

Technical Report on the:

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**'INVISIBLE' GOLD AND SILVER CONTENT OF MAJOR SULPHIDE
MINERALS FROM THE VANGORDA AND FARO MINES**

for

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SYNOPSIS

Samples from the Vangorda and Faro Mines were analyzed for gold and/or silver using the ion probe. The results are given in Tables 1, 2, 3 and 4. Arsenopyrite was the mineral which concentrated 'invisible' gold in samples V1, V2 and V3. Pyrite has relatively less 'invisible' Au but is modally more abundant than arsenopyrite.

Chalcopyrite had by far the highest concentration of silver, in samples V1, V2 and V3, however this mineral is only a minor constituent. Sphalerite has relatively lower Ag concentrations but is a more abundant sulphide mineral.

Silver was quantified in pyrrhotites from Faro sample F4. The average concentration is 1.7 ppm Ag.

1. BACKGROUND AND OBJECTIVES

Curragh Resources Ltd. requested the determination of 'invisible' Au and/or silver distribution in the major sulphide minerals of four samples from the Vangorda and Faro mines. The samples are labelled as follows:

V1 - Vangorda Master Composite, - 150 - 200M, SK 3.3

V2 - Vangorda Footwall, -65 +150M, SK 3.3

V3 - Vangorda Footwall, -150 +200M, SK 3.3, HM

F4 - Faro Zn Scav. Tls, +200M, SK 3.3, HM

It was requested that major sulphide minerals from samples V1, V2 and V3 be analyzed for 'invisible' gold and silver, and that pyrrhotite from Faro sample #F4 be analyzed for silver only. The objective of the study is (a) to identify and quantify 'invisible' gold and silver in sulphide minerals and (b) to determine the major carriers of 'invisible' gold and silver.

2. METHODOLOGY

Samples V1, V2, V3 and F4 were received from CANMET (J. Wilson) in the form of polished grain mounts. The polished mounts were analyzed under the optical microscope to identify and mark grains for ion probe analysis. The Secondary Ion Mass Spectrometer (SIMS) was then used to determine the 'invisible' gold and silver content of individual sulphide mineral grains.

3. RESULTS AND DISCUSSION

The major sulphide minerals in samples V1, V2 and V3 include pyrite \pm marcasite, marcasite, sphalerite, galena, pyrrhotite, chalcopyrite and arsenopyrite. Major sulphide minerals in sample F4 include pyrite, pyrrhotite, sphalerite, arsenopyrite, chalcopyrite and galena.

Gold

The highest 'invisible' gold concentrations in samples V1, V2 and V3 were obtained from arsenopyrite (Tables 1 and 2, Figure 1), with average values of 12.1 ppm, 52 ppm and 33 ppm gold respectively. The average concentration for gold in arsenopyrite from sample V1 is relatively low however; a definite enrichment of gold, in the fine- to medium-grained arsenopyrite, is evident and the average 'invisible' gold concentration for these smaller grains is 37 ppm.

Pyrite is a less significant carrier of 'invisible' gold in samples V1, V2 and V3. The results in Tables 1 and 2, and Figure 1, however, indicate a slight enrichment of gold in marcasite-bearing and fine pyrite grains. Coarse-grained pyrite in sample V1 has an average 'invisible' gold concentration of 0.1 ppm and fine-grained pyrite and marcasite have an average 'invisible' gold content of 0.4 ppm. Similarly, coarse-pyrite from sample V2 and V3 has an average 'invisible' gold concentration of 0.07 ppm and the fine-grained pyrite and marcasite has a considerably higher average of 0.94 ppm.

There is no direct relationship between the arsenic content of pyrite (marcasite) and 'invisible' gold (Tables 1 and 2). It is therefore proposed that this 'invisible' gold is in the form of fine colloidal-size particulates dispersed throughout the pyrite matrix, as opposed to 'invisible' gold in solid solution within pyrite in the presence of arsenic.

It is important to note that a high 'invisible' gold value was determined for one coarse grained pyrite in sample V2 (grain #23, Table 2). The coarse morphology of the grain was confirmed using the optical microscope. The depth profile for this grain (Figure 2) displays a relatively homogeneous distribution of 'invisible' gold as would be expected of gold in solid solution with pyrite. However, the low As content of this particular pyrite grain would indicate that the 'invisible' gold is in particulate form. Thus, the gold in grain #V2 #23 is probably in the form of very fine colloidal size particulates (less than 0.05 μm in diameter), dispersed homogeneously throughout the pyrite matrix. With the analytical conditions used this size of colloidal gold cannot be distinguished from solid solution gold. It should be noted that in the case of solid solution gold, the concentrations of gold and arsenic are positively correlated in the pyrite (or marcasite) crystal structure.

TABLE 1 - "INVISIBLE" Au IN SULPHIDE MINERALS - V1

PYRITE		
Grain #	Au, ppm	As, wt. %
1 +ma	0.11	0.09
2	----	0.013
*3 f	110.0	0.044
5 ma	0.13	----
9	----	0.012
10 +ma	0.79	0.044
12	----	0.02
14	----	0.014
17	0.43	0.08
18 ma	0.18	----
19 b	----	0.027
20 ma	0.39	0.058
23	0.64	0.24
25	----	0.048
26	----	0.029
30 +ma	1.1	0.03
32	0.11	----
33 b	----	----
35	0.13	0.044
36 +ma	0.35	0.04
38	----	0.046
39	----	0.058
40 +ma	0.16	0.10
n $\bar{x} \pm \lambda$		
Total	22	0.21 \pm 0.12
Marcasite	8	0.4 \pm 0.24
Coarse Pyrite	14	0.1 \pm 0.1

ARSENOPYRITE	
Grain #	Au, ppm
4	1.5
7	0.19
8 med +cpy	50.0
16 f	38.0
21	1.0
31 +po	2.0
34	0.5
37	0.26
41 f	23.0
n $\bar{x} \pm \lambda$	
9	12.9 \pm 12.1

PYRRHOTITE	
Grain #	Au, ppm
6	0.17
11	0.43

GALENA	
Grain #	Au, ppm
24	0.08
28	0.13

CHALCOPYRITE	
Grain #	Au, ppm
13	0.086
27	0.07
29	0.17

Legend	
ma	- marcasite
f	- fine-grained
b	- blastic
med	- medium-grained
cpy	- chalcopyrite
po	- pyrrhotite

TABLE 2 - "INVISIBLE" Au IN SULPHIDE MINERALS - V2 AND V3

<u>PYRITE</u>		
<u>Grain #</u>	<u>Au, ppm</u>	<u>As, wt. %</u>
2 ma	0.08	-----
3 ma	1.2	0.034
7 ma	0.34	-----
9	-----	0.048
10 f	0.79	0.3
14 f	0.35	0.11
19	-----	0.045
20 +ma	0.63	-----
21 +ma	0.14	0.025
22	0.21	0.058
23	30.0	0.036
24	7.0	0.064
25	0.79	0.043
28 med	0.35	-----
29	0.61	0.036
30	-----	-----
34	0.19	0.07
35	0.69	0.09

	n	$\bar{x} \pm \lambda$
Total	17	0.79 \pm 0.77 ppm
Marcasite	14	0.94 \pm 0.91 ppm
Coarse Pyrite	3	0.07 \pm 0.11 ppm

<u>ARSENOPYRITE</u>	
<u>Grain #</u>	<u>Au, ppm</u>
V2 5 m	25.0
15 m	51.0
31 m	80.0
V3 26	11.0
27 m	48.0
30 m	40.0
n	$\bar{x} \pm \lambda$
6	42.5 \pm 17.7

<u>PYRRHOTITE</u>	
<u>Grain #</u>	<u>Au, ppm</u>
V2 1	0.21
13	0.3
V3 5	2.5
6	0.82
18	0.74

n $\bar{x} \pm \lambda$

<u>GALENA</u>	
<u>Grain #</u>	<u>Au, ppm</u>
11	0.09
12	0.065
17	0.11
27	0.082
32	0.092

n $\bar{x} \pm \lambda$

<u>CHALCOPYRITE</u>	
<u>Grain #</u>	<u>Au, ppm</u>
V2 6	0.085
8	0.065
V3 1	0.7

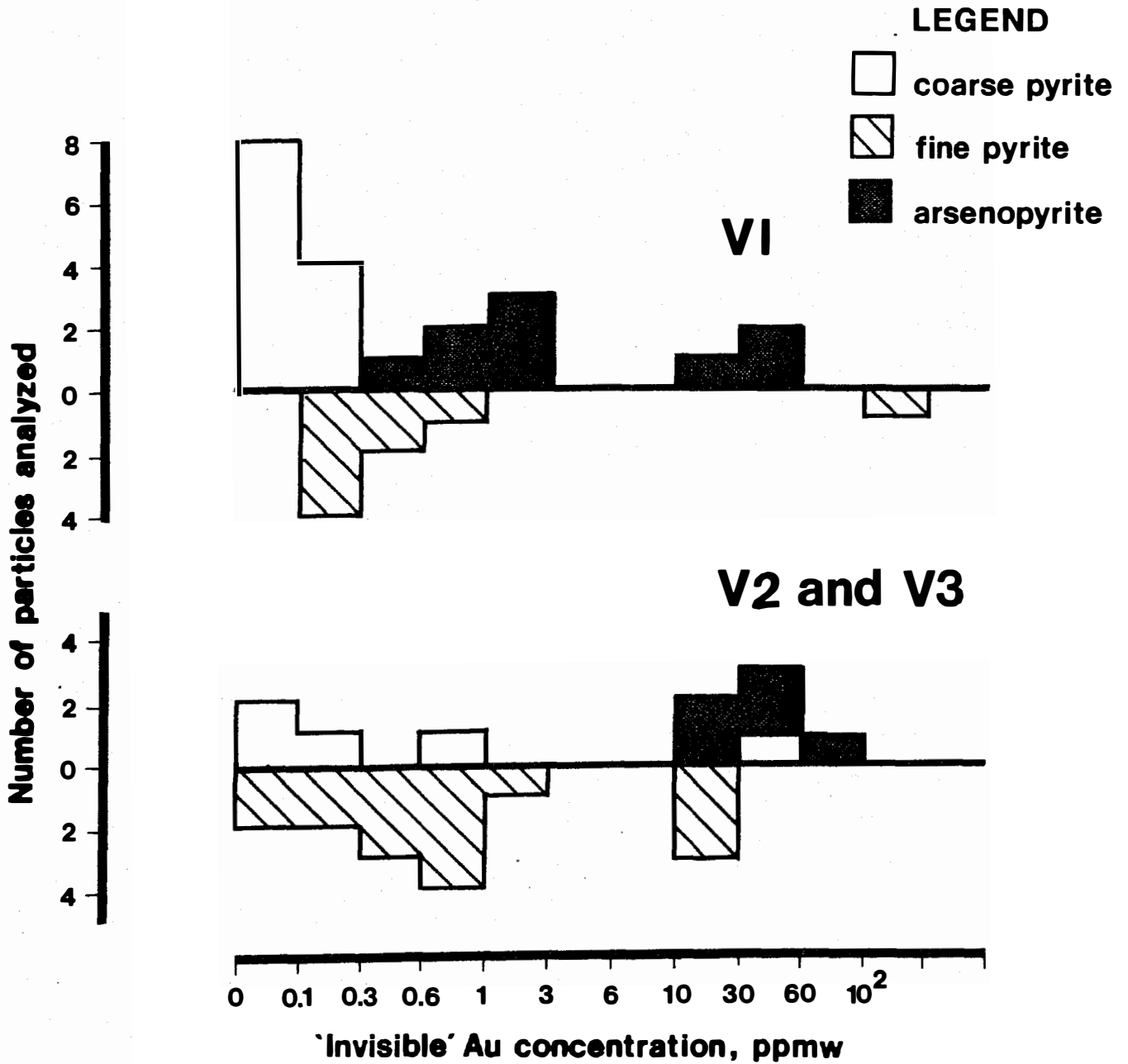


Figure 1

Histogram showing the distribution of 'invisible' Au in pyrite (marcasite) and arsenopyrite.

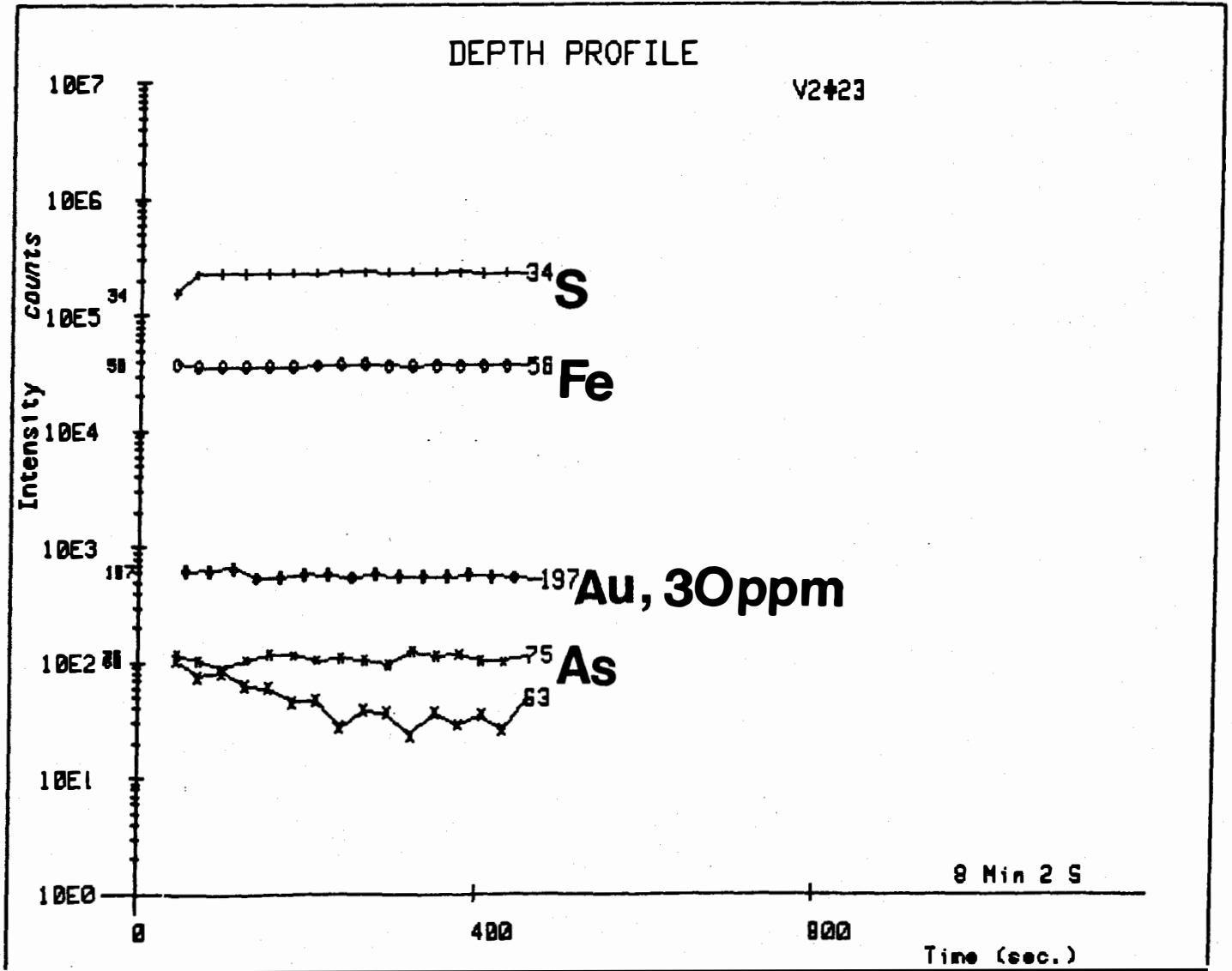


Figure 2 Depth profile of pyrite #23 in sample V2. Note the homogeneous distribution of gold.

The 'invisible' gold concentrations obtained from pyrrhotite, galena and chalcopyrite are relatively insignificant and are given in Tables 1 and 2. Sphalerite was also analyzed; however this gold could not be quantified because of the lack of a calibration standard for sphalerite. The depth profiles for the sphalerite grains had very low gold counts and it is, therefore, evident that sphalerite is an insignificant carrier of invisible gold.

Silver

The major carrier of silver in all three Vangorda samples V1, V2 and V3 is chalcopyrite, with average concentrations of 109 ± 79 ppm, 239 ± 125 ppm and 223 ± 98 ppm respectively (Table 3).

Sphalerite is a less important carrier of silver in Vangorda samples V1, V2 and V3 (Table 3). The results from sample V1 suggest a slightly higher concentration of 24.6 ppm Ag in sphalerites with chalcopyrite inclusions, whereas sphalerites free of chalcopyrite inclusions have a lower average Ag concentration of 17.4 ppm. Sphalerites from samples V2 and V3 have consistently lower average Ag concentrations of 10.1 and 10.5 ppm (Table 3).

Pyrites from V1, V2 and V3 have average Ag concentrations of 2.2 ppm, 2.5 ppm and 3.3 ppm respectively and pyrrhotite concentrations ranged between 0.7 and 1.0 ppm Ag (Table 3).

Ten pyrrhotite grains from Faro sample F4 had an average Ag concentration of 1.7 ± 0.53 ppm (Table 4).

TABLE 3 - Ag CONCENTRATION IN SULPHIDE MINERALS - VANGOORDA

SAMPLE V1

SPHALERITE		PYRITE		CHALCOPYRITE		PYRRHOTITE	
Grain #	Ag, ppm	Grain #	Ag, ppm	Grain #	Ag, ppm	Grain #	Ag, ppm
50	30.0	51	0.44	59	370.	57	0.85
53	52.0	52	0.62	68	16.		
54 +cpy	13.0	55 +ma	0.95	73	3.		
60	23.0	* 56 +ma	54.0	74	28.		
61	3.0	58	7.5	75	80.		
62	13.0	* 63 f	45.0	76	125.		
64 +cpy	37.0	67	1.5	77	82.		
65 +cpy	25.0			78	170.		
66	5.0	$\bar{x} \pm \lambda$					
69 +cpy	11.0	2.2 \pm 2.4 without *		$\bar{x} \pm \lambda$			
70 +cpy	37.0			109 \pm 79			
71	5.1						
72	7.8						
		$\bar{x} \pm \lambda$					
Total	20.2 \pm 8.14						
Sphalerite + cpy	24.6 \pm 10.0						
Sphalerite	17.4 \pm 11.2						

SAMPLE V2

SPHALERITE		PYRITE		CHALCOPYRITE		PYRRHOTITE	
Grain #	Ag, ppm	Grain #	Ag, ppm	Grain #	Ag, ppm	Grain #	Ag, ppm
36	2.1	51 fr	1.4	37	220.	46	1.9
38 +cpy	8.5	* 52 +po	50.0	40	600.		
39	17.0	53 f+ma	2.8	43	550.		
41	20.0	58	1.9	44	92.		
42	8.0	59 med	3.2	45	150.		
50	6.8	* 61 f+ma	64.0	47	80.		
54 +cpy	6.6	62 ma+py	2.7	48	225.		
55	9.4	65	2.7	49	145.		
56	4.3			63	85.		
64	18.0	$\bar{x} \pm \lambda$					
		2.5 \pm 0.49 without *		$\bar{x} \pm \lambda$			
$\bar{x} \pm \lambda$				238.6 \pm 124.7			
10.1 \pm 3.7							

SAMPLE V3

SPHALERITE		PYRITE		CHALCOPYRITE		PYRRHOTITE	
Grain #	Ag, ppm	Grain #	Ag, ppm	Grain #	Ag, ppm	Grain #	Ag, ppm
31	9.0	34 ma+py	5.2	36	300.	32	0.7
33	3.8	40	1.9	42	75.		
35	14.0	50	17.0	49	280.		
37	7.2	53 ma	2.3	52	350.		
38	35.0	54 very f	3.8	55	110.		
39	4.3						
41	12.0	$\bar{x} \pm \lambda$		$\bar{x} \pm \lambda$			
43	6.6	3.3 \pm 1.3 without *		223. \pm 98.			
44	2.6						
45	7.6						
46	12.0						
47	6.8						
48 fr	15.0						
$\bar{x} \pm \lambda$							
10.5 \pm 4.4							

TABLE 4 - Ag CONCENTRATION IN PYRRHOTITE - FARO #4

GRAIN #	Ag, ppm
1	3.0
2	2.5
3	1.0
4	1.6
5	1.0
6	1.1
7	0.66
8	3.0
9	2.4
10	1.1

$n \quad \hat{x} \pm \lambda$
10 1.7 \pm 0.53

4. CONCLUSIONS

Ion probe data indicate that the major carrier of 'invisible' gold in all three Vangorda samples is arsenopyrite. The results also suggest that the 'invisible' Au concentration of the fine-to medium-grained arsenopyrite of sample V1 is higher than that of the coarse arsenopyrite. While arsenopyrite has the highest concentration of 'invisible' Au it is not nearly as abundant as pyrite, especially in samples V2 and V3.

Coarse-grained pyrite has relatively minor amounts of 'invisible' Au in all three Vangorda samples. 'Invisible' Au is slightly enriched, however, in marcasite-bearing and fine-grained pyrite.

Pyrrhotite, galena, chalcopyrite and sphalerite are relatively insignificant carriers of 'invisible' Au.

Chalcopyrite is the major silver-bearing sulphide mineral in samples V1, V2 and V3. Sphalerite is a minor carrier of silver, but is more abundant modally than chalcopyrite. Pyrite and pyrrhotite are relatively insignificant carriers of Ag.

Silver was detected in pyrrhotite grains from Faro sample F4. The average Ag concentration was 1.7 ppm Ag.