15. TRACE METALS IN SNOW STRATA AS INDICATORS OF SILVER-ARSENIDE VEIN MINERALIZATION, CAMSELL RIVER AREA, DISTRICT OF MACKENZIE

Project 740081

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Introduction

As part of a broad program designed to evaluate the usefulness or otherwise of snow strata sampling in geochemical prospecting (Jonasson and Allan, 1972), it was decided to apply the procedures already established in temperate regions, to a study in some permafrost areas of the Canadian sub-arctic in the winter of 1971-72.

With the close co-operation of Terra Mining and Exploration Limited and in particular, Mr. H.A. Sanche, some snow samples were collected from two locations, the Terra mine site near Camsell River, District of Mackenzie and from the nearby Norex property (*see* Mineral Claim Sheets, D.I.N.A., 86.E.9 and 86.F.12).

At the Terra, property mineralization consists primarily of vein deposits of native silver associated with copper, iron, cobalt and nickel arsenides (ramellsbergite, niccolite, etc.) and some bismuth and lead minerals (native bismuth, bismuthinite, matildite, galena). Minor pitchblende also occurs as spherules in the arsenides. Native silver is often highly mercuriferous. Rocks in the immediate area are mainly tuffaceous sediments and intermediate to acid volcanic rocks of the Proterozoic Echo Bay Group. The Terra property also has stratiform copper zinc (chalcopyrite with minor sphalerite and galena) which is cut by the vein mineralization.

Norex Property yields similar minerals from similar rocks. However, the vein materials (arsenides) can be very bismuth rich. Disseminated galena occurs in wallrocks associated with the arsenide veins. In general, vein mineralization is somewhat less enriched in Zn and Cu than at Terra Mines, but perhaps more Pb-rich (R.I. Thorpe, pers. comm.).

Samples of clean snow were collected in early May, 1972 from immediately above soil surface at 20-to 50-foot intervals along 6 traverse lines at Terra Mine site. The lines were selected to traverse buried or suboutcropping mineralized veins as well as suspected barren zones.

Some of the vein occurrences are known to manifest significant radioactivity; in fact scintillometer surveys conducted by Sanche (pers. comm.) have proved useful in delineating small areas for more detailed prospecting. Consequently some of the snow sample lines also cross radiochemical anomalies which may be associated with silver mineralization.

The Norex samples are located at 25-foot intervals on a single line which strikes roughly N70°W and is perpendicular to a long fault valley that may contain mineralized vein material. An unknown depth of overburden covers bedrock in this area.

Results

Analyses for the trace metals, Zn, Cu, Pb, Ni, Ag, Bi were carried out by means of atomic absorption spectrometry on extracts of ammonium pyrrolidine dithiocarbamate complexes in methylisobutylketone. Analyses for As were made using a modified Gutzeit technique, U was determined fluorimetrically and F was determined with a fluoride specific ion electrode. Hg was not determined on these samples, although this was very desirable, because of problems related to sample transport and storage.

It is of interest to note the relative amounts of the metallic (and other) element of interest in ores from Terra and Norex. Table 15.1 provides some data for trace contents of ore beds, grab ore samples, tailings and concentrates. The metal values shown probably provide a fair estimate of the relative amounts of each species present. It was on the basis of these and other data that the metals to be determined in these snow samples were selected. Table 15.2 present analytical results (ppb) for the snow surveys at Terra. Table 15.2 also contains summary information of radiochemical activity of soil surfaces along the traverse lines at Terra. Generally, it can be seen that surface traces of known veins coincide with the highest activity (Fig. 15.1). The direction of drainage with respect to each traverse line is also shown, it is generally northeast towards the Camsell River (Fig. 15.1).

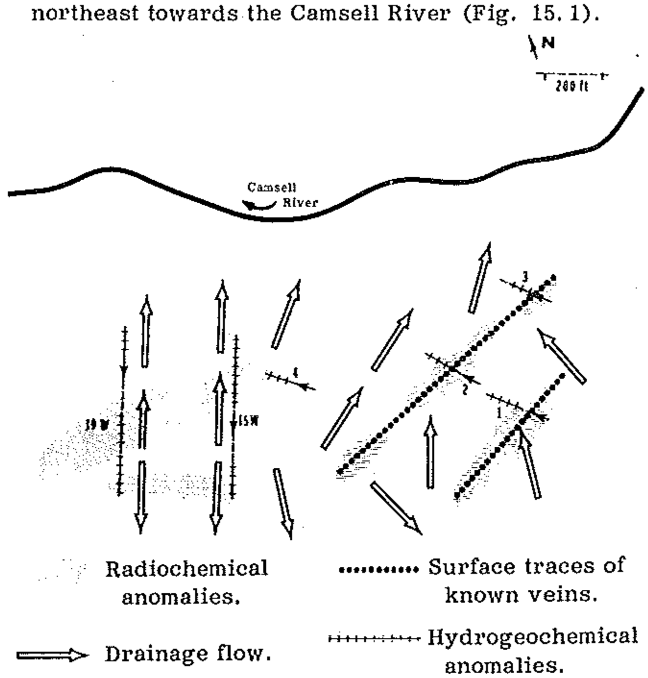

Figure 15.1. Snow traverse lines at Terra Minesite.

Table 15.1. Ore geochemistry of some samples from Terra Mines and Norex property.

Nature of Sample	No	Zn	Cu	Pb	Ni	Co	Ag	Cd	Bi	Hg	As	Sb	Mo	Au	U	Mn	Fe
Native silver ore: Terra	01	773	564	149	4.3%	917	9.2%	6	82	2100	1557	8000	5	0.03	275	1.6%	3.61%
Ramellsbergite	02	79	344	1053	14.3%	2.59%	1613	0.5	3545	7.6	4.8%	3000	26	0.13	3700	-	-
Terra ore heads	03	870	5000	500	1400	1200	2000	4		50.0				0.03		3500	6.1%
mine tailings	04	325	255	135	620	450	150	3		10.4				0.01		3300	5.8%
jig concentrate	05	1300	1.30%	3200	2.10%	1.20%	13.0%	6		6100				0.31		3300	1.0%
flotation sulphide concentrate	06	6900	10.0%	8500	7500	9000	4.20%	22		1000				0.31		1500	20.0%
Norex ore heads	011	-	2100	7700	4500	1.50%	2.52%	-	4.61%	-	16.0%	-	-	-	-	-	-
Norex concentrate	021	-	6000	2.36%	1.50%	4.38%	5.54%	-	11.6%	-	26.8%	-	-	-	-	-	-

1. Samples 03, 04, 05, and 06 represent monthly composites for December, 1972.
2. All values in ppm unless otherwise indicated.
3. Norex values from R.I. Thorpe, (pers. comm.).

Discussion - Terra Mine site

For all three lines across known, but buried, veins (1, 2, 3) Zn, Pb and As consistently show as high levels as the same sample sites. Ag values are quite sporadic but tend to match up too. Surprisingly Ni, Bi and U which are reasonably abundant in ore specimens (Table 15.1) are virtually absent in all samples. F was sought but never found in quantities greater than 40 ppb. Cu is also somewhat low but its highs do match those for Zn, Pb and As. Consequently the anomalous zones of each traverse as shown in Figure 15.1 are composites of all elements which proved useful.

The anomalous zones match quite well the projected surface traces of the veins with one common feature — that they are all displaced about 60 to 80 feet down drainage.

The two lines, 15W and 19W, taken across radiochemical activity highs, also exhibit coherent anomalous zones, for Pb and Ag especially. In this they differ from lines 1, 2, 3 which produced solid multielement haloes in the snow, particularly strong for As and Zn. These also coincide with radiochemical activity highs of Figure 15.1 quite neatly. The traverse, line 4, across ground considered barren shows a few scattered anomalies in Zn, Pb and Ag which may or may not be meaningful. These do lie close to an anomalous zone of line 15W.

Discussion - Norex

Quick inspection of Table 15.3 reveals very strong and coherent snow haloes for Zn, Cu, Pb and As in two locations. One location is reinforced with some good values for Bi. Ag is significant by its absence. The contrast between highs and background values is quite exceptional, especially for Pb and Zn. The main anomalous zone, samples N.12 to N.15, cover that part of the traverse which crosses a fault valley in which mineralized veins are anticipated.

At present, little is known of the source of the measured snow haloes for Cu, Pb, Zn and Bi observed here.

Discussion - General

The best indicators of mineralization in the Norex and Terra areas are Pb, Zn, Ag and As. Occasionally Cu and Bi are useful. Some of the Pb values observed at Norex are considered to be very high when comparisons are made with previously reported data for this element at the New Calumet Mine area, Quebec (Jonasson and Allan, 1972).

Because it is now believed that dispersion haloes of metals in snow strata merely reflect what is present in the frozen soils beneath the snow, it is strongly recommended that soil geochemistry at the same detailed sampling scale be employed to map extensions of existing veins, or to search for new ones. Use of all of the metals considered in this study would be a reasonably initial approach. The usefulness of Ag,

Table 15.2

Trace element data: snow from Terra Mines

Element	Zn	Cu	Pb	Ni	Ag	Bi	As	U	F	Scintillometry
Detection Limit	5	1	5	1	0.3	5	0.5	0.1	40	counts/sec.
Sample No.	Known veins — covered by overburden.									
Line — Vein sample										
1-7-01	16	5	13	0	0	0	1.6	0	0	75
1-7-02	11	3	9	0	0	0	2.6	0	0	80
1-7-03	13	5	9	0	0	0	0	0	0	90
1-7-04	18	6	9	0	0	0	0	0	0	90
1-7-05	29	8	17	0	0	0	0	0	0	80
1-7-06	7	3	17	0	0.4	5	0	0	0	70
1-7-07	49	35	37	0	1.6	0	0	0	0	60
1-7-08	17	5	9	0	1.0	0	1.8	0	0	70
1-7-09	26	16	19	0	0	0	2.2	0	0	70
1-7-10	31	3	6	0	0.3	0	2.2	0	0	85
1-7-11	18	5	13	0	0	0	3.3	0	0	90
3-9-02	22	8	22	0	0.3	0	–	0	0	75
3-9-03	9	3	4	0	0	0	2.7	0	0	80
3-9-04	16	4	9	0	0.7	0	4.2	0	0	80
3-9-05	13	4	11	0	0.3	0	3.3	0	0	60
3-9-06	16	16	9	0	0	0	4.6	0	0	50
3-9-07	20	7	17	0	0	0	2.7	0	0	50
3-9-08	13	5	13	0	0	0	0	0	0	50
2-9-01	52	8	13	0	0.3	0	1.6	0	0	50
2-9-02	9	1	11	0	0	0	0	0	0	55
2-9-03	–	–	–	0	–	0	–	0	0	55
2-9-04	9	3	9	0	0	0	26.0	0	0	50
2-9-05	8	2	15	0	0.3	0	4.2	0	0	70
2-9-06	4	0	24	0	0	0	4.2	0	0	70
2-9-07	15	4	11	0	0	0	5.2	0	0	60
2-9-08	12	3	22	0	0	0	0	0	0	60
2-9-10	8	4	6	0	0	0	1.2	0	0	60
2-9-11	58	6	29	0	0	0	17.0	0	0	60
	no known veins									
4-0-01	40	19	13	0	0.4	0	0	0	0	75
4-0-02	18	7	9	0	0	0	0	0	0	
4-0-03	8	4	6	0	0	0	0	0	0	50
4-0-04	12	2	17	0	0	0	0	0	0	50
4-0-05	97	30	41	0	0.8	0	–	0	0	50
4-0-06	8	4	9	0	0.3	0	3.5	0	0	50
4-0-07	17	4	15	0	0.3	0	0	0	0	50
4-0-08	7	2	6	0	0	0	0	0	0	40
4-0-09	18	8	33	0	0.3	0	0	0	0	40
4-0-10	13	5	6	0	0	0	0	0	0	40
	Radiochemical anomalies									
15W. 0†00	18	5	29	0	0.6	0	0	0	0	50
0.06S	10	6	14	0	0.7	0	0	0	0	60
0.50S	40	13	50	0	1.3	0	0	0	0	70
0.100S	18	9	49	0	1.6	0	0	0	0	70
0.200S	10	4	38	0	1.1	0	0	0	0	75
1.50S	16	6	42	0	1.2	0	0	0	0	105
2.50S	10	5	45	0	1.4	0	0	0	0	200
3.00S	10	10	27	0	1.1	0	0.6	0	0	75
3.50S	10	4	18	0	0.4	0	0	0	0	75
4.00S	20	14	18	0	0.3	0	0	0	0	55
4.50S	14	4	23	0	0.3	0	0	0	0	55

Table 15. 2 (cont.)

Element	Zn	Cu	Pb	Ni	Ag	Bi	As	U	F	Scintillometry
Detection Limit	5	1	5	1	0. 3	5	0. 5	0. 1	40	counts/sec.
Sample No.	Known veins — covered by overburden.									
Line — Vein sample										
5. 00S	10	3	11	0	1. 3	0	0. 5	0	0	55
5. 50S	10	5	18	0	0. 5	0	0	0	0	80
6. 50S	12	8	23	0	1. 1	0	0. 5	0	0	75
7. 00S	20	9	42	0	1. 8	0	0. 8	0	0	85
7. 50S	14	8	27	0	0. 9	0	0. 5	0	0	90
19W.0. 00	10	6	23	0	1. 9	0	0	0	0	55
0. 50	8	3	34	0	0. 4	0	0	0	0	55
1. 00	5	2	5	0	0. 3	0	0	0	0	55
1. 50	5	3	16	0	0. 4	0	1. 2	0	0	55
2. 00	5	2	9	0	1. 1	0	0	0	0	70
2. 50	8	3	9	0	0. 5	0	0. 3	0	0	70
3. 00	8	6	20	0	0. 5	0	0	0	0	55
3. 50	5	4	18	0	2. 3	0	0. 5	0	0	90
4. 00	5	4	18	0	0. 3	0	0	0	0	90
4. 50	10	8	7	0	0. 4	0	0	0	0	55
5. 00	5	3	14	0	0. 5	0	0	0	0	90
5. 50	48	29	74	0	4. 0	10	4. 4	0	0	90
6. 00	8	4	23	0	0. 3	0	0	0	0	55
6. 50	16	7	31	0	0. 7	0	0. 5	0	0	50

Notes: 1. All values in nanograms/ml (ppb) unless otherwise indicated.

Table 15. 3

Trace element data: Norex property

Element	Zn	Cu	Pb	Ni	Ag	Bi	As	U	F
Detection Limit	5	1	5	1	0. 3	5	0. 5	0. 1	40
Sample No.									
N-01	5	2	27	0	0	0	0. 8	0	0
N-02	5	0	7	0	0	0	1. 6	0	0
N-03	8	5	14	0	0	0	0. 7	0	0
N-04	16	17	56	0	0	0	0	0	0
N-05	15	22	75	0	0	0	0. 7	0	0
N-06	5	2	11	0	0	0	0	0	0
N-07	5	5	23	0	0	0	0	0	0
N-08	0	1	9	0	0	0	0	0	0
N-09	0	0	5	0	0	0	0	0	0
N-10	5	3	18	0	0	0	0. 8	0	0
N-11	23	52	155	0	0	5	0. 7	0	0
N-12	104	2	5	0	0	0	0. 5	0	0
N-13	14	35	95	0	0	5	0	0	0
N-14	5	2	9	0	0	0	0	0	0
N-15	20	79	200	0	0	10	14	0	0
N-16	0	1	0	0	0	0	0	0	0
N-17	8	0	14	0	0	0	0. 5	0	0
N-18	12	23	74	0	0	0	0	0	0
N-19	8	4	71	0	0	0	0	0	0
N-20	0	0	25	0	0	0	0. 5	0	0
N-21	5	0	16	0	0	0	0. 5	0	0
N-22	5	2	5	0	0	0	0	0	0
N-23	0	2	18	0	0	0	0	0	0

Notes: 1. All values in nanograms/ml (ppb) unless otherwise indicated.

Pb and As cannot be overemphasized in these regions of continuous and discontinuous permafrost because of their restricted abilities for migration (dispersion). Zn which is much more mobile, may be useful in outlining broader zones for more detailed studies using Ag, Pb and As.

The absence of Ni from the snow samples remain puzzling; perhaps it should also be sought, along with Co and U in the deeper soil horizons in the initial stages of any soil surveys. Perhaps nickel arsenides do not weather appreciably at depth in the bedrock, or else there may be a mutual restriction on the migrational abilities of Ni and As in these soils. Bi may be similarly restricted. Ni was found elsewhere to be quite high in snow overlying tetrahedrite veins wherein Ni reached only 0.7% in content (Jonasson and Allan, 1972).

The absence of U is also something of a problem. Its geochemistry is such that in the VI oxidation state, U is very mobile, usually as uranyl ion, UO_2^{++}, or as anionic complexes of this ion with carbonate or humate ligands. It is, therefore, quite likely that any UO_2^{++} moving into the surface soils is quickly dispersed or washed out of them. Usually a C horizon soil is the preferred sampling material for U. U in snow has been sought elsewhere above known U showings and so far it has not been detected in excess of 0.1 ppb.

In general, metal elements suspected of acquiring anionic character in surface soils seem to be either absent or in very low concentrations in snow strata above mineralization (e.g., U, As, Sb) wherein they are often quite abundant.

Acknowledgments

The close co-operation of Terra Mining and Exploration Ltd. is acknowledged. The advice and discussion of data proffered by Mr. H.A. Sanche, who also collected the samples, proved invaluable to this study.

The technical assistance of Mr. G. Gauthier who was responsible for the analyses of these, at times, difficult samples is also gratefully acknowledged.

Reference

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