soil and stream sediment sampling are other acceptable ways by which a knowledge of Quaternary geology may be exploited in searching for mineralized areas.

Biogeochemistry, the use of dogs trained to scent sulphide mineralization, and pollen analysis may also offer intriguing possibilities as supplementary aids in mineral exploration.

Biogeochemistry

To many of those engaged in the search for drift-covered mineralization, biogeochemistry still is considered to be merely a matter of analyzing "brush". Actually biogeochemistry involves sampling and analyzing specific organs of a specific tree or lesser plant (Warren *et al.*, 1955). More rarely the time of sampling must also be taken into consideration.

The author knows of one promising biogeochemical project in Ontario that was abandoned when the engineer in charge discovered that the people in the field could not distinguish between "tag alder" and "willow". "Tag alder" concentrates molybdenum and copper but willow collects zinc. Obviously inability to know which of these trees was being sampled could be disastrous. Actually, even today few poeple recognize the capacity of a particular species of tree or lesser plant to concentrate a specific element. The following examples may serve to illustrate this feature.

Table I *The arsenic content of the ash of different organs of Douglas Fir trees (*Pseudotsuga menziesii*) growing at various localities.*

Locality	Sample	Plant organ	Arsenic (ppm)
H.B. Mine	64 #3	youngest needles	120
		previous year's needles	25
H.B. Mine	64 #5	youngest needles	450
		previous year's needles	60
Bralorne Mine	64 #2	youngest needles	1060
		previous year's needles	180

Table II *The arsenic content of the ash of similar organs of various species of trees growing in arsenic-bearing localities (young tips).*

Locality	Sample	Species	Arsenic (ppm)
Hedley	#2	Spruce (*Picea* sp.)	7
		Lodgepole pine (*Pinus contorta*)	4
		Willow (*Salix* sp.)	4
		Douglas fir	880
H.B. Mine	#1	Balsam fir (*Abies lasiocarpa*)	1
		Western red cedar (*Thuja plicata*)	1
		Alder (*Alnus* sp.)	1
		White pine (*Pinus flexilis*)	1
		Spruce (*Picea* sp.)	1
		Soopolallie (*Shepherdia canadensis*)	1
		Douglas fir (*Pseudotsuga menzeisis*)	560

Table III *The molybdenum content of the ash of young needles and leaves of various trees and lesser plants.*

Mine	Site Designation	Mineralization	Molybdenum (ppm)
I. Balsam or alpine fir (*Abies lasiocarpa*):			
Endako	#2	molybdenum	1700
Endako	#3	molybdenum	1900
Cariboo Gold Quartz	—	gold	7
H.B. Mine	—	lead-zinc	19
II. White and Engelman spruce (*Picea glauca* and *P. engelmanni*):			
Boss Mountain	#2	molybdenum	600
Endako	#2	molybdenum	1800
Cariboo Gold Quartz	—	gold	7
H.B. Mine	Leadville tunnel	lead-zinc	20
III. Sitka or slide alder (*Alnus sinuata*):			
Endako	#3	molybdenum	9000
Endako	#4	molybdenum	5400
Bethlehem	Iona	copper, minor molybdenum	290
Bethlehem	Jersey	copper, minor molybdenum	560
Cariboo Gold Quartz	—	gold	not detected
H.B. Mine	—	lead-zinc	13
Copper Mountain	—	lead-zinc	52
IV. Fireweed (*Epilobium angustifolium*), whole plant:			
Endako	#2	molybdenum	7700
Endako	#3	molybdenum	12,000
Pinchi	1962 collection	mercury	38
Pinchi	1964 collection	mercury	64
Cariboo Gold Quartz	—	gold	4
Mineral King	Discovery outcrop	lead-zinc	36

0315-0941-82-01/048-050 $01.00/0

Arsenic. Tables I and II demonstrate the ability of several plants to concentrate arsenic at various localities (see Warren *et al.*, 1968, 1964). In practice it is best to collect one or two year old stems. Their ash may be expected to carry from 25 to 200 ppm arsenic over unmineralized ground, whereas over arsenic mineralization they may well contain as much as 8000 ppm. Thus it is obvious from Tables I and II that the selection of an appropriate organ from a particular species of tree is important.

Molybdenum. Biogeochemistry has proved to be a most efficient tool in searching for molybdenum mineralization. Several trees and lesser plants have the ability to collect anomalous amounts of this element. The following examples in Table III were taken from various mining areas in British Columbia and illustrate the efficacy of this technique (see Warren and Delavault, 1965; also Warren *et al.*, 1953). Several other trees and lesser plants have proved to be equally useful in exploring for molybdenum, including: lupin (*Lupinus gracialis*), rhododendrum (*Rhododendron albiflorum*), willow (*Salix*, sp.), and yellow pine (*Pinus ponderosa*).

Gold. Many writers have reported the presence of gold in trees and lesser plants, including Shacklette *et al.* (1970), Jones (1970), and Boyle (1979). Shacklette *et al.* (1970) state: "If gold is present in the soil, and if cyanogenic plants are rooted in this soil, a mechanism is present for the entrance of gold into the biogeochemical cycling process".

However, biogeochemistry in general has found little favour in searching for buried gold deposits. The reason for this has been the necessity in the past for collecting relatively bulky samples and the general unsuitability of the analytical techniques hitherto available. Neutron activation, and improvements in atomic absorption spectrophotometry, have materially changed this stiuation. Whereas 30 years ago samples weighing hundreds of grams were required to analyse adequately for gold, at present only a few grams are required.

Gold concentrations in plants are usually in the ppb range (dry mass). Warren and Delavault (1950) reported on the gold content of both deciduous and evergreen trees growing in a gold enriched area in British Columbia. They carried between 15 and 25 ppb, and horsetails (*Equisetum* sp.) carried as much as 75 ppb. More recently Warren *et al.* (1979) have found that mountain phacelia (*Phacelia serioea*) may concentrate 10 to 15 times its normal quota of gold when growing in a gold enriched area. Mouse-ear chickweed (*Cerastium arvense*) was found to contain the highest concentration of gold in this area. Interestingly enough, *Cerastium* species have been shown to be significant accumulators of other heavy metals in several environments (Shewry and Peterson, 1976).

Girling and Peterson (1980), by taking samples of phacelia across a transect which included a gold-bearing zone, have demonstrated how this plant can reveal the presence of auriferous ground. Besides mountain phacelia, which is a deep-rooted perennial, late yellow locoweed (*Oxytropis campestris* var. *gracilus*), a deep-rooted legume, and stonecrop (*Sedum lanceolatum*), a shallow-rooted fleshy succulent, were also taken across the above transect.

The authors above have shown that fresh root and shoot material of *Phacelia sericea* releases cyanide in measurable quantities and also have confirmed that there is a positive inter-relation between gold accumulation in a plant with the cyanide content of that plant. The death and decay of plants containing cyanide, and the eventual disassociationof the cyanide, may provide a clue to explaining how gold crystals have recently been found in soil below and not far from where mountain phacelia has been found growing in abundance (Warren, 1979).

All the above suggests that biogeochemistry in the future may well play a supplementary role in searching for gold mineralization in areas where glacial drift obscures bedrock.

The Use of Dogs as an Aid to Exploration for Sulphides

The idea of using dogs as prospectors was initiated in Finland by Dr. Aarmo Kahma in 1962. In 1970, the K-9 Syndicate was financed by Falconbridge Nickel Mines Ltd., Kennco Explorations (Western) Ltd., El Paso Mining and Milling Co., and Dynasty Explorations Ltd. The program undertaken by the K-9 Syndicate and the large measure of success achieved by the two dogs that were trained, have been described fully by Brock (1972). Nevertheless, in spite of successful demonstrations across Canada, no government or mining company has yet exploited this new tool in this country.

We learn from Finland that Lari, their first dog prospector, discovered 2000 sulphide boulders and six skarn deposits during his lifetime. Brock describes how Lari was pitted against a human float-boulder prospector on an unprospected field. The results were impressive and Brock described them as follows: "Lari, the dog, found 1330 sulphide-bearing boulders, some of which were located under an overburden of 10 to 20 centimetres. The prospector found only 270 surface boulders". The Swedish Geological Survey has been reported to have four full time Alsatians on their payroll as prospecting dogs.

It would seem obvious that dogs can be used advantageously in boulder tracing. Normally a human is only likely to find boulders exposed on the surface. Lari demonstrated that, under ideal conditions, he could detect boulders buried as much as two metres below the surface. In Finland and Sweden it has clearly been shown that, for success in using dogs for discovering sulphide-bearing boulders, man and dog must work as a team. It is foolish to expect a dog to work successfully with any person in whom he does not have complete understanding and confidence.

The Use of Pollen as an Aid to Boulder Tracing in Mineral Exploration

In 1975 Dr. R.J.F.H. Pinsent, then Research Advisor to the Royal College of General Practitioners in Great Britain, suggested to the writer that pollen might well provide to be a useful addition to the many methods used by geochemists in their search for bured ore deposits. Analytical work carried out by Dr. Townshend of the Department of Chemistry, Birmingham University (now at Hull University), found that pollen collected from a formerly well-known lead-zinc mining region in southwestern Devonshire contained between five and ten times more lead that pollen collected from Norfolk, a county with no known lead or zinc mineralization.

Representative pollen samples from many districts in British Columbia were obtained from beekeeping societies and individual beekeepers in that province. The B.C. Honey Producers Association even had samples analyzed at the Environmental Laboratory of the B.C. Ministry of the Environment. However, due to lack of funds, very little has been accomplished up until the present to establish the trace element capabilities of pollen collected from various trees and lesser plants. Preliminary studies by Prof. G.E. Rouse (Departments of Botany and Geological Sciences, University of British Columbia) indicate that different species of trees and lesser plants vary widely in their ability to collect trace elements in their pollen, and that trace element content of pollen does reflect anomalous trace elements in those areas from which samples have been obtained. Preliminary results are listed in Table IV (also see Warren, 1980).

Table IV *Tentative range of normals and some anomalous trace elements in pollen (ppm dry weight; n.d. not determined).*

	Zinc	Copper	Lead	Cadmium	Molybdenum
A. Normal	30-70	4-15	1-6	.1-1	.4-2
B. Anomalous					
1) Trail	380	15	150	4	n.d.
2) 600 m NW of Afton Smelter, Kamloops	33	54	3	1	n.d.
3) Endako	55	7	7	n.d.	45
4) Gibraltar	50	30	9	.1-.5	1.2
5) Point Grey, Vancouver	345	11	10	not detected	n.d.

As soon as we are able to establish the "normal" trace element content of the pollen of each species of tree and lesser plants it should provide another useful supplementary tool to boulder tracing in any search for buried ore bodies.

Perhaps it may be of interest to point out that some professional beekeepers move their hives - on occasion even by helicopter - to areas where specific plants provide particularly attractive sources for honey. Many of these beekeepers collect pollen as a byproduct. Surely this knowledge should open up attractive possibilities for cooperative ventures between beekeepers and mining companies.

Summary

Boulder tracing is an accepted prospecting tool. Obviously this involves field work and it seems obvious that the use of dogs to detect buried sulphide boulders should enhance this tool. Biogeochemistry, where coordinated with boulder tracing, may also aid significantly in mine finding, particularly where disseminated copper, molybdenum, or gold deposits are being sought. Recently pollen analyses have also demonstrated their usefulness in indicating metal anomalous areas.

Acknowledgements

Dean Warren Kitts (Faculty of Agriculture, University of British Columbia) and Mr. McCutcheon (B.C. Provincial Apiarist) provided valuable contacts with beekeeping societies in the province. Further assistance was provided by Ed Kimura and Jim Balmer of Endako and Gibraltar Mines, respectively, both associated with Placer Development, Ltd., whose cooperation is much appreciated. Mrs. Wescott Myers and Mrs. Margaret Elliott carried out all the analytical work performed in the Department of Geological Sciences, University of British Columbia.

Various mining companies, as the result of an appeal by courtesy of the Mining Association of British Columbia, provided part of the funds which made this work possible. Dr. J.E. Kania, Mr. Alan Wallace, and the Mobile Oil Company, also assisted with donations made through the auspices of the Annual Giving Program of the Alumni Association of the University of British Columbia.

References

Sampling

Warren, H.V., R.E. Delavault, and J.A.C. Fortescue, 1955, Sampling in Biogeochemistry: Geol. Soc. America Bull., v. 66, p. 229-238.

Arsenic

Warren, H.V., R.E. Delavault, and J. Barakso, 1964, The Role of Arsenic as a Pathfinder in Biogeochemical Prospecting: Economic Geology, v. 59, p. 1381-9.

Warren, H.V., R.E. Delavault, and J. Barakso, 1968, The Arsenic Content of Douglas Fir as a Guide to some Gold, Silver, and Base Metal Deposits: Canadian Instit. Mining Metall. Bull., v. 61, p. 860-868.

Molybdenum

Warren, H.V., R.E. Delavault, and D.G. Routley, 1953, Preliminary Studies of the biogeochemistry of Molybdenum: Trans. Royal Soc. Canada, v. 47, Third Series, Sec. 4, p. 71-73.

Warren, H.V. and R.E. Delavault, 1965, Further studies of the Biogeochemistry of Molybdenum: Western Miner, v. 38, p. 64-72.

Gold

Boyle, R.W., 1979, The Geochemistry of Gold and its Deposits: Geol. Survey Canada Bull. 280, p. 1-584.

Girling, C.A. and P.J. Peterson, 1980, Gold in Plants: Gold Bulletin, v. 13, No. 4.

Jones, R.S., 1970, Gold Content of Water, Plants, and Animals: United States Geol. Survey Circular 625, p. 1-15.

Shacklette, H.T., H.W. Lakin, A.E. Hubert and G.C. Curtin, 1970, Absorption of Gold by Plants: United States Geol. Survey Bull. 1314-B, p. 1-23.

Shewry, P. and P.J. Peterson, 1976, Distribution of Chromium and Nickel in Plants and Soil from Serpentine and Other Sites: Jour. Ecology, v. 64, p. 195-212.

Warren, H.V. and R.E. Delavault, 1950, Gold and Silver Content of some Trees and Horsetails in British Columbia: Geol. Soc. America Bull., v. 61, p. 123-126.

Warren, H.V., 1979, Supergene Gold Crystals at Stirrup Lake (Creek), B.C.: Western Miner, v. 52, p. 9-14.

Warren, H.V., C.A. Girling and P.J. Peterson, 1979, Plants as Indicators of Gold Mineralization at Watson Bar, British Columbia, Canada: Econ. Geol., v. 74, p. 902-907.

Dogs in Prospecting

Brock, J.S., 1972, The use of Dogs as an Aid to Exploration for Sulphides: Western Miner, v. 45, p. 28-32.

Pollen as an Aid to Boulder Tracing

Warren, H.V., 1980, Pollen - a Possible Tool for Exploration Geologists: Western Miner, v. 53, p. 35-36.

MS received November 2, 1981